Krajowy Ośrodek Bilansowania i Zarządzania Emisjami

POLAND'S
NATIONAL INVENTORY REPORT
2011

Greenhouse Gas Inventory
for 1988-2009

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

Warszawa, October 2011

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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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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 2011, presents the results of the greenhouse gases (GHGs) inventory in Poland for 2009 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-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).

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) established in the Institute of Environmental Protection 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 review of the initial report of Poland under the Kyoto Protocol made 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 and are not tradable in the first commitment period in 2008−2012, has been estimated on the basis of the newest inventory for 2009, which amounted to 383 224.704 Gg CO_2 eq., multiplied by 5 years:

383 224.704 Gg CO_2 eq. * 5 = **1 916 123.521 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 KPLULUCF activities

ES.2.1 GHG inventory

The GHG emissions in the base year 1988 and the year 2009, expressed as CO_2 equivalents, are presented in table ES.1. In 2009 the total national emission of GHG were 383.22 million tonnes of CO_2 eq., excluding GHG emissions and sinks from category 5 (Land use, land use change and forestry –LULUCF). Compared to the base year (1988), the 2009 emissions have decreased by 32.0%.

Table ES.1 National emissions of greenhouse gases for the base year 1988 and 2009 [Gg CO_2 eq.]

Pollutant	Base year	2009	(2009-base)/base [%]
	Emission in CO_2 eq. [Gg]	Emission in CO_2 eq. [Gg]	
CO_2 (with LULUCF)	436 209.10	274 205.09	-37.1
CO_2 (without LULUCF)	469 143.82	313 721.64	-33.1
CH_4 (with LULUCF)	53 672.51	37 075.84	-30.9
CH_4 (without LULUCF)	53 665.03	34 741.06	-35.3
N_2O (with LULUCF)	40 334.29	27 565.27	-31.7
N_2O (without LULUCF)	40 333.53	27 558.80	-31.7
HFCs	26.44	7 073.32	26651.0
PFCs	250.18	90.47	-63.8
SF_6	23.77	39.42	65.8
TOTAL net emission (with LULUCF)	530 516.30	346 049.40	-34.8
TOTAL without LULUCF	563 442.77	383 224.70	-32.0

*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 indicate 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 modernization processes implemented 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 2006 again caused by animated economic development. Since 2007 decrease in GHG emissions has been noted (tables ES.2, ES.3 and figure ES.1).

Table ES.2 National emissions of greenhouse gases for 1988–2009 according to gases

GHG	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997
	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)	458 866.04	435 749.09	346 894.08	345 240.59	343 624.10	351 132.67	348 544.91	354 538.65	361 007.16	356 202.42
CO_2 (without LULUCF)	471 735.75	451 848.70	369 238.49	368 573.17	360 198.14	366 614.93	362 073.90	366 645.46	375 599.30	369 493.83
CH_4 (with LULUCF)	54 132.79	53 476.75	48 295.81	46 804.39	44 874.31	44 772.75	45 163.09	45 256.52	45 101.80	45 564.21
CH_4 (without LULUCF)	51 940.41	51 274.23	46 096.28	44 622.66	42 521.53	42 560.53	42 947.66	43 049.45	42 860.42	43 354.62
N_2O (with LULUCF)	40 640.77	42 504.19	37 945.25	31 377.18	29 068.08	29 357.85	29 594.05	30 712.04	30 382.20	30 589.65
N_2O (without LULUCF)	40 625.04	42 487.65	37 930.13	31 366.91	29 019.96	29 343.14	29 578.93	30 700.09	30 363.91	30 578.65
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	41.45	162.53	290.51
PFCs	215.99	216.36	208.09	207.27	197.47	212.47	224.09	252.24	235.68	248.92
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	13.91	30.53	24.95	24.02
TOTAL (with LULUCF)	**553 855.59**	**531 946.39**	**433 343.23**	**423 629.43**	**417 763.96**	**425 475.74**	**423 540.04**	**430 831.41**	**436 914.33**	**432 919.73**
TOTAL (without LULUCF)	**564 517.19**	**545 826.93**	**453 472.99**	**444 770.01**	**431 937.11**	**438 731.07**	**434 838.49**	**440 719.21**	**449 246.80**	**443 990.54**

* emissions for 1988 estimated for entire series up to 2009 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table ES.2 (contd). National emissions of greenhouse gases for 1988–2009 according to gases

GHG	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	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)	327 267.82	314 423.23	305 951.60	299 333.62	286 804.05	296 396.10	293 487.38	289 693.21	298 947.43	299 512.63	287 856.44	274 205.09
CO_2 (without LULUCF)	340 646.32	329 919.12	320 925.76	317 511.54	305 723.99	316 830.69	317 096.80	318 164.47	331 023.34	328 805.33	325 057.64	313 721.64
CH_4 (with LULUCF)	44 186.93	44 186.43	41 137.90	40 513.51	39 605.86	39 984.15	39 452.31	39 882.18	40 149.11	39 349.11	38 363.63	37 075.84
CH_4 (without LULUCF)	41 982.37	41 944.70	38 897.21	38 284.50	37 345.70	37 630.28	37 175.11	37 576.02	37 835.09	37 023.23	36 027.36	34 741.06
N_2O (with LULUCF)	30 606.87	29 497.26	29 340.33	29 467.90	28 419.37	28 610.86	29 047.38	29 393.80	30 564.46	31 495.57	31 152.74	27 565.27
N_2O (without LULUCF)	30 599.48	29 485.07	29 330.35	29 461.54	28 410.66	28 583.70	29 040.13	29 384.10	30 553.46	31 488.86	31 145.64	27 558.80
HFCs	360.34	480.70	864.61	1 496.63	1 695.46	2 133.54	2 611.54	4 148.53	4 880.46	6 197.92	7 549.49	7 073.32
PFCs	251.26	239.74	248.87	269.93	286.59	278.39	285.08	259.95	269.75	298.65	226.45	90.47
SF_6	25.09	24.64	24.18	23.96	24.41	21.72	23.44	28.09	34.80	32.66	34.46	39.42
TOTAL (with LULUCF)	**402 698.32**	**388 852.00**	**377 567.50**	**371 105.55**	**356 835.73**	**367 424.77**	**364 907.13**	**363 405.77**	**374 846.02**	**376 886.54**	**365 183.22**	**346 049.40**
TOTAL (without LULUCF)	**413 864.86**	**402 093.96**	**390 290.98**	**387 048.10**	**373 486.81**	**385 478.31**	**386 232.09**	**389 561.16**	**404 596.91**	**403 846.66**	**400 041.04**	**383 224.70**

Table ES.3 National emissions of greenhouse gases for 1988–2009 according to IPCC categories

IPCC sector	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997
	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	469 676.96	448 868.21	369 066.27	371 117.67	362 450.90	371 014.43	365 426.40	369 090.22	379 808.73	371 984.10
2. Industrial Processes	33 327.11	32 599.44	24 074.67	20 630.66	20 034.54	19 887.33	21 363.80	23 436.16	22 108.75	23 581.85
3. Solvent and Other Product Use	1 006.46	946.14	629.23	608.22	558.57	519.36	521.05	524.80	547.11	542.72
4. Agriculture	51 140.34	53 984.63	50 111.57	42 516.48	38 926.34	37 239.19	37 473.59	37 696.60	36 659.16	37 481.72
5. Land-Use, Land-Use Change and Forestry	-10 661.60	-13 880.55	-20 129.76	-21 140.59	-14 173.15	-13 255.33	-11 298.44	-9 887.79	-12 332.47	-11 070.81
6. Waste	9 366.32	9 428.51	9 591.25	9 896.99	9 966.76	10 070.76	10 053.64	9 971.42	10 123.05	10 400.16
TOTAL net emission (with LULUCF)	**553 855.59**	**531 946.39**	**433 343.23**	**423 629.43**	**417 763.96**	**425 475.74**	**423 540.04**	**430 831.41**	**436 914.33**	**432 919.73**

* emissions for 1988 estimated for entire series up to 2009 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table ES.3 (contd). National emissions of greenhouse gases for 1988–2009 according to IPCC categories

IPCC sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	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	343 924.06	333 344.22	321 005.53	320 301.23	308 574.57	318 261.43	318 115.85	314 862.18	325 446.57	321 178.01	316 711.95	310 059.52
2. Industrial Processes	20 311.83	20 431.45	23 735.17	21 814.33	20 050.27	23 205.05	24 316.16	30 399.34	33 344.31	36 058.64	37 121.45	28 044.64
3. Solvent and Other Product Use	543.39	535.04	616.09	637.21	664.25	647.39	704.67	688.81	762.36	733.04	742.04	742.31
4. Agriculture	38 318.20	36 840.45	35 043.22	34 699.33	34 624.24	33 922.84	33 734.17	34 173.47	35 707.19	36 551.06	36 538.04	35 512.41
5. Land-Use, Land-Use Change and Forestry	-11 166.55	-13 241.96	-12 723.48	-15 942.55	-16 651.08	-18 053.54	-21 324.97	-26 155.39	-29 750.89	-26 960.11	-34 857.82	-37 175.30
6. Waste	10 767.39	10 942.80	9 890.97	9 596.01	9 573.48	9 441.59	9 361.23	9 437.36	9 336.47	9 325.91	8 927.55	8 865.84
TOTAL net emission (with LULUCF)	**402 698.32**	**388 852.00**	**377 567.50**	**371 105.55**	**356 835.73**	**367 424.77**	**364 907.13**	**363 405.77**	**374 846.02**	**376 886.54**	**365 183.22**	**346 049.40**

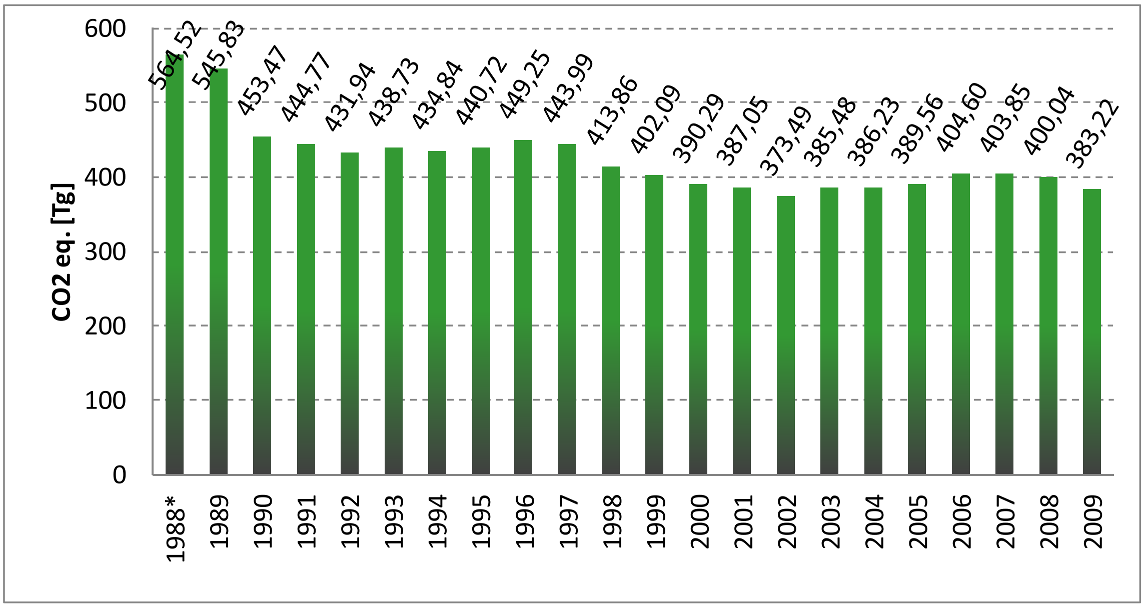

Figure ES.1. Trend of aggregated GHGs emissions excluding category 5 for 1988–2009

*emissions for 1988 estimated for entire series up to 2009 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

Emission and removals estimates of GHGs for the year 2008 in division for Article 3.3 and 3.4 activities are presented in Table ES.4. As concerns the activities related to afforestation of land other than forest land and forest management the balance is negative which means net removal.

Tab. ES.4. Summary of GHG emissions and removals for KP- LULUCF activities in 2009 [Gg CO_2 eq.]

Article 3.3 activities		**Article 3.4 activities**			
Afforestration and Reforestration	Deforestation	Forest Management	Cropland Management	Grazing Land Management	Revegetation
-7 198.38	263.91	-44 857.61	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 2009 were estimated as 313.72 million tonnes. This is 33.1% lower than in the base year. CO_2 emission (excluding category 5) accounted for 81.9% of total GHG emissions in Poland in 2009. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission by 93.5% in 2009. The shares of the main subcategories were as follows: *Energy industries* – 53.1%, *Manufacture Industries and Construction* – 9.6%, *Transport* – 14.9% and *Other Sectors* – 15.9%. *Industrial Processes* contributed to the total CO_2 emission by 6.2% in 2009. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 removal in LULUCF sector in 2009, was calculated to be approximately 39.5 million tonnes. It means that app. 10.3% 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 1 654.34 Gg in 2009 i.e. 34.74 million tonnes of CO_2 equivalents. Compared to the base year, the emission in 2009 was lower by 35.3%. The contribution of CH_4 to the national total GHG emission was 9.1% in 2009. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed 33.6%, 35.5% and 21.6% to the national methane emission in 2009, respectively. The emission from the first mentioned sector was covered by emission from Underground Mines (21.2% of total CH_4 emission) and Oil and Natural Gas system (12.4% of total CH_4 emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 26.5% of total CH_4 emission in 2009. Waste disposal sites contributed to 18.5% 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 2009 were 88.90 Gg i.e. 27.56 million tonnes of CO_2 equivalents. The emission was app. 31.7% lower than the respective figure for the base year. The contribution of N_2O to the national total GHG emission was 7.2% in 2009. The main N_2O emission sources and its shares in total N_2O emission in 2009 are as follow: *Agricultural Soils* – 65.8%, *Manure Management* – 18.3%, *Chemical Industry* – 3.9% and *Fuel Combustion* – 7.4%.

Emissions of industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2009 was 7 203.21 Gg CO_2 eq. what accounts for 1.9% of total GHG emissions share in 2009. Industrial gases emissions were about 2297.9% higher comparing to the base year (table ES.2). Share of HFCs, PFCs and SF_6 in total 2009 emissions was as follows: 1.85%, 0.02% and 0.010%.

ES.3.2 KP-LULUCF activities

Emission and removals estimates of GHGs for the year 2009 under the Kyoto Protocol LULUCF activities are presented in Table ES.5.

Tab. ES.5. Summary of GHG emissions and removals for KP- LULUCF activities [Gg CO2 eq.]

CO_2 emissions	CO_2 removals	CH_4	N_2O	CO_2 emissions and removals balance
263.91	-51 676.68	31.15	5.38	-51 412.77

ES.4. Trends of indirect greenhouse gases and SO_2

Generally emissions of all GHG precursors (CO, NO_x, NMVOC and SO_2) have decreased since 1980 (and since 1990 for CO). The biggest drop characterizes emissions of SO_2, which amounted 861.3 Gg in 2009 and decreased by about 79% between 1980 and 2009, and 73% between 1990 and 2009. Most of the reductions were caused by the decline of heavy industry in the late 1980s and early 1990s. In late 1990s the emissions declined because of the diminished share of hard coal and lignite among fuels used for power and heat generation. Emissions of NO_x in 2009 amounted 819.5 Gg and decreased by about 33% between 1980 and 2009, and 36% between 1990 and 2009. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s and lower share of coal in late 1990s. Increasing emissions from road transport contribute to the national total, and cause comparatively lower emission reductions than in case of SO_2. Similarly emissions of NMVOC decreased by 26% between 1990–2009 amounting 615 Gg in 2009 and CO emissions dropped by about 64% between 1990–2009 amounting to 2694.6 Gg in 2009.

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 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.

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

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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,
- provide opinions on requests to issue the letter of endorsement and the letter of approval for implementation of Joint Implementation (JI) projects in Poland,
- manage the list of JI projects in Poland for which the letters of endorsement or approval have been issued.

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

Evaluation of fuel consumption in national combustion processes	Hard coal	
	10^3 Mg	TJ
In	88 857	2 124 153
From national sources	78 065	1 852 572
1) Indigenous production	77 478	1 838 654
2) Transformation output or return	586	13 918
3) Stock decrease	0	0
Import	10 792	271 581
Out	88 857	2 124 153
National consumption	73 997	1 745 078
1) Transformation input	56 444	1 305 743
a) input for secondary fuel production	9 373	277 052
b) fuel combustion	47 071	1 028 691
2) Direct consumption	17 554	439 335
Non-energy use	38	854
Combusted directly	17 516	438 480
Combusted in Poland	64 587	1 467 171
Stock increase	4 732	103 579
Export	8 395	237 530
Losses and statistical differences	1 733	37 967
Net calorific value	MJ/kg	22.72

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 database 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 *Transport* subcategory, including the fuel consumption data for various types of vehicles, were worked out routinely by experts from the Motor Transport Institute up to 2008. In 2009 these data were estimated by KOBIZE based on ITS data from 2008 as well as on the fuel balance according to Eurostat for 2009.

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

The programme for Quality Assurance and Quality Control has been elaborated to improve and assure high quality of the Polish annual greenhouse gas inventory. It has been elaborated in line with the *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories* (2000). The QA/QC programme contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures.

The Polish inventory is generated in two main steps. First calculations are produced around 9–11 months after the end of the inventoried year (n–1) depending primarily on the availability of required activity data. Initial check of activity data and estimation procedures is then done. When the official statistics are available the revision of data is made and final inventory is produced up to 12 months after given year. Additionally the recalculations of the previous inventories for selected categories are performed because of methodological changes and improvements.

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 National Centre for Emissions Management (KOBiZE) – which is responsible for preparation of GHG inventories − is also responsible for coordination and implementing the QA/QC activities. QA/QC Plan elaborated in 2007 was updated in November 2009 after institutional changes made in the inventory system (*Act on the system to manage the emissions of greenhouse gases and other substances)* (Annex 5).

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

Uncertainty evaluation made for 2009 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 2007-2009. Calculations include simplified method for sector 5 and for fluorinated industrial gases.

The estimate of emission uncertainty for the year 2008 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 that the authors of this report are aware of. However still a few IPCC sources were not covered because of lack of suitable emission factors or national activities, but having a minor effect on the total national GHG emissions. These exceptions are the following:

in *Energy* sector (*Fugitive Emission from Fuels* only):

- CO_2 from *Coal Mining and Handling* (1.B.1.a)
- CO_2 and CH_4 from *Solid Fuel Transformation* (1.B.1.b)
- some individual processes in *Oil and Natural Gas* systems (1.B.2.a and b)

in *Industrial Processes*:

- CO_2 from *Asphalt Roofing* (2.A.5)
- CO_2 from *Road Paving with Asphalt* (2.A.6)
- CH_4 from *Aluminium Production* (2.C.3)
- CO_2 from *Food and Drink Production* (2.D.2)
- some minor emissions of HFCs, PFCs, SF_6 (2.F)

in *Agriculture*

- CH_4 from *Agriculture Soils* (4.D)

in *Waste*

- N_2O from *Industrial Wastewater* (6.B.1)

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 81.9% (excluding category 5) share in 2009, while the methane contributes with 9.1% (excluding category 5) to the national total. Nitrous oxide contribution is 7.2% (excluding category 5) and all industrial GHG together contribute 1.9%. Percentage share of GHG in national total emissions in 2009 is presented at figure 2.1.

Table 2.1 Greenhouse gas emissions in 2009 in CO_2 eq.

Pollutant	2009	
	Emission in CO_2 eq. [Gg]	Share [%]
CO_2 (with LULUCF)	274 205.09	79.24
CO_2 (without LULUCF)	313 721.64	81.86
CH_4 (with LULUCF)	37 075.84	10.71
CH_4 (without LULUCF)	34 741.06	9.07
N_2O (with LULUCF)	27 565.27	7.97
N_2O (without LULUCF)	27 558.80	7.19
HFCs	7 073.32	1.85
PFCs	90.47	0.02
SF_6	39.42	0.01
TOTAL net emission (with LULUCF)	346 049.40	100.00
TOTAL without LULUCF	383 224.70	100.00

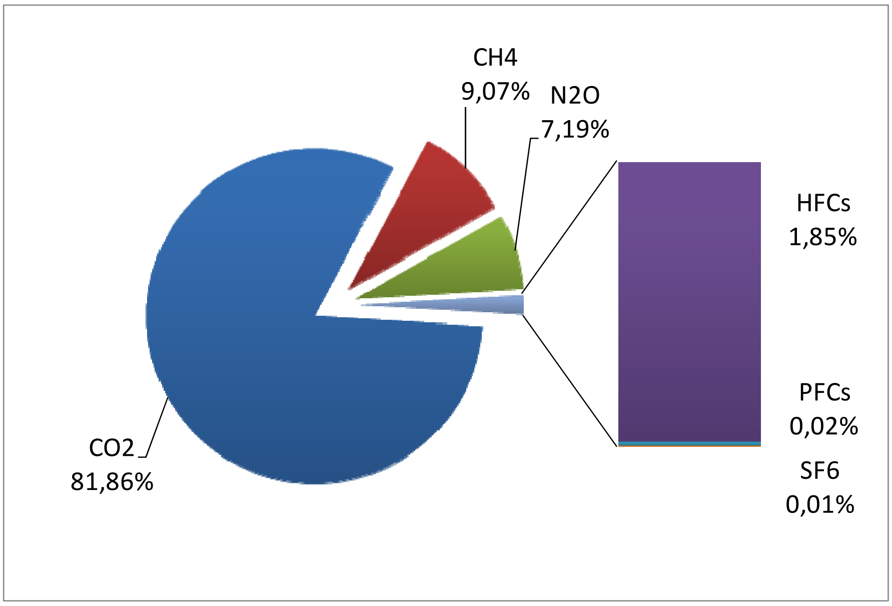

Figure 2.1. Percentage share of greenhouse gases in national total emission in 2009 (excluding category 5)

Emissions of main GHGs in 2009, 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 2009 [Gg]

[Gg]	CO_2	CH_4	N_2O
TOTAL without LULUCF	313 721.64	1 654.34	88.90
TOTAL with LULUCF	274 205.09	1 765.52	88.92
1. Energy	293 462.48	693.48	6.56
A. Fuel Combustion	293 273.61	138.19	6.56
1. Energy Industries	166 693.39	3.68	2.59
2. Manufacturing Industries and Construction	30 191.73	3.33	0.68
3. Transport	46 659.13	5.69	1.91
4. Other Sectors	49 729.36	125.49	1.38
5. Other	IE, NO	IE, NO	IE, NO
B. Fugitive Emissions from Fuels	188.87	555.29	0.00
1. Solid Fuels	1.18	350.08	NA
2. Oil and Natural Gas	187.69	205.21	0.00
2. Industrial Processes	19 409.86	15.94	3.54
A. Mineral Products	8 442.59	NA	NA
B. Chemical Industry	3 495.75	11.16	3.50
C. Metal Production	5 939.69	4.77	0.04
D. Other Production	8.62	NE	NE
G. Other	1 523.20	NO	NO
3. Solvent and Other Product Use	618.31	NE	0.40
4. Agriculture	NE	587.22	74.78
A. Enteric Fermentation	NE	437.83	NE
B. Manure Management	NE	147.94	16.26
D. Agricultural Soils	NE	NA	58.46
F. Field Burning of Agricultural Residues	NE	1.45	0.06
5. Land Use, Land-Use Change and Forestry	-39 516.54	111.18	0.0209
A. Forest Land	-51 943.87	1.53	0.0133
B. Cropland	9 253.56	IE, NO	IE, NO, NA,
C. Grassland	136.04	0.05	0.00073
D. Wetlands	3 002.30	109.61	0.0068
E. Settlements	35.42	NA, NO	NA, NO
F. Other Land	NA, NO	NA, NO	NA, NO
6. Waste	230.99	357.70	3.62
A. Solid Waste Disposal on Land	NA, NO	305.94	NE
B. Wastewater Handling	NE	51.76	3.59
C. Waste Incineration	230.99	NO	0.03

Table 2.3 Emissions of industrial gases: HFCs, PFCs and SF_6 in 2009 [Gg eq. Gg]

2009	HFCs	PFCs	SF_6	Total in eq. CO_2
Total Industrial gases [Gg eq. CO_2]	7 073.32	90.47	39.42	7 203.21
C. Metal Production	NE	76.27	4.35	80.62
3. Aluminium Production	NE	76.27	4.35	80.62
F. Consumption of Halocarbons and SF_6	7 073.32	14.20	35.07	7 122.59
1. Refrigeration and Air Conditioning Equipment	3 377.36	NO	NO	3 377.36
2. Foam Blow ing	330.67	NO	NO	330.67
3. Fire Extinguishers	16.60	14.20	NA	30.80
4. Aerosols	178.23	NA	NA	178.23
8. Electrical Equipment	NA	NA	35.07	3 205.54

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 2009 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 modernization processes implemented 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 2006 again caused by continued economic development. Since 2007 a decrease in GHG emissions has been noted (figure 2.2 and tables 2.5 and 2.6).

Table 2.4 Percentage shares of individual source sectors in 2009 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	93.54	41.92	7.38
A. Fuel Combustion	93.48	8.35	7.38
1. Energy Industries	53.13	0.22	2.92
2. Manufacturing Industries and Construction	9.62	0.20	0.77
3. Transport	14.87	0.34	2.15
4. Other Sectors	15.85	7.59	1.55
5. Other	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.06	33.57	0.00
1. Solid Fuels	0.00	21.16	0.00
2. Oil and Natural Gas	0.06	12.40	0.00
2. Industrial Processes	6.19	0.96	3.98
A. Mineral Products	2.69	0.00	0.00
B. Chemical Industry	1.11	0.67	3.93
C. Metal Production	1.89	0.29	0.05
D. Other Production	0.00	0.00	0.00
G. Other	0.49	0.00	0.00
3. Solvent and Other Product Use	0.20	0.00	0.45
4. Agriculture	0.00	35.50	84.11
A. Enteric Fermentation	0.00	26.47	0.00
B. Manure Management	0.00	8.94	18.30
D. Agricultural Soils	0.00	0.00	65.76
F. Field Burning of Agricultural Residues	0.00	0.09	0.06
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	21.62	4.08
A. Solid Waste Disposal on Land	0.00	18.49	0.00
B. Wastewater Handling	0.00	3.13	4.04
C. Waste Incineration	0.07	0.00	0.03

Table 2.5. National emissions of greenhouse gases for 1988–2009 according to gases [Gg CO_2 eq.]

GHG	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997
	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)	458 866.04	435 749.09	346 894.08	345 240.59	343 624.10	351 132.67	348 544.91	354 538.65	361 007.16	356 202.42
CO_2 (without LULUCF)	471 735.75	451 848.70	369 238.49	368 573.17	360 198.14	366 614.93	362 073.90	366 645.46	375 599.30	369 493.83
CH_4 (with LULUCF)	54 132.79	53 476.75	48 295.81	46 804.39	44 874.31	44 772.75	45 163.09	45 256.52	45 101.80	45 564.21
CH_4 (without LULUCF)	51 940.41	51 274.23	46 096.28	44 622.66	42 521.53	42 560.53	42 947.66	43 049.45	42 860.42	43 354.62
N_2O (with LULUCF)	40 640.77	42 504.19	37 945.25	31 377.18	29 068.08	29 357.85	29 594.05	30 712.04	30 382.20	30 589.65
N_2O (without LULUCF)	40 625.04	42 487.65	37 930.13	31 366.91	29 019.96	29 343.14	29 578.93	30 700.09	30 363.91	30 578.65
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	41.45	162.53	290.51
PFCs	215.99	216.36	208.09	207.27	197.47	212.47	224.09	252.24	235.68	248.92
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	13.91	30.53	24.95	24.02
TOTAL (with LULUCF)	**553 855.59**	**531 946.39**	**433 343.23**	**423 629.43**	**417 763.96**	**425 475.74**	**423 540.04**	**430 831.41**	**436 914.33**	**432 919.73**
TOTAL (without LULUCF)	**564 517.19**	**545 826.93**	**453 472.99**	**444 770.01**	**431 937.11**	**438 731.07**	**434 838.49**	**440 719.21**	**449 246.80**	**443 990.54**

* emissions for 1988 estimated for entire series up to 2009 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table 2.5. (contd) National emissions of greenhouse gases for 1988–2009 according to gases [Gg CO_2 eq.]

GHG	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	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)	327 267.82	314 423.23	305 951.60	299 333.62	286 804.05	296 396.10	293 487.38	289 693.21	298 947.43	299 512.63	287 856.44	274 205.09
CO_2 (without LULUCF)	340 646.32	329 919.12	320 925.76	317 511.54	305 723.99	316 830.69	317 096.80	318 164.47	331 023.34	328 805.33	325 057.64	313 721.64
CH_4 (with LULUCF)	44 186.93	44 186.43	41 137.90	40 513.51	39 605.86	39 984.15	39 452.31	39 882.18	40 149.11	39 349.11	38 363.63	37 075.84
CH_4 (without LULUCF)	41 982.37	41 944.70	38 897.21	38 284.50	37 345.70	37 630.28	37 175.11	37 576.02	37 835.09	37 023.23	36 027.36	34 741.06
N_2O (with LULUCF)	30 606.87	29 497.26	29 340.33	29 467.90	28 419.37	28 610.86	29 047.38	29 393.80	30 564.46	31 495.57	31 152.74	27 565.27
N_2O (without LULUCF)	30 599.48	29 485.07	29 330.35	29 461.54	28 410.66	28 583.70	29 040.13	29 384.10	30 553.46	31 488.86	31 145.64	27 558.80
HFCs	360.34	480.70	864.61	1 496.63	1 695.46	2 133.54	2 611.54	4 148.53	4 880.46	6 197.92	7 549.49	7 073.32
PFCs	251.26	239.74	248.87	269.93	286.59	278.39	285.08	259.95	269.75	298.65	226.45	90.47
SF_6	25.09	24.64	24.18	23.96	24.41	21.72	23.44	28.09	34.80	32.66	34.46	39.42
TOTAL (with LULUCF)	**402 698.32**	**388 852.00**	**377 567.50**	**371 105.55**	**356 835.73**	**367 424.77**	**364 907.13**	**363 405.77**	**374 846.02**	**376 886.54**	**365 183.22**	**346 049.40**
TOTAL (without LULUCF)	**413 864.86**	**402 093.96**	**390 290.98**	**387 048.10**	**373 486.81**	**385 478.31**	**386 232.09**	**389 561.16**	**404 596.91**	**403 846.66**	**400 041.04**	**383 224.70**

Table 2.6. National emissions of greenhouse gases for 1988–2009 according to IPCC categories [Gg CO_2 eq.]

IPCC sector	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997
	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	469 676.96	448 868.21	369 066.27	371 117.67	362 450.90	371 014.43	365 426.40	369 090.22	379 808.73	371 984.10
2. Industrial Processes	33 327.11	32 599.44	24 074.67	20 630.66	20 034.54	19 887.33	21 363.80	23 436.16	22 108.75	23 581.85
3. Solvent and Other Product Use	1 006.46	946.14	629.23	608.22	558.57	519.36	521.05	524.80	547.11	542.72
4. Agriculture	51 140.34	53 984.63	50 111.57	42 516.48	38 926.34	37 239.19	37 473.59	37 696.60	36 659.16	37 481.72
5. Land-Use, Land-Use Change and Forestry	-10 661.60	-13 880.55	-20 129.76	-21 140.59	-14 173.15	-13 255.33	-11 298.44	-9 887.79	-12 332.47	-11 070.81
6. Waste	9 366.32	9 428.51	9 591.25	9 896.99	9 966.76	10 070.76	10 053.64	9 971.42	10 123.05	10 400.16
TOTAL net emission (with LULUCF)	**553 855.59**	**531 946.39**	**433 343.23**	**423 629.43**	**417 763.96**	**425 475.74**	**423 540.04**	**430 831.41**	**436 914.33**	**432 919.73**

* emissions for 1988 estimated for entire series up to 2009 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table 2.6. (contd) National emissions of greenhouse gases for 1988–2009 according to IPCC categories [Gg CO_2 eq.]

IPCC sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
	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	343 924.06	333 344.22	321 005.53	320 301.23	308 574.57	318 261.43	318 115.85	314 862.18	325 446.57	321 178.01	316 711.95	310 059.52
2. Industrial Processes	20 311.83	20 431.45	23 735.17	21 814.33	20 050.27	23 205.05	24 316.16	30 399.34	33 344.31	36 058.64	37 121.45	28 044.64
3. Solvent and Other Product Use	543.39	535.04	616.09	637.21	664.25	647.39	704.67	688.81	762.36	733.04	742.04	742.31
4. Agriculture	38 318.20	36 840.45	35 043.22	34 699.33	34 624.24	33 922.84	33 734.17	34 173.47	35 707.19	36 551.06	36 538.04	35 512.41
5. Land-Use, Land-Use Change and Forestry	-11 166.55	-13 241.96	-12 723.48	-15 942.55	-16 651.08	-18 053.54	-21 324.97	-26 155.39	-29 750.89	-26 960.11	-34 857.82	-37 175.30
6. Waste	10 767.39	10 942.80	9 890.97	9 596.01	9 573.48	9 441.59	9 361.23	9 437.36	9 336.47	9 325.91	8 927.55	8 865.84
TOTAL net emission (with LULUCF)	**402 698.32**	**388 852.00**	**377 567.50**	**371 105.55**	**356 835.73**	**367 424.77**	**364 907.13**	**363 405.77**	**374 846.02**	**376 886.54**	**365 183.22**	**346 049.40**

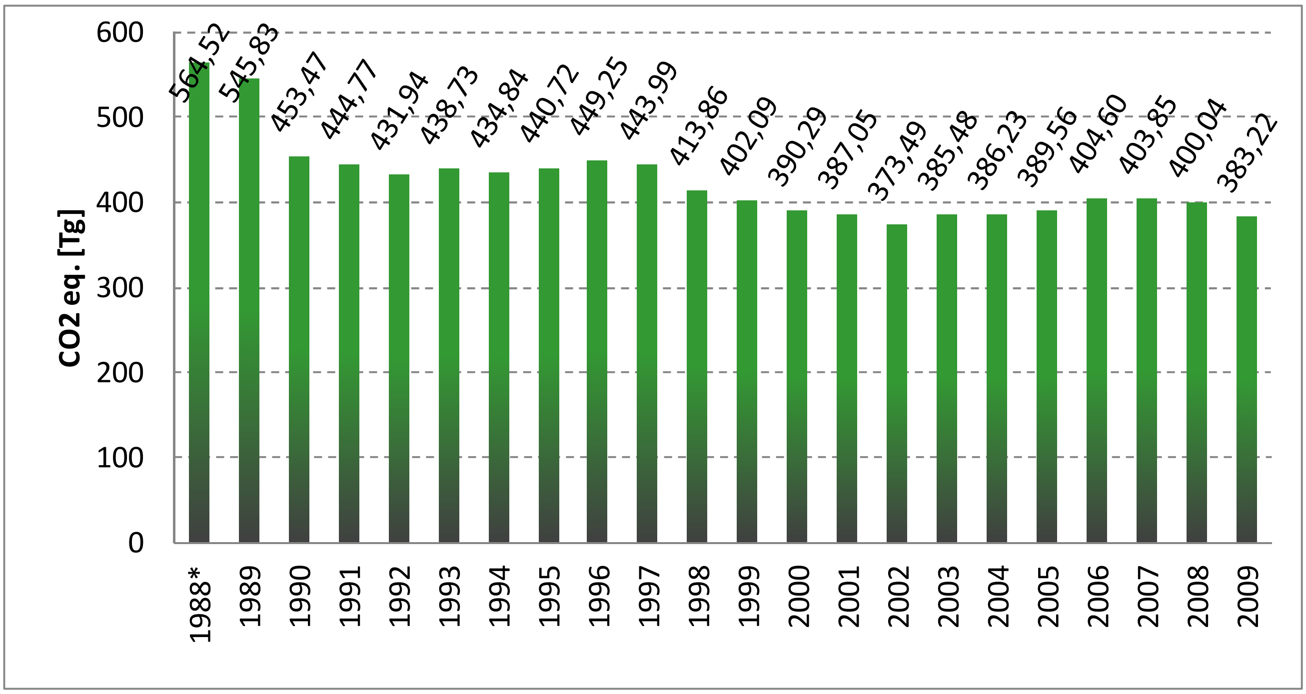

Figure 2.2. Trend of aggregated GHGs emissions (excluding category 5) for 1988–2009

* emissions for 1988 estimated for entire series up to 2009 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 2009, the CO_2 emissions (without LULUCF) were estimated as 313.72 million tonnes, while when sector 5. LULUCF is included the figure reaches 274.21 million tonnes (table 2.1). CO_2 share in total GHG emissions in 2009 amounted to 81.9%. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission (without LULUCF) by 93.5% in 2009 (fig. 2.3). The shares of the main subcategories in 1.A were as follows: *Energy industries* - 53.1%, *Manufacture Industries and Construction* – 9.6%, *Transport* – 14.9% and *Other Sectors* – 15.9%. Sector 2. *Industrial Processes* contributed to the total CO_2 emission by 6.2% in 2009. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 emission/removal in LULUCF sector in 2009, was calculated to be approximately 39.5 million tonnes. It means that app. 10.3% of the total CO_2 emissions are offset by CO_2 uptake by forests.

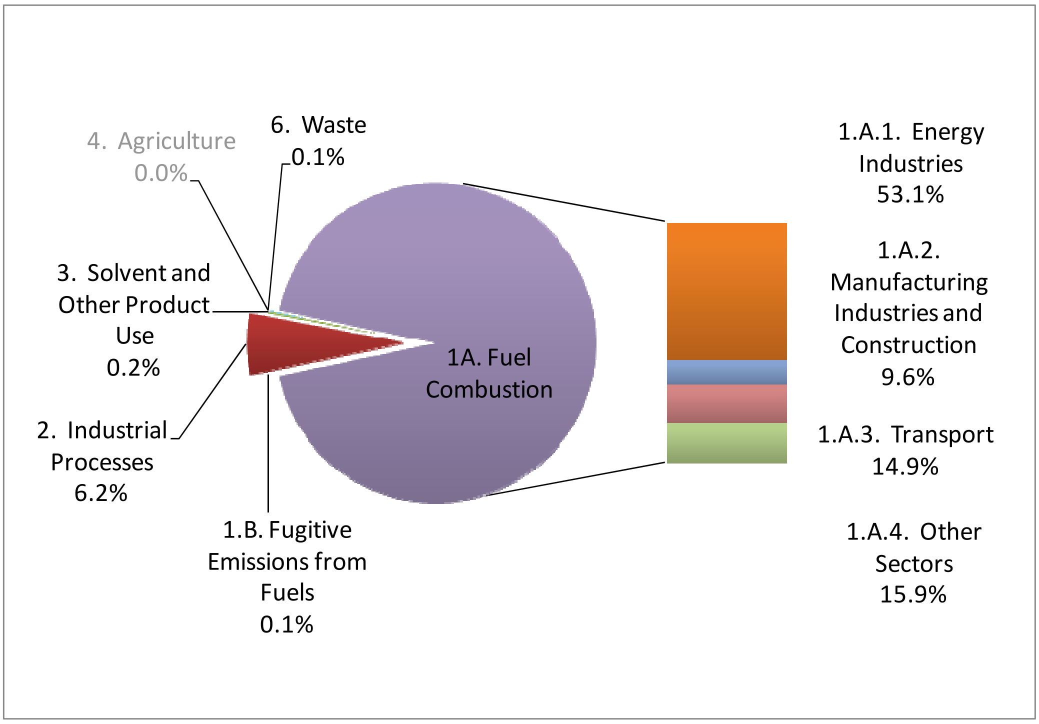

Figure 2.3. Carbon dioxide emission (excluding category 5) in 2009 by sector

Methane (CH_4)

The CH_4 emission (excluding category 5) amounted to 1 654.34 Gg in 2009 i.e. 34.74 million tonnes of CO_2 equivalents (table 2.1). CH_4 share in total GHG emissions in 2009 amounted to 9.1%. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed to 33.6%, 35.5% and 21.6% of the national methane emission in 2009, respectively (fig. 2.4). The emission from the first mentioned sector was covered by emission from *Underground Mines* (app. 21.2% of total CH_4 emission) and *Oil and Natural Gas* system (about 12.4% of total emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 26.5% of total methane emission in 2009. *Disposal sites* contributed to 18.5% of the methane emission and *Wastewater Handling* contributed to 3.1%.

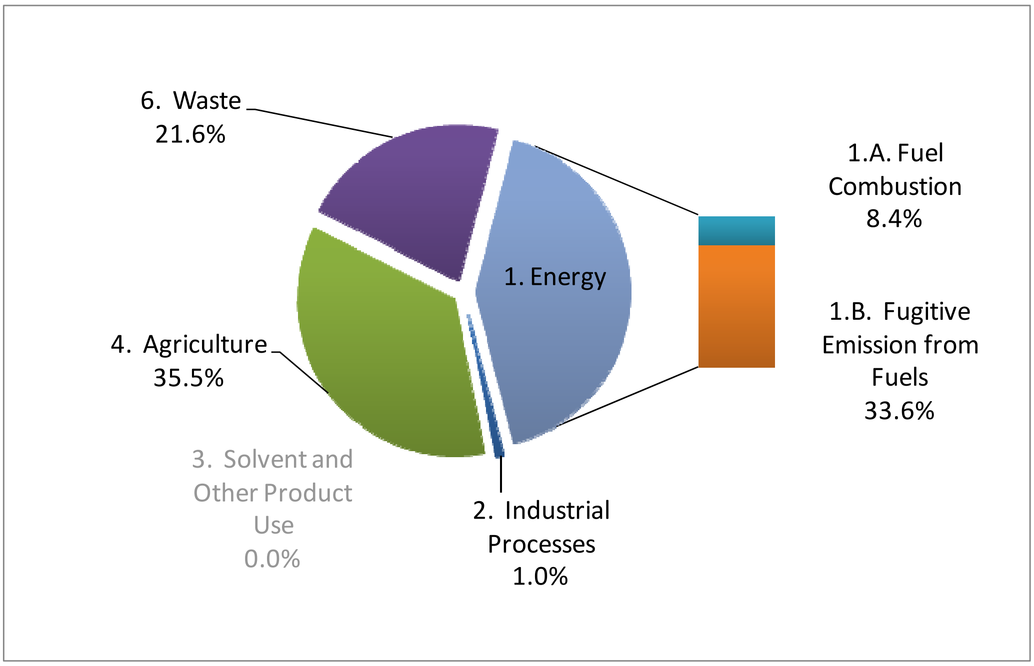

Figure 2.4. Methane emission (excluding category 5) in 2009 by sector

Nitrous oxide (N_2O)

The nitrous oxide emissions (excluding category 5) in 2009 were 88.90 Gg i.e. 27.56 million tonnes of CO_2 equivalents (table 2.2). N_2O share in total GHG emissions in 2009 amounted to 7.2%. The main N_2O emission sources and its shares in total N_2O emission in 2009 are: *Agricultural Soils* – 65.8%, *Manure Management* – 18.3%, *Chemical Industry* – 3.9% and *Fuel Combustion* – 7.4% (fig. 2.5).

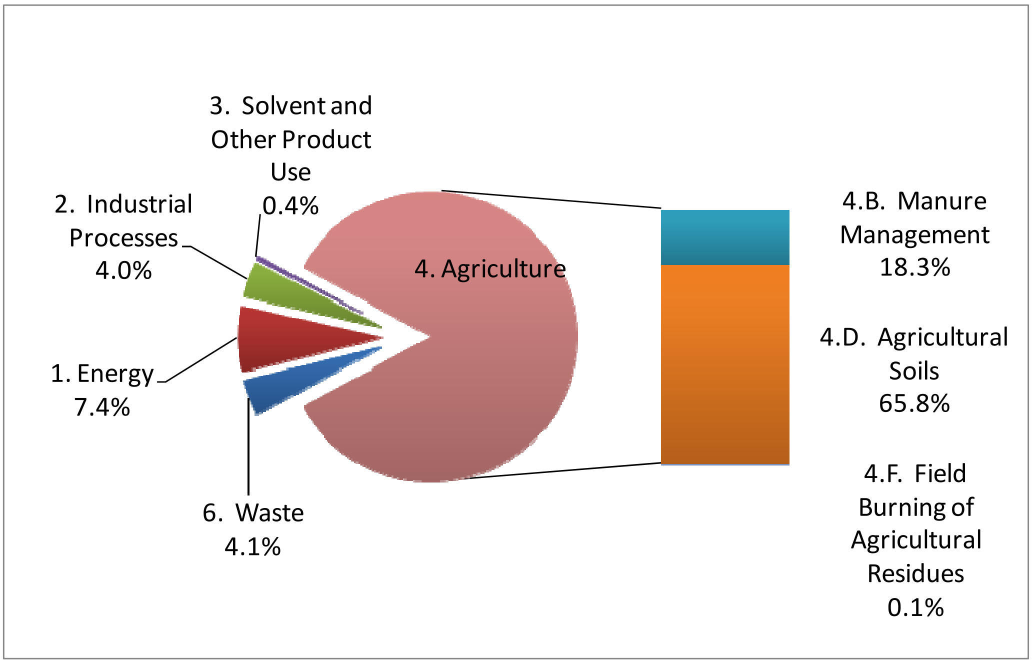

Figure 2.5. Nitrous oxide emission (excluding category 5) in 2009 by sector

Industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2009 was 7 203.21 Gg CO_2 eq. what accounts for 1.9% of total GHG emissions share in 2009. Shares of HFCs, PFCs and SF_6 in total 2009 GHG emissions was as follows: 1.85%, 0.02% and 0.010%.

The total emissions in 2009 according to groups of industrial gases are as follows: HFCs –7.07 million tonnes of CO_2 equivalents, PFCs – 0.09 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 2009 decreased from 83.3% to 81.9%.

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	0.005
PFCs	250.18	0.044
SF_6	23.77	0.004
TOTAL net emission (with LULUCF)	530 516.30	100.0
TOTAL without LULUCF	563 442.77	100.0

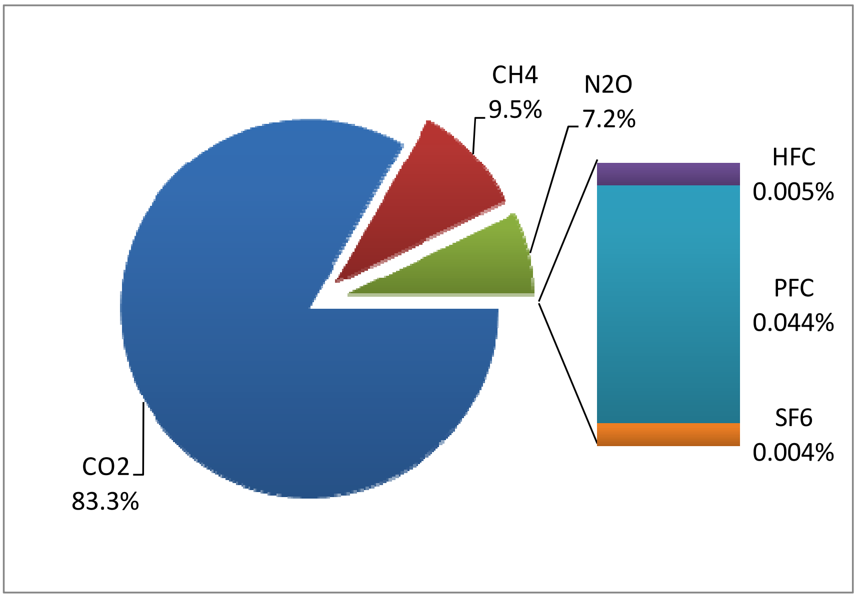

Figure 2.6 Percentage share of national greenhouse gas emissions in base year (1988) excluding emission from sector 5.

The data for the GHGs and for the national total GHG emission for 2009 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 2009 with respect to base year 1988/1995*

Pollutant	Base year Emission in CO_2 eq. [Gg]	2009 Emission in CO_2 eq. [Gg]	2009/base year [%]
CO_2 (with LULUCF)	436 209.10	274 205.09	62.86
CO_2 (without LULUCF)	469 143.82	313 721.64	66.87
CH_4 (with LULUCF)	53 672.51	37 075.84	69.08
CH_4 (without LULUCF)	53 665.03	34 741.06	64.74
N_2O (with LULUCF)	40 334.29	27 565.27	68.34
N_2O (without LULUCF)	40 333.53	27 558.80	68.33
HFCs	26.44	7 073.32	26 751.00
PFCs	250.18	90.47	36.16
SF_6	23.77	39.42	165.85
TOTAL net emission (with LULUCF)	530 516.30	346 049.40	65.23
TOTAL without LULUCF	563 442.77	383 224.70	68.01

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

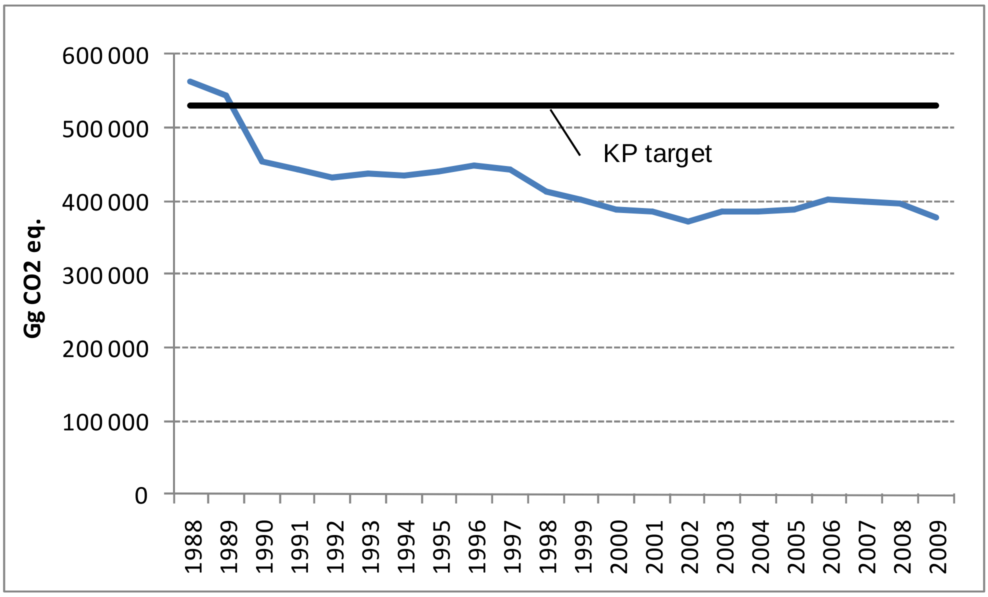

Figure 2.7. Trend of aggregated GHG emissions In 1988-2009 relative to Poland's Kyoto Protocol target

Carbon dioxide

CO_2 emission (excluding category 5) had decreased by app. 33.1% from the base year to 2009.

The following changes took place in the structure of fuel use:

- share of solid fuels decreased from 82.1% in base year 1988 to 56.8% in 2009
- share of liquid fuels increased from 11.1% (base year 1988) to 24.5% (2009)
- share of gaseous fuels increased from 6.0% (base year 1988) to 11.9% (2009).

Methane

CH_4 emission (excluding category 5) had decreased by app. 35.3% from the base year to 2009. The reasons for that are as follow:

- the decrease in emission from *Enteric Fermentation* by 41.5%
- the decrease in *Fugitive Emission* by 48.7%
- the increase in emission from *Waste* by 12.8%.

Nitrous oxide

The nitrous oxide emissions (excluding category 5) in 2009 were app. 31.7% lower than the respective figure for the base year. The share in *Manure Management* decreased from 23.1% in the base year 1988 to 18.3% in 2009, in *Agricultural Soils* increased from 55.5% in the base year 1988 to 65.8% in 2009 and in *Chemical Industry* decreased from 12.4% in the base year 1988 to 3.9% in 2009.

Industrial gases: HFCs, PFCs and SF_6

HFCs emissions in 2009 were 267.5 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 2009 were 63.8% lower than in base year (1995). The PFCs emission changes between 2009 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 2009 were about 65.8% 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. 1.9% to the national total in 2009.

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 2009 according to main categories. In 2009 total GHG emissions accounted for 383.22 million tons CO_2 eq. excluding sector 5. LULUCF. Comparing to the fixed base year emissions in 2009 decreased by 32.0%.

Table 2.9. GHG emissions according to main sectors in base year (1988) and 2009

	Total [Gg eq. CO_2]		(2009-base)/base [%]
	Base year	2009	
TOTAL with LULUCF	530 516.30	346 049.40	-34.8
TOTAL without LULUCF	563 442.77	383 224.70	-32.0
1. Energy	470 309.06	310 059.52	-34.1
2. Industrial Processes	32 832.19	28 044.64	-14.6
3. Solvent and Other Product Use	1 006.46	742.31	-26.2
4. Agriculture	50 893.90	35 512.41	-30.2
5. Land-Use Change and Forestry	-32 926.48	-37 175.30	12.9
6. Waste	8 401.16	8 865.84	5.5

2.3.1. Energy (IPCC category 1)

The emission of GHGs from *Energy* sector in 2009 was 310.1 million tons of CO_2 equivalent. CO_2 emission share exceeded 94.6% 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 2009

GHG emission categories	GHG Emission [Gg CO2-eq]	% share in the total emission from Energy	% Share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
Total Energy	310 059.52	100.0	94.6	4.7	0.7
A. Fuel Combustion	298 209.42	96.2	94.6	0.9	0.7
1. Energy Industries	167 574.26	54.0	53.8	0.0	0.3
2. Manufacturing Industries and Construction	30 472.50	9.8	9.7	0.0	0.1
3. Transport	47 369.88	15.3	15.0	0.0	0.2
4. Other Sectors	52 792.78	17.0	16.0	0.8	0.1
5. Other	0.00	0.0	0.0	0.0	0.0
B. Fugitive Emissions from Fuels	11 850.10	3.8	0.1	3.8	0.0
1. Solid Fuels	7 352.76	2.4	0.0	2.4	0.0
2. Oil and Natural Gas	4 497.34	1.5	0.1	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 2009. CO_2 is dominating among GHGs – it's contribution exceeds 69.2%. 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 (16.7%) and CO_2 emissions (recalculated from NMVOC) (83.3%).

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 2009

GHG emission categories	GHG Emission [Gg CO2-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 SF6
Total Industrial Processes	28 044.64	100.0	69.2	1.2	3.9	25.7
A. Mineral Products	8 442.59	30.1	30.1	0.0	0.0	
B. Chemical Industry	4 813.93	17.2	12.5	0.8	3.9	
C. Metal Production	6 133.70	21.9	21.2	0.4	0.0	0.3
D. Other Production	8.62	0.0	0.0	0.0	0.0	
F. Consumption of Halocarbons and SF6	7 122.59	25.4				25.4
G. Other	1 523.20	5.4	5.4	0.0	0.0	
Total Solvent and Other Product Use	742.31	100	83.3	0.0	16.7	

2.3.3. Agriculture (IPCC category 4)

The main sources of GHG in category 4.*Agriculture* were: 4.D.*Agricultural Soils,* 4.B.*Enteric Fermentation* and 4.A.*Manure Management* (table 2.12). N_2O emission share was the largest in total

GHG emission from 4.*Agriculture* in 2009 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 2009

GHG emission categories	GHG Emission [Gg CO2-eq]	% share in the total emission from Agriculture	% Share in total GHG emission from a given sub-sector	
			CH_4	N_2O
Total Agriculture	35 512.41	100.0	34.7	65.3
A. Enteric Fermentation	9 194.37	25.9	25.9	0.0
B. Manure Management	8 148.66	22.9	8.7	14.2
D. Agricultural Soils	18 121.71	51.0	0.0	51.0
F. Field Burning of Agricultural Residues	47.66	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 2009 (almost 84.7%). 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 2009

GHG emission categories	GHG Emission [Gg CO2-eq]	% share in the total emission from Waste	% Share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
Total Waste	8 865.84	100	2.6	84.7	12.7
A. Solid Waste Disposal on Land	6 424.75	72.5	0.0	72.5	0.0
B. Wastew ater Handling	2 201.09	24.8	0.0	12.3	12.6
C. Waste Incineration	240.00	2.7	2.6	0.0	0.1

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

Changes of gas emissions that have indirect effect on climate are shown below. The gases include precursors of greenhouse gases like: NO_x, CO and non-methane volatile organic compounds (NMVOC), as well as aerosol precursors SO_2.

Figures 2.8-2.11 shows trends of emissions of SO_2, NO_x, NMVOC (1980-2009) and CO (1990-2009). Emissions of SO_2 amounted to 861.3 Gg in 2009 and decreased by about 79% between 1980 and 2009, and 73% between 1990 and 2009. Most of the reductions were 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.

Emissions of NO_x in 2009 amounted 819.5 Gg and decreased by about 33% between 1980 and 2009, and 36% between 1990 and 2009. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s and lower share of hard coal and lignite in 1990s. Increasing emissions from road transport contribute to the national total, and cause comparatively lower emission reductions than in case of SO_2. Similarly emissions of NMVOC decreased by 26% between 1990–2009 and was about 615 Gg in 2009. CO emissions in 2009 amounted 2694.6 Gg and dropped by about 64% between 1990–2009. The main reasons are the same as those described regarding emissions of SO_2 and NO_x.

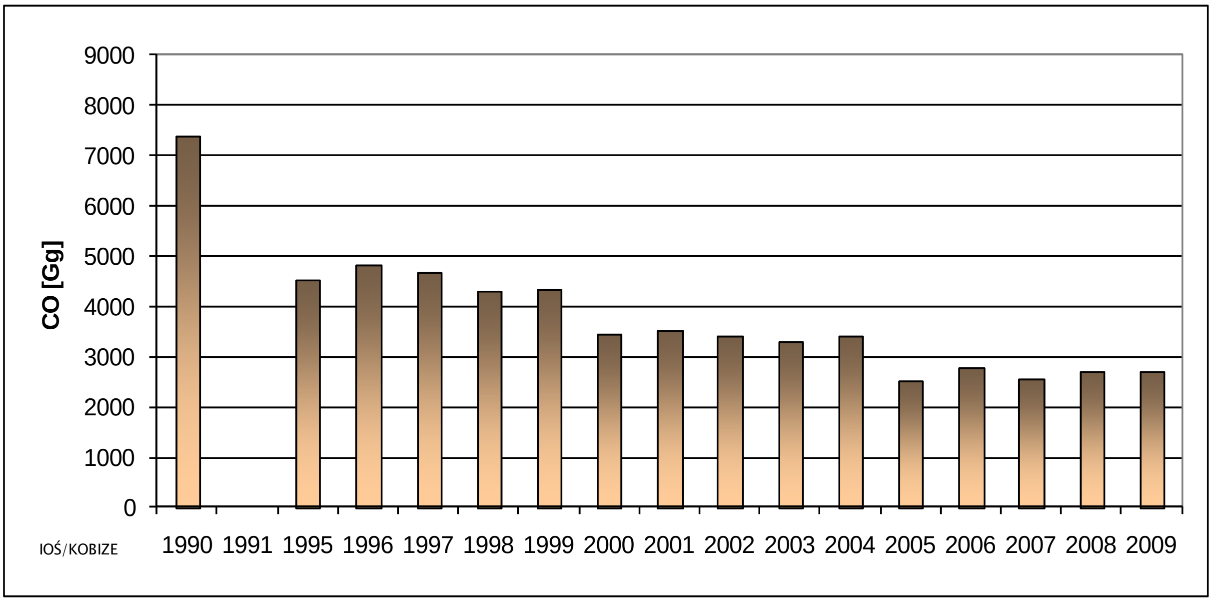

Figure 2.8. Emissions of CO (1990-2009)

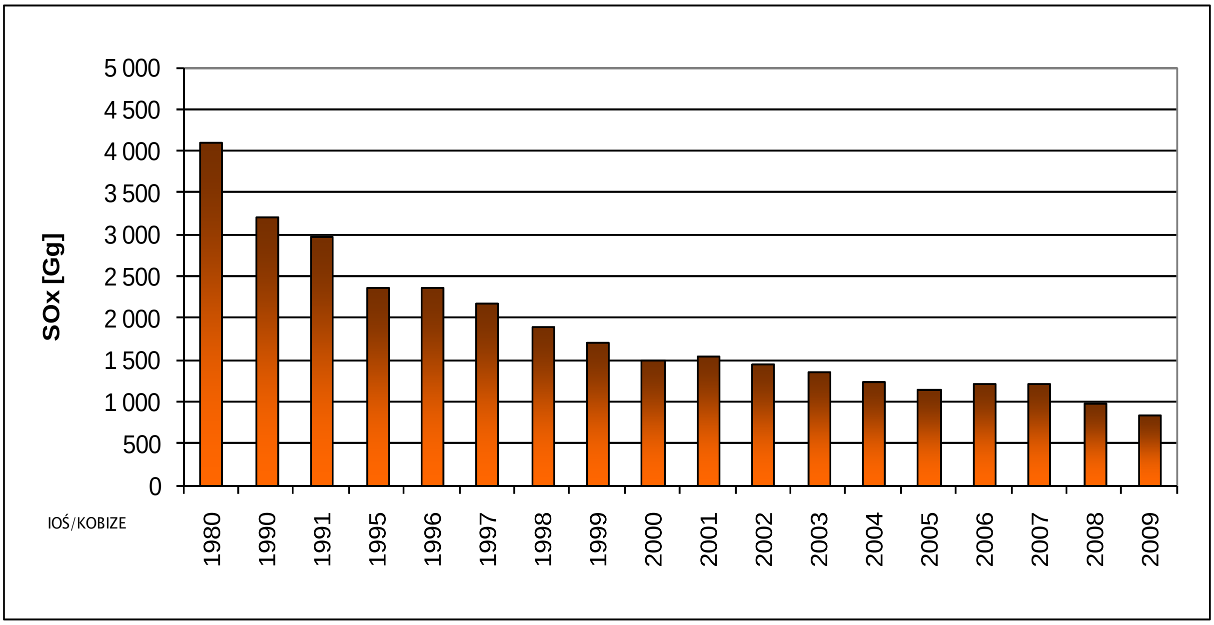

Figure 2.9. Emissions of SO_2 (1980-2009)

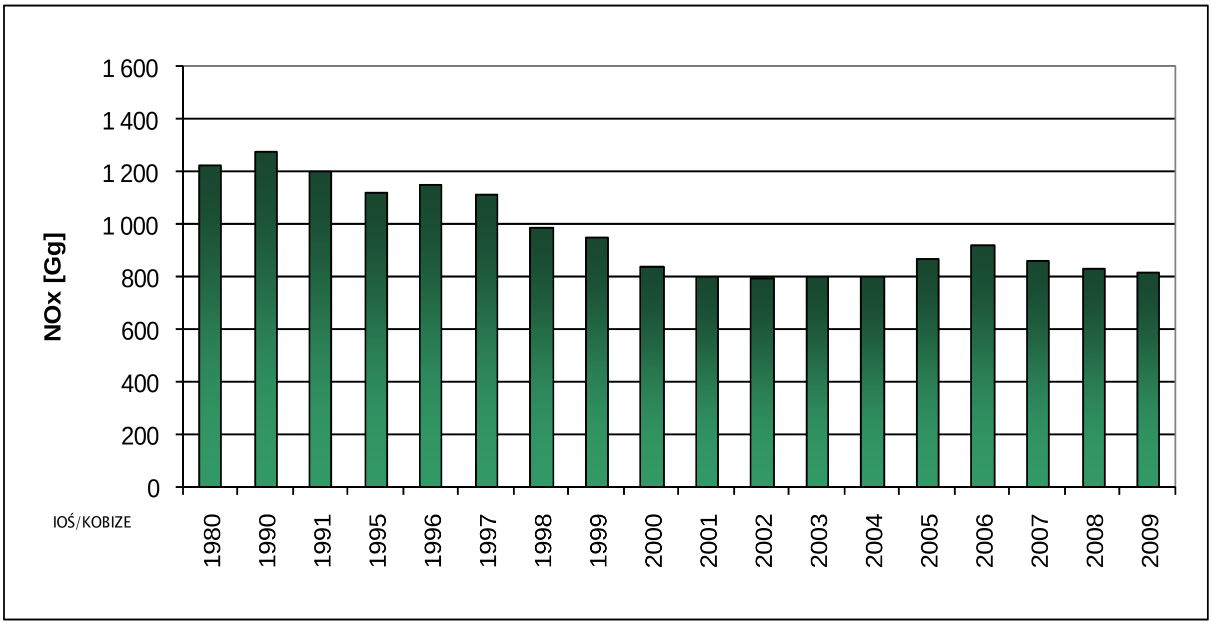

Figure 2.10. Emissions of NO_x (1980-2009)

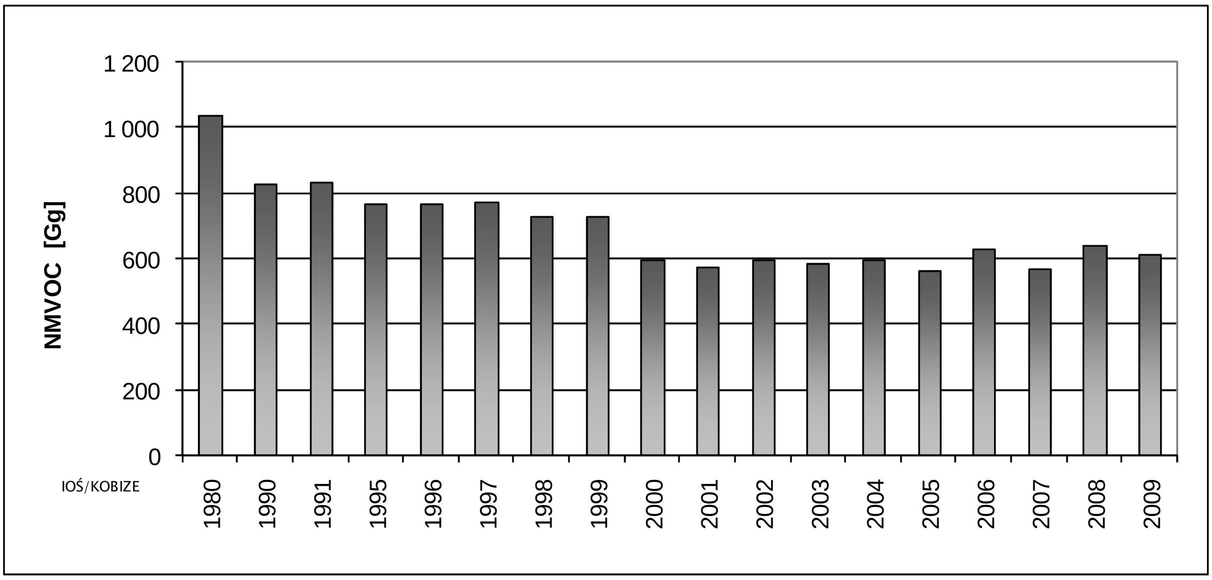

Figure 2.11. Emissions of NMVOC (1980-2009)

3. ENERGY (CRF SECTOR 1)

3.1. Overview of sector

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

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 64.4%
- 1.A.3.b Transport Road Transportation (CO2 emission), share in total GHG emission 11.7%
- 1.B.1.a. Coal Mining and Handling (CH4 emission), share in total GHG emission 1.9%
- 1.B.2.b. Natural Gas (CH4 emission), share in total GHG emission 1.1%

Share of these categories in total Poland's GHG emissions is 79.0%.

Figure 3.3.1 shows emission trend in *Energy* sector and 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 2009 about 96%.

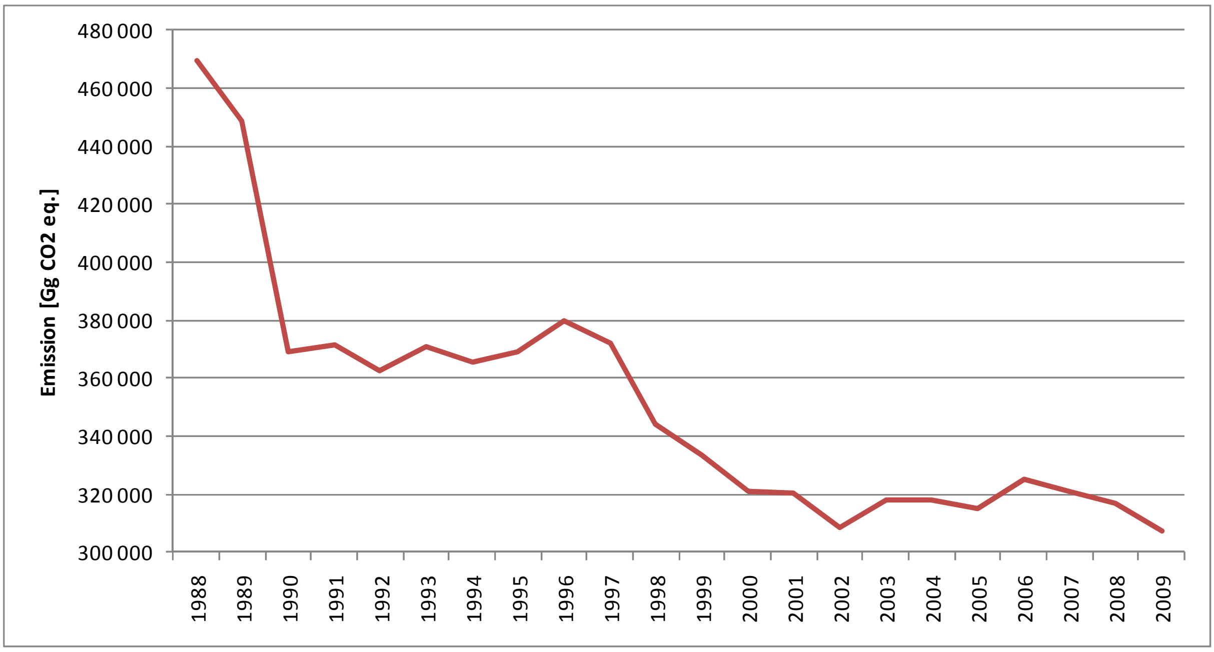

Figure 3.1.1. GHG emission trend in period 1988 - 2009 in sector Energy

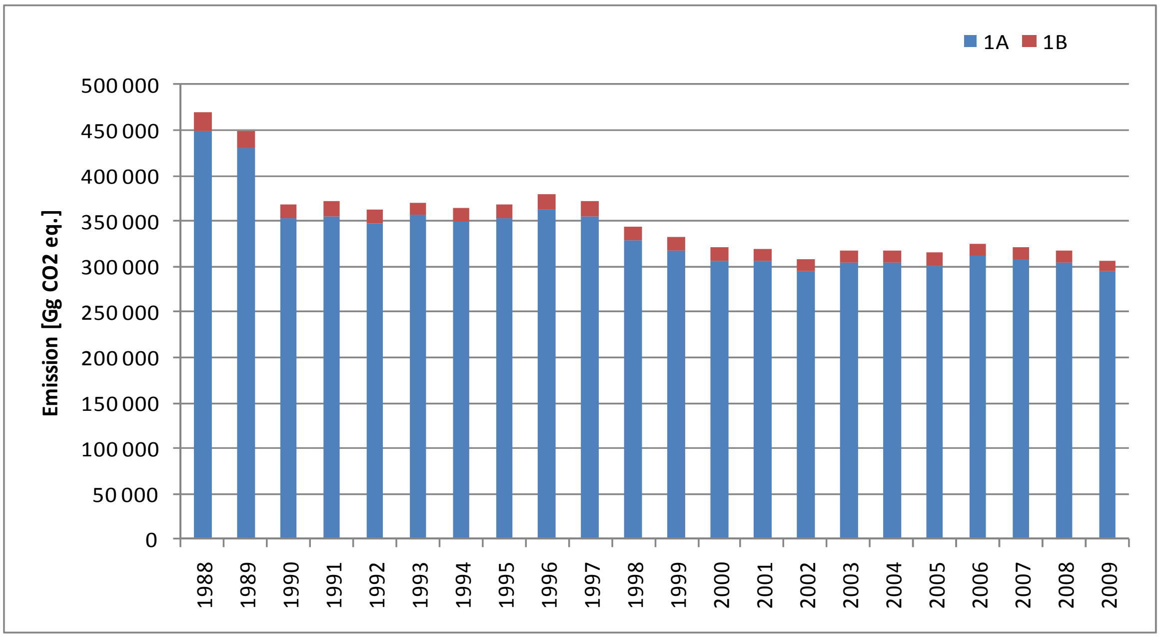

Figure 3.1.2. GHG emission trend in period 1988 - 2009 in subsectors 1.A and 1.B

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 2009 is about 78%. Subsector 1.A.1. *Energy Industries* is by far the largest contributor to emissions from fuel combustion (see figure 3.1.3).

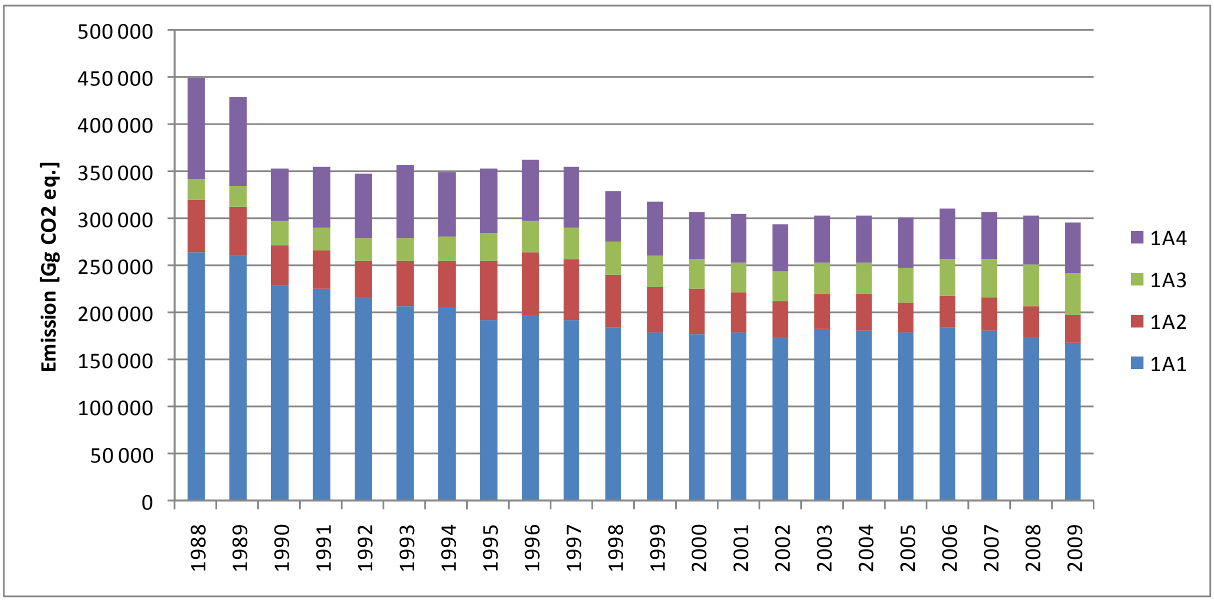

Figure 3.1.3. GHG emissions from fuel combustion in 1988- 2009 according to subcategories.

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*)
f) *Other* - 1.A.2.f:
- construction and other industry branches not included elsewhere
- off-road vehicles and other machinery in industry and construction sub-sectors

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 [GUS 2010a].

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, 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 elemental 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 is 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 1988-2009

Estimation of CO_2 emission from fuel combustion in stationary sources for the years 1988-2009 is based on methodology corresponding to methodology applied for 2009. For the years: 1990-2008 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 12-24). 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 1988-2009 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 involve: 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 11 850.1 Gg in 2009 and decreased since 1988 by 41%.

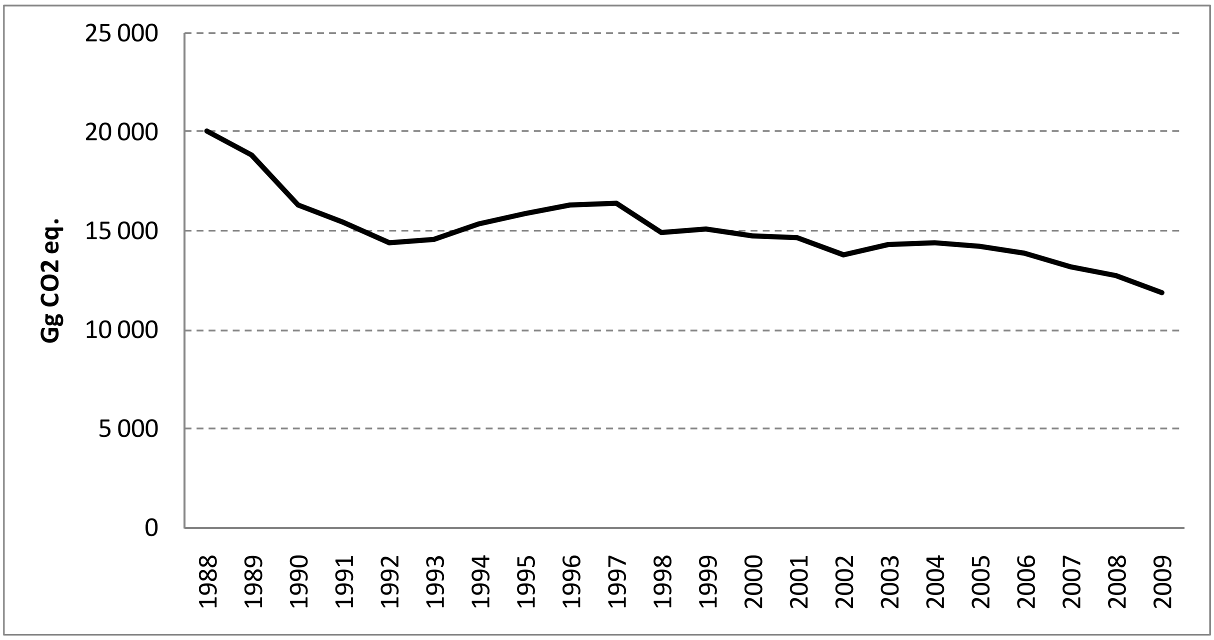

Figure 3.1.4. Changes in GHG emissions from 1.B Fugitive Emissions from Fuels in Gg CO_2 equivalent.

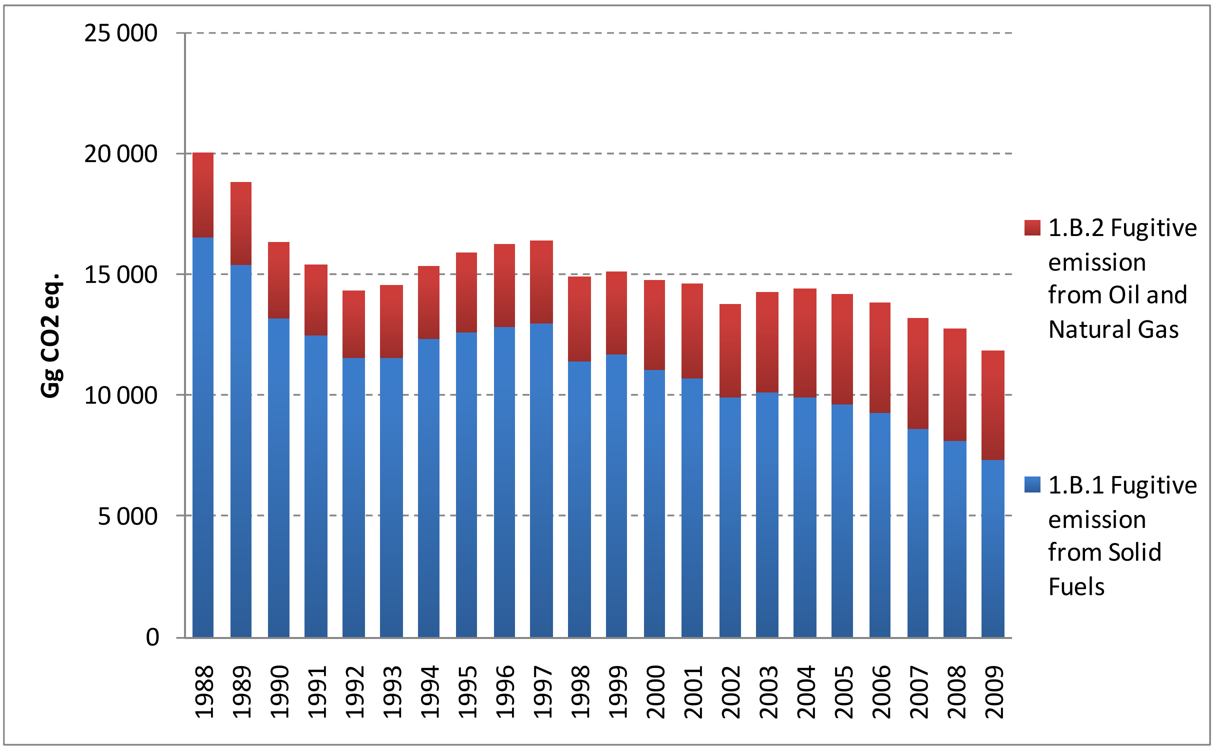

Figure 3.1.5. GHG emissions from 1.B.1 and 1.B.2 subcategories in 1988-2009.

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

3.2.1. 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 3.2.1) – over 95% in 2009.

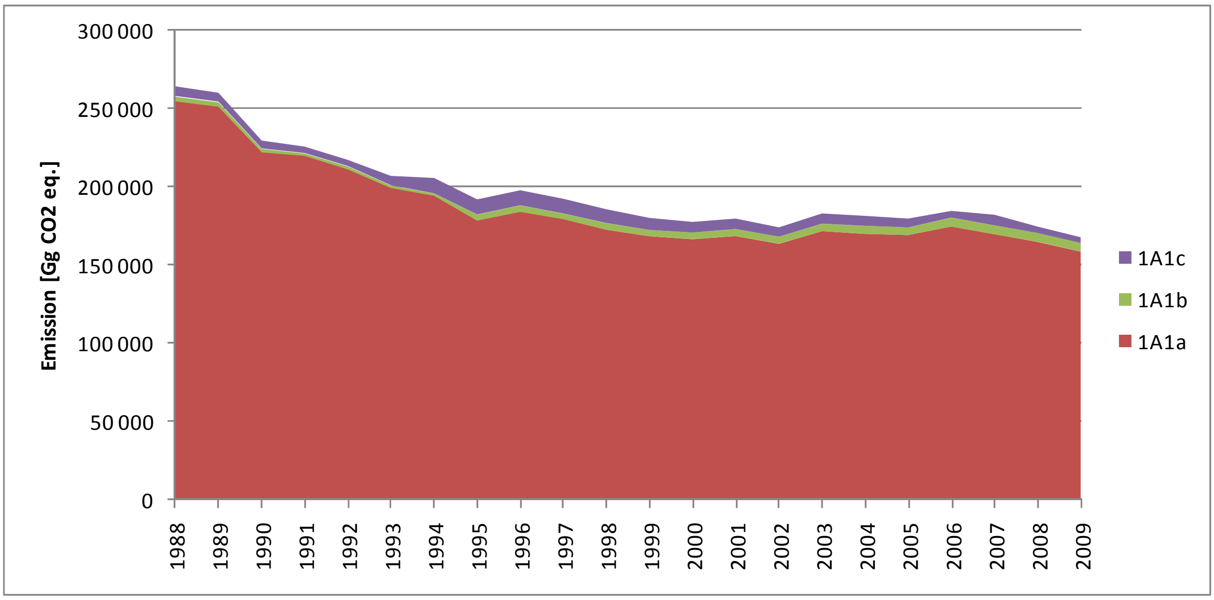

Figure 3.2.1. GHG emissions from *Energy Industries* in years 1988-2009 according to subcategories.

3.2.2. 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.

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

Table 3.2.1 presents the structure and amounts of fuel used in the sub-category 1.A.1.a *Production of electric energy and heat* for the years 1988-2009.

Table 3.2.1. Fuel consumption for the years 1988-2009 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	2449.580	2419.961	2131.502	2130.741	2055.115	1937.193	1882,573	1761,067
Biomass	16.699	15.129	14.585	14.384	17.289	13.783	14,057	1,447
TOTAL	**2563.017**	**2529.984**	**2234.675**	**2224.074**	**2139.564**	**2010.431**	**1957,945**	**1793,483**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	28.870	28.987	19.318	18.527	15.504	16.469	15,324	14,139
Gaseous Fuels	7.157	7.949	10.768	16.210	21.627	28.242	38,700	45,496
Solid Fuels	1820.657	1773.077	1709.723	1667.066	1645.466	1659.828	1605,357	1683,619
Biomass	2.793	3.381	3.877	3.747	3.904	5.449	5,424	6,533
TOTAL	**1859.477**	**1813.394**	**1743.686**	**1705.550**	**1686.501**	**1709.988**	**1664,805**	**1749,787**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	11.472	9.620	9.110	8.004	8.169	7.661		
Gaseous Fuels	53.667	57.039	52.808	49.653	51.711	51.760		
Solid Fuels	1659.194	1655.846	1712.403	1671.980	1614.368	1552.993		
Biomass	10.198	19.320	23.201	27.739	41.481	58.389		
TOTAL	**1734.531**	**1741.825**	**1797.522**	**1757.376**	**1715.729**	**1670.802**		

The data in table 3.2.1 shows that the use of solid fuels is dominant in 1.A.1.a – mainly hard coal and lignite. In 2009, the use of hard coal was almost 1029 PJ i.e. app. 62% of the entire energy of all fuels used in that sub-sector. Lignite made app. 30% of the energy, accordingly. Despite the significant share of solid fuels (app. 93%) 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 93% in 2009). 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 1988-2009 was presented in Annex 2 (tab. 1).

Figure 3.2.2 shows CO_2 emission changes over the period 1988-2009. A significant emission decrease took place over the years 1988-1995 followed by a period of emission stabilization.

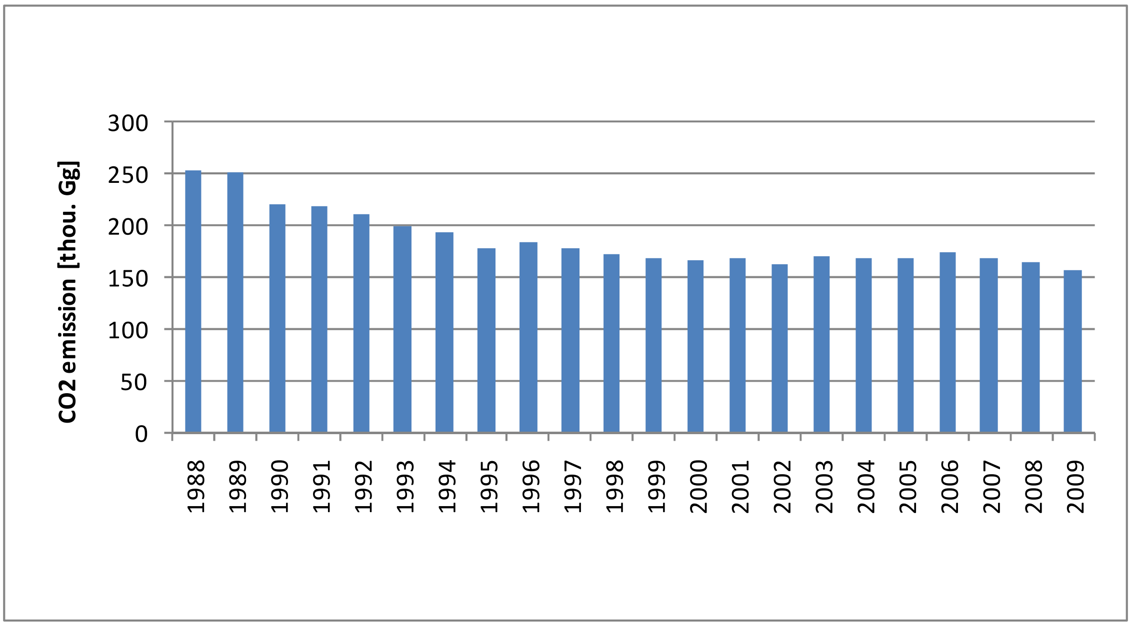

Figure 3.2.2. CO_2 emission for 1.A.1.a category in 1988-2009

Figure 3.2.3 shows emission trends for CH_4 and N_2O between the base year and 2009. 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.

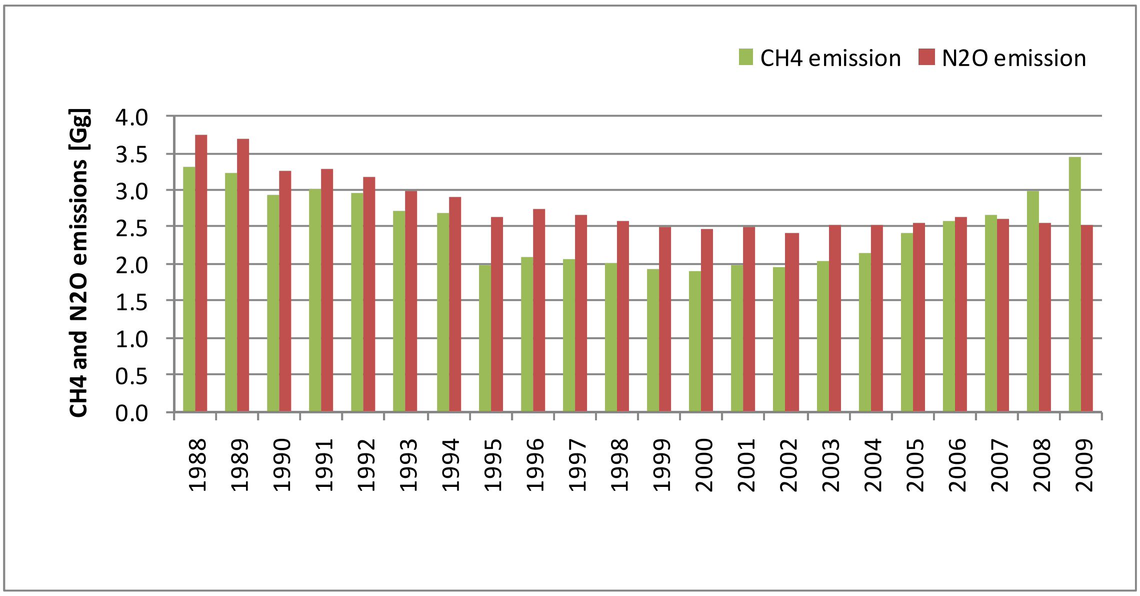

Figure 3.2.3. CH_4 and N_2O emissions for 1.A.1.a category in 1988-2009

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

Table 3.2.2 shows fuel consumption data in sub-category 1.A.1.b *Petroleum Refining* for the years 1988-2009. Detailed data on fuel consumptions in 1.A.1.b subcategory for the entire period 1988-2009 was presented in Annex 2 (table 2).

Table 3.2.2. Fuel consumption in 1988-2009 in 1.A.1.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	23.490	22.919	18.958	18.318	24.366	22.188	19.474	44.685
Gaseous Fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562
Solid Fuels	7.865	7.627	5.268	0.363	0.754	0.268	0.330	3.915
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**33.750**	**32.941**	**25.897**	**20.220**	**26.628**	**24.064**	**21.395**	**50.162**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	50.430	44.276	48.552	45.091	47.074	53.168	53.567	54.278
Gaseous Fuels	1.749	2.529	8.244	10.832	12.110	11.354	10.124	12.770
Solid Fuels	1.837	1.557	1.171	0.965	0.504	0.072	0.024	0.176
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**54.016**	**48.362**	**57.967**	**56.888**	**59.688**	**64.594**	**63.715**	**67.224**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	57.371	54.392	64.990	62.465	63.654	62.909		
Gaseous Fuels	15.454	14.482	14.900	20.816	18.816	17.381		
Solid Fuels	0.221	0.285	0.224	0.000	0.000	0.019		
Biomass	0.000	0.000	0.000	0.000	0.000	0.000		
TOTAL	**73.046**	**69.159**	**80.114**	**83.281**	**82.470**	**80.309**		

Figure 3.2.4 shows CO_2 emission changes in 1988-2009 in sub-category 1.A.1.b.

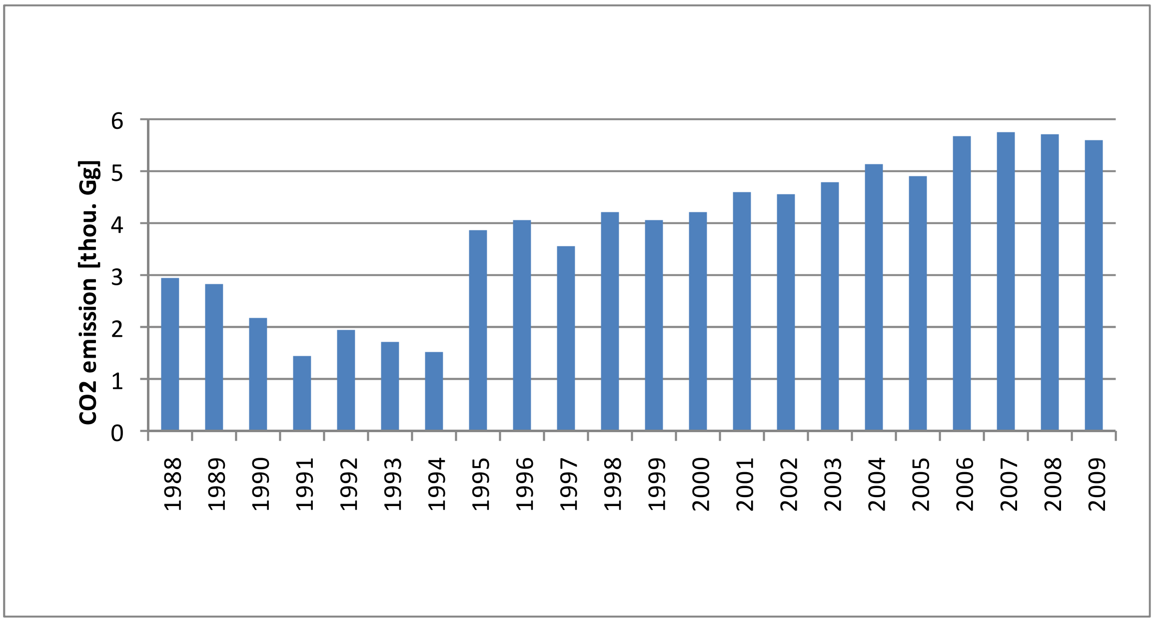

Figure 3.2.4. CO_2 emission for 1.A.1.b category in 1988-2009

Figure 3.2.5 shows the corresponding CH_4 and N_2O emission in that source sub-category between the base year and 2009.

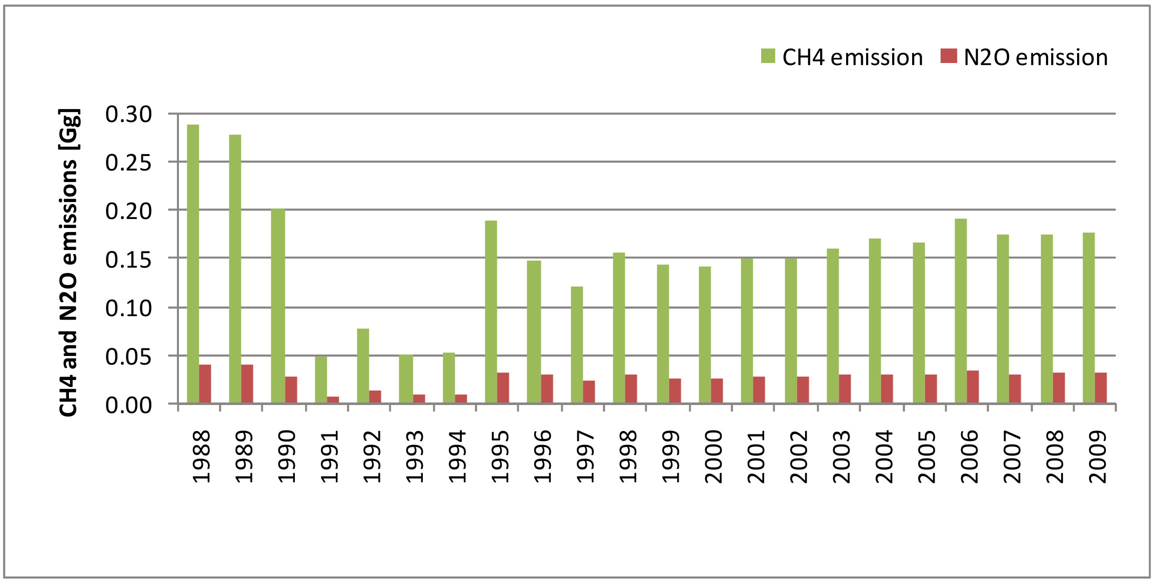

Figure 3.2.5. CH_4 and N_2O emissions for 1.A.1.b category in 1988-2009

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

Table 3.2.3 shows the fuel use data in the sub-category 1.A.1.c over the period: 1988-2009. Particular fuel consumptions in 1.A.1.c subcategory for the entire period 1988-2009 was tabulated in Annex 2 (table 3).

Table 3.2.3. Fuel consumption in 1988-2009 in 1.A.1.c subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Paliwa ciekłe	2.592	2.218	2.009	2.301	2.511	4.924	4.166	4.304
Paliwa gazowe	13.736	15.364	13.382	14.099	16.757	14.880	18.735	15.926
Paliwa stałe	70.511	66.331	58.631	49.206	47.161	63.175	105.168	103.730
Biomasa	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004
SUMA	**86.857**	**83.914**	**74.028**	**65.606**	**66.433**	**82.987**	**128.080**	**123.964**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Paliwa ciekłe	3.736	3.184	3.012	2.242	2.148	1.614	2.135	2.459
Paliwa gazowe	25.112	22.518	18.653	20.198	20.032	14.053	13.325	9.103
Paliwa stałe	98.642	99.434	93.852	80.095	72.596	73.612	61.728	71.037
Biomasa	0.014	0.031	0.026	0.027	0.033	0.051	0.047	0.135
SUMA	**127.504**	**125.167**	**115.543**	**102.562**	**94.809**	**89.330**	**77.235**	**82.734**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Paliwa ciekłe	2.294	2.519	1.424	1.501	1.764	1.699		
Paliwa gazowe	10.278	11.121	13.566	10.101	9.343	19.545		
Paliwa stałe	67.751	59.969	52.867	75.647	54.659	37.840		
Biomasa	0.004	0.014	0.025	0.085	0.037	0.138		
SUMA	**80.327**	**73.623**	**67.882**	**87.334**	**65.803**	**59.222**		

The emission trends of CO_2, CH_4 and N_2O in the 1988-2009 period are shown in figures 3.2.6 and 3.2.7.

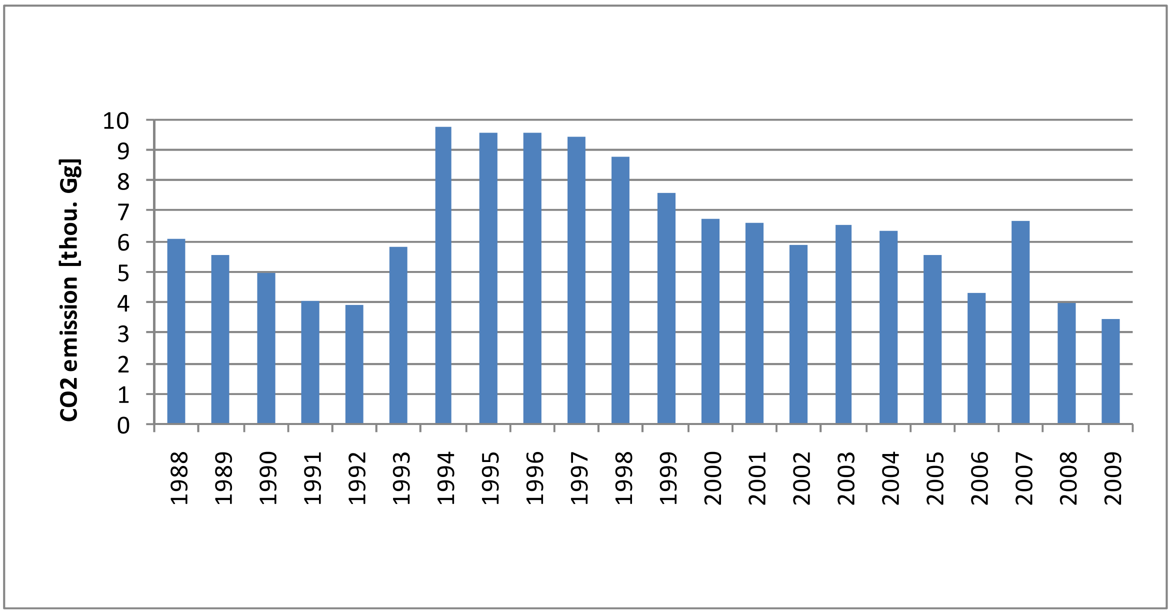

Figure 3.2.6. CO_2 emission for 1.A.1.c category in 1988-2009

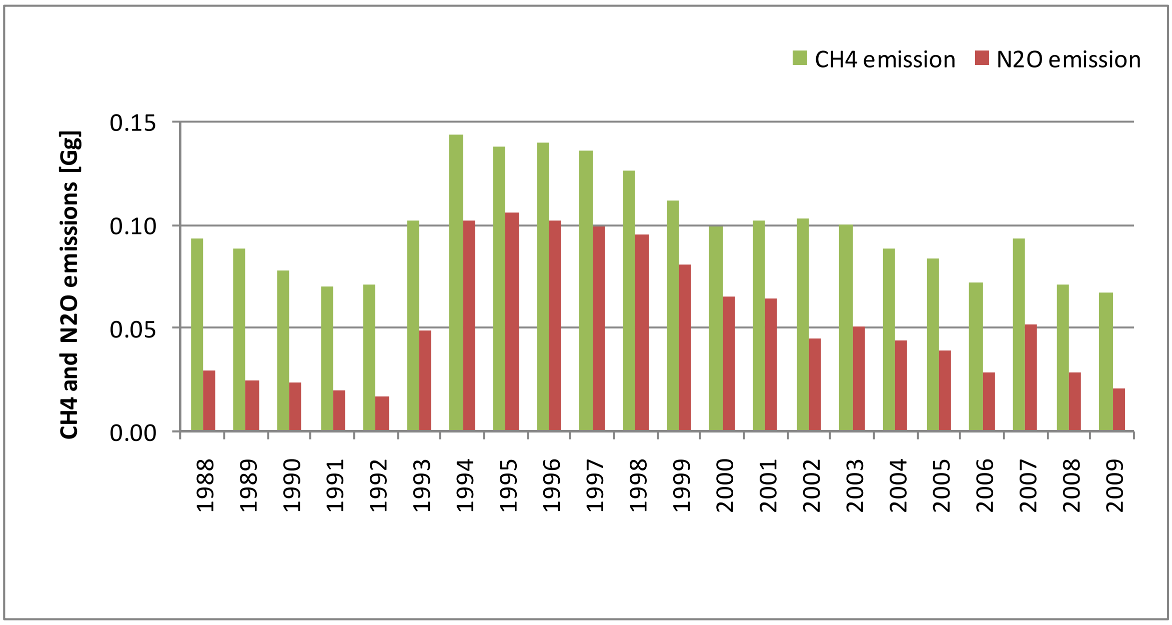

Figure 3.2.7. CH_4 and N_2O emissions for 1.A.1.c category in 1988-2009

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

3.3.1. 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
- off-road vehicles and other machinery in industry and construction sub-sectors

Subsector 1.A.2.f *Other* is the largest contributor to emissions from this category (see figure 3.3.1) – almost 39% in 2009. Subcategory 1.A.2.c *Chemicals* ranked second place in this respect (its share in total emission from 1.A.2 - over 25%)

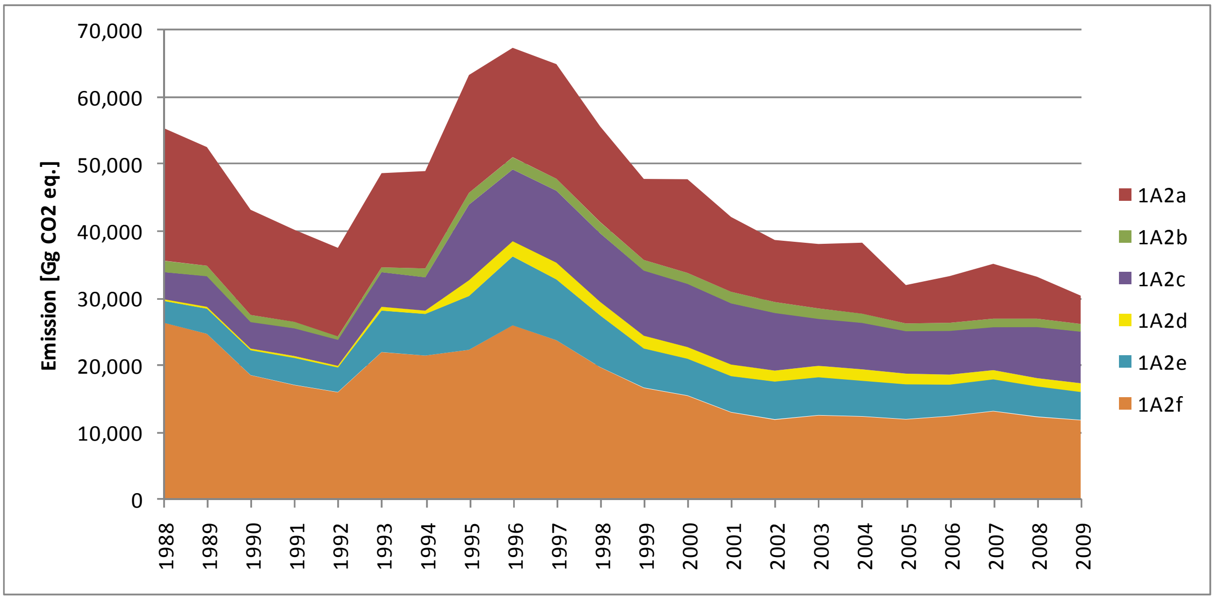

Figure 3.3.1. Emissions from *Manufacturing Industries and Construction* category in years 1988-2009 according to subcategories.

3.3.2. 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.

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

Table 3.3.1 shows the fuel use data in the sub-category 1.A.2.a *Iron and Steel* for the period: 1988-2009. 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 1988-2009 was presented in Annex 2 (table 4).

Table 3.3.1. Fuel consumption in 1988-2009 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	2.807
Gaseous Fuels	73.507	63.332	51.839	32.306	24.476	23.036	24.152	23.163
Solid Fuels	98.404	88.673	80.388	81.765	85.230	95.562	98.752	120.138
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005
TOTAL	**190.249**	**167.610**	**143.397**	**121.999**	**115.156**	**123.235**	**126.432**	**146.113**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.855	5.274	1.898	2.187	1.864	0.994	0.358	0.312
Gaseous Fuels	24.055	26.915	23.119	20.699	21.482	17.261	14.652	14.637
Solid Fuels	112.000	112.605	98.948	81.226	89.781	74.355	63.447	67.029
Biomass	0.006	0.004	0.006	0.004	0.003	0.006	0.003	0.004
TOTAL	**137.916**	**144.798**	**123.971**	**104.116**	**113.130**	**92.616**	**78.460**	**81.982**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	0.266	0.085	0.128	0.085	0.131	0.121		
Gaseous Fuels	19.696	16.622	19.796	20.861	19.655	15.864		
Solid Fuels	71.024	31.213	34.885	40.106	26.872	21.490		
Biomass	0.004	0.002	0.001	0.001	0.001	0.001		
TOTAL	**90.990**	**47.922**	**54.810**	**61.053**	**46.659**	**37.475**		

Significant drop in fuel consumption in the period 2005-2009 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**
Hard coal	1.329	4.839	4.509	3.843	2.234
Natural gas	3.369	0.707	1.443	0.643	0.733
Coke	47.558	53.274	51.695	46.707	25.993
Coke oven gas	4.242	4.832	6.460	5.717	0.609
Blast furnace gas	0.239	0.208	0.230	0.117	0.072

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

Figure 3.3.2 shows CO_2 emissions in the 1988-2009 period.

Emissions of CH_4 and N_2O in the same time period are shown in figure 3.3.3. Emission trends for all three gases follow closely the trends in fuel use.

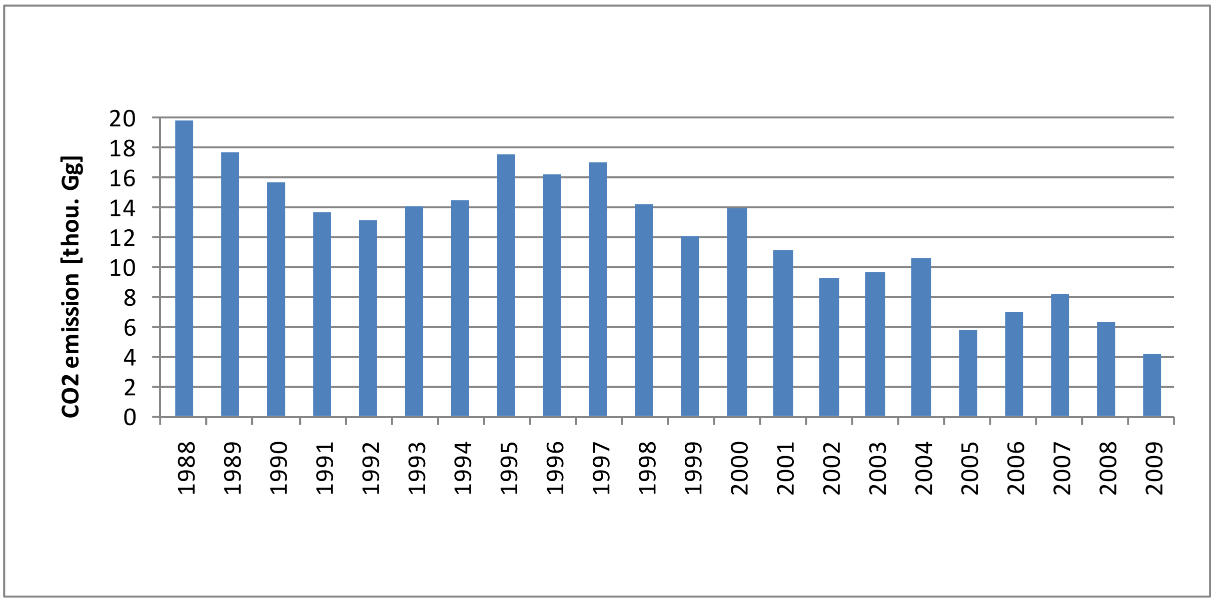

Figure 3.3.2. CO_2 emission for 1.A.2.a category in 1988-2009

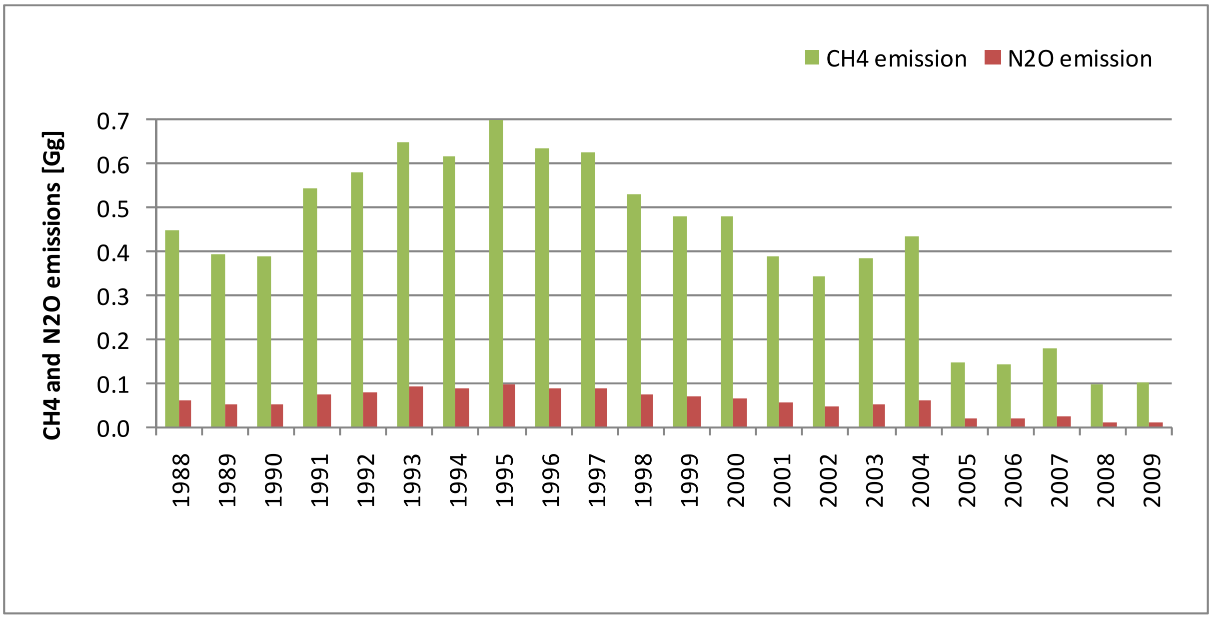

Figure 3.3.3. CH_4 and N_2O emissions for 1.A.2.a category in 1988-2009

3.3.2.2. 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 1988-2009 period are presented in table 3.3.2. More detailed data concerning fuel consumptions was tabulated in Annex 2 (table 5).

Table 3.3.2. Fuel consumption in 1988-2009 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	12.871	11.551	6.908	6.264	3.644	5.438	9.007	12.649
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
TOTAL	**19.195**	**17.827**	**12.310**	**11.740**	**5.785**	**8.029**	**15.257**	**18.986**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	0.939	0.853	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	13.224	12.869	11.879	11.115	11.391	12.351	11.426	10.672
Biomass	0.149	0.042	0.026	0.010	0.011	0.005	0.001	0.000
TOTAL	**19.420**	**19.188**	**18.320**	**17.515**	**18.078**	**18.838**	**17.632**	**17.034**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	0.616	0.616	0.616	0.376	0.376	0.369		
Gaseous Fuels	6.405	6.468	6.884	6.743	6.542	5.851		
Solid Fuels	8.864	6.817	7.070	7.900	7.893	7.316		
Biomass	0.000	0.000	0.000	0.000	0.000	0.000		
TOTAL	**15.885**	**13.901**	**14.570**	**15.019**	**14.811**	**13.536**		

Emissions of the main greenhouse gases in 1.A.2.b between the base year and 2009 are shown in figures 3.3.4 and 3.3.5.

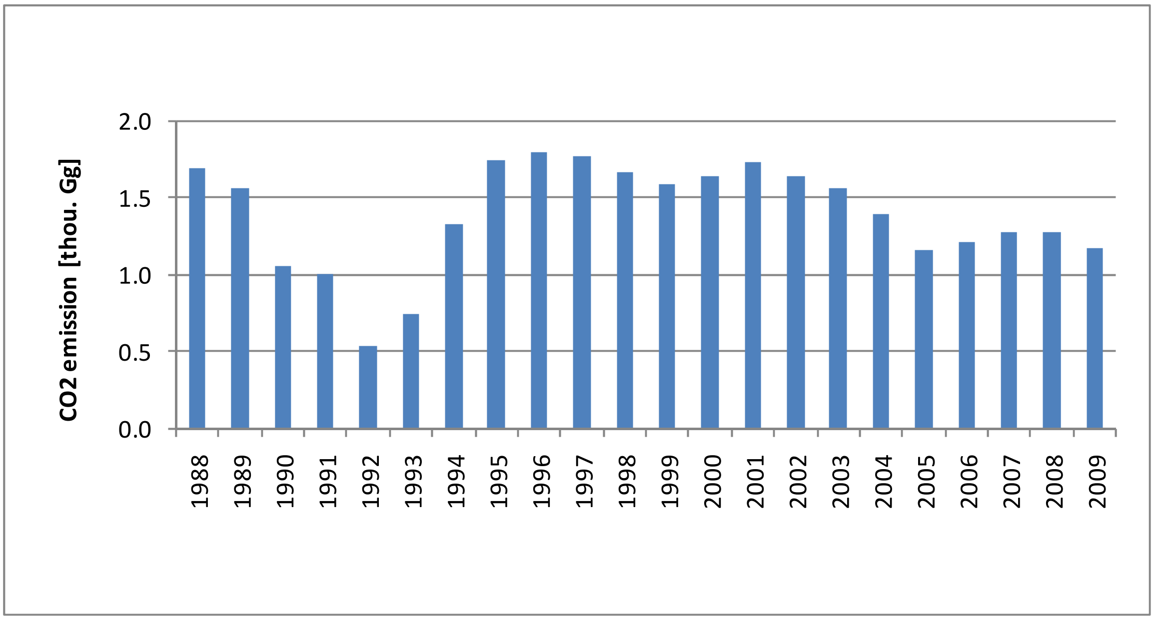

Figure 3.3.4. CO_2 emission for 1.A.2.b category in 1988-2009

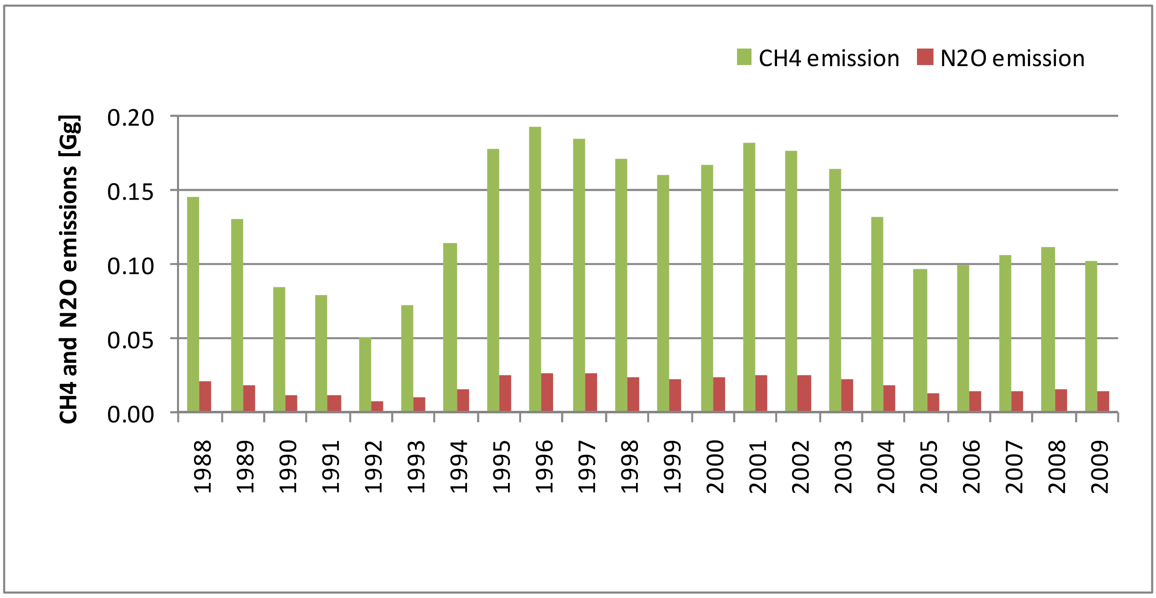

Figure 3.3.5. CH_4 and N_2O emissions for 1.A.2.b category in 1988-2009

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

Detailed data on fuel consumptions in 1.A.2.c subcategory for the entire period 1988-2009 was presented in Annex 2 (table 6).
The data on fuel type use in the sub-category 1.A.2.c *Chemicals* over the 1988-2009 period are presented in table 3.3.3.

Table 3.3.3. Fuel consumption in 1988-2008 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	8.725	7.748	7.888	10.939
Gaseous Fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356
Solid Fuels	24.661	29.901	27.394	27.746	23.915	34.615	32.793	95.837
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007
TOTAL	**42.469**	**45.949**	**36.897**	**38.322**	**37.082**	**52.441**	**45.223**	**113.139**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	21.213	24.570	42.725	40.426	38.577	33.588	33.061	33.617
Gaseous Fuels	6.191	11.024	9.408	9.041	9.464	8.481	7.199	6.457
Solid Fuels	87.011	80.702	65.801	62.240	60.554	61.331	57.593	41.279
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.153
TOTAL	**114.415**	**116.296**	**117.934**	**111.707**	**108.595**	**103.400**	**97.854**	**81.506**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	33.621	25.995	29.362	29.779	23.521	31.204		
Gaseous Fuels	7.498	8.104	9.053	8.771	8.037	9.762		
Solid Fuels	40.379	40.350	38.927	38.256	55.789	49.796		
Biomass	0.102	0.165	0.000	0.121	0.000	0.058		
TOTAL	**81.600**	**74.614**	**77.342**	**76.927**	**87.347**	**90.820**		

Figure 3.3.6 shows CO_2 emissions in the sub-category 1.A.2.c in the 1988-2009 period. Emissions of CH_4 and N_2O, in turn, are shown in figure 3.3.7.

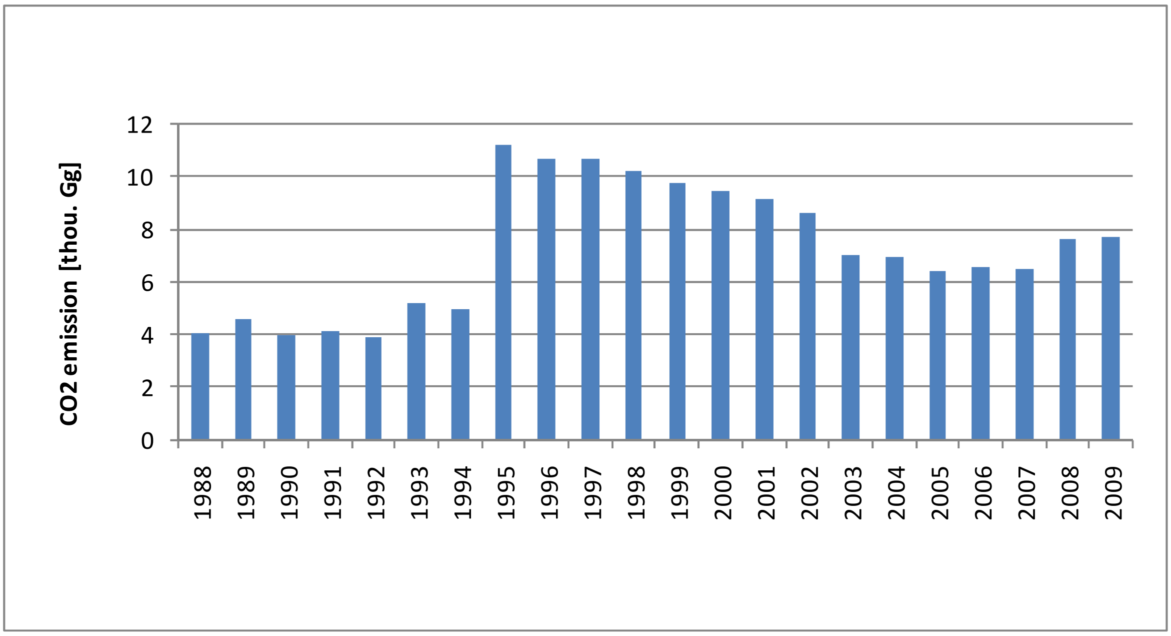

Figure 3.3.6. CO_2 emission for 1.A.2.c category in 1988-2009

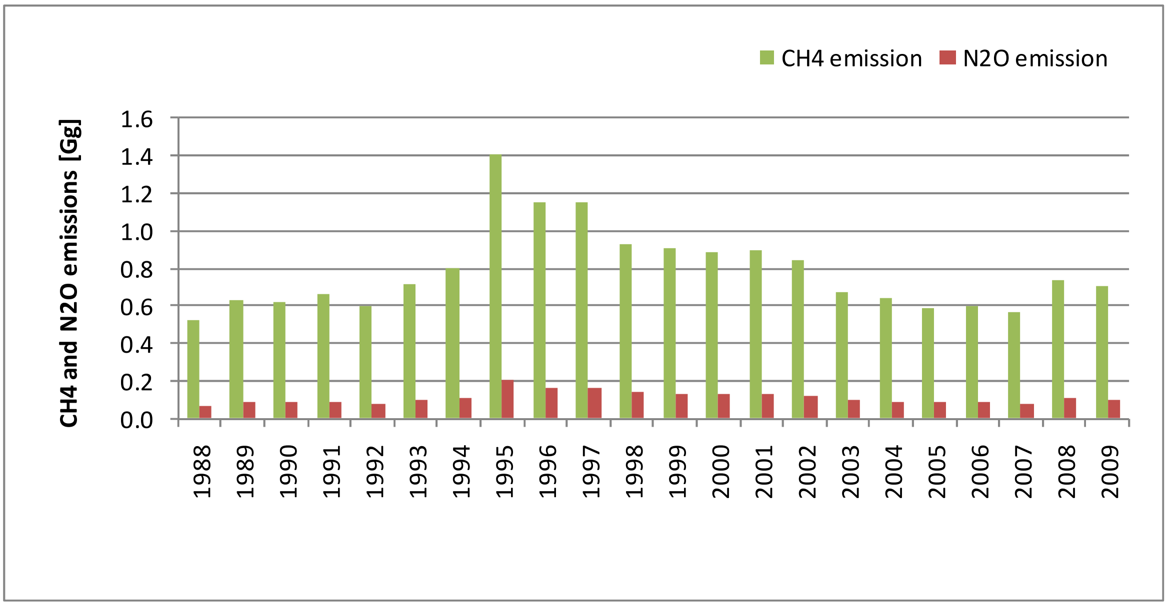

Figure 3.3.7. CH_4 and N_2O emissions for 1.A.2.c category in 1988-2009

3.3.2.4. 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 1988-2009 period are presented in table 3.3.4. 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 3.3.4. Fuel consumption in 1988-2009 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	1.649	1.531	2.534
Gaseous Fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232
Solid Fuels	1.976	2.192	1.805	2.026	1.636	4.838	4.121	22.603
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437
TOTAL	**3.811**	**3.858**	**3.276**	**3.418**	**3.071**	**8.133**	**7.512**	**40.806**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.682	2.112	2.612	2.221	2.094	2.041	2.032	2.115
Gaseous Fuels	0.455	1.096	0.563	1.007	1.211	1.445	1.461	2.094
Solid Fuels	22.493	24.222	19.026	17.532	15.734	15.621	14.456	14.815
Biomass	16.243	16.472	16.476	15.545	15.938	15.138	16.622	17.950
TOTAL	**40.873**	**43.902**	**38.677**	**36.305**	**34.977**	**34.245**	**34.571**	**36.974**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	2.241	1.987	2.075	2.330	1.984	1.965		
Gaseous Fuels	2.657	2.288	2.976	4.087	4.822	4.902		
Solid Fuels	14.175	13.590	11.744	9.599	8.128	8.676		
Biomass	18.957	18.611	30.369	30.877	19.729	19.189		
TOTAL	**38.030**	**36.476**	**47.164**	**46.893**	**34.663**	**34.732**		

Figures 3.3.8 and 3.3.9 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.d in the period: 1988-2009.

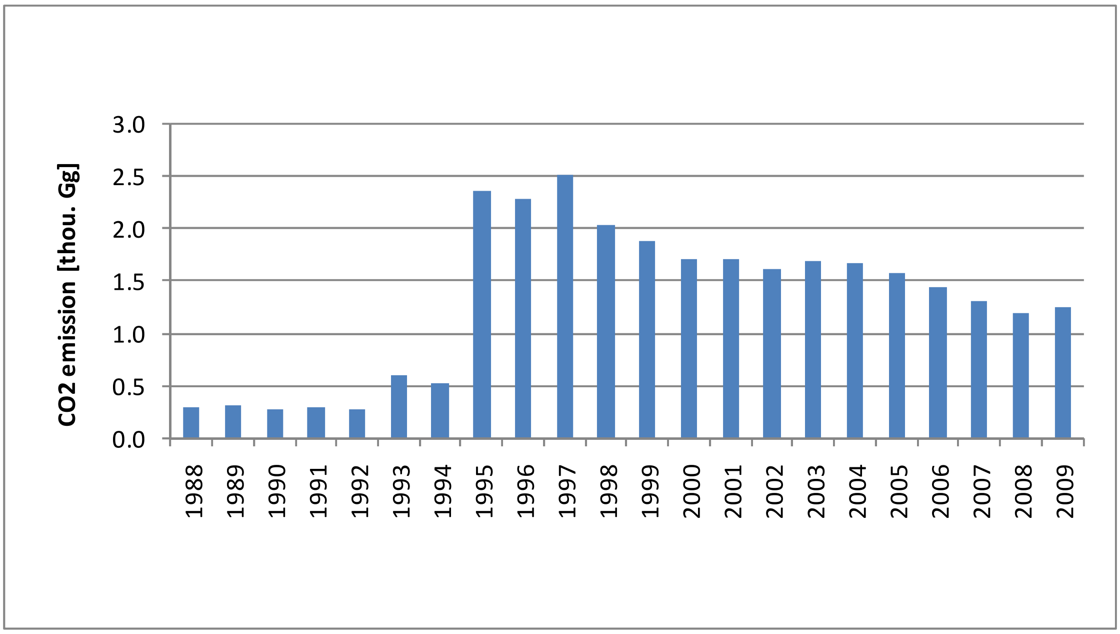

Figure 3.3.8. CO_2 emission for 1.A.2.d category in 1988-2009

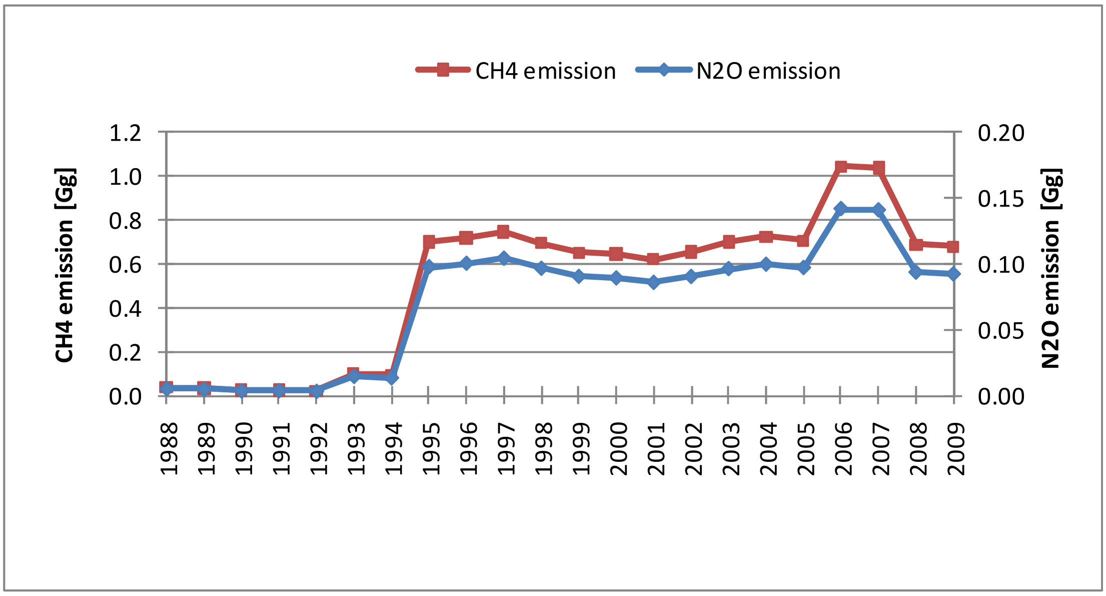

Figure 3.3.9. CH_4 and N_2O emissions for 1.A.2.d category in 1988-2009

3.3.2.5. 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 1988-2009 period are presented in table 3.3.5. Detailed data on fuel consumption was tabulated in Annex 2 (table 8).

Table 3.3.5. Fuel consumption in 1988-2009 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	29.282	35.544	35.418	39.020	35.517	59.363	56.707	75.879
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082
TOTAL	**35.829**	**41.084**	**40.532**	**43.735**	**40.321**	**67.380**	**69.152**	**87.215**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	8.490	7.783	9.817	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	92.361	81.596	67.068	48.284	43.648	41.593	43.546	42.203
Biomass	0.094	0.075	0.104	0.089	0.112	0.104	0.097	0.386
TOTAL	**115.996**	**102.381**	**87.683**	**67.824**	**64.881**	**63.897**	**67.423**	**68.988**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	10.978	9.998	8.633	7.771	9.233	5.528		
Gaseous Fuels	16.164	17.456	18.623	20.614	20.725	20.951		
Solid Fuels	37.972	36.977	31.793	32.095	28.650	27.845		
Biomass	0.447	0.282	0.311	0.248	0.459	0.302		
TOTAL	**65.561**	**64.713**	**59.360**	**60.728**	**59.067**	**54.625**		

Figures 3.3.10 and 3.3.11 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.e in the period: 1988-2009.

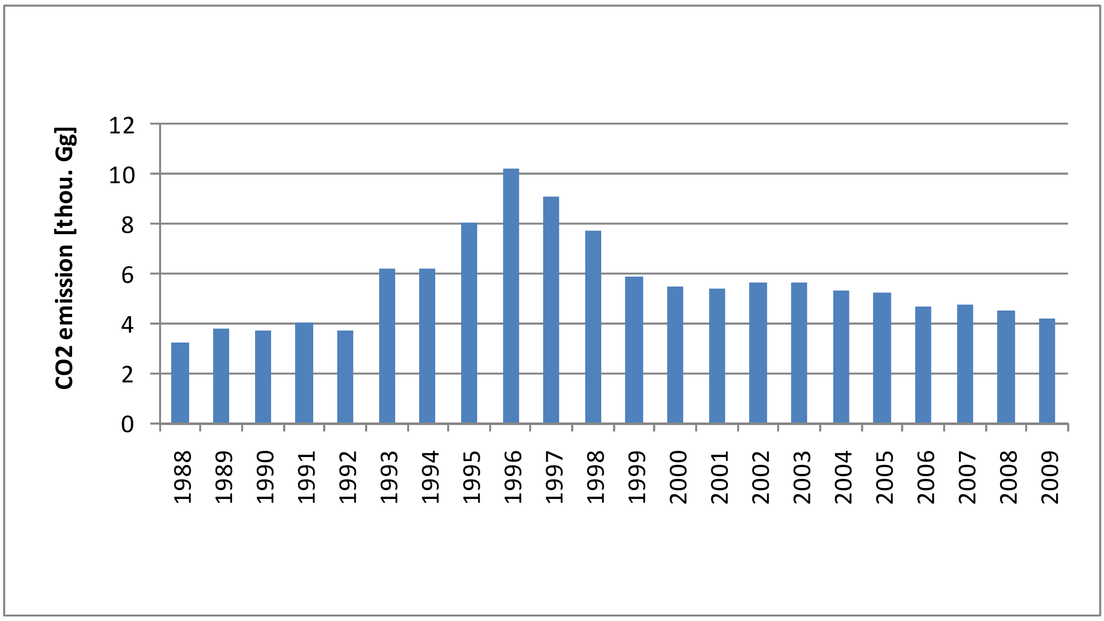

Figure 3.3.10. CO_2 emission for 1.A.2.e category in 1988-2009

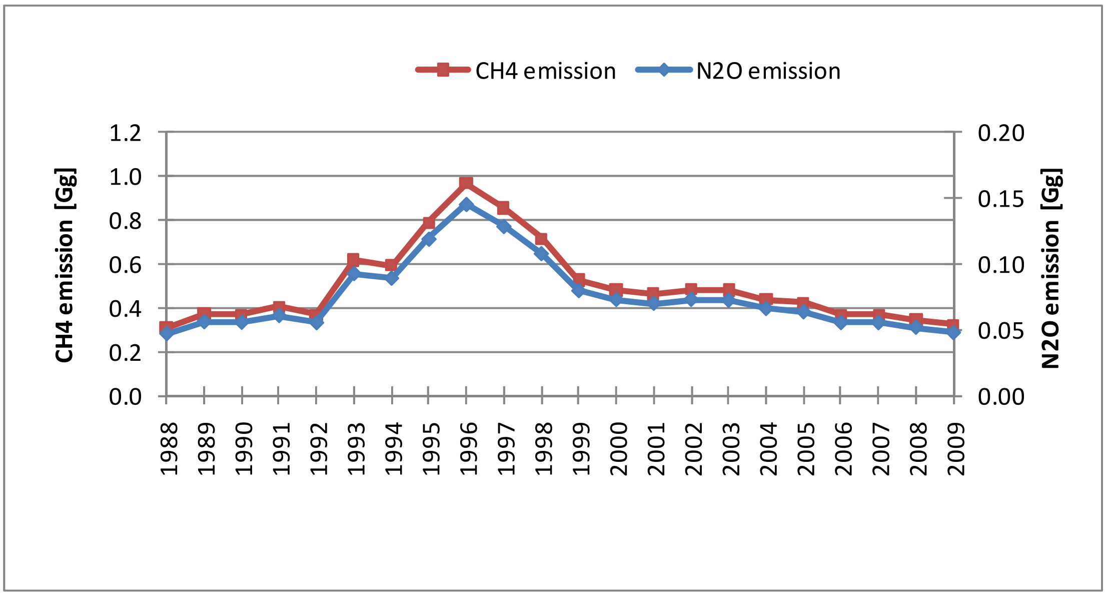

Figure 3.3.11. CH_4 and N_2O emissions for 1.A.2.e category in 1988-2009

3.3.2.6. Other (stationary sources - CRF sector 1.A.2.f)

The data on fuel type use in stationary sources in the sub-category 1.A.2.f *Other* over the 1988-2009 period are presented in table 3.3.6. Detailed data concerning total fuel consumption in 1.A.2.f subcategory (including fuel consumption related to off-road vehicles and other machinery in industry and construction sub-sectors) was tabulated in Annex 2 (table 9)

Table 3.3.6. Fuel consumption in 1988-2009 in 1.A.2.f subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	29.047	27.157	18.889	15.593	14.897	16.817	16.849	22.503
Gaseous Fuels	52.767	50.455	40.220	34.460	36.058	39.907	38.844	40.695
Solid Fuels	210.857	196.647	147.013	138.261	126.838	184.747	180.473	182.615
Biomass	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.980
TOTAL	**302.785**	**283.728**	**213.103**	**194.287**	**182.870**	**246.499**	**239.580**	**250.793**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	28.511	32.298	29.813	25.284	22.610	21.723	22.215	27.019
Gaseous Fuels	40.861	41.717	44.737	40.269	46.522	50.178	52.506	56.740
Solid Fuels	214.186	188.338	148.135	124.024	109.682	83.847	70.744	69.337
Biomass	6.530	8.200	8.240	8.606	10.111	10.991	12.592	12.005
TOTAL	**290.088**	**270.553**	**230.925**	**198.183**	**188.925**	**166.739**	**158.057**	**165.101**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	26.291	29.096	24.102	18.665	18.283	20.171		
Gaseous Fuels	60.828	62.287	65.056	66.426	66.573	64.617		
Solid Fuels	66.323	59.574	63.337	75.376	65.434	57.629		
Biomass	12.452	12.391	11.978	13.922	14.189	16.262		
TOTAL	**165.893**	**163.347**	**164.473**	**174.388**	**164.478**	**158.679**		

Figures 3.3.12 and 3.3.13 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.f in the period: 1988-2009.

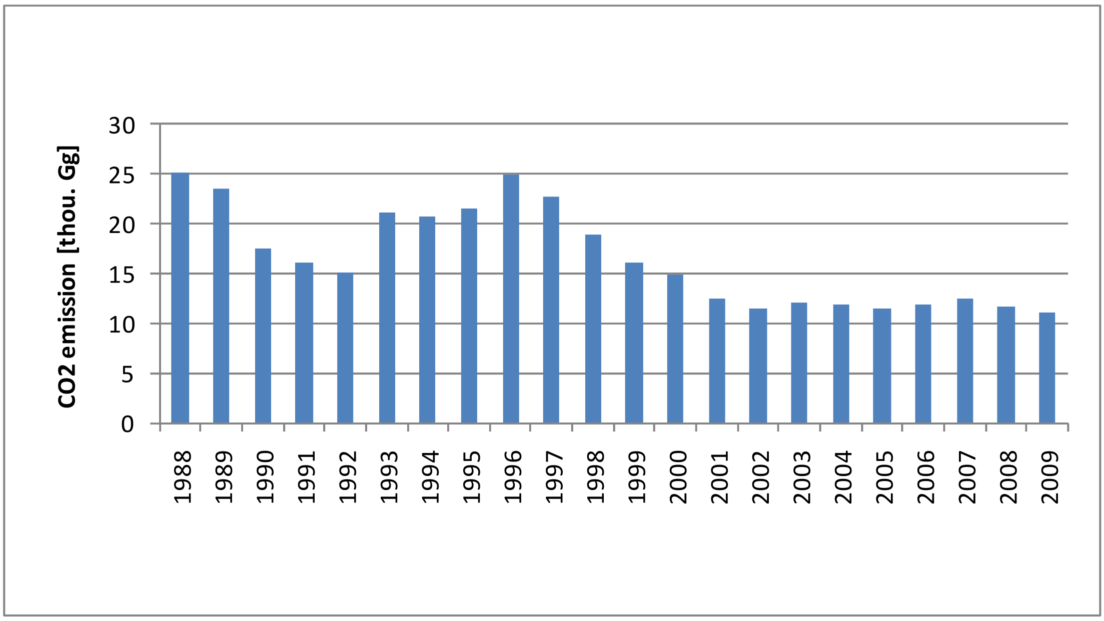

Figure 3.3.12. CO_2 emission from stationary sources in 1.A.2.f category in 1988-2009

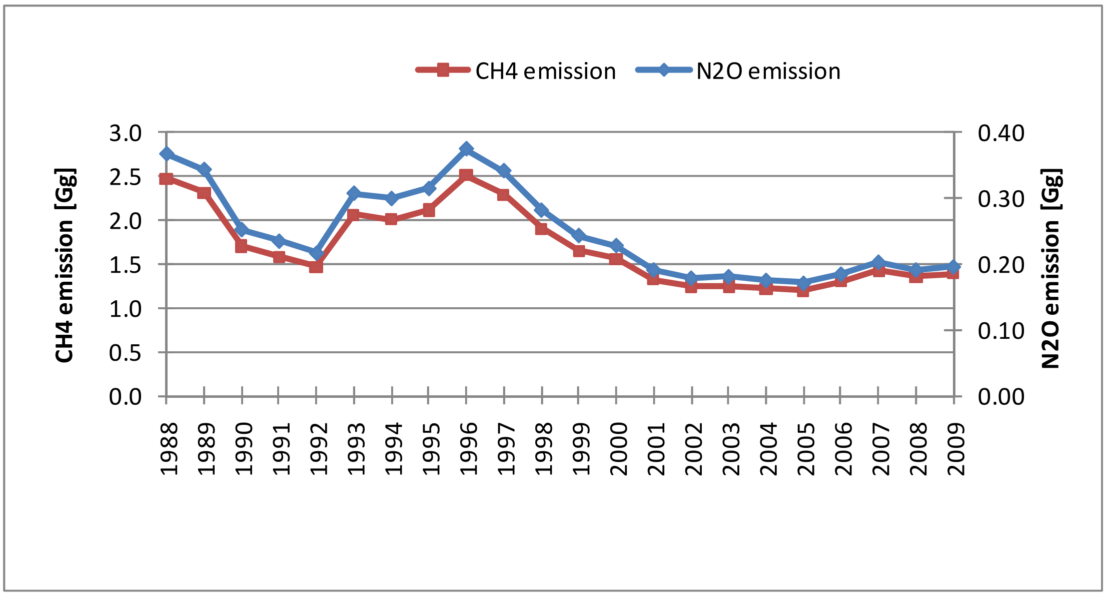

Figure 3.3.13. CH_4 and N_2O emissions from stationary sources in 1.A.2.f category in 1988-2009

The mobile source classified in the sub-category 1.A.2.f (i.e. off-road vehicles and other machinery in industry and construction) are described below in a separate sub-chapter.

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

3.4.1. 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 2009 is about 10.8%. Road transport is by far the largest contributor to transport emissions (see figure 3.4.1) - in year 2009 about 95.7%.

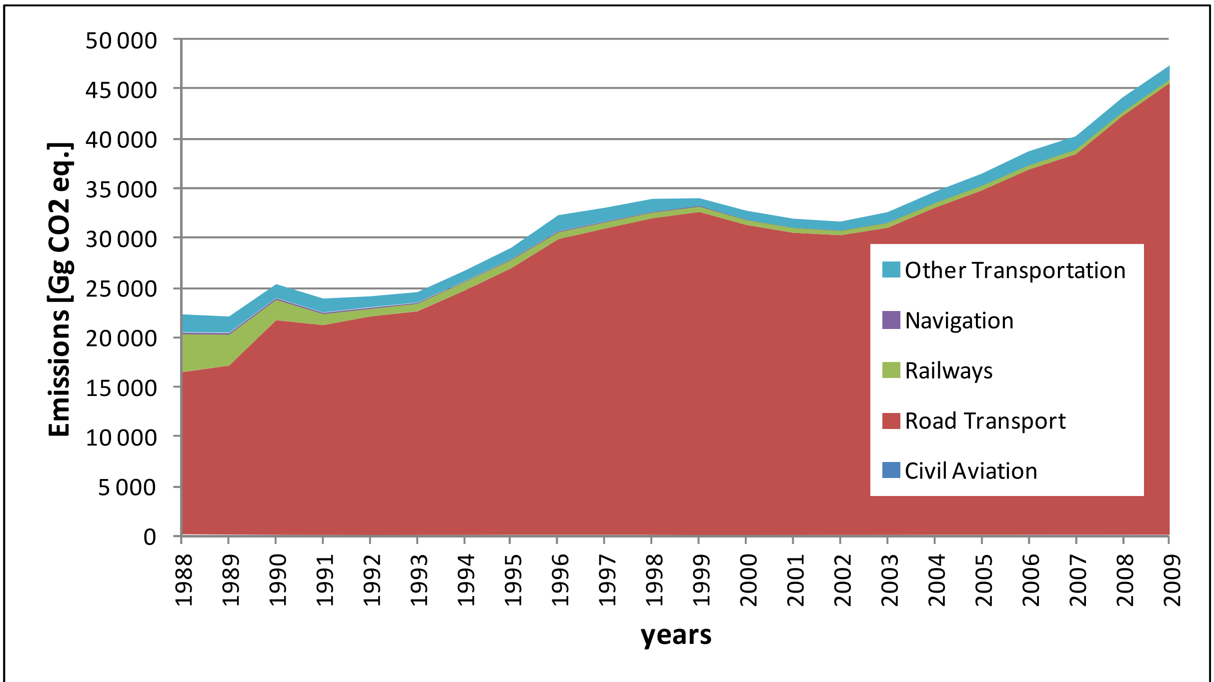

Figure 3.4.1. Emissions from transport in years 1988-2009.

3.4.2. Methodological issues

The methodology used for estimation of GHG emissions in the national inventory for mobile sources for the entire time series 1988-2009 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.

All other emission factors for mobile sources were taken from IPCC guidelines and have constant values over the entire time series 1988-2009. The values of the EFs are those in table 3.4.1. The values of EFs which are expressed in g/kg in the original references may differ from year to year compared to values in table 3.4.1 following the fluctuations of NCVs and subsequent unit conversions. This applies - inter alia - to CO_2 and CH_4 emission factors for jet fuel. Exception is N_2O emission factor from gasoline for passenger cars with catalyst, which based on COPERT IV (following recommendation made by ERT).

Table. 3.4.1. Emission factors [kg/GJ] for transport types (means) in 2009

Type of transport	Category code	EF CO_2	EF CH_4	EF N_2O
1.A.3.a.ii International Aviation - bunker	1.i.PL.	73.26	0.0005	0.0023
1.A.3.a.ii Civil Aviation. Domestic	1.i.PL.	73.26	0.0005	0.0023
	1.i.BL.	72.10	0.0600	0.0009
1.A.3.b.i Passenger Cars without catalysts	2.i.α.BS	70.75	0.03	0.002
	2.i.α.LG	63.11	0.02	0.0002
	2.i.α.ON	73.16	0.002	0.004
	2.i.β.BS	70.75	0.02	0.001
1.A.3.b. Passenger Cars with catalysts	2.i.γ.BS	70.31	0.007	0.003
	2.i.γ.LG	63.11	0.02	0.0002
	2.i.γ.ON	73.16	0.002	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t without catalysts	2.ii.α.BS	70.75	0.02	0.001
	2.ii.α.LG	63.11	0.03	0.0002
	2.ii.α.ON	73.16	0.001	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t with catalysts	2.ii.γ.BS	70.31	0.02	0.001
	2.ii.γ.LG	63.11	0.01	0.0002
	2.ii.γ.ON	73.16	0.001	0.004
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. without catalysts	2.iii.α.ON	73.16	0.006	0.003
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. with catalysts	2.iii.γ.ON	73.16	0.006	0.003
1.A.3.b.iii Buses	2.iii.α.ON	73.16	0.0039	0.0013
	2.iii.γ.ON	73.16	0.0039	0.0013
1.A.3.b.iv Motorcycles	2.iv.BS	70.75	0.1	0.001
1.A.3.b.iv Mopeds	2.iv.BS	70.75	0.1	0.001
1.A.3.b.vi Tractors	2.vi.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	3.ON	75.00	0.005	0.0006
1.A.3.d.ii Domestic Navigation - inland	4.ON	73.00	0.004	0.030
1.A.3.d.ii Domestic Navigation - marine	5.i.ON	74.10	0.007	0.002
	5.i.OP	77.60	0.007	0.002
1.A.3.d.i Domestic Navigation - bunker	5.i.ON	74.10	0.007	0.002
	5.i.OP	77.60	0.007	0.002
1.A.4.c.iii Fishery	5.ii.ON	74.10	0.007	0.002
	5.ii.OP	77.60	0.007	0.002
1.A.4.c.ii Agriculture - Off-Road Vehicles	6.i.ON	73.00	0.004	0.0039
1.A.4.c.ii Agriculture - Machines	6.ii.ON	73.00	0.004	0.030
1.A.2.f.ii Off-Road Vehicles in Industry, Other	7.i.ON	73.00	0.004	0.030
1.A.3.e.ii Other Off-Road Transport	7.ii.BS	71.00	0.120	0.002
	7.ii.LG	63.10	0.062	0.0002
	7.ii.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:

- report of the Motor Transport Institute [ITS 2009] – activity data in road transport
- Eurostat database – use of fuels in the following sub-categories: 1.A.3.a – *Civil Aviation*, 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
- GUS G-03 reports – selected aggregated data from the energy balance statistics [GUS 2010e] – used for estimation of fuel use for part of the sub-category 1.A.3.d – *Navigation* - for maritime shipping
- „Fuel-Energy Economy" [GUS 2010a] – publication used as a source for fuel use estimation in the sub-category 1.A.2.f.ii – machinery and off-road vehicles In industry and in 1.A.3.e – other off-road vehicles
- Statistical Yearbook [GUS 2010] – 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.2.f.ii – machinery in industry and construction, 1.A.3.e – other off-road vehicles, 1.A.4.c. iii – Fishing

3.4.2.1. Civil Aviation (CRF sector1.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 3.4.2. 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. Figures 3.4.3 and 3.4.4 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.a in the period 1988-2009.

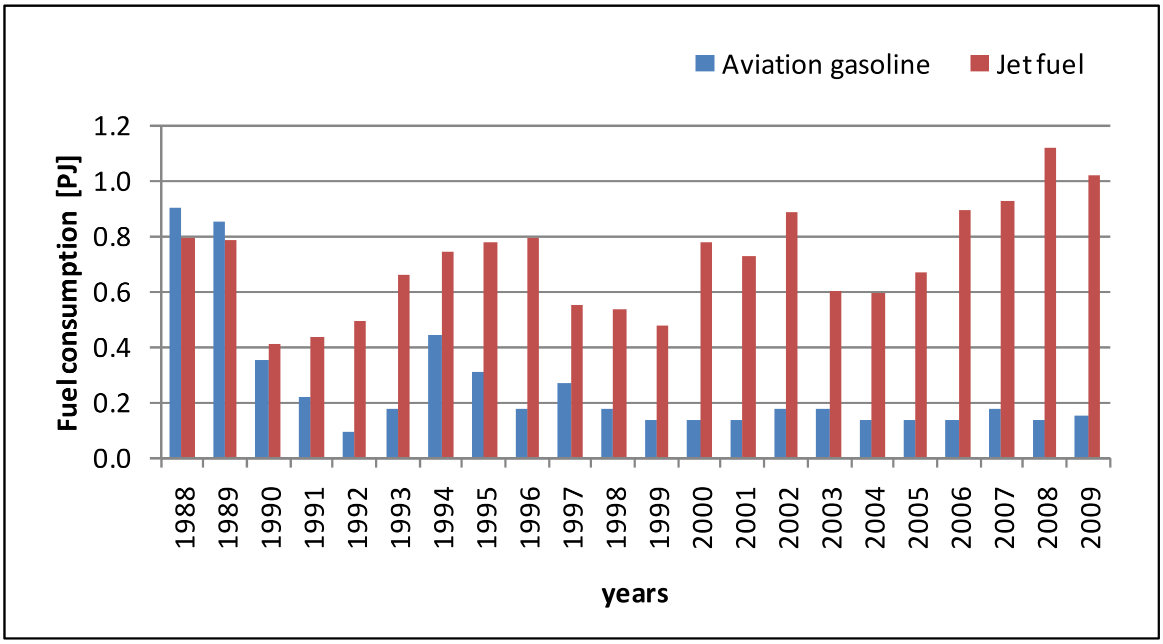

Figure 3.4.2. Fuel consumption in 1.A.3.a category for 1988-2009

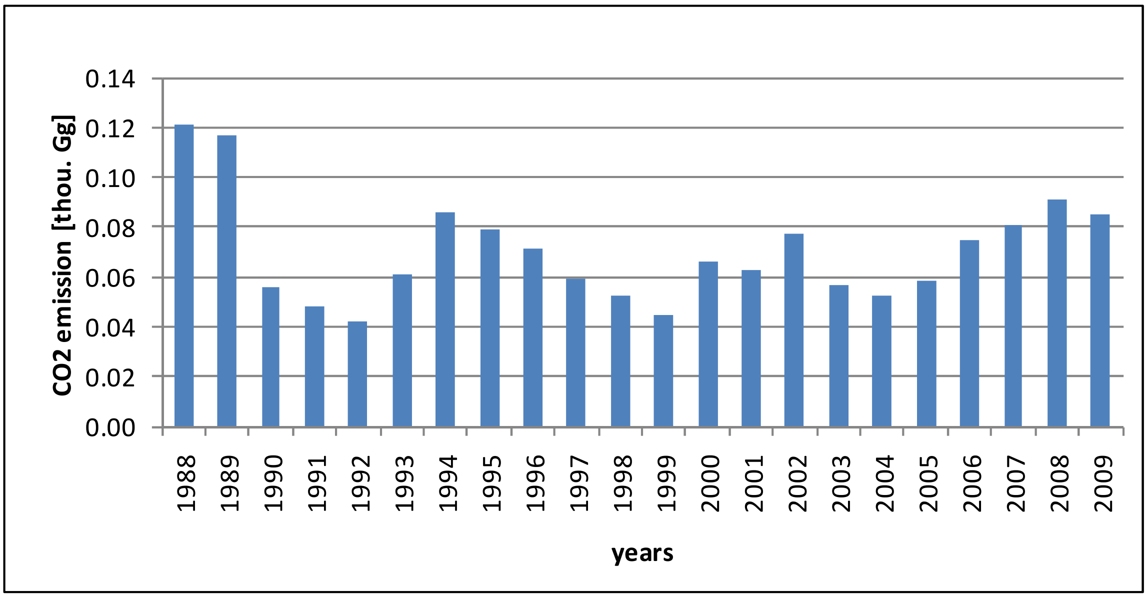

Figure 3.4.3. CO_2 emission for 1.A.3.a category in 1988-2009

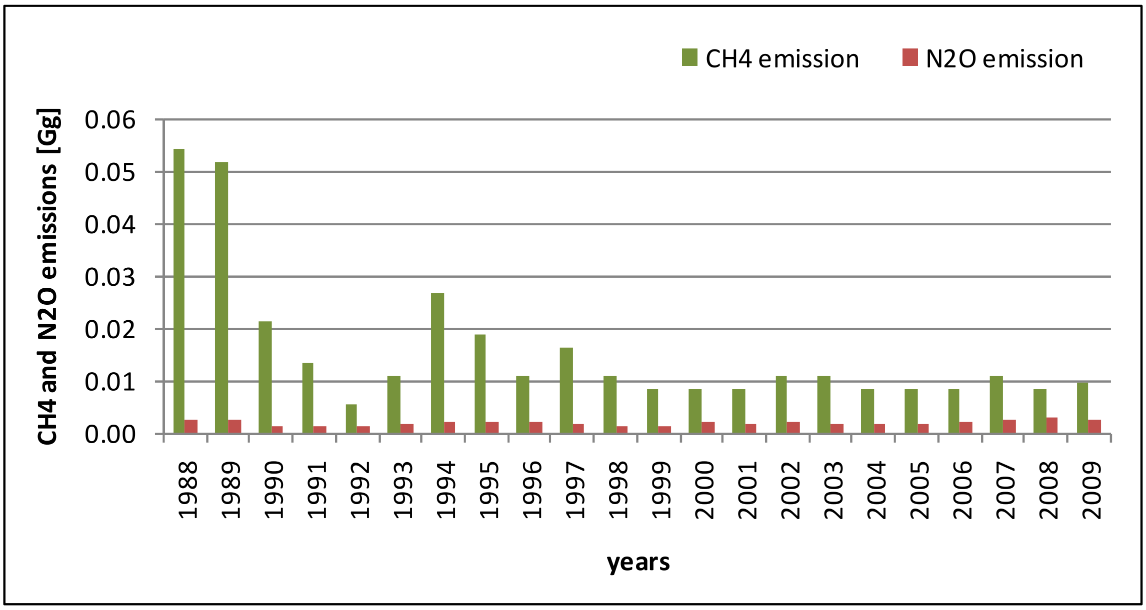

Figure 3.4.4. CH_4 and N_2O emissions for 1.A.3.a category in 1988-2009

3.4.2.2. Road Transportation (CRF sector1.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 1990-2008 for calculation are taken from reports of the ITS and converted into values expressed in energy units using the country-specific average NCV of the individual fuels for that year. Fuel is allocated to specific vehicle type using a Polish transport model developed and run by ITS. Fuel consumption in year 2009 comes from Eurostat database and was disaggregated on individual type of vehicle according to ITS report for year 2008.

The amount of vehicles according to categories in 2009 [GUS 2010] is given in table below.

Table 3.4.2. Amount of vehicles according to categories in 2009.

Category	Amount [thous. pcs.]
Passenger cars	16 495
Trucks	2 595
Buses	95
Motorcycles	975
Tractors	1 530

Consumption of main fuels in road transport (gasoline, diesel oil and LPG) in 1988-2009 period is shown in figure 3.4.5.

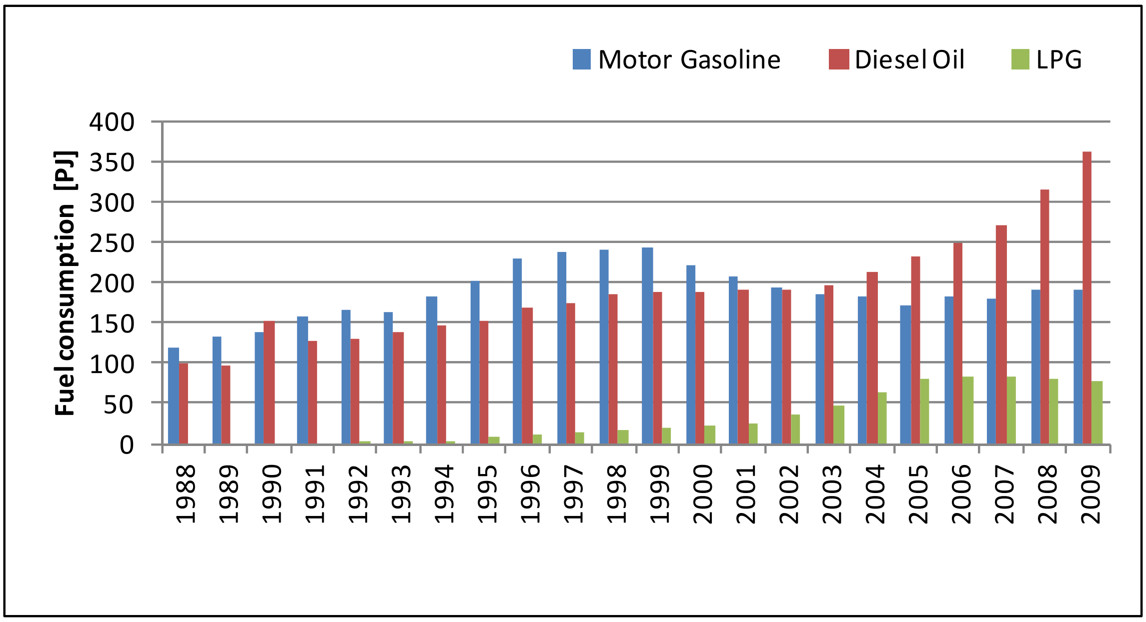

Figure 3.4.5. Fuel consumption in 1.A.3.b category for 1988-2009

There is a growing trend of consumption of biofuels in road transport. Amounts of biofuels used in years 2005 - 2009 are given in table 3.4.3.

Table 3.4.3. Amounts of biofuels used in years 2005 – 2009 [PJ]

Fuel type	2005	2006	2007	2008	2009*
Biodiesel	0.626	1.472	1.053	13.195	19.60
Bioethanol	1.420	2.305	3.002	5.287	8.16

Source: Energy from renewable sources in 2009. GUS, Warsaw, 2010 (data for years 2005-2008 comes from Eurostat)

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 2009 is equal 44 773 Gg. Figure 3.4.6 shows CO_2 emissions in sub-category 1.A.3.b in period 1988-2009. Emissions of CH_4 and N_2O in the same sub-category are shown in figure 3.4.7.

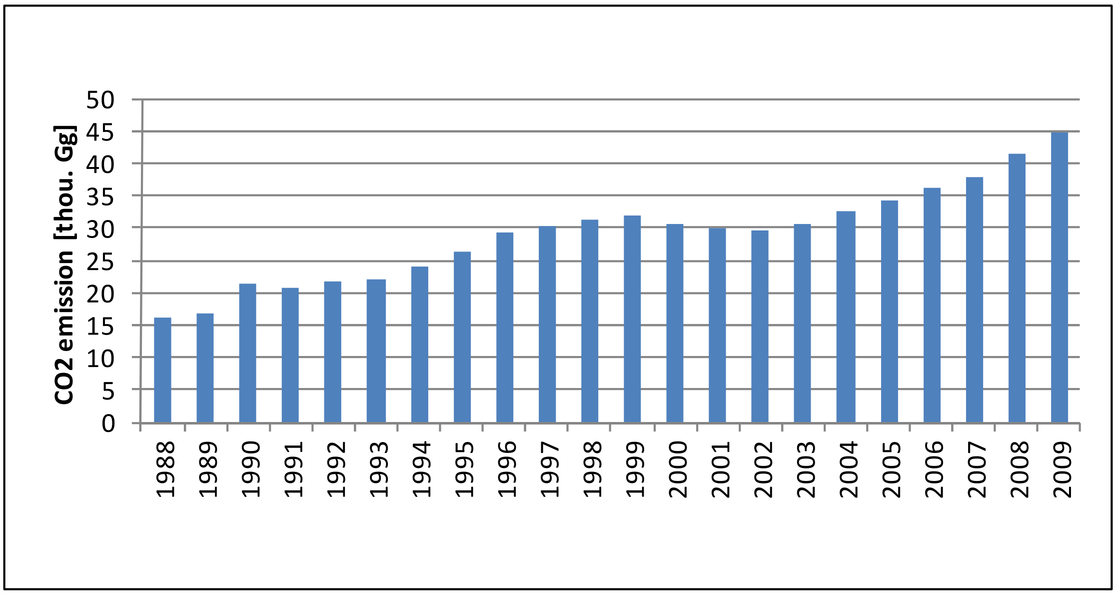

Figure 3.4.6. CO_2 emission for 1.A.3.b category in 1988-2009

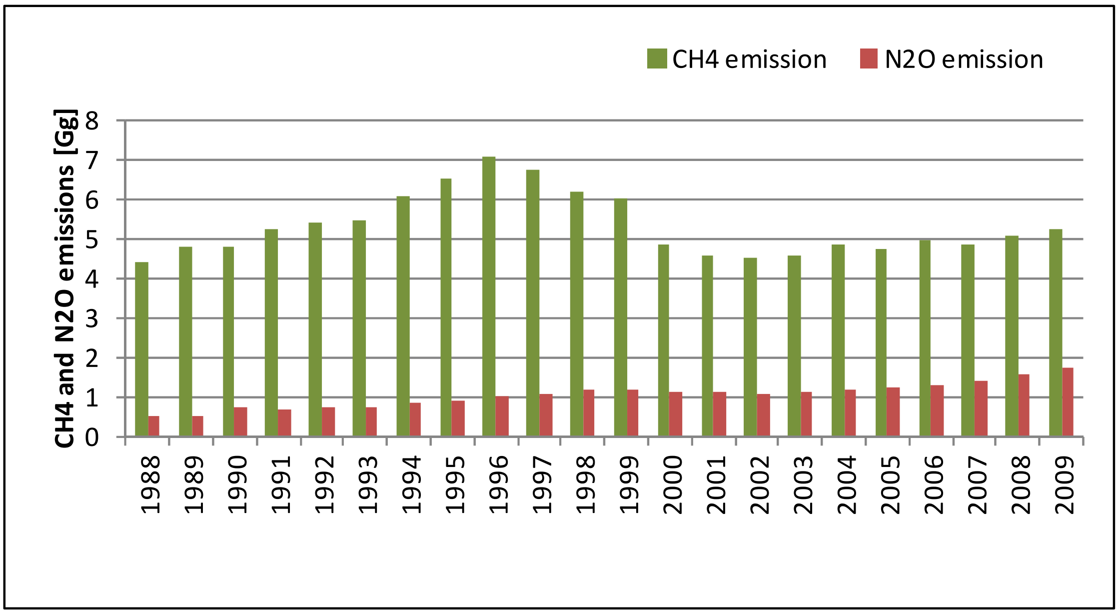

Figure 3.4.7. CH_4 and N_2O emissions for 1.A.3.b category in 1988-2009

3.4.2.3. 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 1988-2009 period are shown in figure 3.4.8.

Figures 3.4.9 and 3.4.10 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.

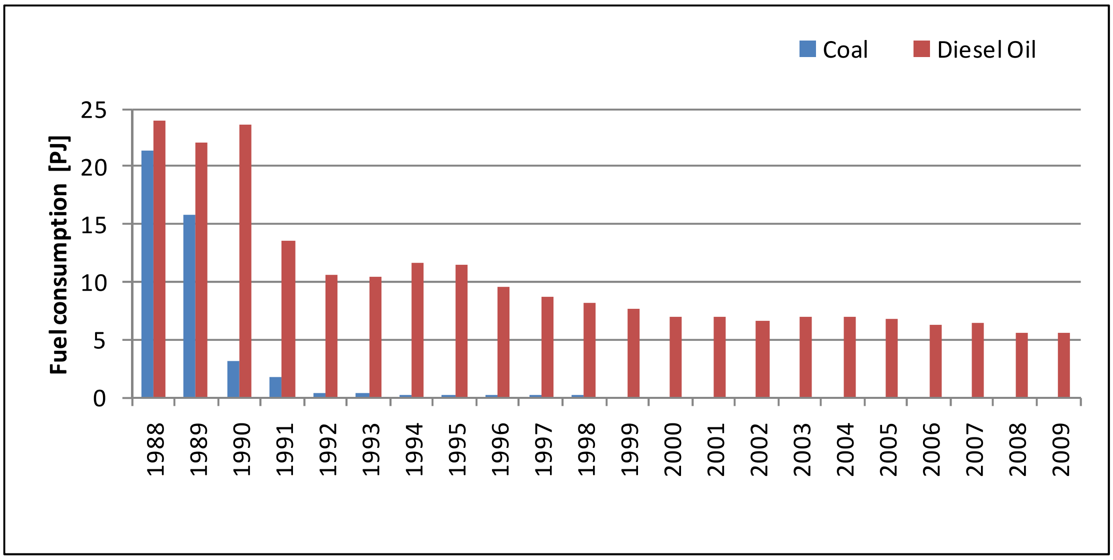

Figure 3.4.8. Fuel consumption in 1.A.3.c category for 1988-2009

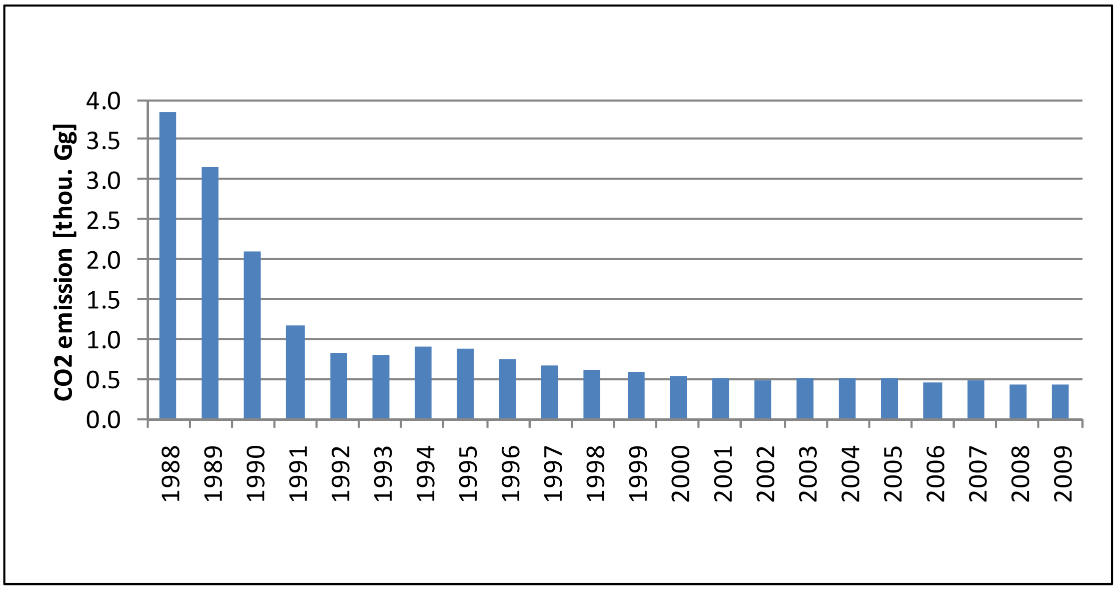

Figure 3.4.9. CO_2 emission for 1.A.3.c category in 1988-2009

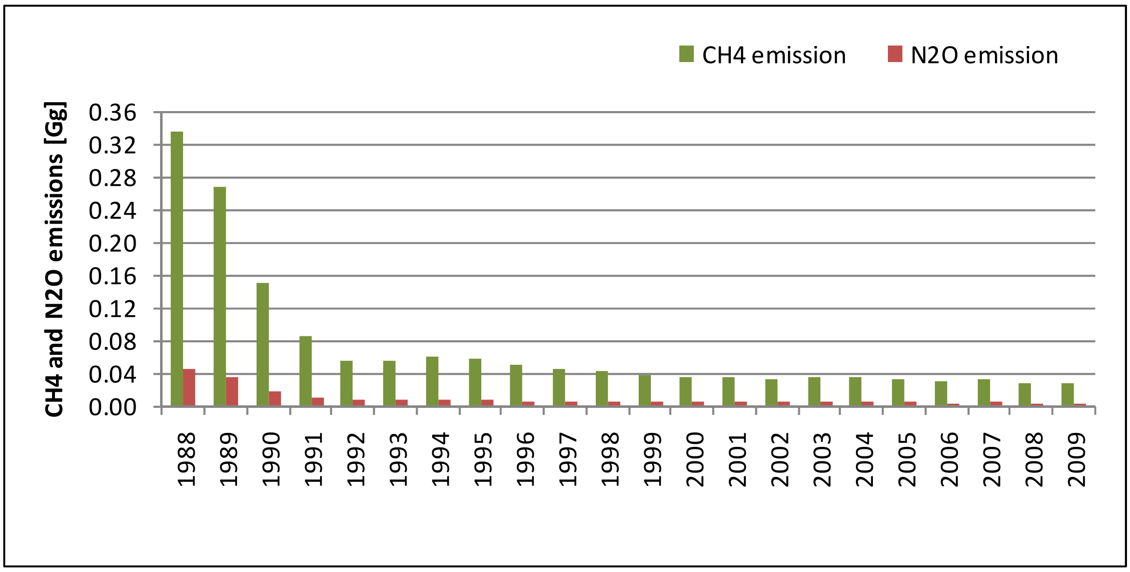

Figure 3.4.10. CH_4 and N_2O emissions for 1.A.3.c category in 1988-2009

3.4.2.4. Navigation (CRF sector1.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 1997-2009). The amounts of fuels (diesel and fuel oil) used in both inland water and maritime navigation in the 1988-2009 period are shown in figure 3.4.11.

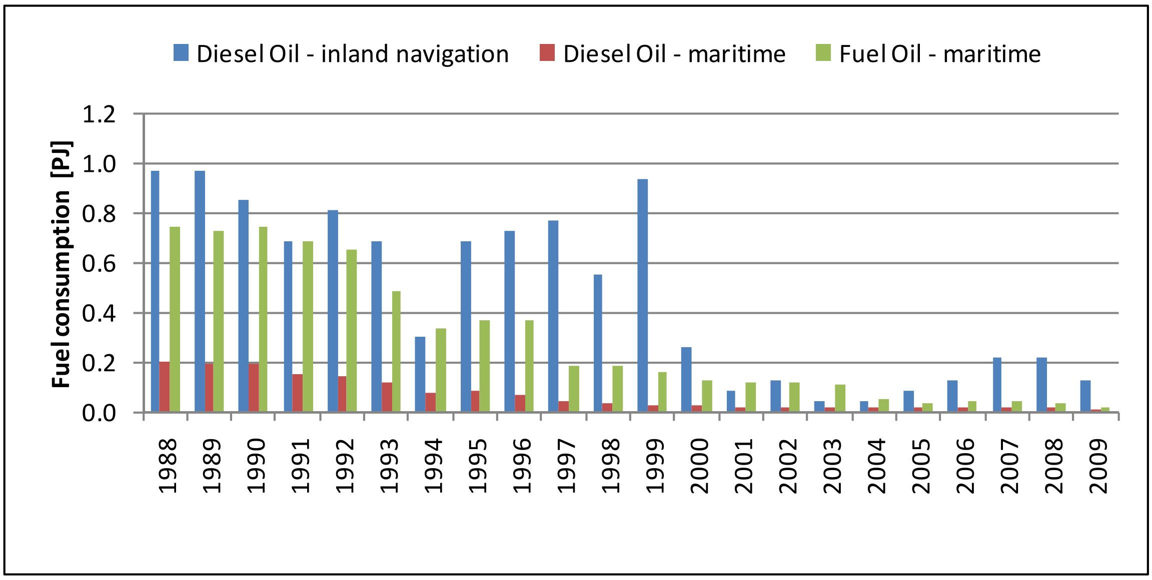

Figure 3.4.11. Fuel consumption in 1.A.3.d category for 1988-2009

Figures 3.4.12 and 3.4.13 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.d for the entire time series 1988-2009.

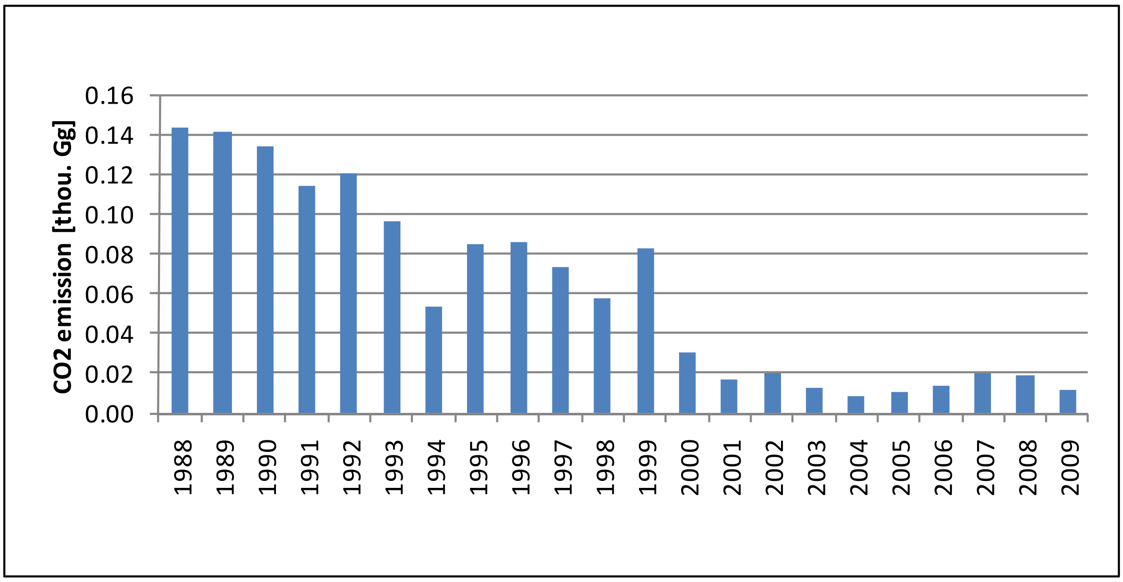

Figure 3.4.12. CO_2 emission for 1.A.3.d category in 1988-2009

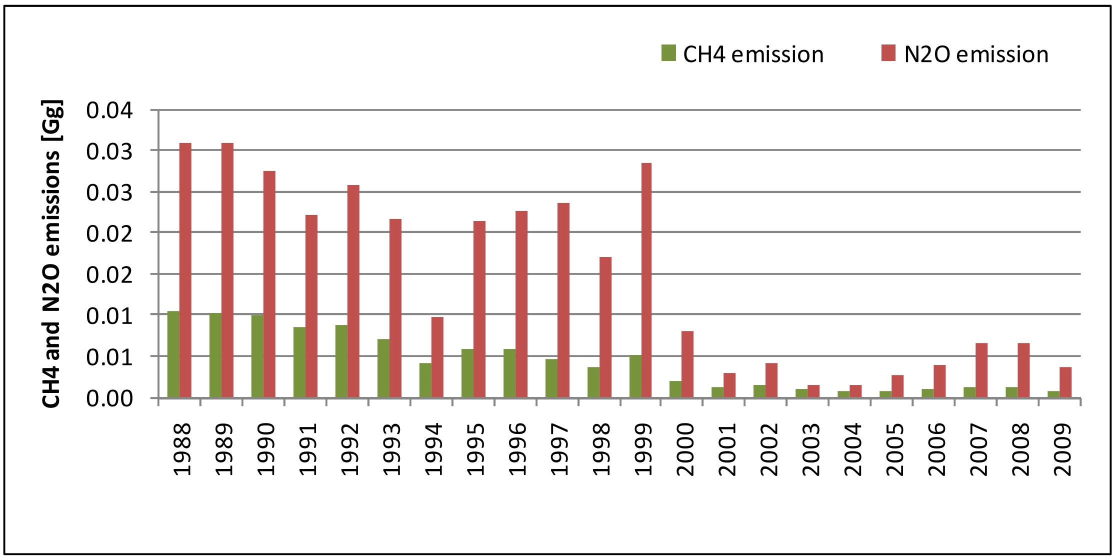

Figure 3.4.13. CH_4 and N_2O emissions for 1.A.3.d category in 1988-2009

3.4.2.5. Other transportation (CRF sector1.A.3.e)

Emission sources of other transportation are off-road vehicles and machinery (from construction and industry sectors), excluding those machinery which are allocated in IPCC categories 1.A.2.f *Other* and 1.A.4.c. *Agriculture, Forestry, Fishery* and pipeline transportation.

<u>Off-road transportation</u>

The amounts of fuels (gasoline, diesel oil and LPG – without pipelines) used in the sub-category 1.A.3.e in the 1988-2009 period are shown in figure 3.4.14.

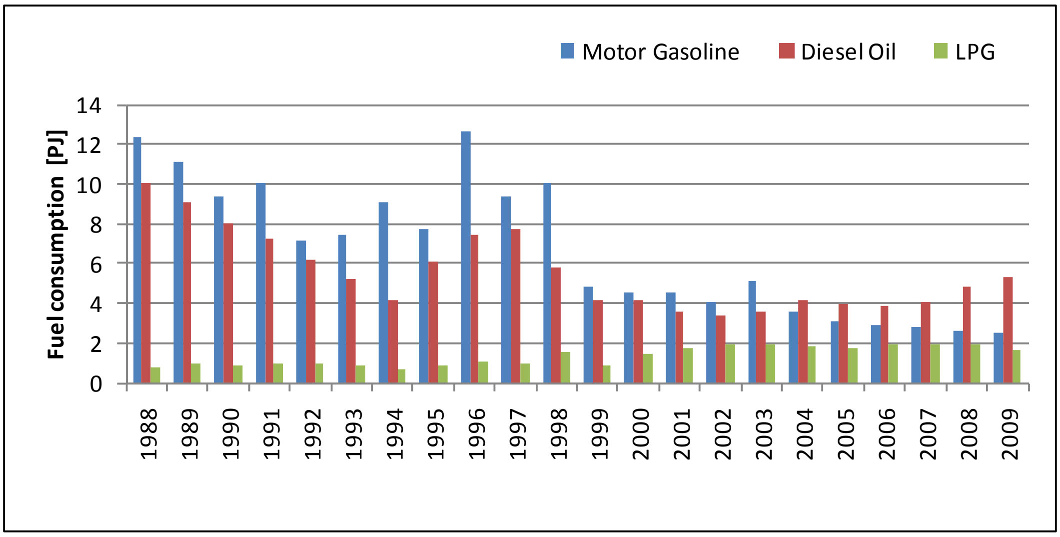

Figure 3.4.14. Fuel consumption in 1.A.3.e category for 1988-2009

Figures 3.4.15 and 3.4.16 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.e for the entire time series 1988-2009.

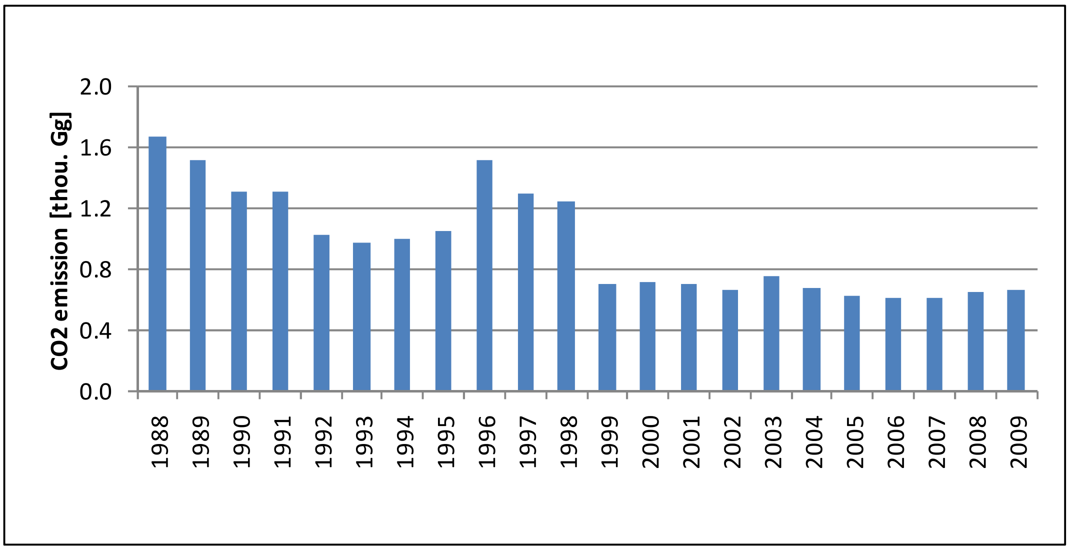

Figure 3.4.15. CO_2 emission for 1.A.3.e category in 1988-2009

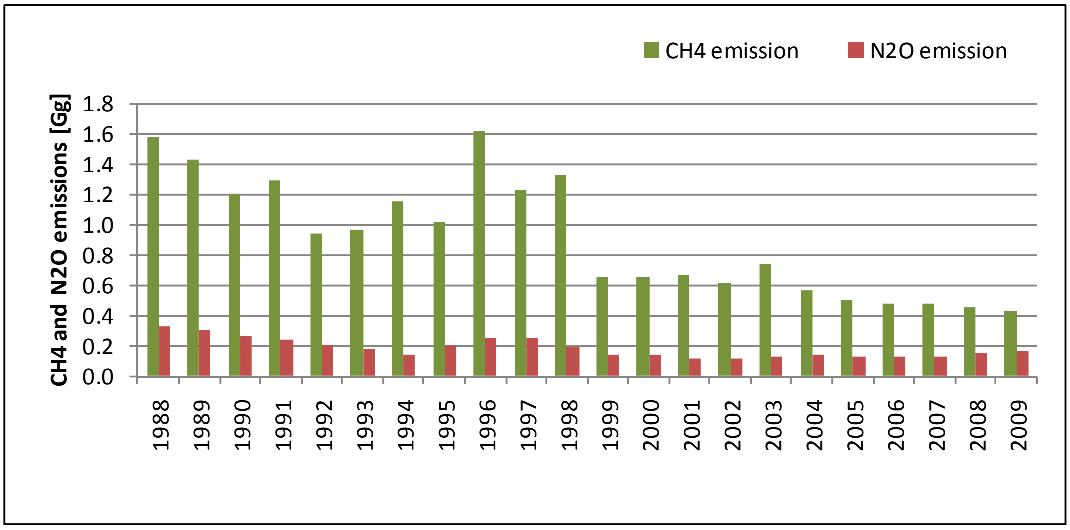

Figure 3.4.16. CH_4 and N_2O emissions for 1.A.3.e category in 1988-2009

Pipeline transport

Pipeline transport contain 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. Since 2008, data from the transport via pipelines covered by the Community Emission Trading Scheme (EU ETS) were taken directly into GHG inventory.

The amounts of natural gas used in the sub-category 1.A.3.e.i. *Pipelines transport* in the 1988-2009 period are shown in figure 3.4.17. Figure 3.4.18 shows consumption of motor gasoline and diesel oil. Figures 3.4.19 and 3.4.20 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 2000-2009.

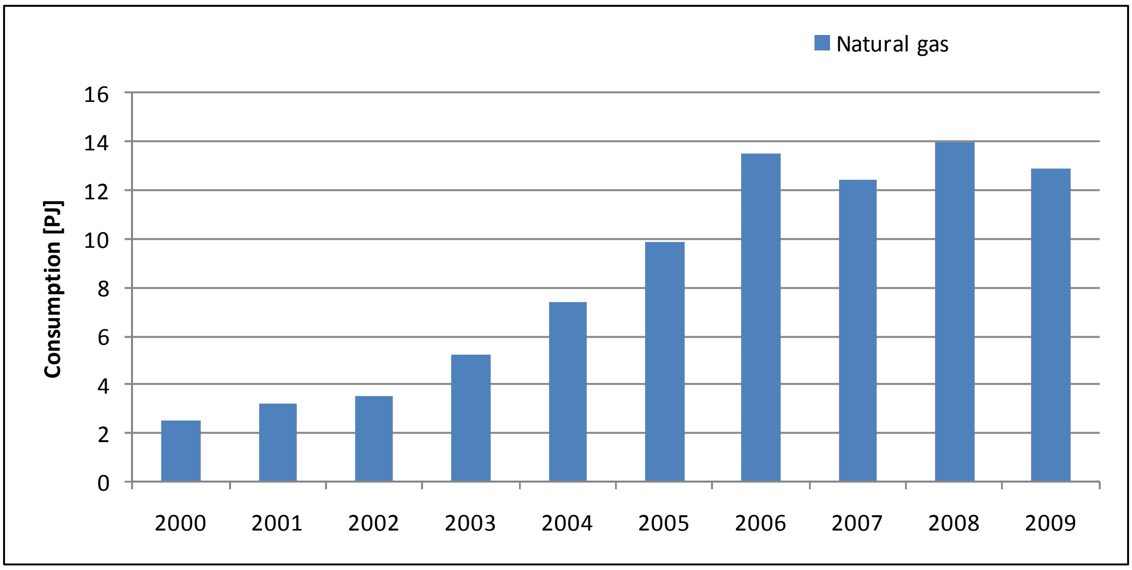

Figure 3.4.17. Natural gas consumption in *Pipelines transport* category for 2000-2009

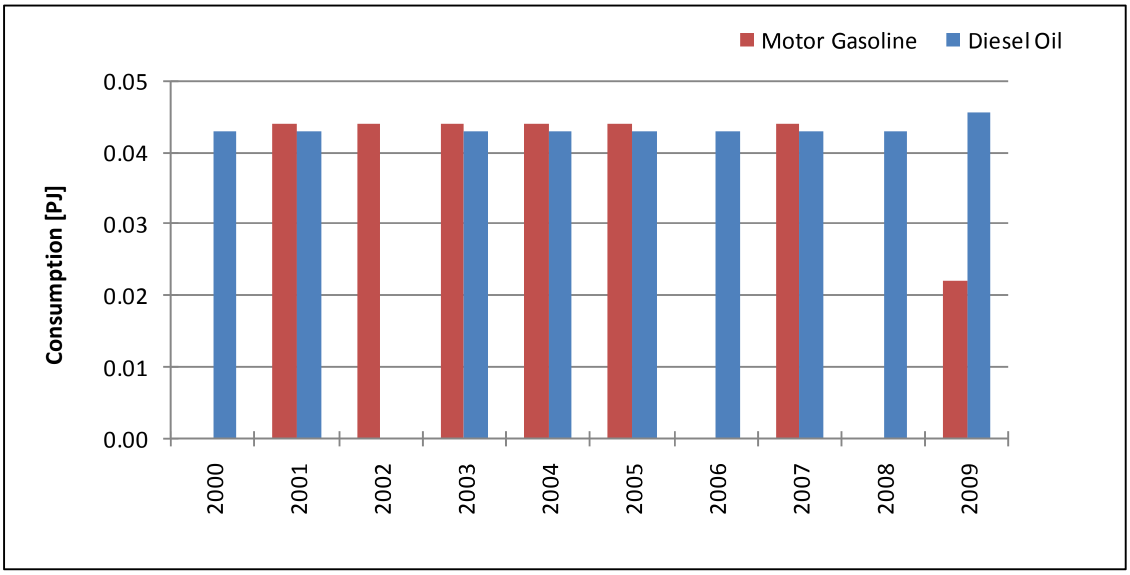

Figure 3.4.18. Motor gasoline and diesel oil consumption in *Pipelines transport* category for 2000-2009

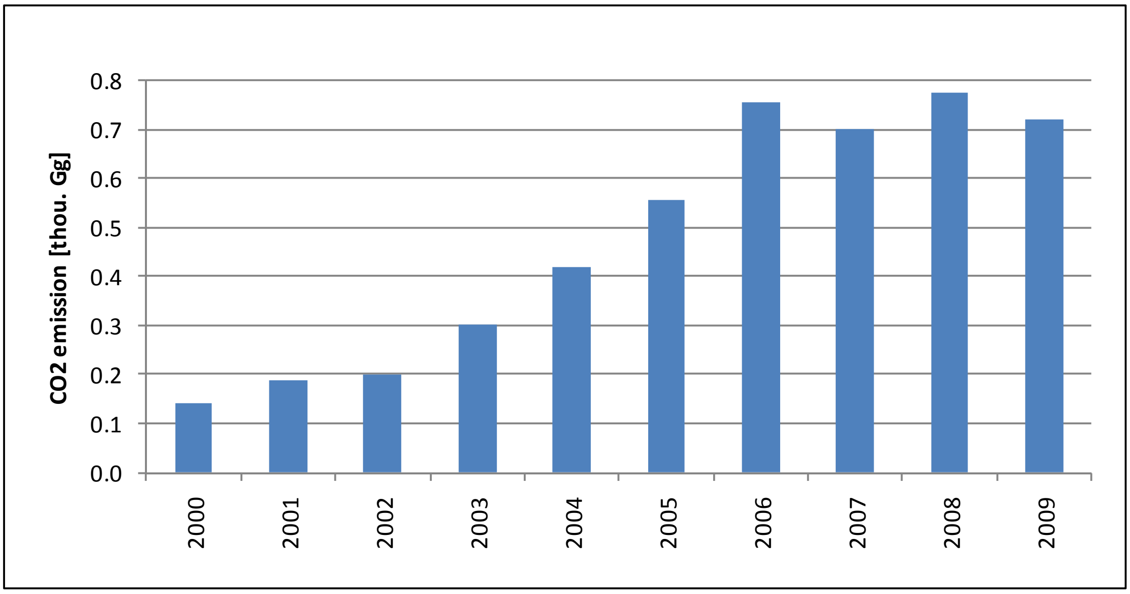

Figure 3.4.19. CO_2 emission from Pipelines category in 2000-2009

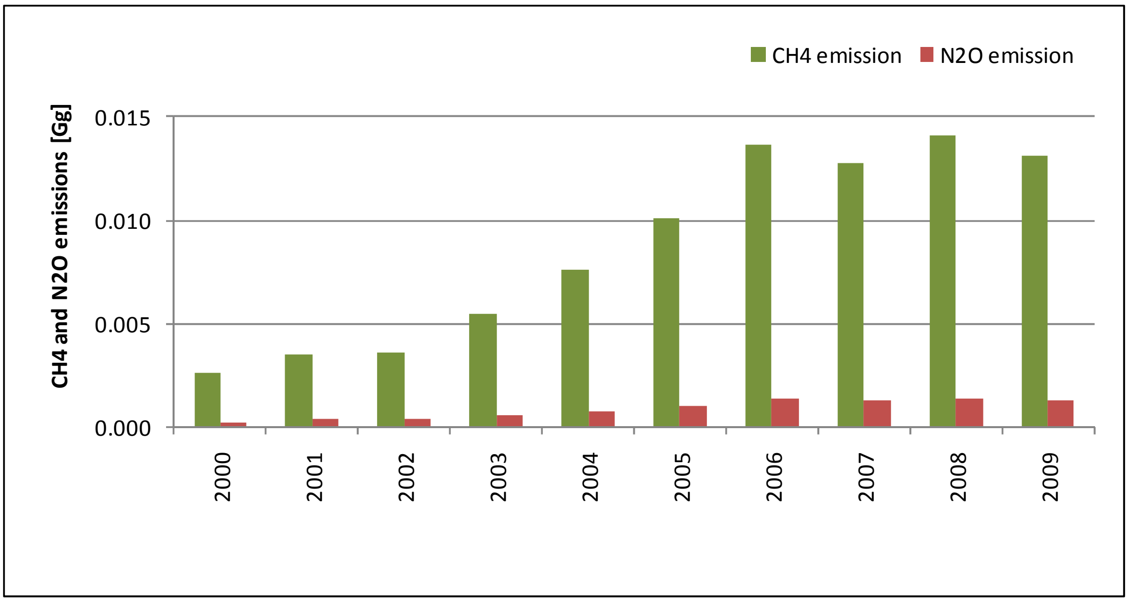

Figure 3.4.20. CH_4 and N_2O emissions from Pipelines category in 2000-2009

3.4.2.6. 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
- machinery and off-road transport in industry and construction (sub-category 1.A.2.f.ii) - classified in source category 1.A.2

The amounts of fuels used in the above listed sub-categories in the 1988-2009 period are presented in table 3.4.4. The amounts of corresponding emissions of CO_2, CH_4 and N_2O are shown in tables 3.4.5–3.4.7.

Table 3.4.4. Fuel consumption [PJ] in 1988-2009 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
ON-1.A.4.c.ii	50.27	48.72	37.19	36.51	45.10	59.99	65.81	69.31	75.35	91.27	81.03	85.80	96.89	89.47	89.16	90.49	92.31	94.68	67.07	59.49	55.89	52.20
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	1.92
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
ON-1.A.2.f.ii	13.70	12.43	10.96	9.92	8.52	8.64	7.23	8.29	10.21	10.51	7.88	5.71	5.63	4.89	4.80	4.93	5.67	5.37	5.28	5.54	6.62	7.21

ON - diesel oil, OP - fuel oil

Table 3.4.5. CO_2 emission [thous. Gg] in 1988-2009 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
1.A.4.c.ii	3.669	3.556	2.715	2.665	3.292	4.379	4.804	5.060	5.501	6.663	5.915	6.263	7.073	6.531	6.509	6.606	6.739	6.912	4.896	4.343	4.080	3.810
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
1.A.2.f.ii	1.000	0.907	0.800	0.724	0.622	0.631	0.528	0.605	0.745	0.767	0.575	0.417	0.411	0.357	0.350	0.360	0.414	0.392	0.385	0.405	0.484	0.526

Table 3.4.6. CH_4 emission [Gg] in 1988-2009 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
1.A.4.c.ii	0.201	0.195	0.149	0.146	0.180	0.240	0.263	0.277	0.301	0.365	0.324	0.343	0.388	0.358	0.357	0.362	0.369	0.379	0.268	0.238	0.224	0.209
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
1.A.2.f.ii	0.055	0.050	0.044	0.040	0.034	0.035	0.029	0.033	0.041	0.042	0.032	0.023	0.023	0.020	0.019	0.020	0.023	0.021	0.021	0.022	0.026	0.029

Table 3.4.7. N_2O emission [Gg] in 1988-2009 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
1.A.4.c.ii	0.327	0.317	0.242	0.238	0.294	0.391	0.428	0.451	0.491	0.594	0.527	0.559	0.631	0.582	0.580	0.589	0.601	0.616	0.437	0.387	0.364	0.340
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
1.A.2.f.ii	0.411	0.373	0.329	0.298	0.256	0.259	0.217	0.249	0.306	0.315	0.236	0.171	0.169	0.147	0.144	0.148	0.170	0.161	0.158	0.166	0.199	0.216

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

3.5.1. 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) (PKD – 41 and sections excluding subcategories included elsewhere, that means excluding sections A-F and I)
b) *Residential* (1.A.4.b)
c) *Agriculture/Forestry/Fishing* (1.A.4.c) (PKD – sections A and B)

- 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 3.5.1) – about 65% in 2009.

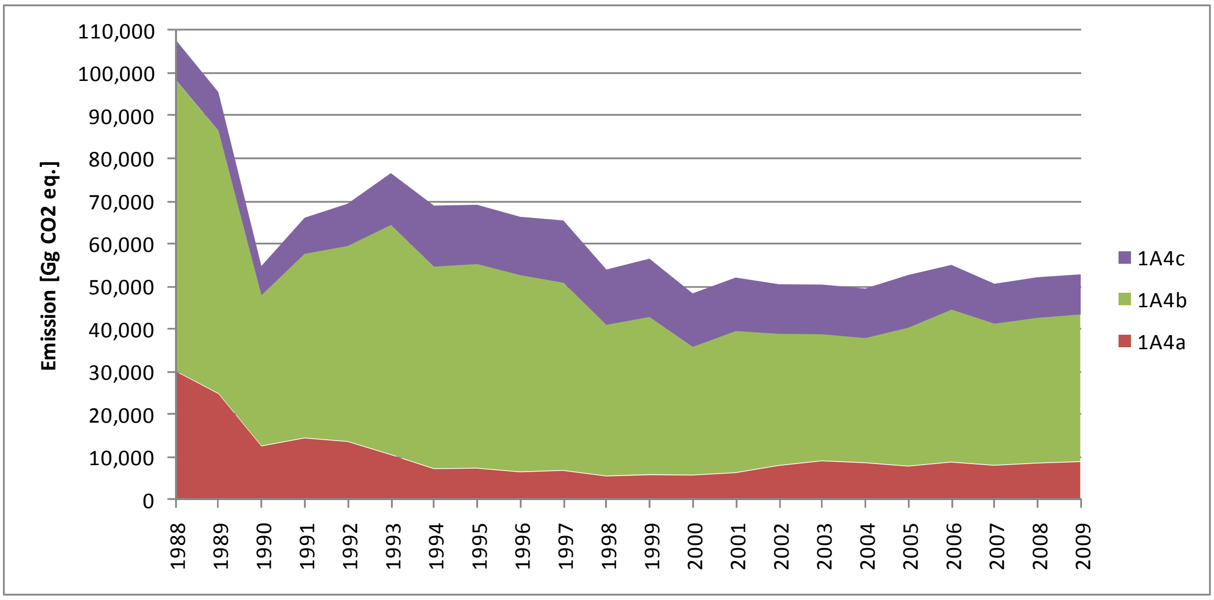

Figure 3.5.1. GHG emissions from 1.A.4. *Other sectors* in years 1988-2009 according to subcategories.

3.5.2. 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.

3.5.2.1. 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 1988-2009 period are presented in table 3.5.1. Detailed data concerning fuel consumption in 1.A.4.a subcategory was tabulated in Annex 2 (table 10).

Table 3.5.1. Fuel consumption in 1988-2009 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	299.156	244.760	119.662	141.980	132.178	99.762	66.206	64.891
Biomass	0.084	0.123	0.379	0.187	0.206	2.610	0.249	11.983
TOTAL	**312.319**	**257.484**	**133.828**	**153.144**	**143.574**	**113.920**	**77.362**	**90.916**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.762	6.088	7.741	10.613	16.869	22.846	19.042	31.058
Gaseous Fuels	18.771	24.256	32.769	37.697	38.567	49.971	61.001	67.057
Solid Fuels	51.828	48.938	30.632	29.040	23.093	18.675	31.704	30.706
Biomass	10.625	9.627	9.085	9.216	9.212	6.596	6.440	6.463
TOTAL	**82.986**	**88.909**	**80.227**	**86.566**	**87.740**	**98.088**	**118.186**	**135.284**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	28.227	17.849	29.741	23.453	23.334	20.757		
Gaseous Fuels	69.570	68.410	62.880	64.850	70.682	75.024		
Solid Fuels	27.400	28.124	32.216	27.913	30.351	33.015		
Biomass	6.621	6.529	5.099	5.788	7.402	7.945		
TOTAL	**131.817**	**120.912**	**129.936**	**122.003**	**131.768**	**136.742**		

Figures 3.5.2 and 3.5.3 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.4.a in the period 1988-2009.

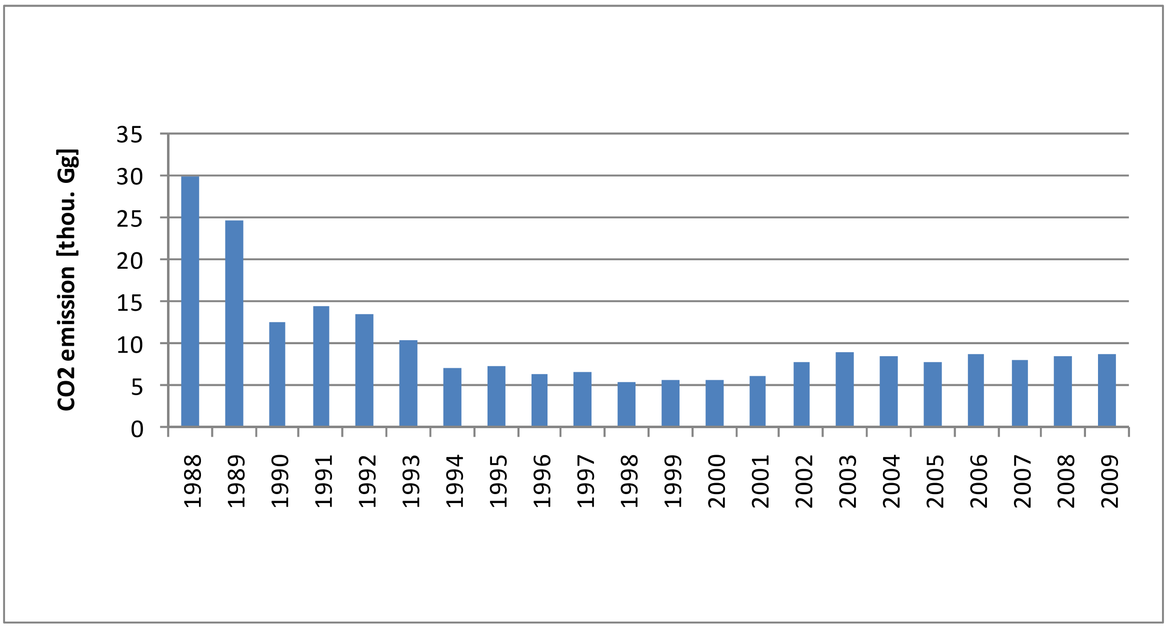

Figure 3.5.2. CO_2 emission for 1.A.4.a category in 1988-2009

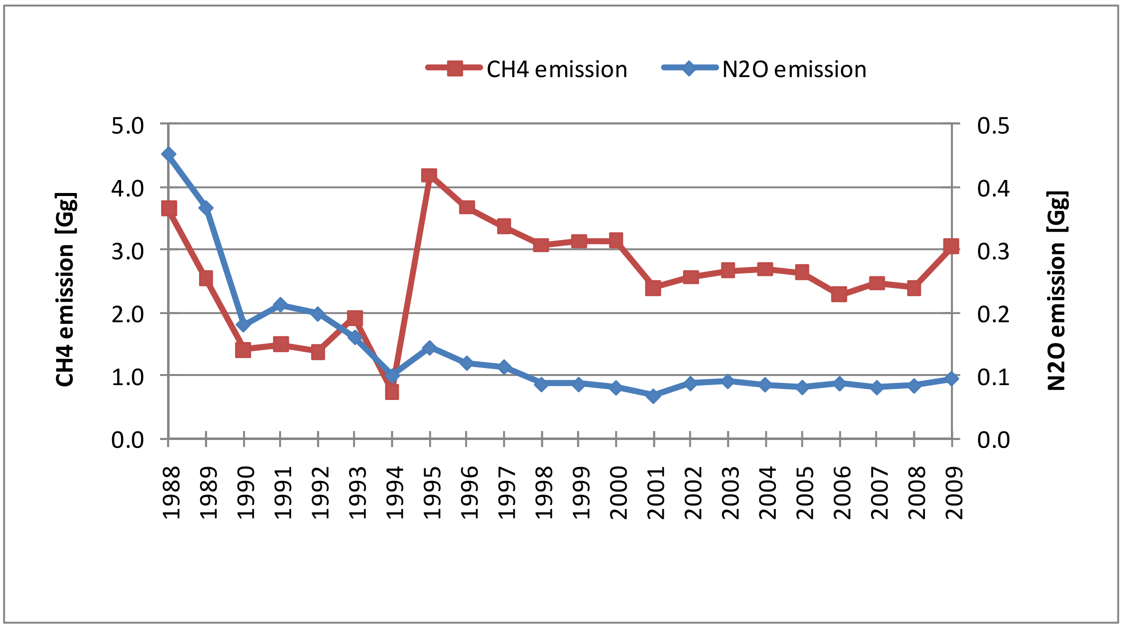

Figure 3.5.3. CH_4 and N_2O emissions for 1.A.4.a category in 1988-2009

3.5.2.2. 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 1988-2009 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 1988-2009 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	285.477	356.059	373.933	440.350	367.483	366.031
Biomass	33.615	32.351	34.335	27.721	33.969	123.084	123.154	105.000
TOTAL	**761.015**	**694.315**	**443.718**	**518.466**	**550.954**	**711.096**	**651.278**	**643.424**
	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	353.779	324.014	246.351	261.554	192.839	216.185	196.118	181.701
Biomass	101.000	100.000	100.700	95.000	95.000	104.500	104.500	103.075
TOTAL	**616.066**	**598.826**	**512.239**	**521.582**	**452.730**	**496.422**	**471.892**	**460.496**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	48.730	44.470	39.870	40.330	33.480	33.020		
Gaseous Fuels	126.376	135.111	138.686	132.622	131.450	134.857		
Solid Fuels	176.859	208.687	242.209	219.897	234.114	237.341		
Biomass	103.360	100.700	104.500	102.000	102.500	102.500		
TOTAL	**455.325**	**488.968**	**525.265**	**494.849**	**501.544**	**507.718**		

Figure 3.5.4 show emissions of CO_2 in 1.A.4.b in the 1988-2009 period while CH_4 and N_2O, emissions in the same sub-category are shown in figure 3.5.5.

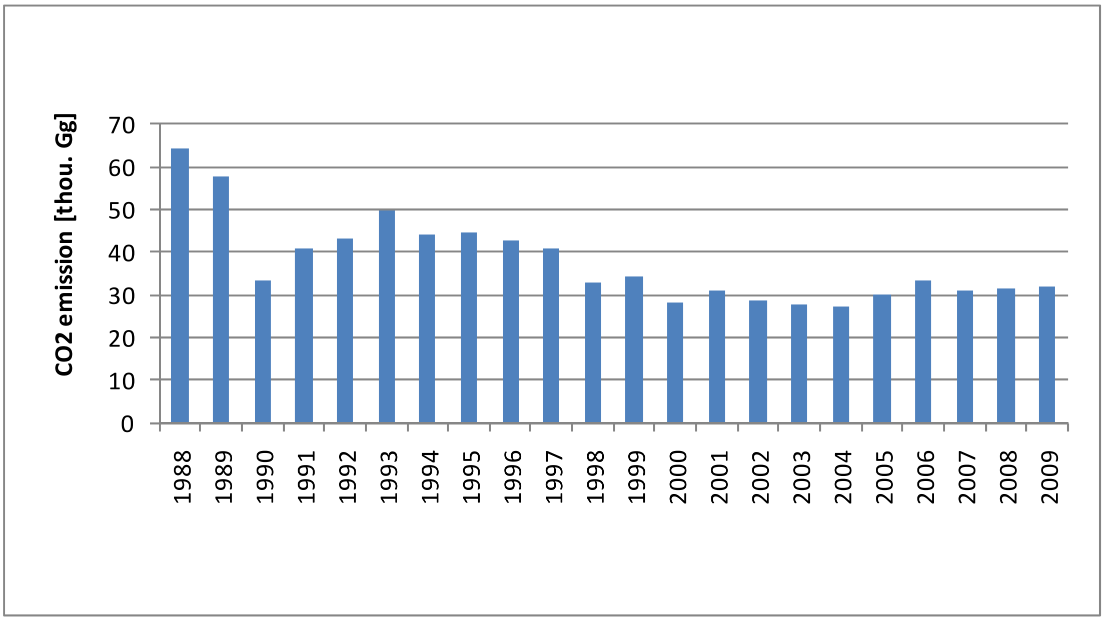

Figure 3.5.4. CO_2 emission for 1.A.4.b category in 1988-2009

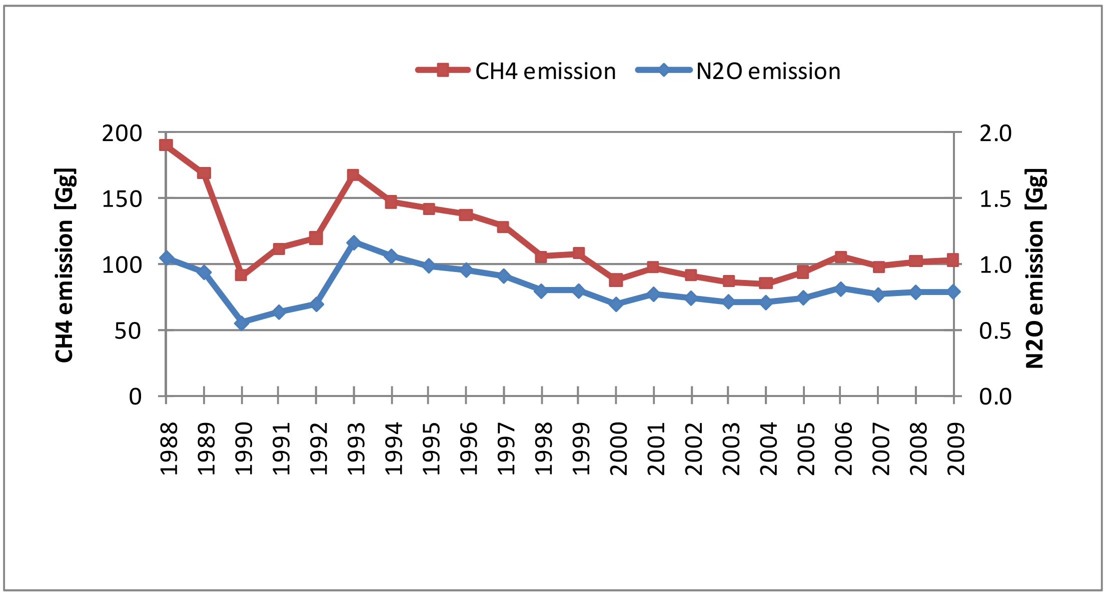

Figure 3.5.5. CH_4 and N_2O emissions for 1.A.4.b category in 1988-2009

3.5.2.3. 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 1988-2008 period are presented in table 3.5.3. 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 3.5.3. Fuel consumption in stationary sources in 1.A.4.c subcategory for years 1988-2009 [PJ]

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Paliwa ciekłe	2.733	2.613	2.760	2.000	0.480	14.060	18.280	10.510
Liquid Fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243
Gaseous Fuels	42.690	42.027	30.374	47.645	56.993	58.049	70.428	69.392
Solid Fuels	0.039	0.113	0.039	0.278	0.583	12.737	11.647	18.500
Biomass	**45.969**	**45.198**	**33.621**	**50.198**	**58.111**	**84.978**	**100.567**	**98.645**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	6.250	9.128	8.160	8.410	8.804	8.464	6.904	9.528
Gaseous Fuels	0.428	0.571	0.869	0.476	0.536	0.777	0.914	1.197
Solid Fuels	67.091	61.993	55.488	59.399	40.348	45.503	37.621	35.351
Biomass	17.567	17.000	17.100	17.100	17.100	19.043	19.010	19.017
TOTAL	**91.336**	**88.692**	**81.617**	**85.385**	**66.788**	**73.787**	**64.449**	**65.093**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**		
Liquid Fuels	8.560	10.804	4.088	3.720	3.926	3.499		
Gaseous Fuels	1.182	1.084	1.493	1.841	1.901	1.578		
Solid Fuels	34.465	39.001	46.023	40.728	44.628	45.326		
Biomass	19.878	19.038	19.977	19.060	19.024	19.031		
TOTAL	**64.085**	**69.927**	**71.581**	**65.349**	**69.479**	**69.433**		

Figures 3.5.6 and 3.5.7 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.4.c in the period: 1988-2009.

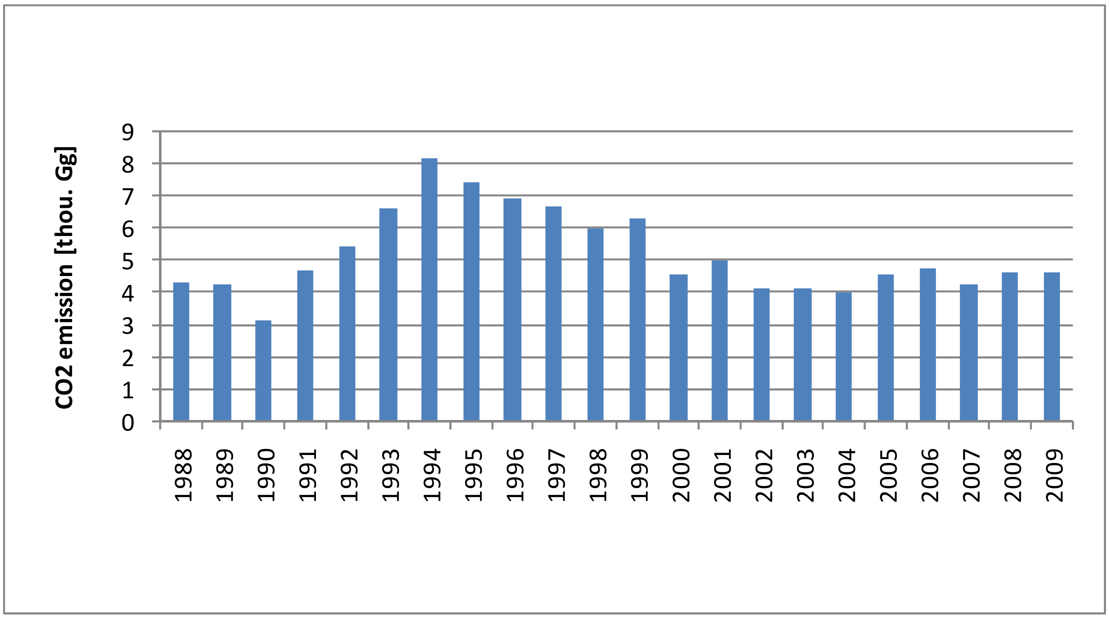

Figure 3.5.6. CO_2 emission for stationary sources in 1.A.4.c category in 1988-2009

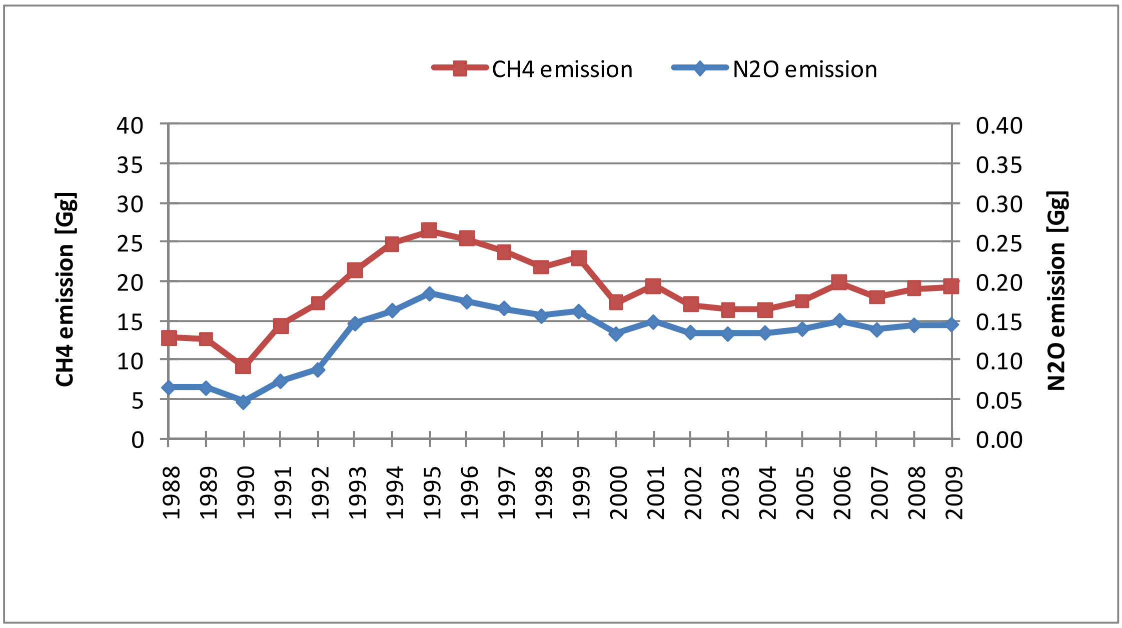

Figure 3.5.7. CH_4 and N_2O emissions for stationary sources in 1.A.4.c category in 1988-2009

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 3.4.2.6.

3.6. International bunker fuels

1990-2009 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 1988-2009 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 1990-2009 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 1988-2009 period are presented in table 3.6.1.

Table 3.6.1. Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2009

AVIATION BUNKER										
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Fuel consumption – jet fuel [Gg]	351.15	352.45	181.45	192.85	216.60	289.75	327.75	342.00	351.50	241.30
Fuel consumption – jet fuel [PJ]	15.65	15.71	7.80	8.29	9.31	12.46	14.09	14.71	15.11	10.38
Calorific value [MJ/kg]	44.58	44.58	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
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
CO_2 potential emission factor [Gg]	1 106.1	1 110.2	571.6	607.5	682.3	912.7	1 032.4	1 077.3	1 107.2	760.1
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
CH_4 emission [Gg]	0.008	0.008	0.004	0.004	0.005	0.006	0.007	0.007	0.008	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
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
N_2O emission [Gg]	0.035	0.035	0.018	0.019	0.022	0.029	0.033	0.034	0.035	0.024
NAVIGATION BUNKER										
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Fuel consumption – diesel oil [PJ]	13.61	10.88	6.43	3.03	4.18	2.56	0.64	2.09	1.58	0.72
Fuel consumption - diesel oil [PJ]	8.24	9.37	11.28	4.48	7.72	1.68	3.00	5.84	7.52	5.48
CO_2 potential emission - ON [Gg]	1008.3	806.0	476.7	224.2	309.4	189.4	47.3	154.6	116.8	53.6
CO_2 potential emission - OP [Gg]	639.4	726.7	875.3	347.6	599.1	130.4	232.8	453.2	583.6	425.2
Total CO_2 potential emission [Gg]	1647.6	1532.7	1352.0	571.8	908.4	319.8	280.1	607.8	700.3	478.9
CH_4 emission - ON [Gg]	0.095	0.076	0.045	0.021	0.029	0.018	0.004	0.015	0.011	0.005
CH_4 emission - OP [Gg]	0.058	0.066	0.079	0.031	0.054	0.012	0.021	0.041	0.053	0.038
Total CH_4 potential emission [Gg]	0.153	0.142	0.124	0.053	0.083	0.030	0.025	0.055	0.064	0.043
N_2O emission - ON [Gg]	0.027	0.022	0.013	0.006	0.008	0.005	0.001	0.004	0.003	0.001
N_2O emission - OP [Gg]	0.016	0.019	0.023	0.009	0.015	0.003	0.006	0.012	0.015	0.011
Total N_2O potential emission [Gg]	0.044	0.040	0.035	0.015	0.024	0.008	0.007	0.016	0.018	0.012

Table 3.6.1. (cont.). Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2009

AVIATION BUNKER												
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Fuel consumption – jet fuel [Gg]	237.50	209.95	341.05	321.10	391.40	265.05	260.30	295.45	394.25	410.40	493.04	447.53
Fuel consumption – jet fuel [PJ]	10.21	9.03	14.67	13.81	16.83	11.40	11.19	12.70	16.95	17.65	21.20	19.24
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]	748.1	661.3	1 074.3	1 011.5	1 232.9	834.9	819.9	930.7	1 241.9	1 292.8	1553.1	1409.7
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	0.007	0.007	0.008	0.006	0.006	0.006	0.008	0.009	0.011	0.010
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]	0.024	0.021	0.034	0.032	0.039	0.027	0.026	0.030	0.039	0.041	0.049	0.045
NAVIGATION BUNKER												
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Fuel consumption – diesel oil [PJ]	2.85	4.73	1.87	0.94	1.83	1.96	1.66	4.94	3.71	2.13	2.09	2.74
Fuel consumption - diesel oil [PJ]	8.08	17.60	9.92	9.80	9.32	9.80	8.80	8.48	8.56	8.16	9.32	7.58
CO_2 potential emission - ON [Gg]	211.5	350.4	138.9	69.4	135.8	145.2	123.1	366.2	274.6	157.8	154.6	202.8
CO_2 potential emission - OP [Gg]	627.0	1365.8	769.8	760.5	723.2	760.5	682.9	658.0	664.3	633.2	723.2	588.5
Total CO_2 potential emission [Gg]	838.5	1716.2	908.7	829.9	859.0	905.7	806.0	1024.3	938.9	791.0	877.9	791.3
CH_4 emission - ON [Gg]	0.020	0.033	0.013	0.007	0.013	0.014	0.012	0.035	0.026	0.015	0.015	0.019
CH_4 emission - OP [Gg]	0.057	0.123	0.069	0.069	0.065	0.069	0.062	0.059	0.060	0.057	0.065	0.053
Total CH_4 potential emission [Gg]	0.077	0.156	0.083	0.075	0.078	0.082	0.073	0.094	0.086	0.072	0.080	0.072
N_2O emission - ON [Gg]	0.006	0.009	0.004	0.002	0.004	0.004	0.003	0.010	0.007	0.004	0.004	0.005
N_2O emission - OP [Gg]	0.016	0.035	0.020	0.020	0.019	0.020	0.018	0.017	0.017	0.016	0.019	0.015
Total N_2O potential emission [Gg]	0.022	0.045	0.024	0.021	0.022	0.024	0.021	0.027	0.025	0.021	0.023	0.021

3.7. 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 based on Eurostat database. In table 3.7.1 are given these data for year 2009. Share of individual fuels categories in reference approach in 2009 is shown in figure 3.7.1.

Table 3.7.1. Production, imports, exports, bunkers and stock change in 2009.

FUEL TYPES [TJ]			Production	Imports	Exports	International bunkers	Stock change	Apparent consumption
Liquid Fossil	Primary Fuels	Crude Oil	29 007	854 071	9 541	-	11 692	871 985
	Secondary Fuels	Gasoline	-	21 666	16 553	0	6 822	-1 709
		Jet Kerosene	-	55	9 742	19 243	-266	-28 664
		Gas / Diesel Oil	-	93 504	5 004	2 737	10 560	75 203
		Residual Fuel Oil	-	2 009	39 898	7 584	-840	-44 633
		LPG	-	92 716	841	-	631	91 244
		Ethane	-	IE	0	-	0	IE
		Naphtha	-	134	3 020	-	-183	-2 704
		Bitumen	-	10 366	9 831	-	382	154
		Lubricants	-	6 143	10 267	0	-119	-4 006
		Petroleum Coke	-	4 131	0	-	0	4 131
		Refinery Feedstocks	-	58 266	0	-	0	58 266
		Other Oil*	-	10 652	10 543	-	-3 763	3 872
Other Liquid Fossil – Natural gas – input to refinery			-	0	0	-	0	10 140
Liquid Fossil Totals			**29 007**	**1 153 714**	**115 240**	**29 564**	**24 917**	**1 023 138**
Solid Fossil	Primary Fuels	Anthracite	NO	NO	0	-	0	NO
		Coking Coal**	IE	IE	IE	-	IE	IE
		Other Bituminous Coal	1 852 572	271 581	237 530	0	103 579	1 783 044
		Lignite	509 986	261	606	-	-121	509 762
	Secondary Fuels	BKB and Patent Fuel	-	757	8	-	44	705
		Coke Oven/Gas Coke	-	1 528	134 767	-	-10 077	-123 162
Other Solid Fossil			-	0	0	-	0	0
Solid Fossil Totals			**2 362 558**	**274 127**	**372 911**	**-**	**93 425**	**2 170 349**

FUEL TYPES [TJ]		Production	Imports	Exports	International bunkers	Stock change	Apparent consumption
Gaseous Fossil	Natural Gas (Dry)	153 980	341 507	1 399	-	-19 904	503 852
Other Gaseous Fossil		-	0	0	-	0	0
Gaseous Fossil Totals		**153 980**	**341 507**	**1 399**	**-**	**-19 904**	**503 852**
Total (without biomass)		**2 545 545**	**1 769 348**	**489 550**	**29 564**	**98 438**	**3 697 340**
Biomass total		**244 102**	**10 141**	**320**	**-**	**-94**	**254 017**
	Solid Biomass	222 119	0	0	-	0	222 119
	Liquid Biomass	17 879	10 141	320	-	-94	27 794
	Gas Biomass	4 104	0	0	-	0	4 104

* Other Oil includs: Non-specified petroleum products, White and industrial spirit and Paraffin waxes. Here the Eurostat data were applied where paraffin waxes were separated for the first time in 2011.
**IE – included in other bituminous coal

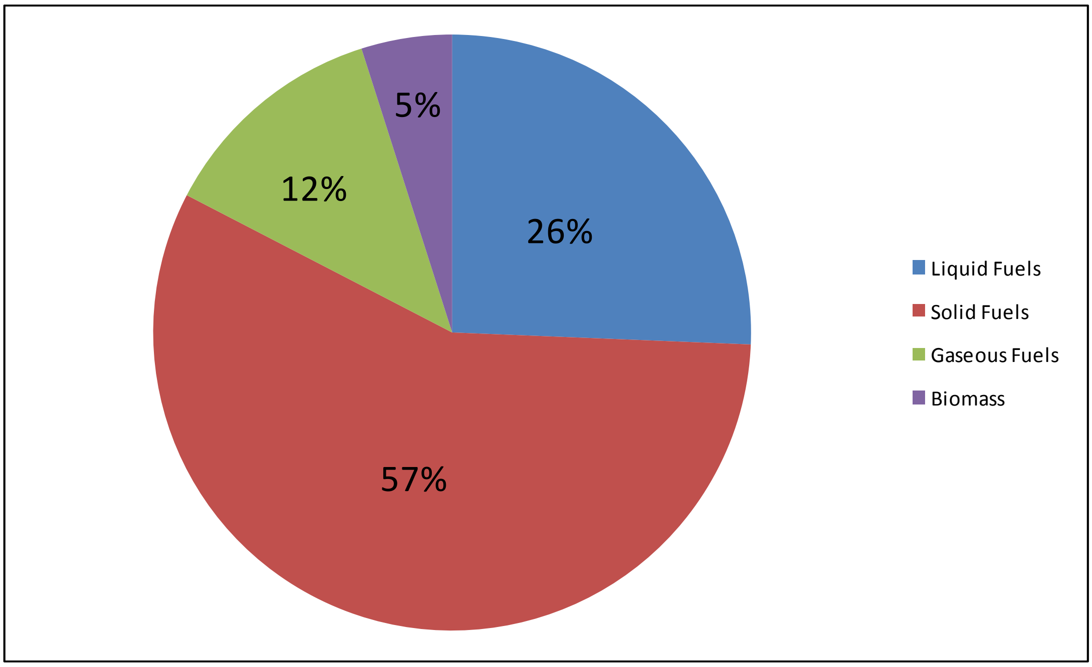

Figure 3.7.1 Share of individual fuels categories in reference approach in 2009.

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 (for years 2008 and 2009).

The Reference Approach and the Sectoral Approach often have different results because the Reference Approach is a top-down approach using a country's energy supply data and has no detailed information on how the individual fuels are used in each sector. Calculating CO_2 emissions with the two approaches can lead to different results. In 2009 the difference between reference and sectoral approaches in CO_2 emissions is equal 1.53%. Comparison of both methods is given in table 3.7.2.

Table 3.7.2. Differences between CO_2 emissions in sectoral and reference approach in period 1988 – 2009.

Year	Reference approach [Gg]	Sectoral approach [Gg]	Difference [%]
2009	294 842	293 274	0.53
2008	309 020	299 133	3.31
2007	306 149	303 327	0.93
2006	311 886	306 716	1.69
2005	303 847	296 128	2.61
2004	300 840	299 415	0.48
2003	301 773	299 650	0.71
2002	294 154	290 417	1.29
2001	297 580	301 047	-1.15
2000	297 633	301 829	-1.39
1999	313 921	313 153	0.25
1998	323 622	323 939	-0.10
1997	348 611	349 796	-0.34
1996	354 260	357 449	-0.89
1995	341 585	347 123	-1.60
1994	332 237	344 121	-3.45
1993	354 995	350 088	1.40
1992	351 289	343 021	2.41
1991	356 986	350 816	1.76
1990	357 862	348 407	2.71
1989	434 295	423 629	2.52
1988	457 926	442 614	3.46

3.8. Fugitive emissions (CRF sector 1.B)

3.8.1. 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). CH_4 emission from solid fuel transformation is included in category 2.C.1 (following ERT recommendation NA notation key was changed to IE).

The biggest share of emission in 1.B category comes from coal mining and handling (61%). This subcategory depends on hard coal and lignite mining, and from 1988 this decreased by 63% (hard coal) and by 23% (lignite). The main reason for the decrease was the declining demand for coal and lignite in economy.

3.8.2. Methodological issues

3.8.2.1 Fugitive emissions from fuels – coal mining (CRF sector 1.B.1.a)

Coal Mining and Handling – underground mines (1.B.1.a.i)

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, 2010].

Table 3.8.1. Domestically derived methane emission factors

	1992 data	1999 data	2003 data
Emissions sources	[Gawlik et al. 1994]	[Gawlik & Grzybek 2001]	[Kwarciński et al. 2005]
	Gg CH_4 /Mg extracted coal	Gg CH_4 /Mg C 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:

1988-2009 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 CH4 emissions from closed mines was applied to years: 2000-2009.

Table 3.8.2 shows data on hard coal extraction and total methane emissions from coal mines in 1988-2009. The total CH4 emissions include estimates from: venting systems, methane capture systems, post-mining processes, production waste and closed mines.

Table 3.8.2. Hard coal extraction and total methane emissions from coal mines in 1988-2009

	Extraction of hard coal in Mg	Total CH4 emission [Gg]
1988	191 624 000	782.22
1989	175 947 000	727.29
1990	151 321 000	622.67
1991	143 131 000	587.41
1992	132 730 000	545.70
1993	131 400 000	545.51
1994	134 078 000	583.46
1995	135 523 000	597.74
1996	136 272 000	608.79
1997	132 576 000	613.39
1998	113 859 000	540.60
1999	109 986 000	554.56
2000	102 081 000	521.28
2001	102 477 000	505.99
2002	96 160 000	469.68
2003	97 274 000	476.11
2004	95 623 000	468.09
2005	93 006 000	455.38
2006	89 342 000	437.57
2007	82 779 000	405.69
2008	77 989 000	382.41
2009	70 500 000	346.03

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, 2010] 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.

3.8.2.2 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 3.8.3 have been taken from domestic case study [Steczko 1994]. Activity data for 1990-2009 come from [EUROSTAT]. For years: 1988-1989, the activity data come from [IEA] database.

Table. 3.8.3. 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. So the consumption of coke oven gas was recalculated from PJ into Gg, using specific gravity factor. In 2009 this factor was changed into more detailed number, which caused insignificant change in activity data for years 1988-2008. Since 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.

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

3.9.1. Source category description

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

Emissions from 1.B.2 subcategory increased from 1988 to 2009 by 29% (Figure 3.1.5). This is mostly due to increase of consumption of natural gas (by 27% from 1988 to 2009). There is also significant increase in production of oil (by 528 Gg from 1988 to 2009). But the share of GHG emission from oil system amounts only to 2% of total emission from category 1.B.

3.9.2. Methodological issues

3.9.2.1 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 3.9.1. 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	6.70	160	13 126	13 286	537.83
1991	6.63	158	11 454	11 612	492.14
1992	8.43	200	13 052	13 252	554.25
1993	9.91	235	13 674	13 909	563.81
1994	11.91	284	12 721	13 005	563.96
1995	12.18	292	12 957	13 249	560.59
1996	13.26	317	14 026	14 343	610.48
1997	12.17	289	14 713	15 002	626.52
1998	15.17	360	15 367	15 727	675.13
1999	18.33	434	16 022	16 456	706.10
2000	27.60	653	18 002	18 655	772.49
2001	32.45	767	17 558	18 325	759.86
2002	30.61	728	17 942	18 670	747.70
2003	32.26	765	17 448	18 213	736.24
2004	37.41	886	17 316	18 202	765.01
2005	35.86	848	17 912	18 760	768.15
2006	33.67	796	19 813	20 609	847.90
2007	30.36	721	20 885	21 606	847.03
2008	32.27	755	20 787	21 542	884.02
2009	29.01	687	20 098	20 785	862.83

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. 3.9.2).

Table 3.9.2. 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

3.9.2.2 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 1990-2009 come from [EUROSTAT]. For years 1988-1989 activity data come from [IEA] database. Activity data are given in table 3.9.3

Table 3.9.3. 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	518 052
2007	163 147	518 190
2008	154 487	525 306
2009	153 980	513 992

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 3.9.4 and 3.9.5.

Table 3.9.4. 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 3.9.5. 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

3.9.2.3 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.

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.

3.10. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2009 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 1988-2009 ensured consistency for whole time-series.

Table 3.10.1. Results of the sectoral uncertainty analysis in 2009

2009	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
1. Energy	**293 462.48**	**693.48**	**6.56**	2.2%	25.1%	22.9%
A. Fuel Combustion	**293 273.61**	**138.19**	**6.56**	2.2%	11.8%	22.9%
1. Energy Industries	166 693.39	3.68	2.59	3.4%	14.8%	11.2%
2. Manufacturing Industries and Construction	5 351.29	0.19	0.04	2.8%	75.0%	75.0%
3. Transport	156 391.74	1.74	2.33	3.6%	13.6%	11.9%
4. Other Sectors	4 950.36	0.09	0.01	2.2%	17.1%	20.1%
5. Other	6 248.41	1.67	0.22	15.0%	28.3%	39.9%
B. Fugitive Emissions from Fuels	**30191.73**	**3.33**	**0.68**	2.5%	12.5%	28.0%
1. Solid Fuels	4780.22	0.14	0.24	3.2%	41.9%	75.1%
2. Oil and Natural Gas	18604.50	1.99	0.29	3.6%	13.8%	12.1%

3.11. 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 element 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.

Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE).

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.

3.12. Source-specific recalculations

1.A. Fuel combustion

Stationary sources

- Activity data on fuel consumption for years 1990-2008 were updated due to changes made in EUROSTAT database
- Empirical function, that links the content of carbon in hard coal with the corresponding net calorific value of this fuel was corrected (the function: C_{hc} = 10(2.4858*NCV + 3.3132)/NCV was changed into: 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)
- Values of GHG emission for the years 2005-2008 were estimated according to methodology applied for the years 1988-2004 – i.e. based on statistical data on fuel consumption (in energy units) and country specific emission factors for hard coal and lignite or default EFs (from IPCC guidelines) for other fuels respectively.
- Activity data and emissions from *Other petroleum products* were corrected for entire period (petroleum coke consumption was excluded from *Other petroleum products use* in order to elimination of double counting).

Mobile sources

- Biodiesel and bioethanol consumption was corrected based on Eurostat and GUS;
- Fuel consumption in 1990-2008 for the following subcategories: 1.A.3.*a Civil aviation* 1.A.3.*c Railways*, 1.A.3.d *Navigation* (inland navigation) and for international bunker, were corrected based on updated Eurostat database;
- Fuel consumption for category 1.A.3.e. Other transportation were corrected based on publication “Energy statistics 2008/2009” by GUS 2010;
- Data concerning diesel oil consumption in 2007 from Off-road vehicles and other machinery in agriculture (classified in 1.A.4.c subcategory) were updated
- Consumption of aviation gasoline in 1991 were corrected
- Consumption of diesel oil in inland navigation in 1990 was corrected.

Reference Approach

- Carbon emission factors for Bituminous Coal, Lignite, Coke, Natural Gas and Gasoline were corrected;
- for the years 1990-2008, data were updated based on Eurostat database corrected in mid-year 2010;

1.B Fugitive emissions

- Activity data (on oil extraction) for years 1990-2008 were recalculated on the basis of updates in EUROSTAT database.

3.13. Source-specific planned improvements

1.A. Fuel combustion

- Extension of cooperation with institutions responsible for elaboration of Polish energy data in order to explain and verify time-trends of activity data in 1.A category
- Updating and verification of data concerning off-road transport (both in subcategory 1.A.3 as well as for mobile sources in other sectors (1.A.4.c – *off-road vehicles and other machinery in agriculture*, *Fishing* and 1.A.2.f – *off-road vehicles and other machinery in industry*).
- updating and verification of data concerning off-road transport (both in subcategory 1.A.3 as well as for mobile sources in other sectors (1.A.4.c – *Machinery and off-road vehicles in agriculture*, *Fisheries* and 1.A.2.f. – *Machinery and other mobile sources in industry*).
- COPERT IV model implementation to calculate emissions from road transport
- Improving Reference Approach to minimize differences between reference and sectoral approaches.

1.B Fugitive emissions

- Domestic emission factors for the systems of coke-oven gas, natural gas and oil are based on a publication from year 1994. New studies are needed to update these data.

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 (CO2 emission), share in total GHG emission 1.5%
- 2.B.1. Ammonia Production (CO2 emission), share in total GHG emission 0.9%
- 2.C.1. Iron and Steel Production (CO2 emission), share in total GHG emission 1.5%
- 2.F.1. Refrigeration and Air Conditioning Equipment (HFC emission), share in total GHG emission 0.9%
- 2.F.9. Potential emissions as a proxy for actual emissions (HFC emission), share in total GHG emission 0.8%

Share of these categories in total Poland's GHG emissions is 5.6%.

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

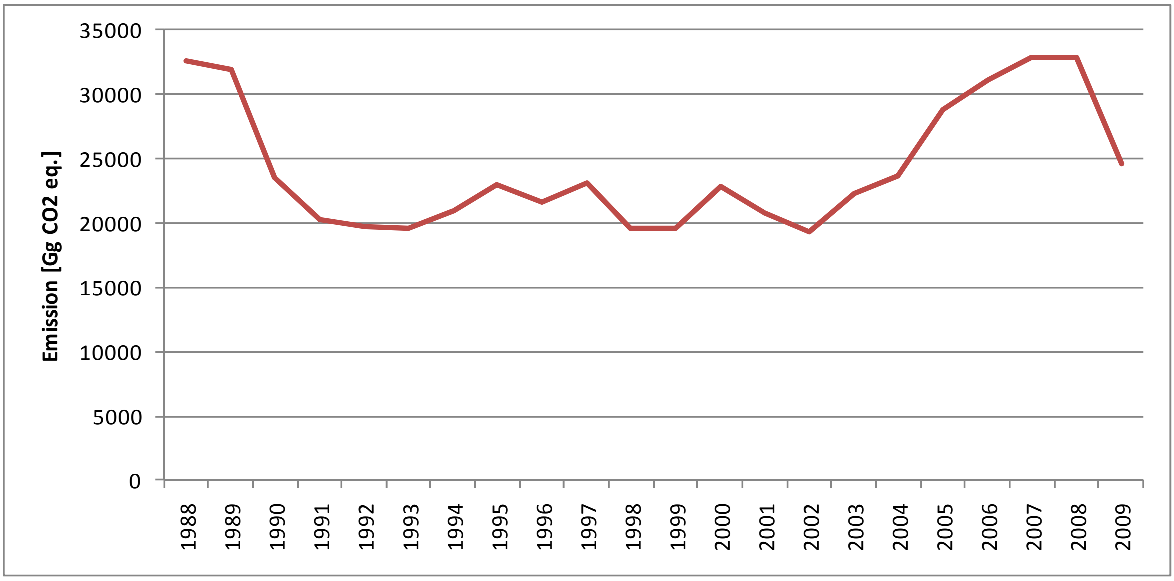

Figure 4.1.1. Emission trend in *Industrial processes* sector in period 1988 – 2009

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 2009 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 – 2009 are shown in figure 4.1.2

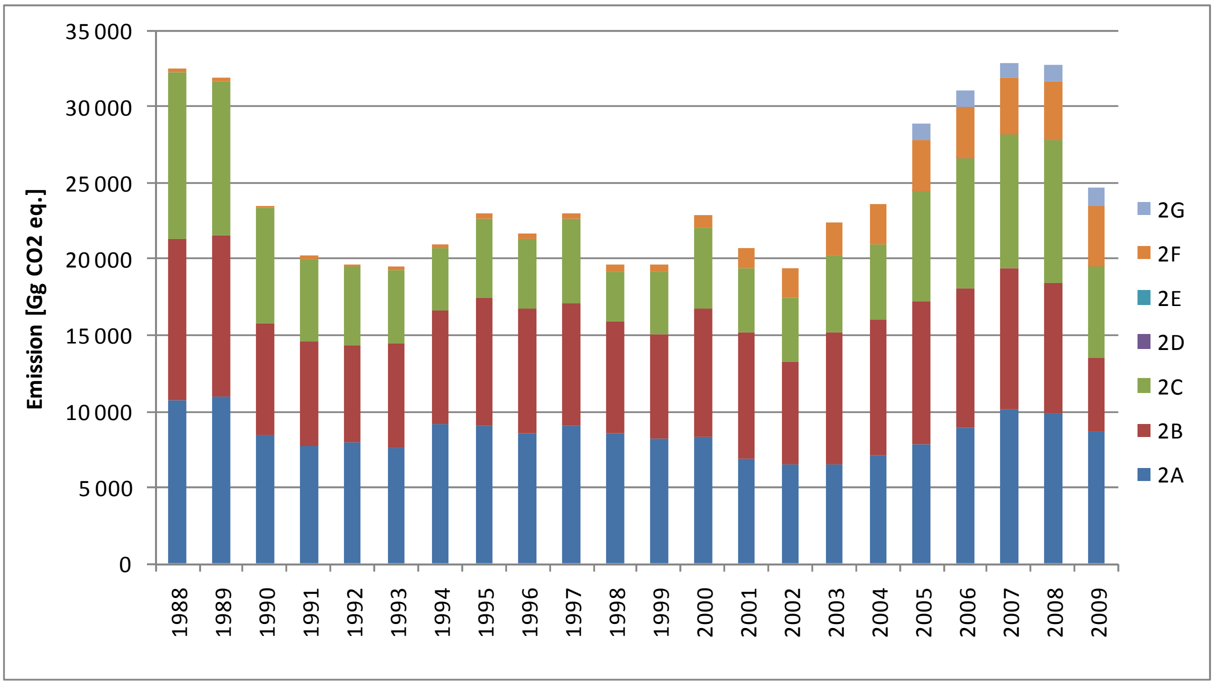

Figure 4.1.2. GHG emissions from *Industrial processes* in 1988- 2009 according to subcategories

4.2. Mineral Products (CRF sector 2.A)

4.2.1. Source category description

Estimation of emissions in 2.A. *Mineral products* are 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 66% in 2009.

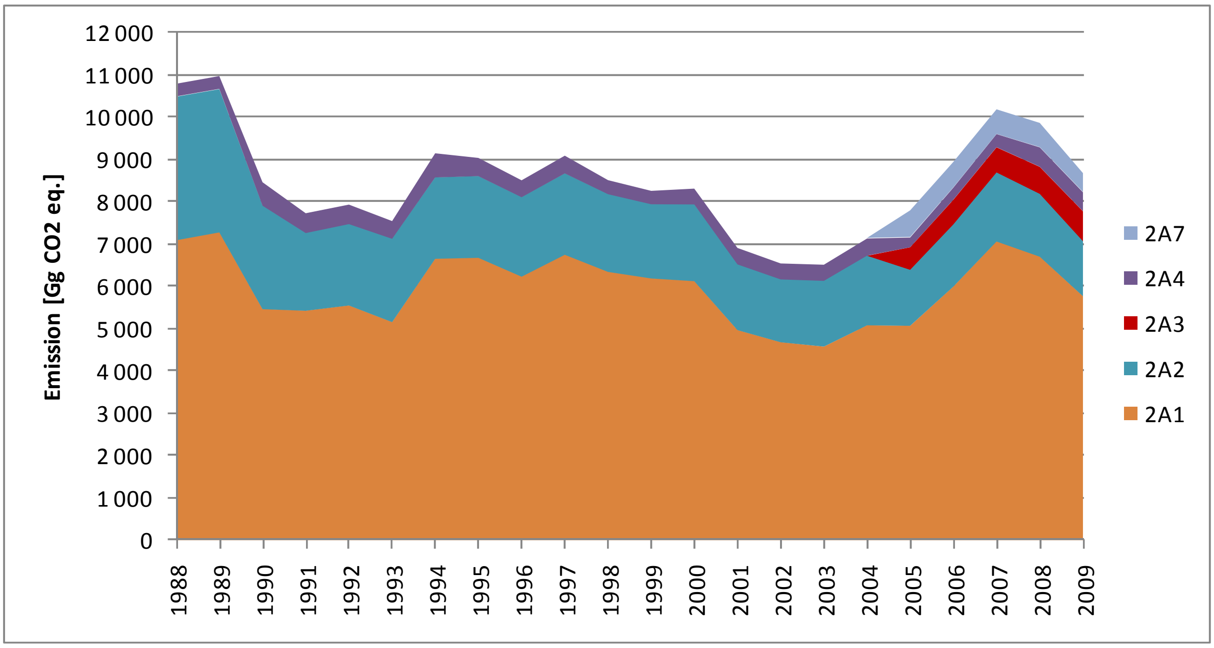

Figure 4.2.1. Emissions from *Mineral Products* sector in years 1988-2009 according to subcategories.

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 2009 for installation of clinker production, which participate in the EU ETS [KASHUE 2010]. This emission was estimated as 5757.2 Gg CO_2. Data on clinker production was taken from [GUS 2010b].

The clinker production in period 1988-2009 is shown on figure 4.2.2. Data on clinker production for the entire inventoried period was taken from [GUS 1989b-2010b].

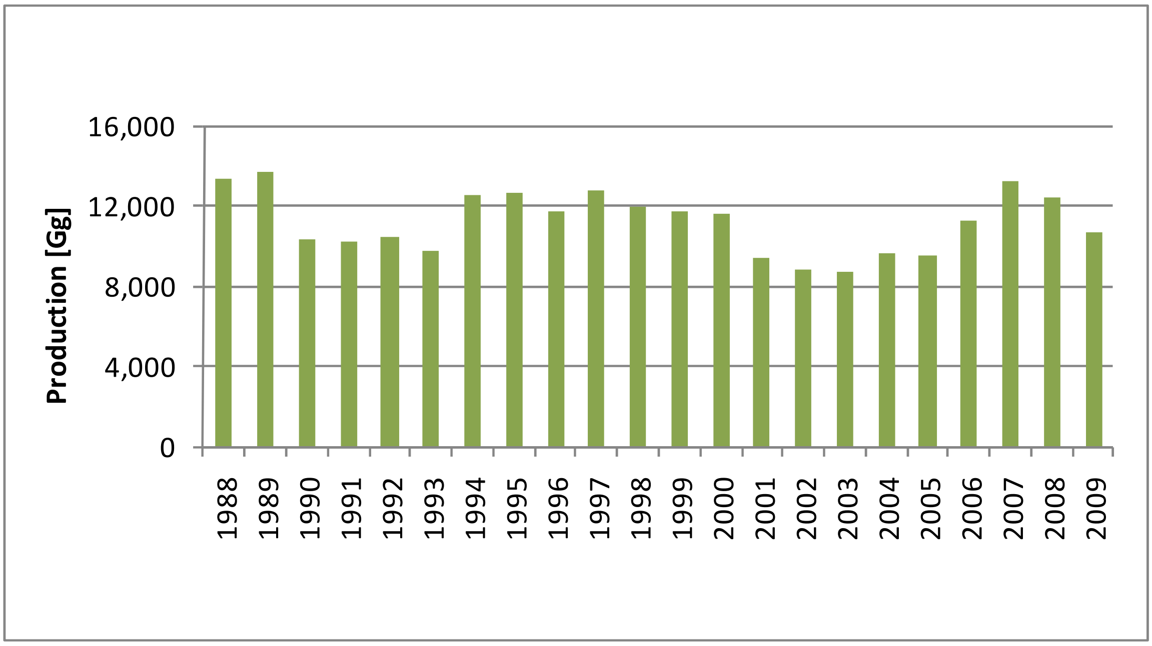

Figure 4.2.2. Clinker production in 1988-2009

CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2009 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 1988-2009 are shown on figure 4.2.3.

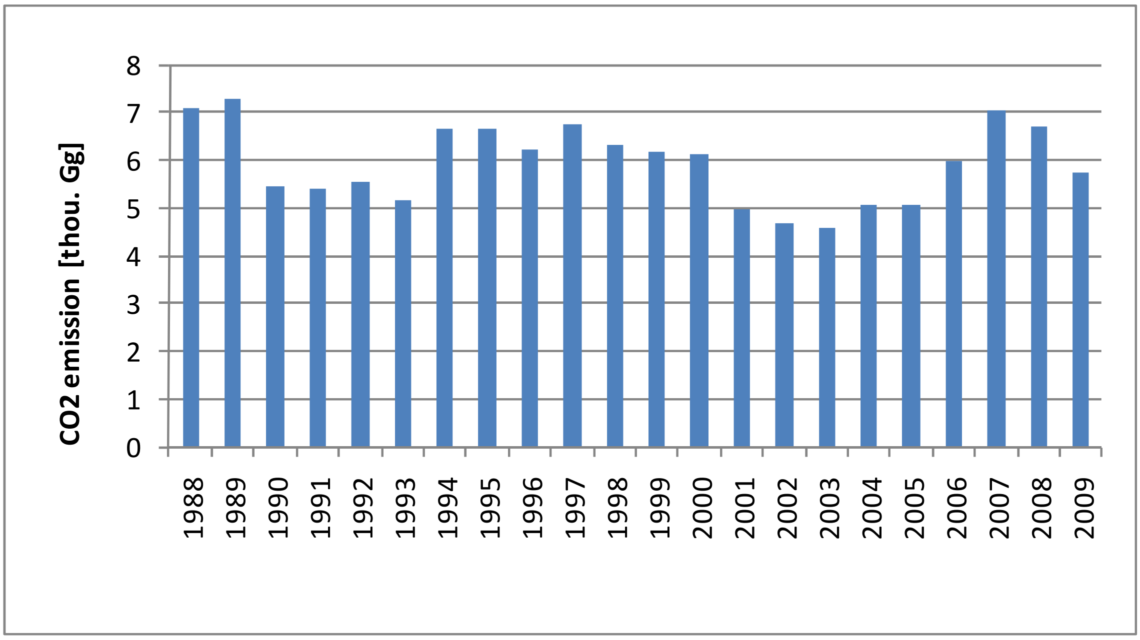

Figure 4.2.3. CO_2 process emission for clinker production in 1988-2009

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 2010b]. 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-2010b] – 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 1988-2009 are shown on figure 4.2.5.

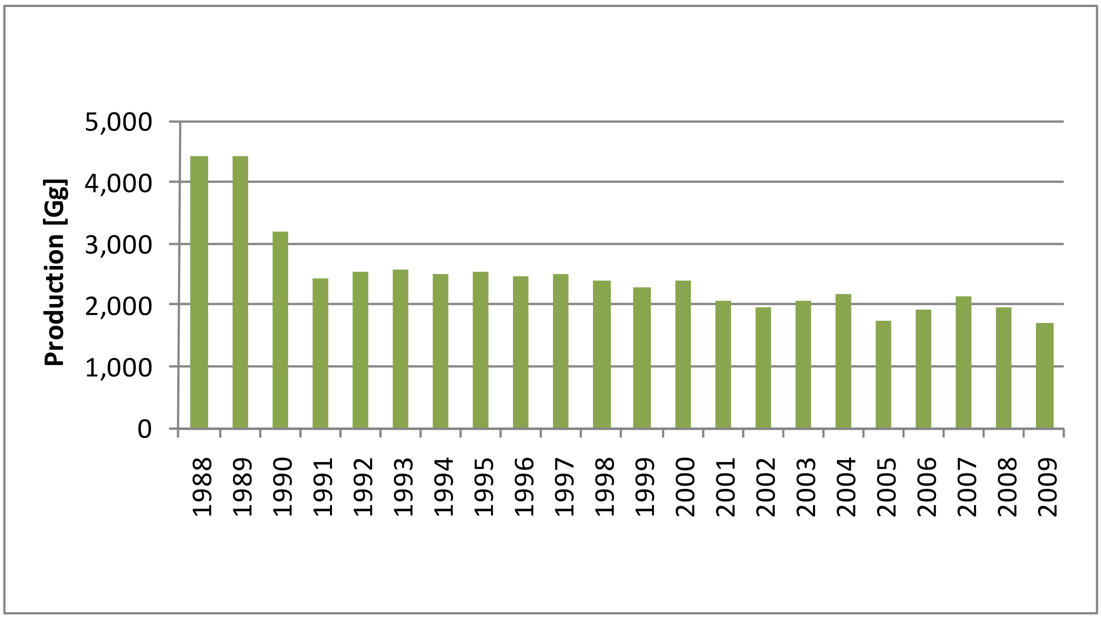

Figure 4.2.4. Lime production in 1988-2009

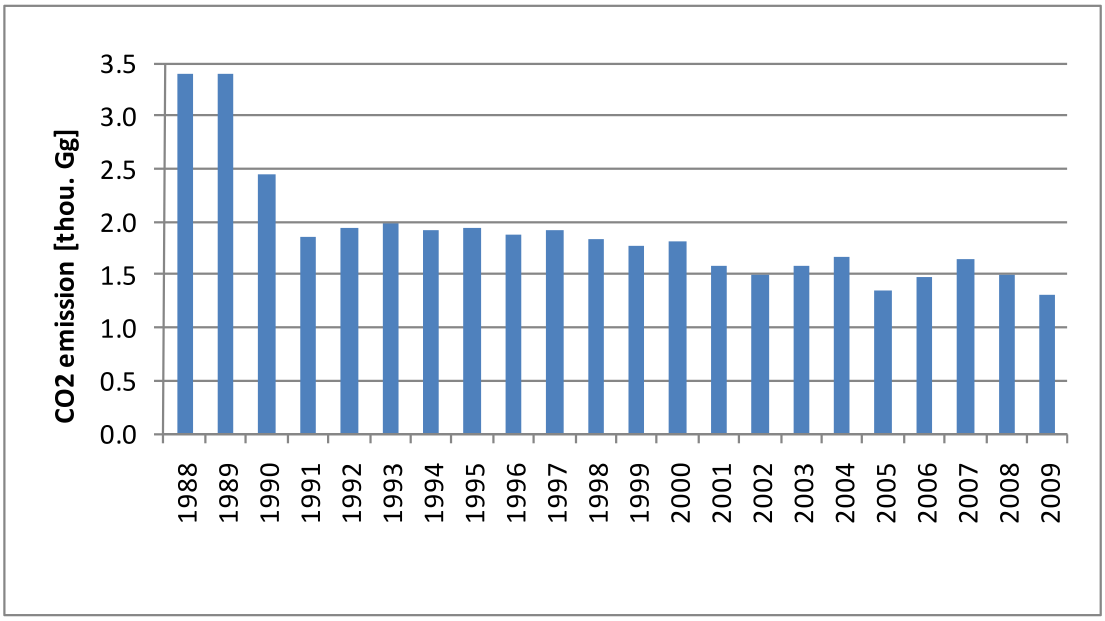

Figure 4.2.5. CO_2 process emission for lime production in 1988-2009

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 2009 the emission value was 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 2009 in other categories mentioned above were as follows:

- from iron ore sinter production: 340.6 Gg
- from pig iron and steel production: 5.6 Gg
- from steel cast production: 4.8 Gg
- from glass production: 125.1 Gg
- from ceramics production: 73.2 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: 8.4 Gg

CO_2 emission from limestone and dolomite use according to information given above was estimated for 2009 at 1200 Gg (excluding 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 2010e]. 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: 1988-2009 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 2005-2009, 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 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.

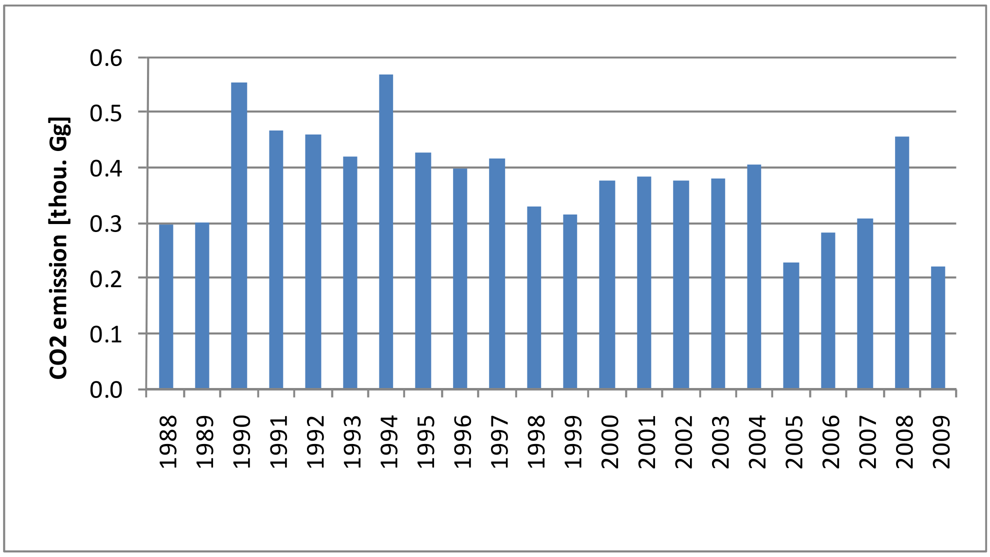

Figure 4.2.6. CO_2 emission from soda ash use and production in 1988-2009 (excluding soda ash use included in glass, ceramics and paper productions).

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 2009 for installation of glass and glass wool production, which participate in the emission trading scheme [KASHUE 2010]. In 2009 this emission amounted to 273.4 Gg. In 2008 emission taken from the verified reports for installations participating in the emission trading scheme was 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 2009 for installation of ceramics production, which participate in EU ETS [KASHUE 2010]. This emission value was equal to 169.1 Gg. For the years 2005-2008, the emissions were also taken from the verified reports for installations participating in EU ETS and amounted as follows: 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.

4.3. 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) – almost 77% in 2009.

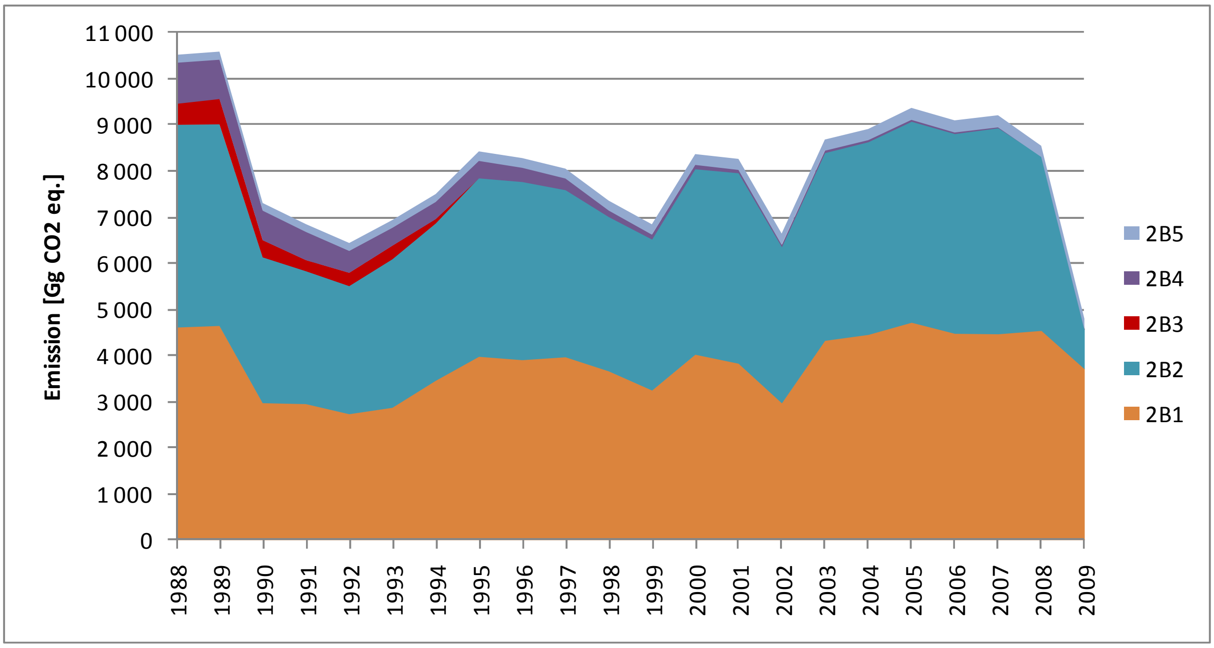

Figure 4.3.1. Emissions from *Chemical Industry* category in years 1988-2009 according to subcategories.

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 1988-2009 was presented in Annex 3). The amount of natural gas consumption expressed in volume units was taken from [GUS 2010e]. 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: 1988-2009. 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: 1988-2009 are shown in figure 4.3.2.

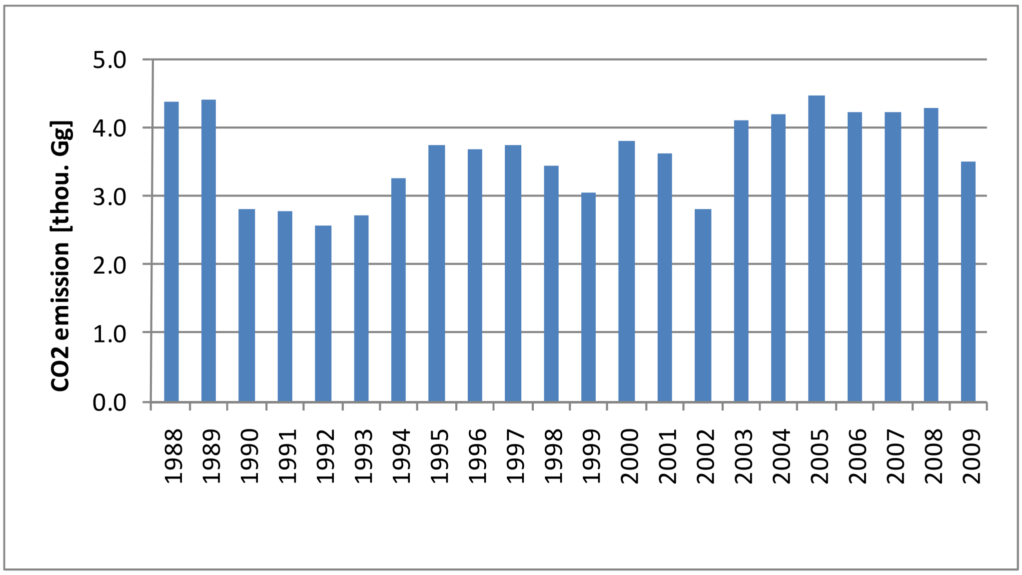

Figure 4.3.2. CO_2 process emission for ammonia production in 1988-2009

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].

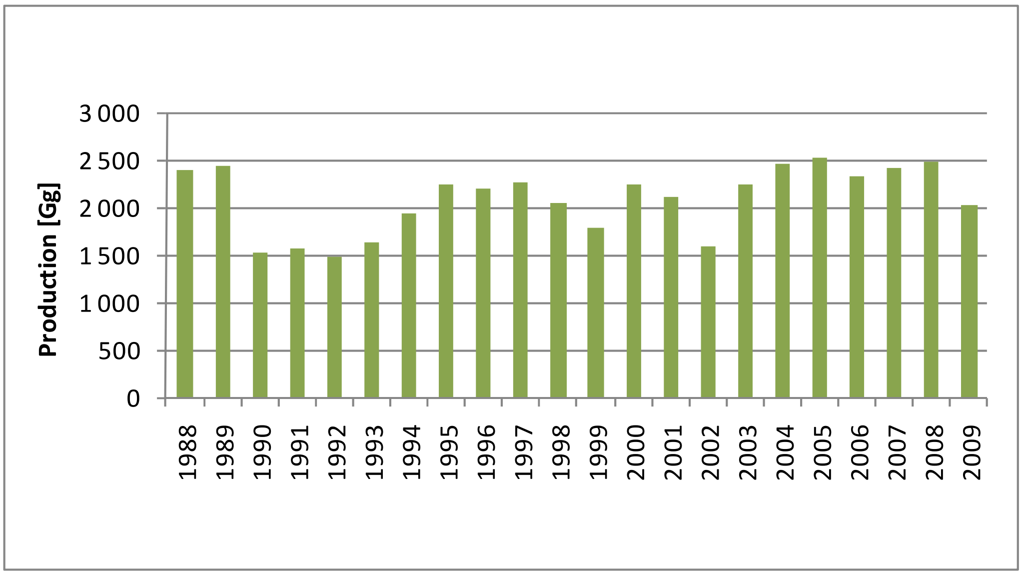

Figure 4.3.3. Production of ammonia in 1988-2009

According to a 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 2009 was based on annual HNO_3 production data from [GUS 2010b]. The applied country specific emission factor: 1.31 kg/Mg nitric acid was estimated based on the reports from all producers of HNO_3 [KOBIZE 2010]. The N_2O emission factors for years 2005-2008 were calculated also based on mentioned reports provided by installations of nitric acid production. The values of N_2O EFs applied for the years 2005-2007 were as follows: for 2005: 6.34 kg/Mg nitric acid, for the years 2006 and 2007: 6.35 kg/Mg nitric acid while for 2008: 5.39 kg/Mg HNO_3.

Decrease of the N_2O EF value from nitric acid production in 2008 and its significant drop in 2009 are the result of the implementation of the JI projects.

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-2010b] for the entire period 1988-2009. The amount of production and N_2O emissions from nitric acid production are shown in figures 4.3.4 and 4.3.5, respectively.

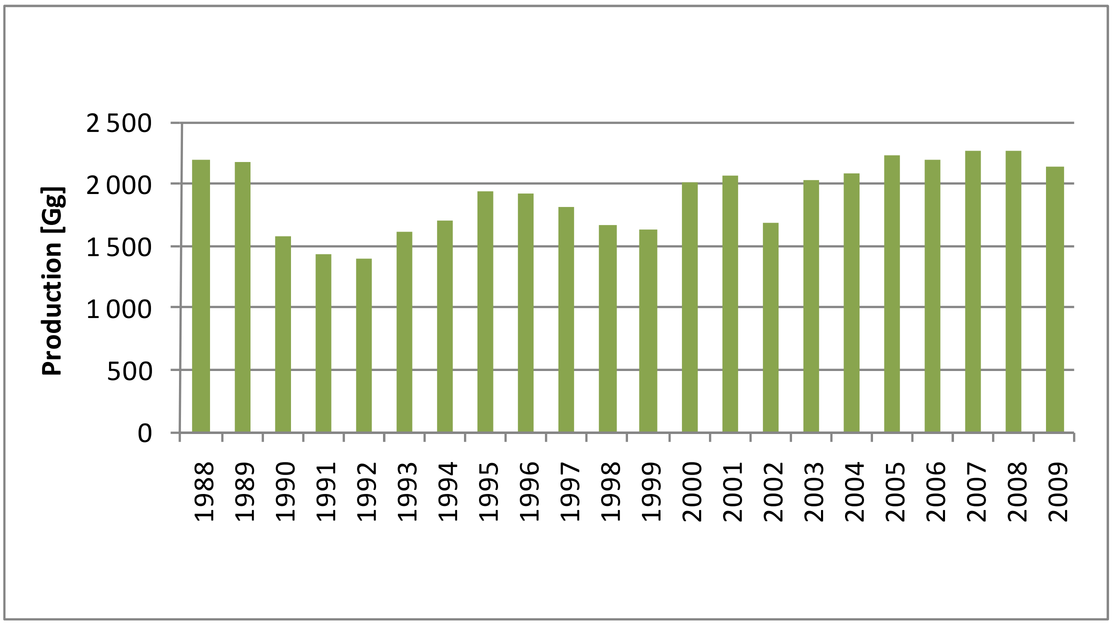

Figure 4.3.4. Production of nitric acid in 1988-2009

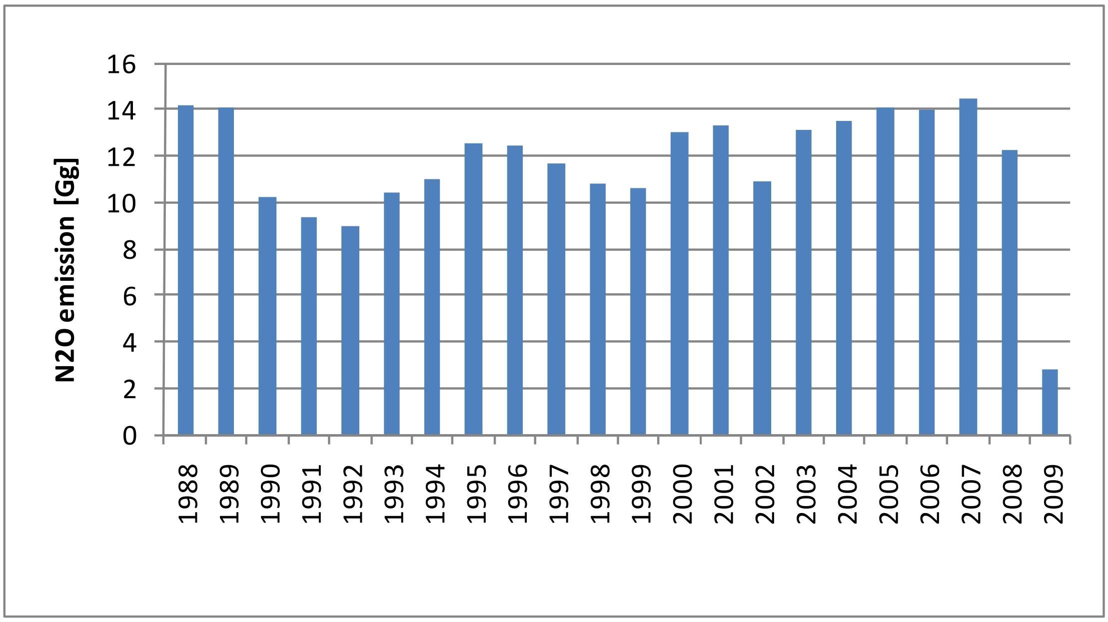

Figure 4.3.5. N_2O process emission for nitric acid production in 1988-2009

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

Data on carbide production was taken from [GUS 2010b]. CO_2 emission factor applied for this subcategory amounts to 2 190 kg CO_2/Mg carbide (1090 kg CO_2/Mg carbide from production + 1100 kg CO_2/Mg carbide from use) and was taken from [IPCC 1997].
For all years, starting from the base year, the same source of data on annual production amounts [GUS 1989b-2010b] and the same EF equal 2190 kg CO2/Mg of carbide [IPCC 1997] were used.

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 2010e]. 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-2010e].
The emission factor of 11 kg CH_4/Mg was applied for calculation of CH_4 emission for the entire period 1988-2009.

- Ethylene Production

Emission of CO_2 from ethylene production was calculated based on ethylene annual production from [GUS 2010b]. Emission factor was taken from [CITEPA 1992]. Its value is 0.3 kg CO_2/Mg ethylene produced.

For the entire time series 1988–2009 the same activity data source – GUS publications [GUS 1989b-2010b] 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 1988-2009.

- Caprolactam Production

Data on annual caprolactam production for inventory calculation purpose was taken from [GUS 2010b]. 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-2010b] 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 2010b] 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-2010b].

- Styrene Production

Methane emissions from styrene production for the entire period 1988-2009 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 1995-2009 was taken from G-03 questionnaires [GUS 1996e-

2010e], while for previous years (1988-1994) the activity data were obtained directly from the only styrene producer (personal communication).

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) – over 95% in 2009.

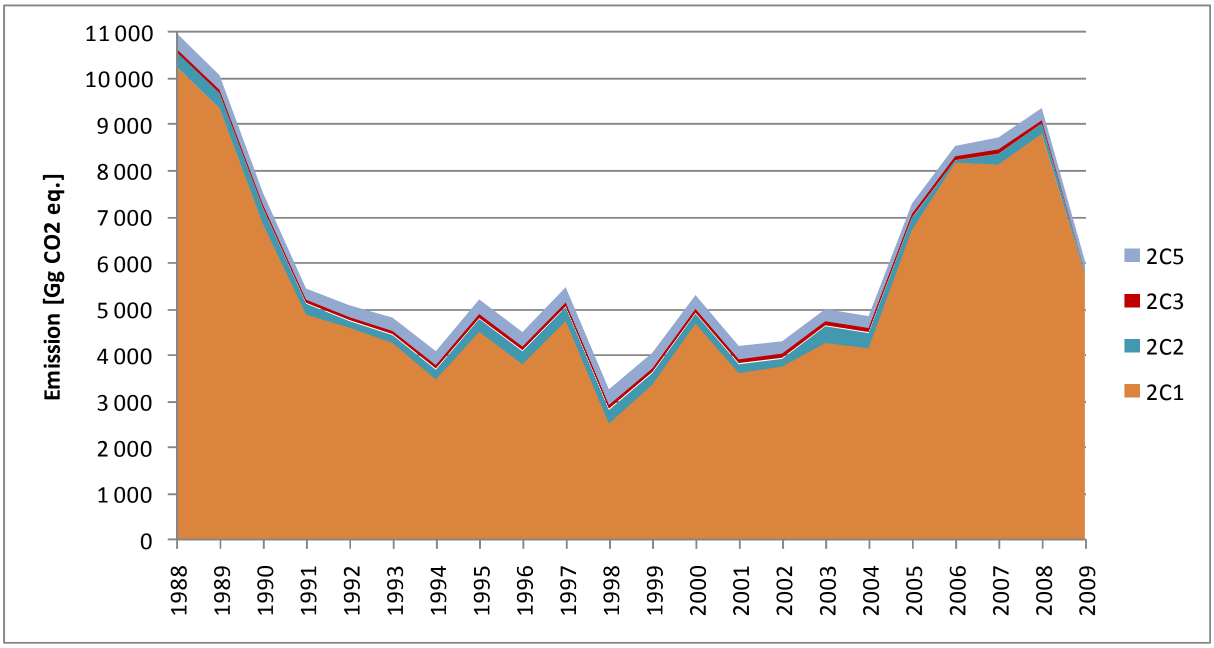

Figure 4.4.1. Emissions from *Metal Production* sector in years 1988-2009 according to subcategories.

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 2009 come from the verified reports on annual emissions of CO_2 from iron ore sinter installations in EU ETS [KASHUE 2010]. 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 2005-2008 were estimated.

In 2.C.1.a sub-category for 2005-2009, 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) was subtracted from activity data in 1.A.2.a to avoid double counting.

Amounts of fuels (in PJ) consumed in sintering plants and subtracted from activity data in 1.A.2.a are as follows:

	2005	**2006**	**2007**	**2008**	**2009**
coke	8.499	8.957	8.638	7.103	5.473
anthracite	0.587	0.856	0.962	1.695	0.718
blast furnace gas	0.133	0.107	0.115	0.116	0.070
coke oven gas	0.369	0.294	0.285	0.279	0.224

Due to exclusion 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.

Above mentioned emissions [Gg] are as follows:

	2005	**2006**	**2007**	**2008**	**2009**
CH_4	0.091	0.099	0.096	0.088	0.024
N_2O	0.014	0.015	0.014	0.013	0.004

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 [KASHUE 2008]. 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 1988-2009 are presented in table 4.4.1.

For the entire period 1988-2008 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 2005-2009, 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 1988-2009 [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 emissions	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 emissions	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**								
Production	6 306.4	4362.6								
CO_2 emissions	1 656.0	1151.1								

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 1988-2009 equals 41.7-46.1% (cast steel production was calculated based on the yield value and steel cast production published in [*Modern Casting*]); due to the production of ferrous casting products for 2009 was published in [*Modern Casting*] as aggregated amount, the activity data for 2009 was estimated based on additional information published in Foundry Journal of the Polish Foundrymen's Association [Sobczak 2011].

- 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 1988-2009 were presented in table 4.4.2.

Table 4.4.2. Activity data for estimation of CO_2 process emission from steel casting in 1988-2009

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

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 1988-2009 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); because of the production of ferrous casting products for 2009 was published in [*Modern Casting*] as aggregated amount, the activity data for 2009 was estimated based on additional information published in Foundry Journal of the Polish Foundrymen's Association [Sobczak 2011].
- 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 as follow: for 1988 – 1998 – 80%, for 1999 66.7% , since 2000 was significant drop of share of cast iron melted in cupola in total cast iron production – from 77.3% in 2000 to app. 35% in 2009,
- 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 1988-2009 were presented in the table 4.4.3.

Table 4.4.3. CO_2 process emission from cast iron production in years 1988-2009

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

CH_4 emission for entire period 1988-2009 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 2009 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 2009 was estimated at 2259.5 Gg. Emission values for the years 2005-2008 were estimated according to methodology applied for 2009 and amounted to: 2952.7 Gg for 2005, 3700.3 Gg for 2006, 3879.2 Gg CO_2 for 2007, and 4284.6 Gg for 2008.
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
hard coal (including anthracite)	0.482	3.647	3.036	2.174	1.496
natural gas	2.829	0.109	0.742	0.143	0.040
coke	38.806	44.032	42.789	39.332	24.282
coke oven gas	3.264	3.884	5.569	4.813	0.000

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 2005-2009, mentioned above, are as follows:

	2005	2006	2007	2008	2009
CH_4	0.399	0.481	0.465	0.420	0.258
N_2O	0.060	0.072	0.069	0.063	0.039

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-2010e]. The data for 2009 amounted to 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
CO2 EMISSION [Gg]	**1 696**	**1 650**	**1 430**	**945**	**890**	**819**	**957**	**979**	**835**
CO2 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
CO2 EMISSION[Gg]	**862**	**707**	**578**	**780**	**680**	**599**	**648**	**694**
CO2 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 2009 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 2009 was 373.1 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 2005-2008 were estimated in line with the method applied for 2009. The values of CO_2 emissions for 2005-2008 are as follows: 547.5 Gg for 2005, 843.4 Gg for 2006, 766.9 Gg for 2007 and 500.2 for 2008.

Basic oxygen steel production in 2005-2009 amounted to: 4892.7 Gg, 5766.4 Gg, 6187.9 Gg and 5225.1 Gg and 3235 Gg, respectively [GUS 2006b-2010b].

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**
natural gas	0.540	0.598	0.701	0.499	0.661
coke	0.216	0.254	0.236	0.216	0.000
coke oven gas	0.609	0.654	0.607	0.625	0.385
blast furnace gas	0.105	0.101	0.115	0.001	0.002

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**
CH_4	0.003	0.004	0.004	0.003	0.001
N_2O	0.0004	0.0005	0.0005	0.0004	0.0001

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 2009 were taken from the verified reports prepared by installations included in EU ETS. The amount of emissions for 2009 was estimated at 315.1 Gg. Values of emissions for 2005-2008, 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 and 387.8 Gg. In addition to process emissions from electric furnaces, these values include 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
hard coal (including anthracite)	0.261	0.336	0.511	0.582	0.019
coke	0.036	0.032	0.032	0.062	0.055

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 2005-2009, are as follows:

	2005	2006	2007	2008	2009
CH_4	0.003	0.004	0.005	0.006	0.001
N_2O	0.0004	0.0006	0.0008	0.0010	0.0001

Annual electric furnace steel production in 2005-2009 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 and 3892.8 Gg for 2009 [GUS2006b-GUS 2010b].

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 1988-2009 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 2005-2009, 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. m3]	259 384	251 965	251 779	200 878	218 266	215 203	245 719	268 495	236 075
Technological indicator									
BOF Gas [thous. m3/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
CO2 process emission from steel production [Gg]	**427.386**	**418.336**	**409.570**	**309.058**	**339.475**	**334.711**	**371.857**	**409.707**	**361.227**
CO2 EMISSION FACTOR [kg CO2/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. m3]	263 108	217 386	190 494	237 549	203 412	202 592	212 057	239 572
Technological indicator								
BOF Gas [thous. m3/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
CO2 process emission from steel production [Gg]	**401.486**	**334.456**	**299.781**	**477.747**	**394.514**	**379.458**	**414.384**	**450.388**
CO2 EMISSION FACTOR [kg CO2/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
CO2 process emission from steel production [Gg]	**89.389**	**83.635**	**85.272**	**70.446**	**57.359**	**77.317**	**86.292**	**85.341**	**87.541**
CO2 EMISSION FACTOR [kg CO2/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
CO2 process emission from steel production [Gg]	**96.066**	**111.664**	**82.345**	**144.912**	**123.888**	**116.900**	**122.202**	**205.004**
CO2 EMISSION FACTOR [kg CO2/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 1990-2009 was estimated based on carbon budgets in the coking plants (tab. 4.4.7). Data concerning input and output are based on [Eurostat] and [GUS 1991a-2010a]. Coke productions for 1990-2009 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. 4.4.7) 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 1990-2009 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 4.4.7. Carbon balance for coke production in years 1988-2009

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
INPUT [TJ]											
Coking coal	657996	639196	534118	448516	438558	405168	436596	451761	403902	420825	373917
High Methane Natural Gas	0	1239	0	0	0	0	0	0	0	0	0
Coke	0	0	969	542	1767	1568	2394	2337	1824	1682	2109
Blast furnace gas	0	152	0	0	0	0	0	0	0	0	0
Tar	390	306	619	330	157	115	82	194	0	0	15
Industrial waste	7	0	0	0	0	0	0	0	0	0	0
NCV [MJ/kg]	0	0	0	0	0	0	0	0	0	0	0
Coking coal	29.47	29.48	29.33	29.44	29.47	29.41	28.49	29.36	29.36	29.45	29.54
INPUT – Material-specific carbon content [kg C/GJ]											
Coking coal	26.02	26.02	26.03	26.02	26.02	26.02	26.06	26.03	26.03	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
Coke	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	66	66	66	66	66	66	66	66	66	66
Tar	22	22	22	22	22	22	22	22	22	22	22
Industrial waste	39	39	39	39	39	39	39	39	39	39	39
INPUT – Carbon contents in charge components [Gg]											
Coking coal	17122.5	16633.2	13901.8	11672.0	11412.3	10544.3	11378.1	11757.8	10512.1	10951.1	9729.2
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
Coke	0.0	0.0	28.6	16.0	52.1	46.3	70.6	68.9	53.8	49.6	62.2
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
Tar	8.6	6.7	13.6	7.3	3.5	2.5	1.8	4.3	0.0	0.0	0.3
Industrial waste	0.3	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	13944.0	11695.2	11467.9	10593.1	11450.5	11831.0	10565.9	11000.7	9791.7
OUTPUT [TJ]											
Coke	471498	455829	389624	325214	316179	293037	326496	330002	294690	300276	277790
Coke-Oven Gas	118915	117040	100628	89478	85741	77314	84100	84769	76036	79286	73457
Tar	27580	27429	22885	20268	20648	19071	21147	21265	19832	19600	17950
Benzol	7702	7231	6167	5151	5646	5159	6011	6057	5447	5429	4857
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
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
Tar	22	22	22	22	22	22	22	22	22	22	22
Benzol	23	23	23	23	23	23	23	23	23	23	23
OUTPUT – Carbon content in products [Gg]											
Coke	13909.2	13446.9	11493.9	9593.8	9327.3	8644.6	9631.6	9735.1	8693.4	8858.1	8194.8
Coke-Oven Gas	1545.9	1521.5	1308.2	1163.2	1114.6	1005.1	1093.3	1102.0	988.5	1030.7	954.9
Tar	606.8	603.4	503.5	445.9	454.3	419.6	465.2	467.8	436.3	431.2	394.9
Benzol	177.1	166.3	141.8	118.5	129.9	118.7	138.2	139.3	125.3	124.9	111.7
Carbon content in products – SUM [Gg]	16239.0	15738.2	13447.4	11321.4	11026.0	10187.9	11328.4	11444.2	10243.4	10444.9	9656.3
C process emission[Gg]	**892.4**	**930.7**	**496.6**	**373.8**	**441.8**	**405.2**	**122.1**	**386.8**	**322.5**	**555.8**	**135.4**
CO2 process emission[Gg]	**3272.1**	**3412.6**	**1820.9**	**1370.7**	**1620.1**	**1485.8**	**447.7**	**1418.2**	**1182.5**	**2038.0**	**496.4**
Coke output [Gg]	17007	16499	13671	11411	11094	10282	11456	11579	10340	10536	9747
EF [kg CO2/Mg of coke]	**192**	**207**	**133**	**120**	**146**	**145**	**39**	**122**	**114**	**193**	**51**

Table 4.4.7. (cont.) Carbon balance for coke production in years 1988-2009

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
INPUT [TJ]											
Coking coal	334582	363260	359331	351567	406805	401491	331593	378744	399294	387497	277052
High Methane Natural Gas	0	0	0	0	0	0	0	0	0	0	0
Coke	1482	2024	1055	1710	1568	1710	2138	2366	2651	3050	1679
Blast furnace gas	0	0	0	0	0	0	0	0	0	0	22
Tar	0	0	0	0	0	0	0	0	0	0	0
Industrial waste	0	0	0	0	0	0	0	0	0	0	0
NCV [MJ/kg]	0	0	0	0	0	0	0	0	0	0	0
Coking coal	29.48	29.62	29.53	29.53	29.56	29.55	29.51	29.59	29.50	29.60	29.56
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
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
Coke	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	66	66	66	66	66	66	66	66	66	66
Tar	22	22	22	22	22	22	22	22	22	22	22
Industrial waste	39	39	39	39	39	39	39	39	39	39	39
INPUT – Carbon contents in charge components [Gg]											
Coking coal	8706.5	9450.8	9349.8	9147.8	10584.6	10446.4	8628.3	9854.0	10390.0	10081.7	7208.6
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
Coke	43.7	59.7	31.1	50.4	46.3	50.4	63.1	69.8	78.2	90.0	49.5
Blast furnace gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
Tar	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	0.0
Carbon contents in charge – SUM [Gg]	8750.2	9510.5	9381.0	9198.2	10630.8	10496.9	8691.4	9923.8	10468.2	10171.6	7259.6
OUTPUT [TJ]											
Coke	238488	255702	254961	248606	288192	287765	239514	273971	289788	280184	196763
Coke-Oven Gas	62989	68849	69008	65570	75091	72947	61947	71712	76950	74046	53806
Tar	16265	17003	17233	16463	18188	17421	14603	16219	17366	15712	11834
Benzol	4525	2499	4789	4475	5253	5358	4403	3804	5316	4712	3373
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
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
Tar	22	22	22	22	22	22	22	22	22	22	22
Benzol	23	23	23	23	23	23	23	23	23	23	23
OUTPUT – Carbon content in products [Gg]											
Coke	7035.4	7543.2	7521.3	7333.9	8501.7	8489.1	7065.7	8082.1	8548.7	8265.4	5804.5
Coke-Oven Gas	818.9	895.0	897.1	852.4	976.2	948.3	805.3	932.3	1000.4	962.6	699.5
Tar	357.8	374.1	379.1	362.2	400.1	383.3	321.3	356.8	382.1	345.7	260.3
Benzol	104.1	57.5	110.1	102.9	120.8	123.2	101.3	87.5	122.3	108.4	77.6
Carbon content in products – SUM [Gg]	8316.1	8869.8	8907.7	8651.4	9998.8	9943.9	8293.5	9458.7	10053.4	9682.1	6841.9
C process emission[Gg]	**434.1**	**640.7**	**473.3**	**546.8**	**632.0**	**553.0**	**397.9**	**465.1**	**414.8**	**489.6**	**417.7**
CO2 process emission[Gg]	**1591.6**	**2349.3**	**1735.3**	**2005.0**	**2317.5**	**2027.6**	**1458.8**	**1705.4**	**1521.0**	**1795.1**	**1531.4**
Coke output [Gg]	8368	8972	8946	8723	10112	10097	8404	9613	10168	9831	7091
EF [kg CO2/Mg of coke]	**190**	**262**	**194**	**230**	**229**	**201**	**174**	**177**	**150**	**183**	**216**

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 2010b]. 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 1988-2008 CO_2 and CH_4 process emission from ferroalloys production was estimated also based on annual ferrosilicon production taken from [GUS 1989b-2009b] (figure 4.4.2) and emission factors as in year 2009.

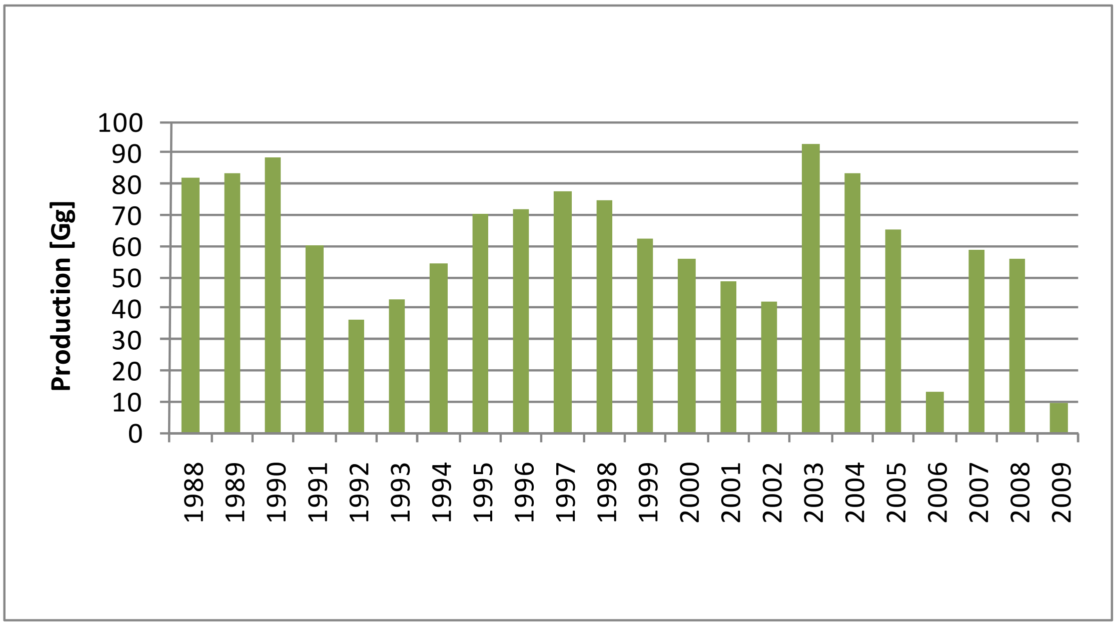

Figure 4.4.2. Production of ferrosilicon in 1988-2009

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

Calculation of CO_2 emission from primary aluminium production for 2009 is based on the data on aluminium production published in [GUS 2010b]. 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 1988-2009 was estimated according to the above mentioned description. The amount of emissions for the entire trend is shown in figure 4.4.3.

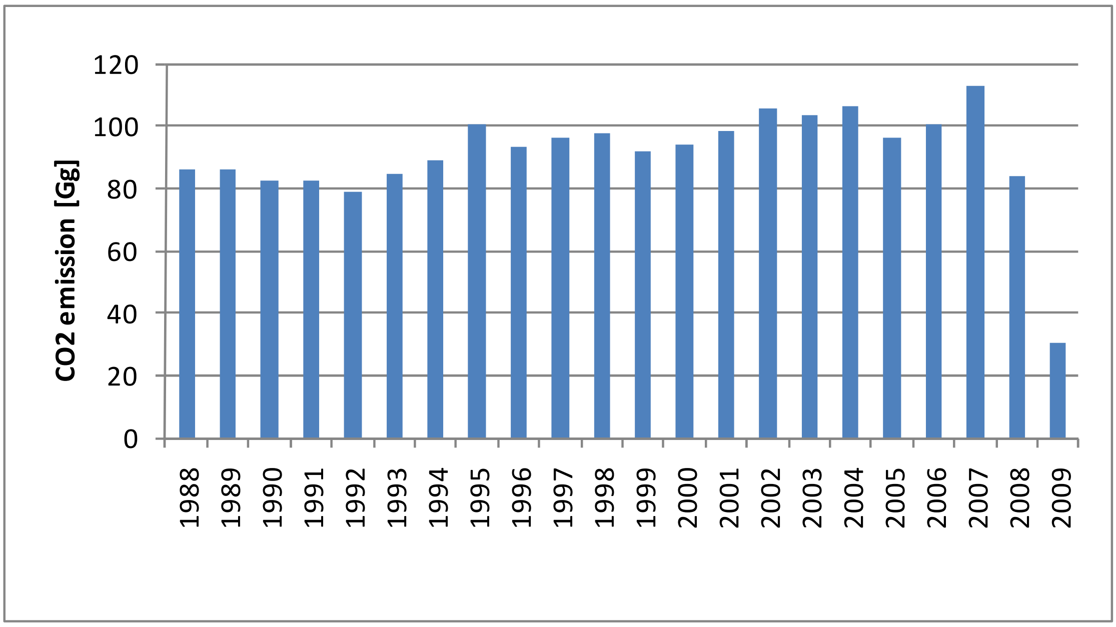

Figure 4.4.3. CO_2 process emission for aluminium production in 1988-2009

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 2010b]. The emission factor comes from [IPCC 2006] – table 4.24 and is 1.72 Mg CO_2/Mg zinc.

For the entire period 1988-2009 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.

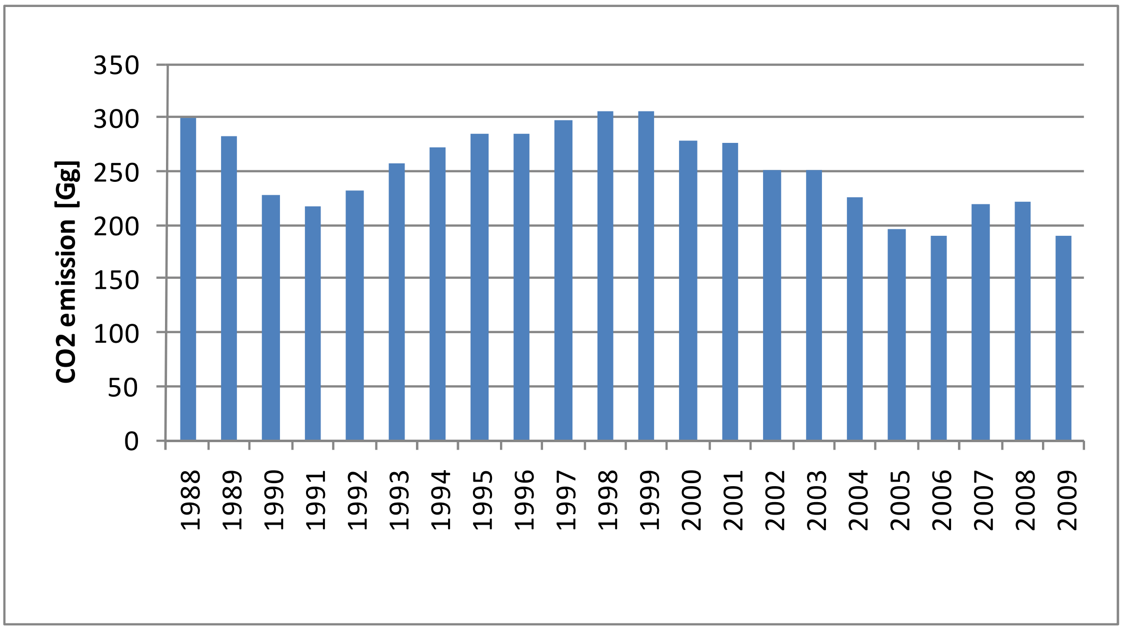

Figure 4.4.4. CO_2 process emission for zinc production in 1988-2009

- *Lead production*

Process emission of CO_2 from lead production was estimated based on annual lead production taken from GUS [GUS 2010b]. The default emission factor of 0.52 Mg CO_2/Mg lead from [IPCC 2006] – table 4.21 was applied.

For the entire period 1988-2009 the same emission factor was used. Data on lead production come from [GUS 1989b-2010b]. The trend of process emissions from lead production is given in figure 4.4.5.

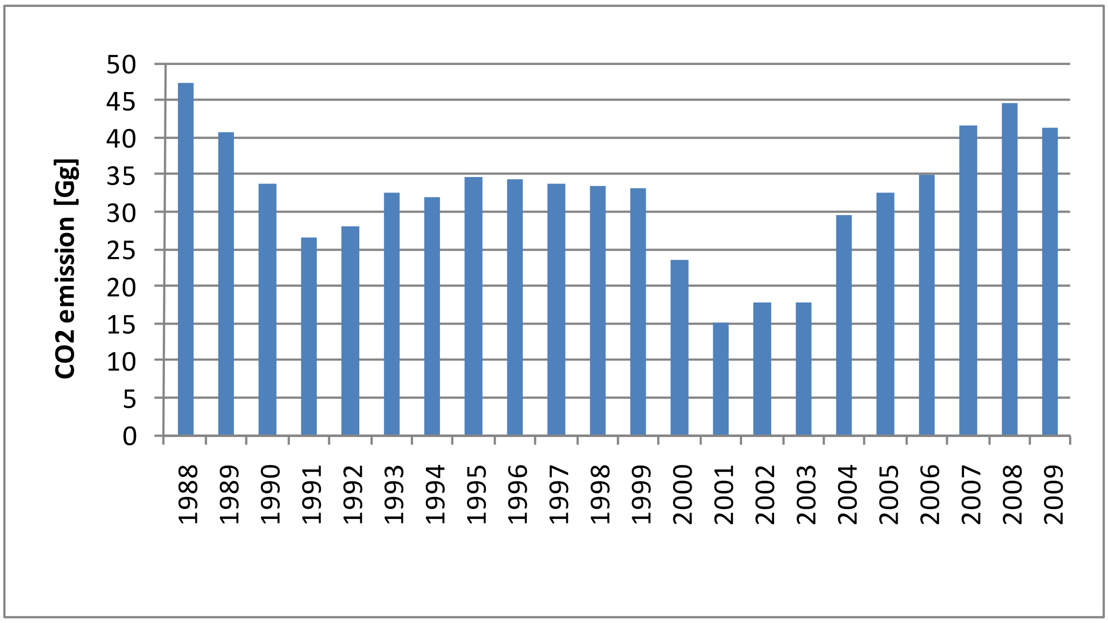

Figure 4.4.5. CO_2 process emission for lead production in 1988-2009

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 2009 and for 2005-2008 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS [KASHUE 2010]. These emissions were as follows: 8.6 Gg CO_2 for 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 2011]. All emission factors used in the national GHG inventory are default IPCC values.

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), refrigeration and air-conditioning equipment – 2.F.1 the dominating sub-sector in terms of emission volume. The main emission factors for HFC-134a [IPCC 2000] in the refrigeration and air-conditioning equipment sub-sector are given in table 4.6.1.

Table 4.6.1. Main HFC-134a emission factors

Emission sources	Emission factor
Transport refrigeration – product life factor	30 %
Commercial refrigeration (window refrigerators and chamber freezers) – product life factor	20 %
Commercial refrigeration (window refrigerators and chamber freezers) – product manufacturing factor	3 %

Due to lack of available statistical data on storage in equipment containing HFC 23, 32, 125, 143a, and 152a only potential emission estimates are available for those gases.

Table 4.6.2 shows aggregated national total HFCs emissions over 1995-2009 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 4.6.2. 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	10.52	41.45
1996	21.71	162.53
1997	39.37	290.51
1998	57.72	360.34
1999	96.76	480.70
2000	300.03	864.61
2001	605.31	1 496.63
2002	929.29	1 695.46
2003	1 166.22	2 133.54
2004	1 490.14	2 611.54
2005	1 812.17	4 148.53
2006	2 195.85	4 880.46
2007	2 676.06	6 197.92
2008	3 153.85	7 549.49
2009	3 377.36	7 073.32

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 aluminium production (tables: 4.8c and 4.9a). Activities on aluminium production were taken from [GUS 2010b]. *Tier 1* method and the following emission factors as in [IPCC 2000] were used for estimation of PFC emissions:

for CF4 EF = 0.61 kg/Mg aluminium produced
for C2F6 EF = 0.061 kg/Mg aluminium produced

Table 4.6.3 shows aggregated national total PFCs emissions over 1988-2009 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 4.6.3. 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	215.99	215.99
1989	216.36	216.36
1990	208.09	208.09
1991	207.27	207.27
1992	197.47	197.47
1993	212.47	212.47
1994	224.09	224.09
1995	252.24	252.24
1996	235.02	235.68
1997	242.67	248.92
1998	245.18	251.26
1999	230.72	239.74
2000	236.88	248.87
2001	247.13	269.93
2002	266.14	286.59
2003	259.08	278.39
2004	266.73	285.08
2005	242.52	259.95
2006	253.19	269.75
2007	282.92	298.65
2008	211.51	226.45
2009	76.27	90.47

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 4.6.4 includes the activity data used for estimation of PFC and SF6 emissions over the period: 1988-2009.

Table 4.6.4. 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**
2.C. Metal production													
3. Aluminium Production [Gg]	47.720	47.801	45.974	45.793	43.628	46.942	49.509	55.728	51.924	53.614	54.168	50.974	52.335
4.SF_6 Used in Magnesium foundries – amount of imported SF_6 [Mg]							320	400	400	345	291	236	181
2.F Consumption of HFC, PFC and SF_6													
8. Electrical equipment – amount of SF_6 in use [Mg]								11.000	14.024	17.048	20.072	23.096	26.120
8 Electrical equipment – amount of imported SF_6 [Mg]								0.000	0.600	0.600	2.000	2.330	2.660

Activity characteristic for the source sector	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
2.C. Metal production									
3. Aluminium Production [Gg]	54.600	58.800	57.240	58.931	53.582	55.939	62.508	46.730	16.851
4.SF_6 Used in Magnesium foundries – amount of imported SF_6 [Mg]	127	72	46	20	30	65	100	100	100
2.F Consumption of HFC, PFC and SF_6									
8. Electrical equipment – amount of SF_6 in use [Mg]	28.702	32.039	33.748	36.446	40.567	46.232	48.632	51.318	55.798
8. Electrical equipment –amount of imported SF_6 [Mg]	3.303	4.160	2.500	3.588	5.160	6.890	3.536	3.892	5.858

Table 4.6.5 shows aggregated national total SF6 emissions over 1994-2009 expressed in CO_2 equivalents and 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 [Gg CO_2 eq.]	Total SF_6 emissions [Gg CO_2 eq.]
1994	0.00	13.91
1995	13.15	30.53
1996	7.56	24.95
1997	9.01	24.02
1998	12.46	25.09
1999	14.38	24.64
2000	16.30	24.18
2001	18.46	23.96
2002	21.28	24.41
2003	19.72	21.72
2004	22.57	23.44
2005	26.79	28.09
2006	31.98	34.80
2007	28.32	32.66
2008	30.11	34.46
2009	35.07	39.42

4.7. Other Processes (CRF sector 2.G)

In this category the following CO_2 emission was included:

- associated CO_2 emissions concerning use of lubricants and waxes (for entire period 1988-2009),

- CO2 emission reported from refineries for EU ETS purpose, as process emission and as emission from flaring (CO2 emission from refineries given in verified reports prepared for EU ETS purpose as CO2 process emission and CO2 emission from flaring.

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

Values of CO_2 process emission and flaring emission from refineries were estimated based on the verified reports for refineries, which participate in EU ETS [KASHUE 2010]. These values amounted to: 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.

4.8. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2009 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 1988-2009 ensured consistency for whole time-series.

Table 4.8.1. Results of the sectoral uncertainty analysis in 2009

2009	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
2. Industrial Processes	**19 409.86**	**15.94**	**3.54**	5.3%	14.2%	29.7%
A. Mineral Products	8 442.59			11.0%		
B. Chemical Industry	3 495.75	11.16	3.50	7.1%	19.1%	30.1%
C. Metal Production	5 939.69	4.77	0.04	5.7%	15.6%	
D. Other Production	8.62			5.0%		
G. Other	1 523.20			5.0%		

4.9. 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.

4.10. Source-specific recalculations

- Activity data on coke production and associated CO_2 emission estimates were updated for the years: 1988-2008. Carbon emission factors for hard coal in mass balance of coke production process for the entire period were corrected. This change was the result of the correction of the empirical function, that links the content of carbon in hard coal with the corresponding net calorific value of this fuel. Additionally, for the years: 1990-2008, input data for the mass balance were updated based on updates made at EUROSTAT database.

- CO_2 EF for lime production, for the entire period 1988-2008, was changed. EF = 785 kg/Mg was replaced with default EF, that was estimated according to IPCC guidelines [IPCC 2000] (EF = 0.85*0.75 + 0.15*0.86 = 0.767 Mg CO2 /Mg of lime)

- CO_2 emission values in 2.G subcategory were corrected for the years 2005-2008 (2.G subcategory includes emission reported by EU ETS installations as process emissions from refineries and emission from flaring).

4.11. Source-specific planned improvements

- Attempt to re-allocate CO_2 emission from fuel use in sinter, steel and pig iron productions from 1.A.2.a sub-sector into particular sub-categories of 2.C.1 in the period 1988-2004 for improvement of comparability of data in particular subsectors.

- Undertaking actions for collection of more detailed information on type of lime produced

- Attempt to complete CO_2 process emission data from glass and ceramics production in the period 1988-2004

- Development of methodology of EU ETS data implication in GHG inventory

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 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 2009 was estimated to 742.31 Gg CO_2 equivalent. This emission decreased by 26% from year 1988 to 2009 (Figure 5.1). This is mostly due to decrease of using solvents in paint applications (by 48%) (Figure 5.2).

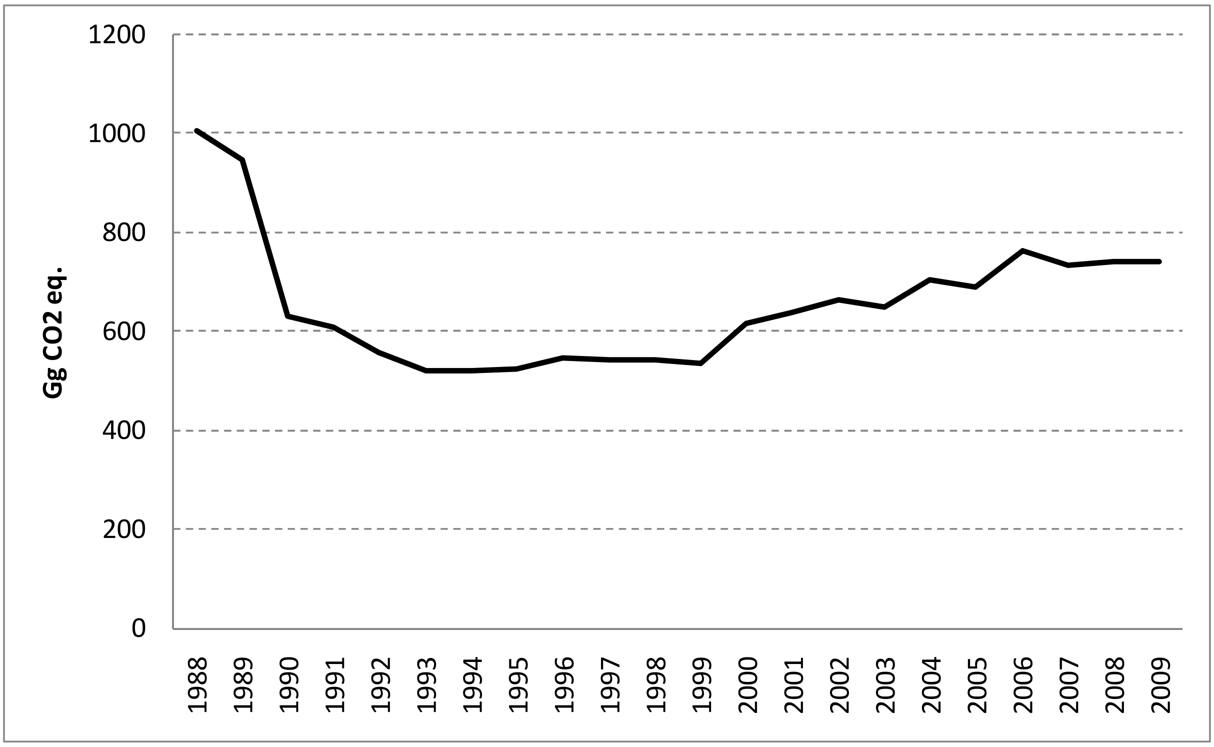

Figure 5.1. GHG emission from Solvent and Other Product Use sector in 1988-2009.

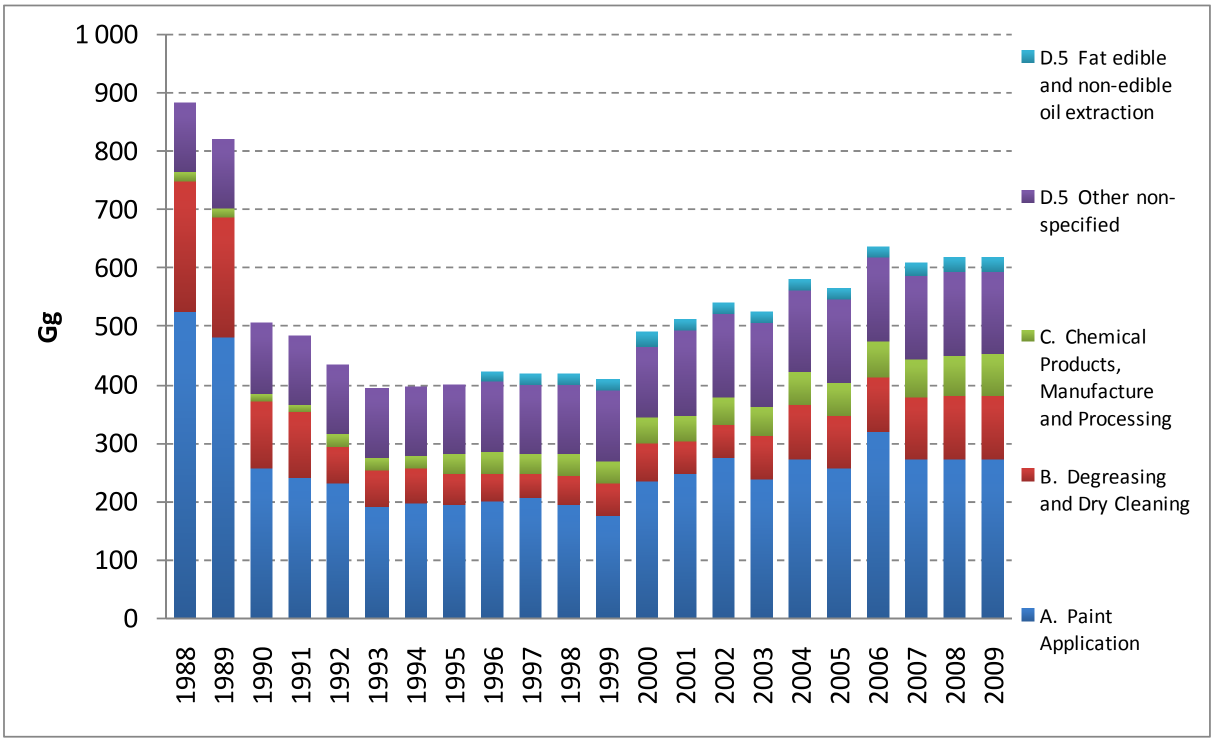

Figure 5.2. CO_2 emission from Solvent and Other Product Use sector in 1988-2009.

5.2 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 2011]. 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:

$$CO_2 = 0.85 * 44/12 * NMVOC$$

where:

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

N_2O emissions from anesthesiology were minor and were estimated on the basis of [IOŚ 2001] report.

5.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2009 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 1988-2009 ensured consistency for whole time-series.

Table 5.3.1. Results of the sectoral uncertainty analysis in 2009

2009	CO_2 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	N_2O Emission uncertainty [%]
3. Solvent and Other Product Use	**618.31**	**0.40**	15.0%	50.0%

5.4. Source-specific QA/QC and verification

Activity data concerning solvent use are taken from Institute for Ecology of Industrial Areas which performs its own QA/QC activities. 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.

5.5. Source-specific recalculations

There were no recalculation in this sector.

5.6. Source-specific planned improvements

Experts study is planned on N_2O use in anesthesiology.

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 (CH4 emission), share in total GHG emission 2.4%
- 4.B. Manure Management (N2O emission), share in total GHG emission 1.3%
- 4.D.1. Direct Soil Emissions (N2O emission), share in total GHG emission 3.4%
- 4.D.3. Indirect Soil Emissions (N2O emission), share in total GHG emission 1.2%

Share of these categories in total Poland's GHG emissions is 8.3%.

Total emissions of methane and nitrous oxide presented as carbon dioxide equivalent amounted to 35512 Gg in 2009 and decreased since 1988 by 29.9%. The biggest changes in emissions occurred in 1989-1993 due to economy transformation performed in Poland (Fig. 6.1). Conversion from centrally planned economy into a free market one was accompanied by collapse of many state-own agricultural farms. Changes also touched private farms which had to adapt to the new market circumstances. Interannual changes in agricultural production and thus in emissions since mid-1990-ties were mainly caused by internal market demand and international trade, prices for agricultural means of production (like mineral fertilisers and tractors) as well as prices for agricultural products. Since 2004, when Poland joined the European Union, agricultural subventions influence the directions of farming.

Agricultural output increased in 2009 but index of growth was lower than in previous year. It is estimated that gross agricultural output increased for 2.4% in relation to 2008, due to the growth of crop output by 3.0% and animal output by 1,6%. In 2009 in Poland was 1765.9 thous. of agricultural farms exceeding 1 ha of agricultural land, which were farming on 14453 thous. ha of agricultural land. Gradually, average agricultural area per one agricultural farm increased. In this year it was 8,0 ha to 7.8 ha in the previous year and 7.6 in 2005. The total sown area for harvest in 2009 was similar to last year by 0.1% less and amounted to 11.6 mln ha. The total cereals (basic cereals including cereal mixed, maize, buckwheat, millet and other cereals) and feed plants, decreased in relation to previous year. The sown area of rape and turnip rape, sugar beets and vegetables Increased. Total production of animals for slaughter (cattle, calves, pigs, poultry, sheep, horses, goats and rabbits) in live weight amounted 4834 thous. tones and it was lower by 2,8% than in the previous year. It was caused by significant decrease of production pigs for slaughter by 11.3% with an increased production of poultry by 7.1% and cattle (including calves) for slaughter by 1.7% [GUS R4 2010].

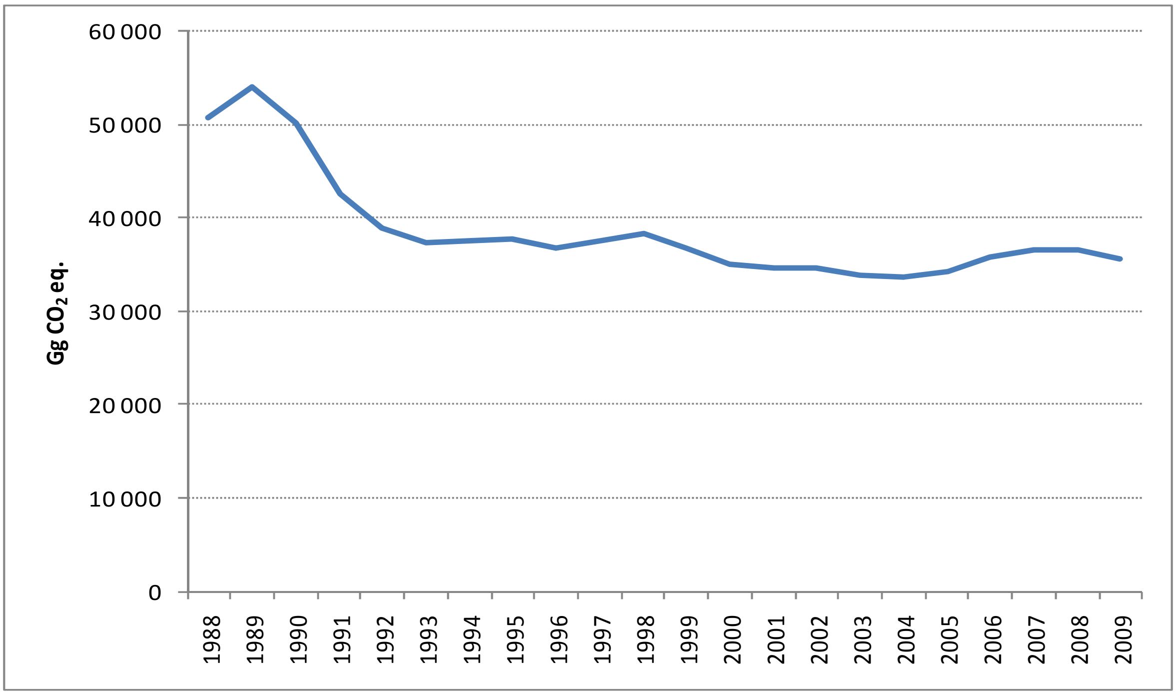

Figure 6.1. Total greenhouse gas emissions from the Polish agriculture in 1988–2009 presented in CO_2 equivalent

Most of methane emissions originate from enteric fermentation (73.8%) and about 26% is related to manure management. Share of field burning of agricultural residues represent only 0.2% of emissions (Fig. 6.2).

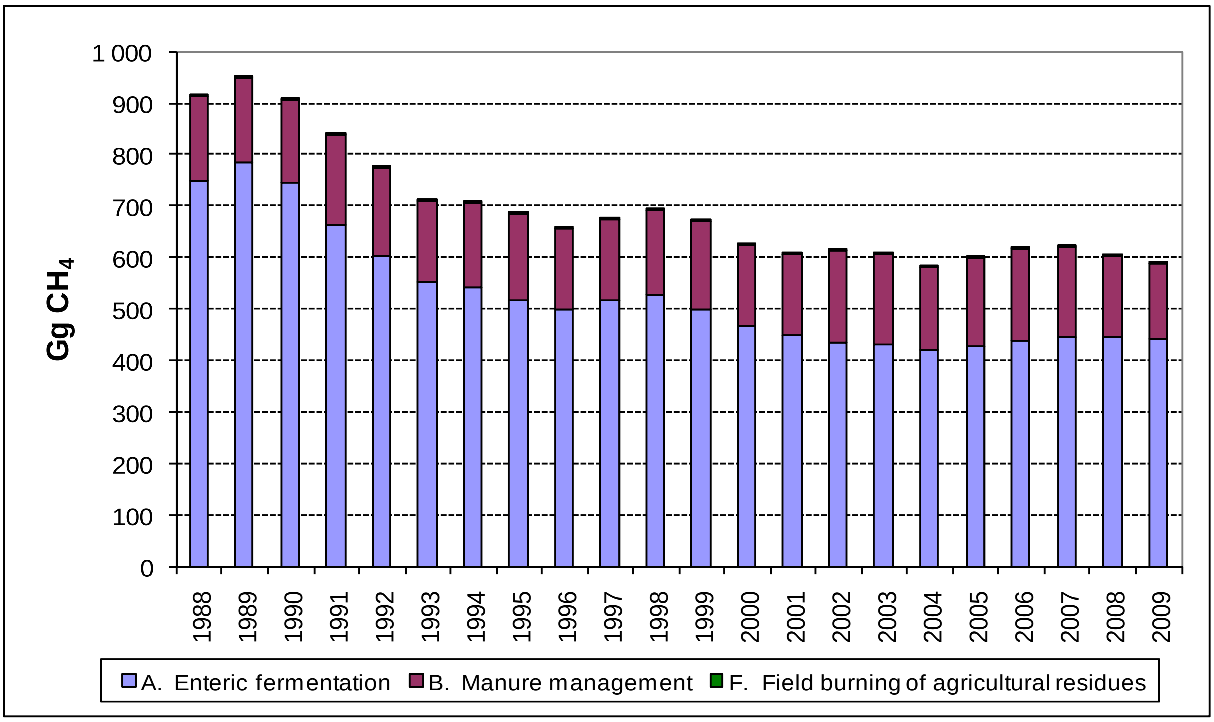

Figure 6.2. Methane emissions from the Polish agriculture in 1988–2009 according to subcategories

As concerns the nitrous oxide emissions, the main source is agricultural soils responsible for 78.5% while manure management – for 21.4%. Emissions from field burning of agricultural residues are negligible (0,1%) (Fig. 6.3).

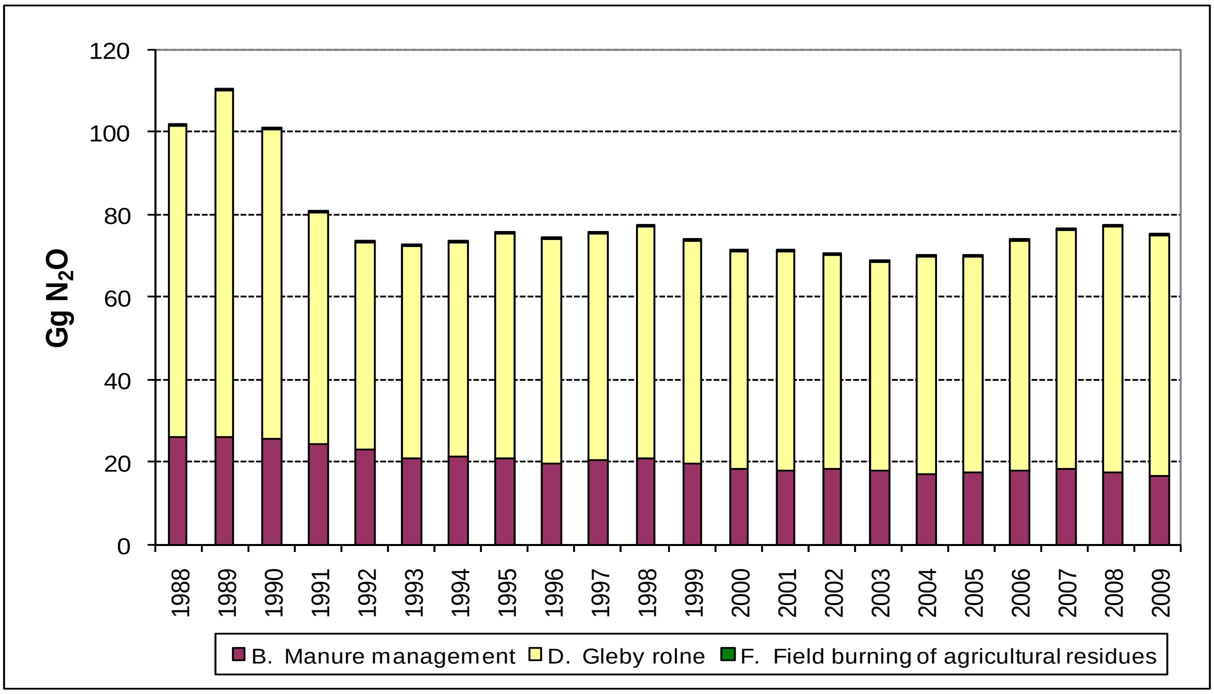

Figure 6.3. Nitrous oxide emissions from the Polish agriculture in 1988-2009 according to subcategories

6.2. Enteric Fermentation (CRF sector 4.A)

6.2.1. Source category description

CH_4 emissions from animals' enteric fermentation in 2009 amounted to 437.8 Gg CH_4 and decreased since 1988 by 41.4%. 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 exceeded 93% in 1988-2009. Majority of CH_4 emissions, more than 90%, come from enteric fermentation caused by cattle.

Table 6.1. Trends in CH_4 emissions from enteric fermentation in 1988-2009 [Gg CH4]

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Total
1988	444.79	219.35	34.41	0.90	18.92	29.41	747.77
1989	464.97	235.87	35.15	0.90	17.51	28.25	782.65
1990	450.72	211.68	33.32	0.90	16.94	29.20	742.75
1991	412.83	172.36	25.64	0.90	16.90	32.80	661.43
1992	378.52	154.93	15.29	0.90	16.20	33.13	598.97
1993	354.05	143.12	10.30	0.90	15.14	28.29	551.80
1994	344.42	148.13	7.15	0.90	11.20	29.20	540.99
1995	317.90	146.38	5.85	0.90	11.45	30.63	513.11
1996	310.12	143.58	4.54	0.90	10.24	26.95	496.33
1997	315.57	155.60	4.06	0.91	10.04	27.20	513.40
1998	320.04	162.41	3.70	0.93	10.10	28.75	525.93
1999	307.18	148.73	3.22	0.91	9.92	27.81	497.76
2000	281.37	142.28	2.96	0.88	9.89	25.68	463.07
2001	277.25	128.69	2.88	0.86	9.83	25.66	445.16
2002	265.49	128.99	2.70	0.97	5.94	27.94	432.03
2003	269.07	123.02	2.64	0.96	5.99	27.91	429.60
2004	261.03	121.63	2.60	0.88	5.78	25.48	417.40
2005	262.69	127.34	2.62	0.71	5.62	27.17	426.14
2006	266.33	133.28	2.48	0.65	5.53	28.32	436.59
2007	267.21	139.43	2.68	0.72	5.92	27.19	443.16
2008	270.96	141.37	2.64	0.68	5.86	23.14	444.65

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Total
2009	260.81	147.30	2.34	0.59	5.36	21.42	437.83
share [%] in 2009	59.6	33.6	0.5	0.1	1.2	4.9	100
change [%] 1988-2009	−41.4	−32.8	−93.2	−33.7	−71.7	−27.2	−41.4

6.2.2. Methodological issues

Activity data for 2009 are reported by from national statistics (Central Statistical Office) [GUS R2 2009] and were compiled on the basis of:

- generalized results of the sample survey on land use, sown area, and livestock, conducted in June in individual farms,
- generalized results of 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 2009. 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 (table 6.2).

Table 6.2. Trends of livestock population in 1988-2009

Years	Livestock population [thousands]						
	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry
1988	4 806	5 516	4 377	179	1 051	19 605	246 175
1989	4 994	5 739	4 409	179	973	18 835	265 976
1990	4 919	5 130	4 159	179	941	19 464	228 021
1991	4 577	4 267	3 234	179	939	21 868	221 088
1992	4 257	3 964	1 870	179	900	22 086	203 373
1993	3 983	3 660	1 268	179	841	18 860	198 352
1994	3 863	3 833	870	179	622	19 466	199 423
1995	3 579	3 727	713	179	636	20 418	192 438
1996	3 461	3 675	552	179	569	17 964	209 454
1997	3 490	3 817	491	182	558	18 135	203 585
1998	3 542	3 413	453	186	561	19 168	201 773
1999	3 418	3 137	392	181	551	18 538	202 904
2000	3 098	2 985	362	177	550	17 122	198 095
2001	3 005	2 729	343	172	546	17 105	206 727
2002	2 873	2 660	345	193	330	18 629	198 783
2003	2 897	2 592	338	192	333	18 605	146 321
2004	2 796	2 557	318	176	321	16 988	130 289
2005	2 795	2 688	316	142	312	18 112	125 073
2006	2 824	2 782	301	130	307	18 881	141 808
2007	2 787	2 909	332	144	329	18 129	150 620
2008	2 806	2 950	324	136	325	15 425	145 496
2009	2 688	3 012	286	119	298	14 279	140 826

Change in reporting population data for non-dairy cattle introduced by Central Statistical Office in 1998, following Eurostat guidelines, triggered a certain change in population number of young cattle under 1 year and between 1 and 2 years. The change was revealed in sudden increase of the weighted mean CH_4 emission factor between 1997 and 1998 (tab. 6.4). Still harmonization of data is considered but lack of availability of alternative – to the public statistics – source of activity data on cattle in the time considered.

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 2010], milk production [GUS R4 2010], percent of fat in milk [GUS R 2010] 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 97.0 kg CH_4/animal/year in 2009, 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 48.9 kg CH_4/animal/year in 2009. Relatively low EF (IPCC default is 56 kg CH_4/animal/year) depends on big share of youngest cattle within this category. For sheep GE factor was calculated for two subcategories: lambs up to 1 year and mature sheep above 1 year and presented in table 6.5 as the weighted mean value. Weighted mean emission factors for sheep for 1988–2009 oscillate around IPCC default value of 8 kg CH_4/animal/year (7.9 in 1988 up to 8.2 kg CH_4/animal/year in 2009). 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 R 2009].

Table 6.3. Average milk production, daily gross energy intake (GE) and CH_4 emissions factors for dairy cattle in 1988–2009

Years	Average milk production [l/year/cow]	GE gross energy intake [MJ/cow/day]	EF emission factor [kg CH_4/animal/year]
1988	3165	235.173	92.548
1989	3260	236.590	93.105
1990	3151	232.836	91.628
1991	3082	229.198	90.196
1992	3015	225.947	88.917
1993	3075	225.881	88.891
1994	3121	226.560	89.158
1995	3136	225.712	88.825
1996	3249	227.696	89.605
1997	3370	229.767	90.420
1998	3491	229.602	90.355
1999	3510	228.373	89.872
2000	3668	230.791	90.824
2001	3828	234.447	92.262
2002	3902	234.819	92.409
2003	3969	235.931	92.846
2004	4082	237.233	93.359
2005	4147	238.822	93.984
2006	4200	239.649	94.309
2007	4292	243.636	95.878
2008	4351	245.383	96.566
2009	4455	246.568	97.032

Table 6.4. Weighted mean mass, daily gross energy intake (GE) and CH_4 emissions factors for non–dairy cattle in 1988–2009

Years	Weighted mean mass [kg]	GE gross energy intake (Weighted mean) [MJ/animal/day]	EF emission factor (Weighted mean) [kg CH_4/animal/year]
1988	248	101.074	39.776
1989	257	104.437	41.099
1990	259	104.856	41.264
1991	254	102.646	40.395
1992	245	99.320	39.085
1993	245	99.369	39.105
1994	242	98.205	38.647
1995	246	99.805	39.276
1996	244	99.279	39.070
1997	256	103.591	40.766
1998	309	120.919	47.591
1999	311	120.480	47.413
2000	308	121.123	47.666
2001	305	119.830	47.157
2002	303	123.221	48.491
2003	311	120.655	47.463
2004	315	120.878	47.569
2005	307	120.384	47.375
2006	312	121.738	47.943
2007	316	121.767	47.919
2008	313	121.778	47.924
2009	317	124.270	48.904

Table 6.5. Daily gross energy intake (GE) and CH_4 emissions factors for sheep in 1988–2009

Years	GE gross energy intake (Weighted mean) [MJ/animal/day]	EF emission factor (Weighted mean) [kg CH_4/animal/year]
1988	17.933	7.863
1989	18.128	7.972
1990	18.192	8.011
1991	18.035	7.927
1992	18.479	8.175
1993	18.384	8.124
1994	18.552	8.216
1995	18.527	8.205
1996	18.578	8.231
1997	18.668	8.279
1998	18.466	8.173
1999	18.544	8.212
2000	18.474	8.167
2001	18.873	8.383
2002	17.901	7.838
2003	17.858	7.823
2004	18.458	8.174
2005	18.651	8.280
2006	18.402	8.145
2007	18.131	7.992
2008	18.444	8.163
2009	18.428	8.157

6.3. Manure Management (CRF sector 4.B)

6.3.1. Source category description

CH_4 emissions related to animal manure management in 2009 amounted to 147.9 Gg and decreased since 1988 by 9.1%. Most of CH_4 emissions in 2009 come from manure generated by swine – 63.1%. Again the biggest change over time in CH_4 emissions relates to sheep breeding where cut of emissions amounted to 93.3% in 1988–2009 (tab. 6.6).

Table 6.6. Trends in CH_4 emissions from manure management according to livestock categories in 1988–2009

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total
1988	28.16	11.05	0.73	0.02	1.46	102.21	19.20	162.83
1989	29.51	14.91	0.74	0.02	1.35	98.20	20.75	165.49
1990	27.69	8.28	0.70	0.02	1.31	105.16	17.79	160.94
1991	25.24	8.90	0.54	0.02	1.31	122.28	17.24	175.53
1992	22.42	7.84	0.32	0.02	1.25	127.67	15.86	175.38
1993	19.93	6.69	0.22	0.02	1.17	112.59	15.47	156.08
1994	19.37	6.72	0.15	0.02	0.86	119.88	15.55	162.56
1995	17.87	6.25	0.12	0.02	0.88	129.60	15.01	169.76
1996	16.53	7.84	0.10	0.02	0.79	117.42	16.34	159.04
1997	17.67	5.90	0.08	0.02	0.78	118.54	15.88	158.88
1998	16.76	6.71	0.08	0.02	0.78	125.29	15.74	165.37
1999	20.00	12.33	0.07	0.02	0.77	121.17	15.83	170.18
2000	19.27	11.66	0.06	0.02	0.76	111.92	15.45	159.15
2001	18.87	10.57	0.06	0.02	0.76	111.81	16.12	158.21
2002	26.79	16.03	0.06	0.02	0.46	121.77	15.51	180.63
2003	26.93	15.31	0.06	0.02	0.46	121.61	11.41	175.80
2004	25.91	15.16	0.05	0.02	0.45	111.04	10.16	162.80
2005	26.07	15.81	0.05	0.02	0.43	118.39	9.76	170.54

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total
2006	26.44	16.61	0.05	0.02	0.43	123.42	11.06	178.01
2007	29.00	14.01	0.06	0.02	0.46	118.50	11.75	173.78
2008	29.40	14.19	0.06	0.02	0.45	100.83	11.35	156.29
2009	28.30	14.84	0.05	0.01	0.41	93.33	10.98	147.94
share [%] in 2009	19.1	10.0	0.0	0.0	0.3	63.1	7.4	100
change [%] 1988-2009	+0.5	+34.4	-93.3	-33.7	-71.7	-8.7	-42.8	-9.1

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 2009] (tab. 6.2). Country specific data on the animal waste management systems (AWMS) come from [Walczak 2006, 2009].

The fractions of manure managed in given AWMS for cattle were assessed on an annual basis for period 1988‐2001, then mean value for 2002-2005 was established and value estimated for 2007 was also applied for 2008−2009. The share of pastures was assessed for the key years: 1988-1989 and for 2005-2006 and the values in-between were interpolated. Individual data were estimated for 2007 which was used also for 2008 and 2009. The share of solid storage complete total AWMS systems up to 100% (tab. 6.7).

As concern swine manure management systems there was a permanent share of liquid system established [Myczko 2001] for entire period but in 2006 there was a correction made for 1988 based on detail data related to AWMS systems according to swine subcategories [Walczak 2006]. Then interpolation was made between 1989-1995 and since 1996 up to 2009 the same value is applied.

For other animals permanent shares of AWMS were taken: for sheep ‐ 50% on pastures and 50% solid storage, for goats and horses 10% on pastures and 90% on solid storage and for poultry 20% on liquid systems and 80% on solid storage [Myczko 2001, IPCC 1997].

Table 6.7. Fractions of manure managed in given AWMS for cattle and swine

years	Dairy cattle			Other cattle			Swine		
	liquid	solid storage	pasture	liquid	solid storage	pasture	liquid	solid storage	pasture
1988	0.0278	0.7522	0.2200	0.0492	0.7708	0.1800	0.2230	0.7770	0
1990	0.0267	0.7606	0.2127	0.0317	0.7943	0.1740	0.2321	0.7679	0
1995	0.0234	0.8006	0.1760	0.0379	0.8181	0.1440	0.2773	0.7227	0
2000	0.0367	0.8240	0.1393	0.0926	0.7934	0.1140	0.2863	0.7137	0
2005	0.0680	0.8220	0.1100	0.1540	0.7560	0.0900	0.2863	0.7137	0
2009	0.0768	0.8068	0.1164	0.1189	0.7862	0.0950	0.2863	0.7137	0

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]:

$$EF = Vs * 365\ days/year * Bo * 0,67kg/m3 * \Sigma MCF * MS$$

gdzie:

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 for 2009 are shown in table 6.8.

Table 6.8. Methane-producing potential (B_o), volatile solids excreted (Vs) and CH_4 emission factors for manure management in 2009

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	4.58	10.53
Non-dairy cattle	0.17	2.15	4.93
Sheep	0.19	0.37	0.17
Goats	0.17	0.28	0.12
Horses	0.33	1.72	1.39
Swine	0.45	0.50	6.54
Poultry	0.32	0.10	0.08

At the figure 6.4 changes of CH_4 emission factors for dairy cows and non-dairy cattle in 1988–2009 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.

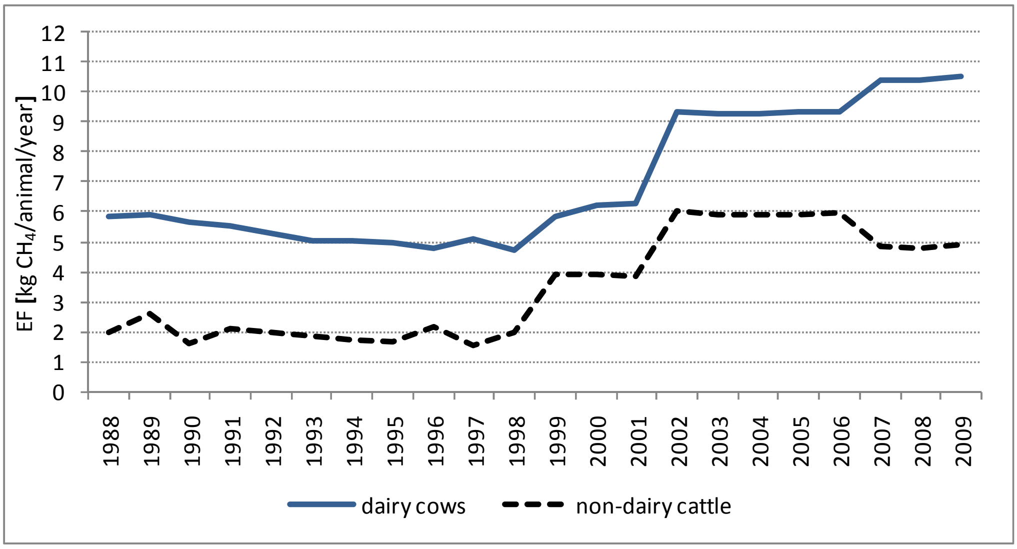

Figure 6.4. Methane emission factors from manure management for dairy cows and non-dairy cattle in 1988–2009

6.3.2.2. Estimation of N_2O emissions from manure management

Nitrous oxide emissions from manure management in 2009 were estimated based on recommended IPCC methodology [IPCC 1997] using domestic data on animal waste management systems for animal categories (tab. 6.7) [Walczak 2009]. Following the ERT recommendation made in 2009 country specific values of nitrogen content in animals manure (Nex).

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 1988-2009 was used. For poultry Nex parameters come from publication [Jadczyszyn et al 2009]. Country specific Nex values are in line with parameters published in [UNECE 2001].

Table 6.9. 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
light 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 6.10).

Table 6.10. 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

6.4. Agricultural Soils (CRF sector 4.D)

6.4.1. Source category description

Nitrous oxide emissions from agricultural soils amounted to 58.5 Gg N_2O in 2009 and dramatically decreased after 1989 and then stabilized. Since 2004 N_2O emissions slightly go up (figure 6.5). 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.

More than 71% of N_2O emissions here are related to direct soil cultivation, while about 26% are generated in indirect emission processes. Only 2% 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.

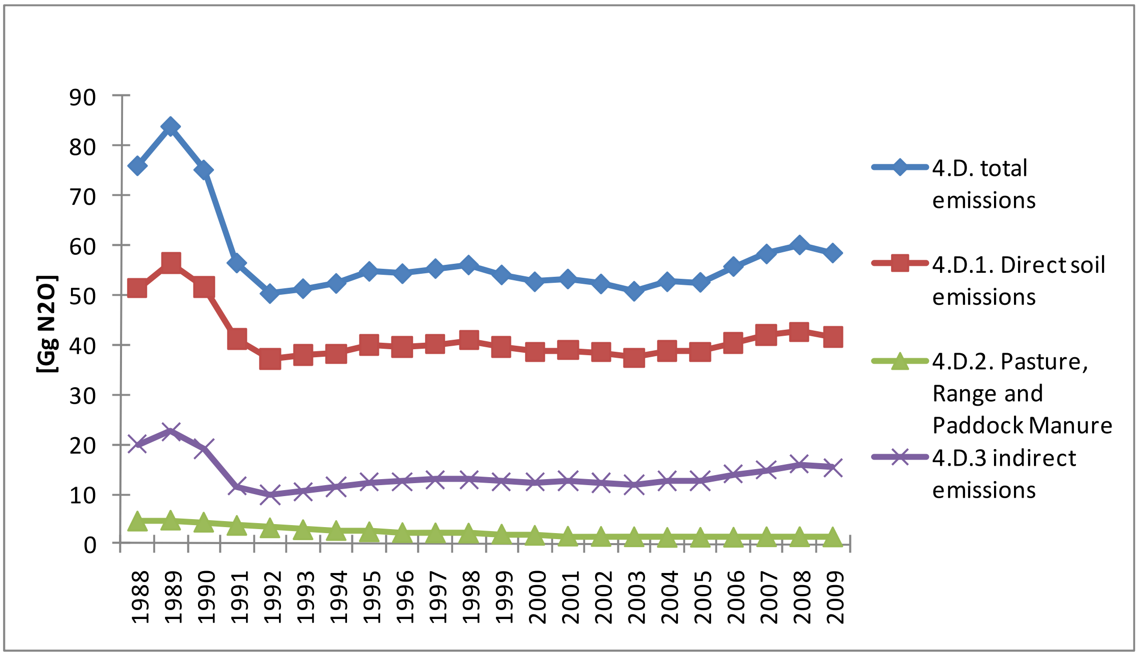

Figure 6.5. N_2O emissions from agricultural soils for 1988–2009

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 R4 2009]. 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 (table 6.11).

Table 6.11. Nitrogen fertilizers use in 1988–2009 in Poland

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Nitrogen fertilizers [Gg N]	1 335	1 520	1 274	735	619	683	758	836	852	890	891
Year	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Nitrogen fertilizers [Gg N]	862	861	895	862	832	895	895	996	1 056	1 142	1095

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 2009 was about 19.4 Gg N_2O and comparing to 2008 emissions was lower by 4% because of decreased use of nitrogen fertilizers by 47 Gg. 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.

The total amount of nitrogen in animal manure was calculated based on animal population taken from [GUS R2 2009] and the country specific values of nitrogen excretion for each type of animal (table 6.9). 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] (table 6.7). 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 2009 was about 9.7 Gg N_2O and constantly decreases. This is caused by decreasing trend of livestock population, mainly cattle and sheep after 1989 (see table 6.2).

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:

$$F_{BN} = Crop_{BF} * (1 + Res/Crop) * Frac_{DM} * Frac_{NCR}$$

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
$Frac_{NCR}$ – fraction of crop biomass that is nitrogen specific to each crop type

Data on N-fixing crops yields is published in [GUS R3 2010]. Factors like: residue/crop ratio (Res/Crop), dry matter fraction ($Frac_{Dm}$) and fraction of crop biomass that is N ($Frac_{NCR}$) were taken from the Polish case study [Loboda 1994] 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). 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 2009 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]:

$$F_{CR} = Crop_Y * Frac_{DM} * Res/Crop * Frac_{NCR} * (1 - Frac_{BURN} - Frac_R)$$

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
$Frac_{NCR}$ – 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

Activity data concerning crop production was taken from national statistics [GUS R3 2010]. 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 2009 was 3.2 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 2009 was about 8.9 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, for the first time the N_2O emissions from the application of the sewage sludge as the fertilizer in agriculture were estimated. Activity data on the amount of sewage sludge applied on the fields were taken from GUS [GUS 2010d] 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 regards only the years 2003-2009, so the emissions within this subcategory were estimated only for this period.

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 still increasing – from 105 thousand tonnes of dry matter in 2003 up to 190 thousand tonnes of dry matter in 2009. Emissions of N_2O for this subcategory amounted to 0.1 Gg N_2O 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)

Animal population for calculation of N_2O emission from pasture range and paddock was taken from [GUS R2 2010]. Total amount of nitrogen in animal excreta (Nex) was estimated based on country specific parameters presented in table 6.9. The data on fraction of manure related to grazing animals was presented in chapter 6.3.2.2, table 6.7. 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-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 6.12. Nitrogen excreted during grazing in 1988–2009

Year	N exretion - grazing [kg N/yr]	Year	N exretion - grazing [kg N/yr]
1988	146 701 462	**1999**	63 376 240
1989	152 131 174	**2000**	55 581 478
1990	139 542 799	**2001**	50 286 889
1991	118 866 246	**2002**	48 691 272
1992	103 608 424	**2003**	46 332 391
1993	91 704 901	**2004**	42 427 245
1994	86 293 795	**2005**	42 928 411
1995	78 472 104	**2006**	43 607 962
1996	72 927 908	**2007**	46 578 440
1997	71 174 423	**2008**	46 884 934
1998	69 962 521	**2009**	45 632 980

Emissions in 2009 from pasture, range and paddock manure were 1.4 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 6.13. 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	162 840 292	**1999**	98 875 248
1989	182 426 235	**2000**	97 216 296
1990	155 308 560	**2001**	99 557 378
1991	97 273 249	**2002**	95 938 254
1992	82 621 685	**2003**	93 015 622
1993	86 640 980	**2004**	98 636 905
1994	93 058 759	**2005**	98 752 798
1995	99 294 421	**2006**	109 040 908
1996	99 785 582	**2007**	115 770 724
1997	103 234 885	**2008**	124 522 851
1998	103 092 504	**2009**	119 658 918

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 6.14. 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	444 510 439	**1999**	277 612 872
1989	501 639 352	**2000**	274 974 443
1990	424 062 840	**2001**	283 586 067
1991	256 159 874	**2002**	273 207 382
1992	216 782 527	**2003**	263 499 717
1993	232 411 470	**2004**	281 228 174
1994	253 288 138	**2005**	281 378 523
1995	274 341 631	**2006**	311 882 389
1996	277 478 372	**2007**	330 773 532
1997	288 352 327	**2008**	356 665 480
1998	288 288 756	**2009**	342 309 894

Total indirect emission in 2009 was about 15.4 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.

6.5. Field Burning of Agricultural Residues (CRF sector 4.F)

6.5.1. Source category description

Greenhouse gas emissions in 2009 from field burning of agricultural residues amounted for 1.5 Gg CH_4 and 0.1 Gg N_2O and was higher than in 2008 because of increased crop production. 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 6.6 and fluctuates following the annual crop production.

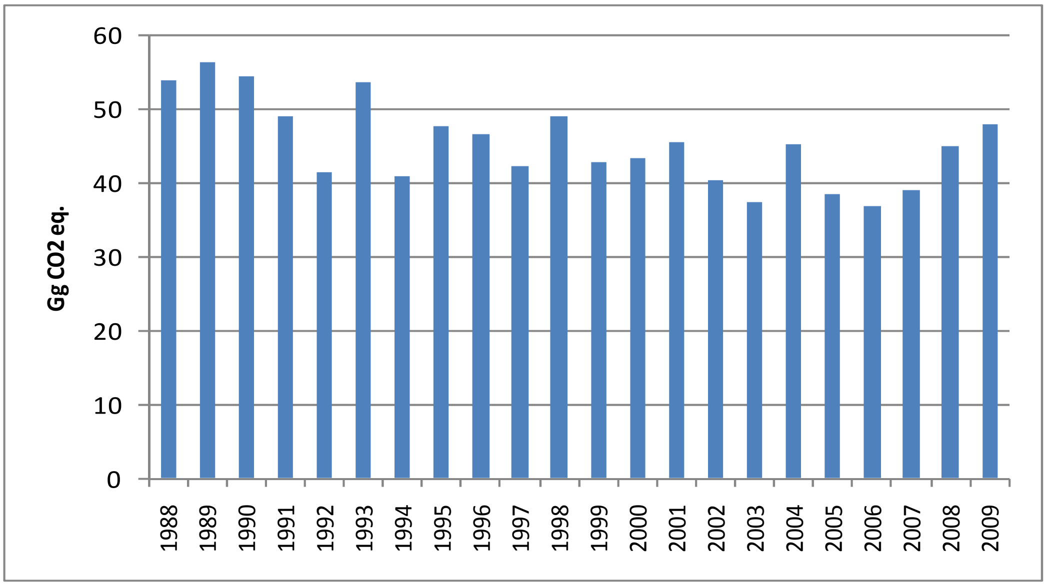

Figure 6.6. CH_4 and N_2O emissions from field burning of agricultural residues presented as CO_2 equivalent

6.5.2. Methodological issues

While estimating GHG emissions in this subcategory only methane and nitrous oxide are taken into account assuming that carbon 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 2010]. Factors applied for emissions calculation were taken from country study [Łoboda 1994] where experimental and literature data as well as default emission factors were used. These values are presented in the table 6.15.

Table 6.15. Factors applied for CH_4 and N_2O emission estimation from field burning of agriculture residues

Crops	Residue to crop ratio	Dry matter fraction	Fraction burned in fields	Fraction oxidized	Carbon fraction of residue	N/C	Aggregated emission factors	
							CH_4 [Gg/Gg]	N_2O [Gg/Gg]
wheat	1.45	0.86	0.005	0.90	0.4853	0.014	0.0032	0.0001
rye	1.60	0.87	0.005	0.90	0.4800	0.011	0.0032	0.0001
barley	1.25	0.86	0.005	0.90	0.4567	0.015	0.0030	0.0001
oats	1.50	0.89	0.004	0.90	0.4700	0.016	0.0031	0.0001
triticale	1.50	0.86	0.005	0.90	0.4853	0.013	0.0032	0.0001
cereal mixed	1.40	0.87	0.004	0.90	0.4730	0.015	0.0032	0.0001
buckwheat & millet	1.70	0.86	0.002	0.90	0.4500	0.020	0.0030	0.0001
maize	1.30	0.50	0.002	0.90	0.4709	0.020	0.0031	0.0001
edible pulses	1.50	0.88	0.001	0.90	0.4500	0.040	0.0030	0.0002
feed pulses	2.00	0.85	0.001	0.90	0.4500	0.045	0.0030	0.0002
potatoes	0.30	0.25	0.100	0.85	0.4226	0.048	0.0028	0.0002
rape	2.35	0.87	0.030	0.90	0.4500	0.015	0.0030	0.0001
other oil-bearing crops	3.50	0.87	0.030	0.90	0.4500	0.015	0.0030	0.0001
flax straw	0.25	0.86	0.001	0.90	0.4500	0.016	0.0030	0.0001
tobacco	1.28	0.50	0.002	0.85	0.4500	0.040	0.0030	0.0002
hop	4.00	0.25	0.020	0.90	0.4500	0.035	0.0030	0.0002
hay from greenland	0.05	0.23	0.001	0.90	0.4500	0.044	0.0030	0.0002
hay from pulses	0.05	0.23	0.001	0.90	0.4500	0.045	0.0030	0.0002
hay from legumes	0.05	0.23	0.001	0.90	0.4500	0.061	0.0030	0.0003
tomatoes	0.60	0.15	0.050	0.85	0.4500	0.050	0.0030	0.0002
other ground veget.	0.35	0.15	0.010	0.90	0.4500	0.055	0.0030	0.0003
veget. cult. under cover	0.40	0.35	0.010	0.90	0.4500	0.060	0.0030	0.0003
apples	1.50	0.35	0.050	0.90	0.4500	0.033	0.0030	0.0002
pears & other	1.50	0.35	0.070	0.90	0.4500	0.033	0.0030	0.0002
plums	1.50	0.35	0.100	0.90	0.4500	0.033	0.0030	0.0002
cherries	1.50	0.35	0.100	0.90	0.4500	0.033	0.0030	0.0002
sweet cherries	1.50	0.35	0.100	0.90	0.4500	0.033	0.0030	0.0002
strawberries	0.50	0.18	0.010	0.90	0.4500	0.033	0.0030	0.0002
raspberries	1.20	0.30	0.250	0.90	0.4500	0.033	0.0030	0.0002
currants	1.20	0.30	0.250	0.90	0.4500	0.033	0.0030	0.0002
gooseberries & other	1.20	0.30	0.250	0.90	0.4500	0.033	0.0030	0.0002

6.6. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2009 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 1988-2009 ensured consistency for whole time-series.

Table 6.16. Results of the sectoral uncertainty analysis in 2009

2009	CH_4 [Gg]	N_2O [Gg]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
4. Agriculture	**587.22**	**74.78**	27.8%	57.5%
A. Enteric Fermentation	437.83		34.5%	
B. Manure Management	147.94	16.26	41.7%	148.6%
D. Agricultural Soils		58.46		60.8%
F. Field Burning of Agricultural Residues	1.45	0.06	24.0%	101.4%

6.7. Source-specific QA/QC and verification

Activity data 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.

6.8. Source-specific recalculations

Recalculations in Agriculture sector were related to correction of activity data for maize production for 1988−2008 where N2O emissions were estimated in category 4.D. Agricultural soils and emissions of CH4 and N2O in category 4.F.Field burning of agricultural residues. GHG emissions were estimated only for maize cultivated for seed skipping this cultivated for silage, because in this second case whole plant is collected from the field and residue does not exist (this higher AD for maize was used only for Submission 2010). This correction in AD decreased emissions of GHG in both categories.

The amounts of nitrogen excreted by livestock were corrected for 1988 influencing N_2O emissions from 4.B category.

The explanation should be given here that in 2010 recalculations of direct N_2O emissions in *Agricultural soils* were made. Country specific methodology taken from [Mercik 2011] applied earlier for direct N_2O emissions from synthetic fertilisers use, animal manure applied to soils and from crop residue was substituted with the default methodology and EFs from [IPCC 2000]. Some changes were introduced in 4.D.1 category in 2007−2009 after reviews where completion of emissions were recommended. To be totally consistent with emissions estimation in this subcategory the IPCC methodology was implemented. In case of developing country specific methods or emission factors in this area the next modifications will be undertaken.

6.9. Source-specific planned improvements

The following improvements are scheduled in the agriculture sector:

- Adjustment of population of young non–dairy cattle between 1997 and 1998 to avoid significant change in population number.
- Diversification of AWMS for subcategories for non–dairy cattle and updating the AWMS for swine for entire inventoried period.

7. Land use, land use change and forestry (sector 5).

7.1. Overview of sector.

Information relating to the land area changes by the different types of land use are presented in accordance with the methodology recommended by the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry. Information regarding to the status and changes in registered land designation is classified according to ownership and register groups of land included in the register as a result of the decree of the Minister of the Ministry of Regional Development and Construction dated 29 III 2001 in regard to the registration of land and buildings.

Regarding to that issue, statistics performed by the Polish Central Statistical Office are based on changes in the area of lands at a cadastral level. As a result of that changes, different types of land use areas estimations are based on official statistics. Data concerning the land use has been compiled also according to administrative boundaries.

Presented data included in the Central Statistical Office publications are compiled on the basis of:

- generalized results of the sample survey on land use, sown area, and livestock, conducted in June in individual farms,
- information on the country area, obtained from the Head Office of Geodesy and Cartography.

The sample survey conducted in June 2008, with respect to land use, sown area and livestock covered 65 thousand of sampled individual farms, according to the place of residence of the farm user, i.e.

- for private farms – according to the place of residence (dwelling) of the user,
- for state owned farms, cooperative farms and companies – according to the place of business of the enterprise (farm).

The aim of the survey was to collect information about the agricultural area, sown area, and livestock including: cattle, pigs, poultry, sheep, goats and horses. Therefore, the subject matter of this survey was similar to the issue of the subject matter of the surveys regarded as the June surveys, conducted by the CSO in preceding years. The adopted number of samples corresponded to approx. 65 thousand farms. The surveyed population amounted to approx. 2781 thousand farms. Information obtained from the agricultural survey conducted in the years 2003-2008. Generalized results of the sample survey on land use, sown area, and livestock, conducted in June in individual farms. Data for the years prior 2002 were taken from official statistics performed by CSO (Central Statistical Office). Those data were based on annually reported information on the country area, obtained from the Head Office of Geodesy and Cartography, and data on forest land area based on the survey entitled ,, Forest resources”. Therefore 1990 was sampled with statistical data based on generalized results of the sample survey on land use, sown area and livestock.

Individual results of the National Census of 2002 and of the Agricultural Census, carried out at simultaneously, were employed for establishing the sampling frame. The sampling frame was further updated with the results of the survey carried out after 2002. The following information was recorded for each farm:

- farm identifier,
- voivodship code,
- agricultural land in a farm (or in farms).

Sample drawing was done with a stratified sampling scheme. Due to the fact that the survey is multipurpose in terms of the subject matter, all variables itemised in the sampling frame have been used as the criteria for establishing the strata. On the other hand, given the relatively small number of the sample and the necessity to provide representative results for voivodships, individual variables were used in a diversified way for stratification purposes.

In the first stage, the sampling units were divided into four groups:

1) farms keeping cattle or pigs, or having agricultural land with the area of 10 ha and more, but simultaneously keeping no more than 1000 heads of poultry, or 50 heads of sheep or goats,
2) farms not keeping any cattle or pigs, and keeping up to 1000 heads of poultry, and up to 50 heads of sheep or goats, with the area of agricultural land of less than 10 ha,
3) farms not keeping any cattle or pigs, and keeping over 1000 heads of poultry, or over 50 heads of sheep or goats.

The farms classified to group (1), in the number of approx. 1132 thousand sampling units, were stratified separately in each voivodship, according to 10 strata. Three variables were adopted as the stratification criterion, namely: the number of cattle heads, the number of pigs heads, and the area of agricultural land.

The following assumptions were made while drawing the sample from this category of farms:

1) the size of ***n*** sample is established for the population of farms in Poland, and not for individual voivodships, where *n* consists of approx. 47 thousand farms,
2) the sample is drawn in individual voivodships according to the stratified and optimal sampling scheme,
3) the population in each voivodship is simultaneously divided into 10 strata (h = 1, 2, ... , 10), and then the sample is allocated between these strata,
4) stratum No. 10 (i.e. h = 10) in each voivodship consists of such sampling units for which the value of at least one of the variables adopted as the stratification basis is above the specified threshold. The stratum created in this way, regarded as the upper stratum, includes the units which are not drawn, but which are all included in the sample,
5) it has been assumed that the expected accuracy of the survey results with respect to this group of farms, measured with the variation coefficient of pigs or cattle stocks, and the area of agricultural land, will be identical for each voivodship and will be equal approximately to 1,4%.

Total area of land of an agricultural farm is understood as the entire land (without exception) which comprises an agricultural farm, i.e. the entire land utilized for agricultural purposes (arable land, orchards, meadows, and pastures) which is cultivated, other arable land, as well as any related land utilized for non-agricultural purposes, such as: forests, forest land and other land (courtyards, land under buildings, or earmarked for development, ornamental gardens, land under waters, roads, peat lands, quarries, gravel mines, wasteland, and any arable land non utilized for agricultural purposes if such land is not meant to be used for agricultural purposes in future), irrespective of the type of ownership (owned, leased with or without an agreement, other type of use).

In the country's total area of approximately 31.3 million hectares, the total land area of the private sector were estimated at about 20.4 million hectares, i.e. 0.1% more compared to 2008, while the total area of public land in 10, 8 million ha, or 0.2% less than last year. The total area of land constituting the farm was close to 12.9 million ha and was bigger than last year by 0.6%. Various land holdings constituting the private sector were estimated at about 2.7 million ha, and the public sector at nearly 10.2 million ha (including manage forest, national parks on land constituting the farm – about 7.6 million hectares).

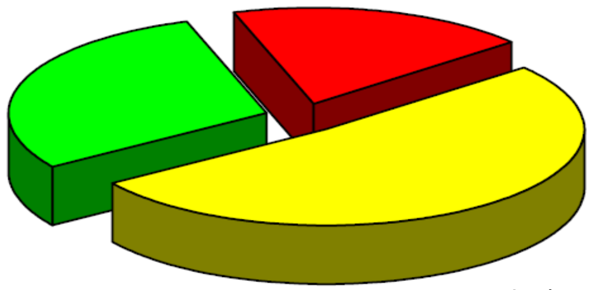

Figure 7.1. General types of land use .
Source: Land use, sawn area and livestock population in 2009. Central Statistical Office 2009

Inventory of greenhouse gas emissions (CO2, CH4, and N2O) for the year 2009 was prepared in accordance with the recommendations of the International Panel of Experts on Climate Change (GPG for LULUCF, IPCC 2003), using recent statistical data compiled include on the basis of the above surveys and the results are shown in the table. 7.1:

Table 7.1. Total CO_2 emissions and removals from LULUCF sector in 2009.

Greenhouse gas source and sink categories	2009		
	Net CO_2 emissions/ removals	CH_4	N_2O
	(Gg)		
5. Total Land-Use Categories	-39 516,54	111.18	0.021
5A. Forest Land	-51 943.87	1.53	0.013
1. Forest Land remaining Forest Land	-44 604.70	1.53	0.013
2. Land converted to Forest Land	-7 339,17	IE	IE
5B. Cropland	-9 253.56	IE	IE
1. Cropland remaining Cropland	-9 253.56	IE	IE
2. Land converted to Cropland	0.00	IE	IE
5C. Grassland	136.04	0.05	0.001
1. Grassland remaining Grassland	136.04	0.05	0.001
2. Land converted to Grassland	0.00	IE	IE
5D. Wetlands	3 002.3	109.61	0.007
1. Wetlands remaining Wetlands	3 002.3	IE	IE
2. Land converted to Wetlands	0.007	109.61	0.007
5E. Settlements	35.42	NO	NO
1. Settlements remaining Settlements	-76.94	NO	NO
2. Land converted to Settlements	112.36	NO	NO
5F. Other Land	0.00	0.000	0.000
1. Other Land remaining Other Land	0.00	0.000	0.000
2. Land converted to Other Land	0.00	0.000	0.000
5G. Other(please specify)	NO	NO	NO
Harvested Wood Products	NO	NO	NO

IE – included elsewhere, NO – not occurring

The country area balance by geodesic status and directions of land use, consistent with IPCC 2003 guidelines, is presented below in table 7.2.

Table 7.2. Country area balance in 2009.

Year	2009
Greenhouse gas source and sink categories	Area [ha]
5. Total Land-use categories	
5.A. Forest Land	9 296 000.00
total mineral soils area at forest area	9 051 080.00
total organic soils area at forest area	244 920.00
5.A.1. Forest Land remaining Forest Land	8 851 546.10
mineral soils	8 618 271.91
organic soils	233 274.19
5.A. 2. Land converted to Forest Land	444 453.90
mineral soils	432 808.09
organic soils	11 645.81
5.B. Cropland	12 940 000.00
5.B.1. Cropland remaining Cropland	12 445 000.00
mineral soils	11 886 707.00
drained organic soils	558 293.00
5.B.1.A. Other Cropland remaining Cropland (temporarily not in use)	495 000.00
5.B.2. Land converted to Cropland	0.00
5.C. Grassland	3 180 000.00
5.C1. Grassland remaining Grassland	3 180 000.00
mineral soils	3 031 593.00
drained organic soils	148 407.00
5.C.2. Land converted to Grassland	0.00
5.D. Wetlands	882 000.00
5.D.1. Wetlands remaining Wetlands	881 000.00
Area of nutrient rich organic soils managed for peat extraction, including abandoned areas in which drainage is still present	1 028.13
Area of nutrient poor organic soils managed for peat extraction, including abandoned areas in which drainage is still present	171.87
Total flooded surface area, including flooded land, flooded lake and flooded river surface area	881 000.00
5.D.2. Land converted to Wetlands	1 000.00
Area of land converted annually to flooded land	1 000.00
Area of land converted annually to peat extraction	0.00
Area of nutrient poor organic soils converted to peat extraction	0.00
5.E. Settlements	2 080 000.00
5.E.1. Settlements remaining Settlements	2 060 000.00
5.E.2. Land converted to Settlements	20 000.00
5.F. Other Land	2 891 000.00
5.G. Other(please specify)	NO
Harvested Wood Products	NO
Area balance	31 269 000.00

NO – not occurring

Generally Sector 5. Land Use, Land-Use Change and Forestry in 2009 was a net CO_2 sink. Detail results of inventory made according to subcategories are given below.

7.2. Forest Land (CRF sector 5.A.)

GHG balance in this category is a net sink. In 2009 net CO_2 sink was about 51 944 Gg CO_2 .

Area of forest lands in Poland in year 2009.

In our climatic and geographical zone, forests are the least deteriorated natural formation. They are an indispensable element of ecological balance and at the same time the form of land use which ensures biological productivity with a market value. Forests are a public good impacting the quality of human life. Forests once covered almost the whole territory of our country. However, Poland's forests have undergone substantial changes as a result of historical, social and economic processes dominated by both expansion of agriculture and the demand for timber.

In accordance with the international standard (taking account of the land associated with forest management) adopted in assessment, the area of Poland's forests as of 31 December 2009 was 9.3 million hectares. [Report 2009].

Figure 7.2. Forest cover by provinces
Source: Report on the state of forests in 2009. (CILP 2010)

Ownership structure

With regard to the ownership structure (Fig.7.3), forests in Poland are mainly publicly-owned – 82.0 per cent, including the forests under the management of the State Forests – 77,8.0 per cent of the total. [Report 2009].

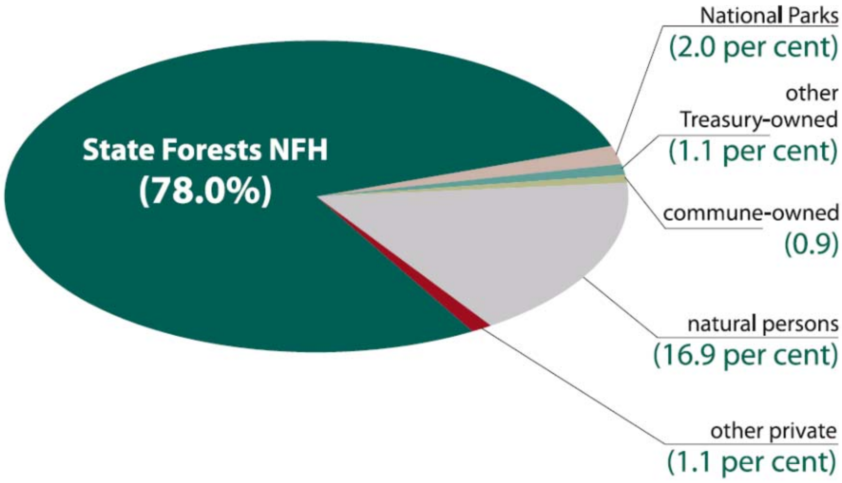

Figure 7.3. Structure of forest ownership in Poland
Source: Forests in Poland 2009.

There are geographical differences in the proportion of forests in private ownership in Poland (Fig. 7.4) – the greatest being in the Małopolskie Province – 43.3 per cent in its total forest cover (187 400 ha), in the Mazowieckie Province – 43.2 per cent (346 400 ha) and in the Lubelskie Province – 39.8 per cent (228 500 ha). The lowest share of private forests was reported in the following provinces: Lubuskie 1.3 per cent (8 800 ha), Zachodniopomorskie – 1.7 per cent (13 600 ha) and Dolnośląskie – 2.7 per cent (15 600 ha).

Figure 7.4. Share of private forests in total forest area in provinces.
Source: Forests in Poland 2009.

Habitat structure

Poland has mainly retained forest on the poorest soils which is reflected in the structure of forest habitat types. Coniferous forest habitats predominate in the habitat structure, accounting for 52.6 per cent of the total forest area, while broadleaved forest habitats cover 47.4 per cent , of which 5.4 per cent are alder carr and floodplain forests. [Report 2009].

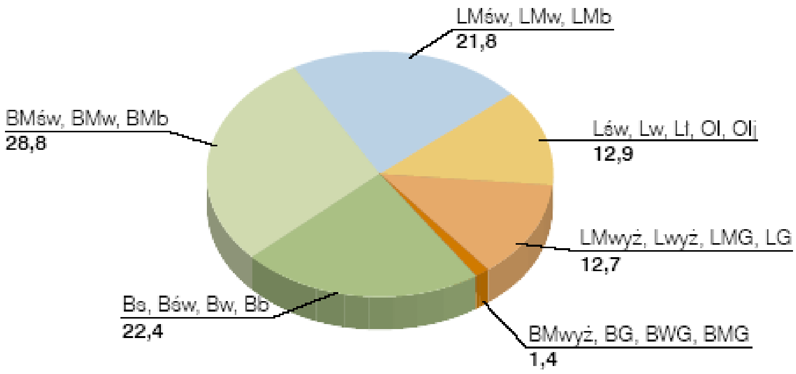

Figure 7.5. Areal share of forests by habitat forest type in the State Forests, National Parks, private and commune-owned forests.
Source: Forests in Poland 2009.

The geographical distribution of habitats is, to a great extent, reflected in the spatial structure of dominant tree species. While in the mountains spruce (west) and spruce and beech (east) are the main species in stand composition and in a few locations stands have differentiated species structure, it is stands with pine as the dominant species that prevail in most of the country.

Species composition.

Coniferous species dominate in Polish forests, covering nearly three fourth of the total forest area (Fig. 7.5). Pine (accounting for 62 per cent in the State Forests and 58 per cent in private and commune-owned forests) has found the optimal climatic and site conditions within its Euro-Asiatic natural range, thus being capable of developing a number of important ecotypes (e.g. the Taborska pine or the Augustowska pine). [Report 2009].

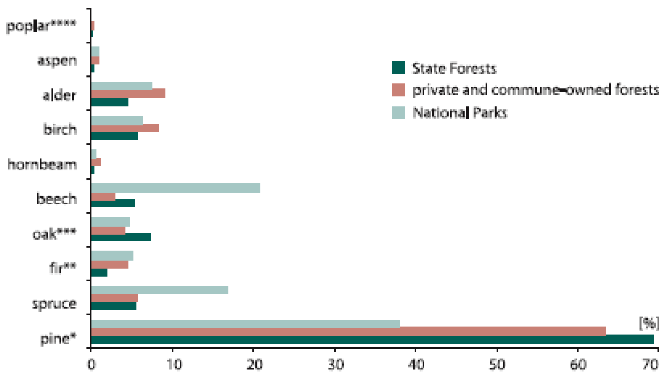

Figure 7.6. Areal share of dominant species in the State Forest (as of 1 January 2007), private and commune-owned forests (as of 1 January 2007), National Park (as of 31 December 1998) including: *larch, ** Douglas-fir, ***ash, maple, sycamore, elm, ****linden and willow.
Source: Forests in Poland 2009.

Age structure

Stands aged 41–80, representing age classes III and IV prevail in the age structure of forests under State Forests administration, covering 28 per cent and 18 per cent of the area, respectively.
Stands older than 100 years, including stands in the restocking class (KO)[1], stands in the class for restocking (KDO)[2] and stands with selection structure (BP)[3] under the management of the State Forests account for 14 per cent of the area. The share of unforested land in private and commune-owned forests accounts for nearly 5 per cent, while in the State Forests, it is 1.3 per cent.

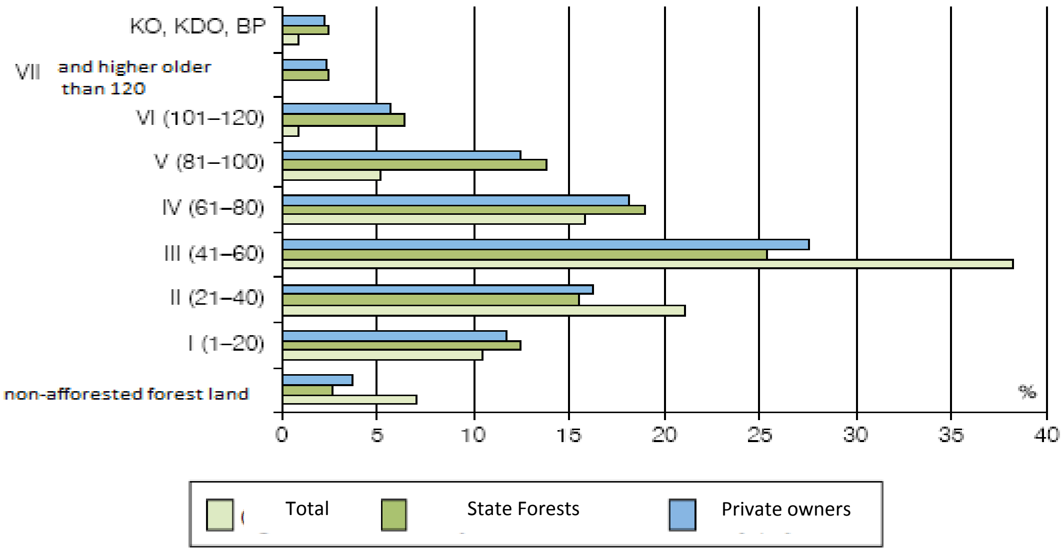

Figure 7.7. Area share of stands by age class in the States Forests, private and commune-owned forests.
Source: Forests in Poland 2009.

Structure of timber resources by volume.

Results of ongoing work related to successive stages of National Forest Inventory for all ownership forms become to be the main source of information about timber resources. Moreover, forests resoureces under the management of the State Forests as a subject of annually publicised report '*The Annual Update on Forest Area and Timber Resources'* are fully described in adequate elaboration performed by the Forest Management and Geodesy Bureau and the State Forests. As of 1 January 2009, the estimated timber resources in the forests managed by the State Forests amounted to 1.714 billion m^3 of gross merchantable timber. The estimated timber resources in the all forests as a result of first cycle of NFI amounted to 2.304 billion m^3 of gross merchantable timber.

[1] Restocking class (KO) – a type of vertical stand structure in which there is simultaneous utilisation of the stand and regeneration under the canopy of the parent stand, and in which the level of regeneration allows to proceed with subsequent stages of tending (cf. class for restocking).
[2] Class for restocking (KDO) – a type of vertical stand structure in which there is simultaneous utilisation of the stand and regeneration under the canopy of the parent stand, and in which the level of regeneration does not yet meet the assumed requirements (cf. restocking class).
[3] Selection structure (BP) – a type of vertical structure of stands, representing groups and clumps of uneven-aged and sized trees.

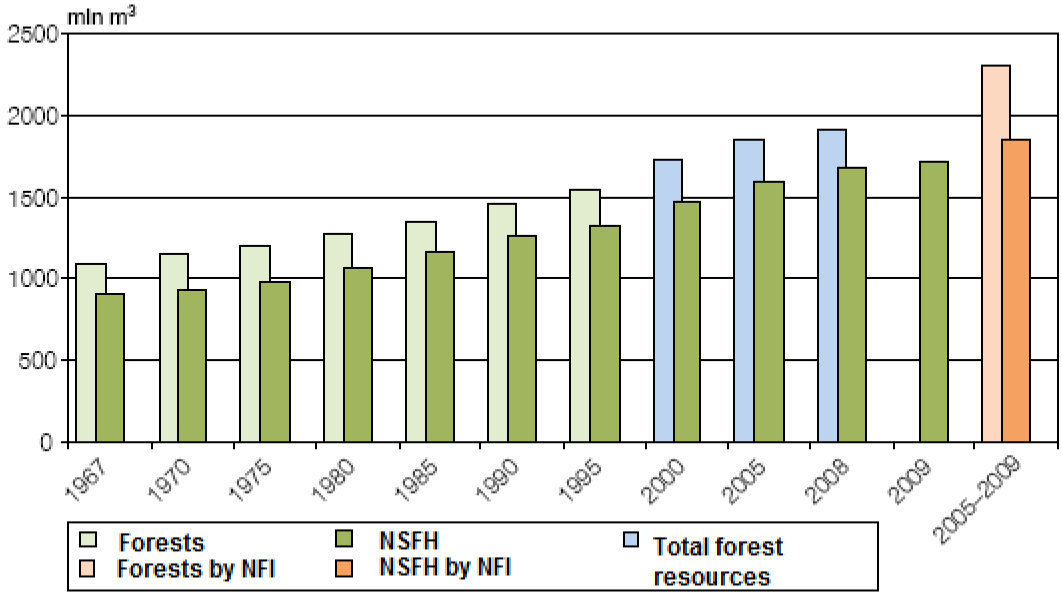

Figure 7.8. Timber resources in Poland's forests in 1967-2009, in millions of m^3 of gross merchantable timber.

Source: Forests in Poland 2009.

7.2.1. Forest Land remaining Forest Land (CRF sector 5.A.1)

GHG balance in this category is a net sink. In 2009 net CO_2 sink was about 44 605 Gg CO_2 .

This subcategory includes entire land with woody vegetation consistent with thresholds used to define forest land in the national GHG inventory:

- 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.

According to the Forest Act, forestlands also include lands related to the forestry, occupied by the buildings intended for the forestry use, drainage appliances, special division lines in forest, forest routes, areas situated under power lines, nurseries, timber – stocking spots, forest parking spaces and tourist appliances. Area related to the forestry in Poland in 2009 was 207.000 ha. [Central Statistical Office – Forestry 2010].

7.2.2. Land converted to Forest Land (CRF sector 5.A.2)

GHG balance in this category is a net sink. In 2009 net CO_2 sink was about 7 339 Gg CO_2. Estimated carbon stock changes for all pools in this are analogous to those used in calculations for subcategory 5.A.1.

CH_4, N_2O, CO and NOx emissions from forest fires were calculated in subcategory 5.A.1.

7.2.3. Methodological issues.

Live organic matter

Increase in forest

Increase of woody biomass in forest of all owners forms was estimated based on data published in Statistical Year Book for Forestry [Central Statistical Office 2010]. Source data contains also area–volume tables with age classes prepared by Forest Management and Geodesy Bureau in order of Directorate General of State Forests published in annual reports "Results of updated estimates of forestry areas and resources in state owned forests" [BULiGL 2009 and 2010].

Data published in statistical yearbooks are of synthetic character – (apply to all types together or separately for conifers and broadleaves only). Estimation of actual increase (m^3/ha/year) for all forests is based on data of increment in growing stock and harvest of thick.

Scheme for calculation of increase in biomass in forests is presented bellow (Figure 7.9):

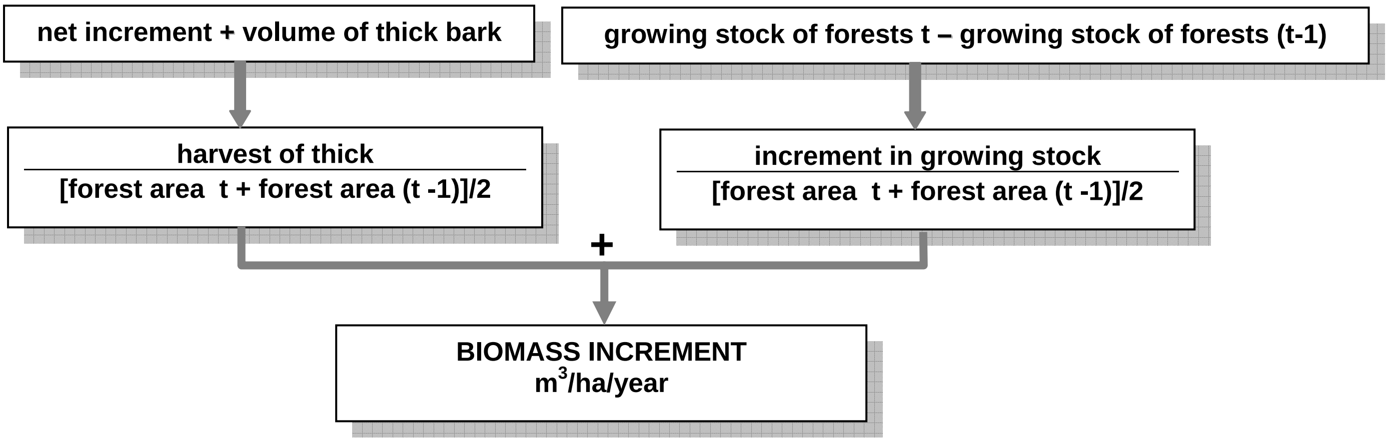

Figure 7.9. Scheme for calculation of increase in biomass in forests.

Calculations of annual increment are based on forest area and growing stock of forests [Central Statistical Office 2010]. Because of big differences between succeeding years, ten-year average of increment in growing stock were used for calculations. Forest management cycle in Poland is 10 years, and ten-years average better demonstrates long term trends in increment. Regarding to the impossibility of comparison of existing statistical data and the values obtained on the basis of National Forest Inventory, the threshold value of the current increment in a given period (based on 1 ha, in 2009) in The Annual Update on Forest Area and Timber Resources performed by Forest Management and Geodesy Bureau of January 1, 2010 were used in estimation process. The results are presented at the graph bellow (Figure 7.10):

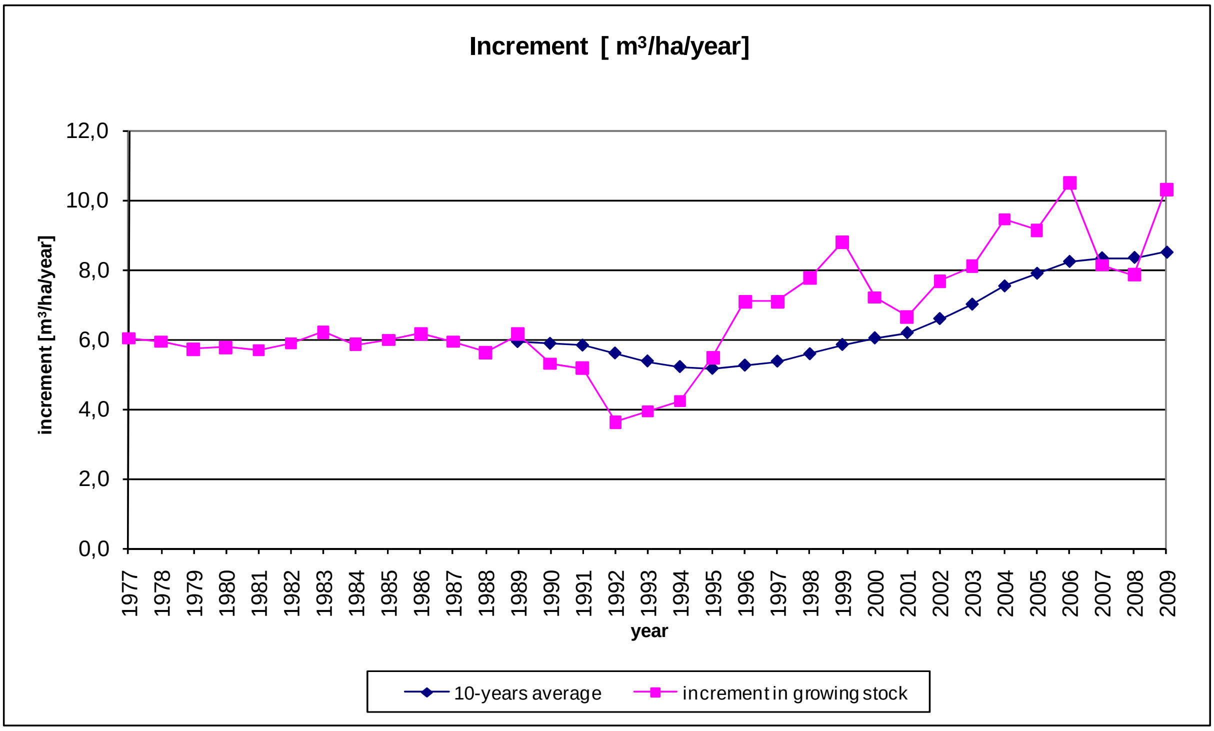

Figure 7.10. Increament in growing stock in period 1977 – 2009.

Methodology for biomass annual increase calculations should be still improved, among others for better estimation of long and short term trends.

Basic wood density

Basic wood density was calculated based on weighted mean wood density by wood species (national ratio), and is presented in table below:

Table 7.3. Scheme for weighted mean wood density calculation, by wood species in Poland based on data describing timber resources from The Annual Update on Forest Area and Timber Resources performed by Forest Management and Geodesy Bureau. (2010.01.01)

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/ΣBi
Pine	0.43	1210861.5	0.3193
Spruce	0.38	106240.6	0.0247
Fir	0.36	50850.3	0.0113
Beech	0.57	105168.9	0.0367
Oak	0.57	117444.4	0.0410
Hornbeam	0.63	4730.9	0.0018
Birch	0.52	73739.1	0.0237
Alder	0.43	68395.1	0.0180
Poplar	0.35	1761.8	0.0004
Aspen	0.36	3980.4	0.0009
Sum	-	1743173.0	-
Weighted mean wood density			0.478

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.

Harvest of thick and growing stock were converted into mass of biomass separately, using expansion ratio 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 7.4. Scheme for calculation of expansion factors for harvest of thick BEF2 based on data describing timber resources from The Annual Update on Forest Area and Timber Resources performed by Forest Management and Geodesy Bureau. (2010.01.01)

Species	Volume of thick in age classes V-VII*	Wood density	Dry matter	Dry matter with thin wood and underbrush destroyed during filling	Biomass expansion factor for converting volumes of extracted roundwood to total aboveground biomass (including bark) BEF_2
	[thous. m^3]	[t/m^3]	[thous. t]	[thous. t]	
Pine	423797.1	0.43	181910.7	246816.4	-
Spruce	50353.5	0.38	19053.8	25852.1	-
Fir	32138.1	0.36	11635.0	15786.3	-
Beech	67008.3	0.57	38098.2	51691.7	-
Oak	67000.5	0.57	38063.0	51643.9	-
Hornbeam	1949.5	0.63	1236.7	1678.0	-
Birch	9814.7	0.52	5136.8	6969.6	-
Alder	18223.9	0.43	7804.6	10589.2	-
Poplar	633.6	0.35	222.6	302.1	-
Aspen	1533.8	0.36	546.0	740.9	-
Sum	672453	-	303707.4	412070.1	1.3568

* Age class – conventional period, usually 20 years long, which allows grouping of forest stands by their age. First age class contains forest stands up to 20 years, Second age class contains forest stands in age between 21 – 40 years etc. To calculate the biomass expansion factor BEF_2 for converting volumes of extracted roundwood into total aboveground biomass (including bark), there were used the data only for trees from V, VI and VII age classes, because in Poland only wood from these classes is logged

Methodology for calculation of expansion factors should be still 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 – 0.3 [IPCC 2006]).

Dead organic matter

According to the Tier 2 method (IPCC GPG LULUCF 2003) and to results of National Forest Inventory for all ownership forms provided information with average thickness of dead wood on forest land (about 5,7 m3/ha for all ownership form of forests). Presented thickness of dead wood is an average volume for the five-year period 2005-2009 of sampling scheme (as a result of measurements on sample plots for the entire time of first cycle of NFI) . As a result of this situation is assumed that the carbon stock change in dead wood in the following years 2008 and 2009 is constant and is equal to zero.

National inventory team is aware of the need of preparing of higher tiers use analysis for data involved in KP-LULUCF calculations, however there was no sufficient data available at the moment of submission. In-country experts consultations has been implemented, uncertainty data is analyzed and calculation model has been set up. Poland is going to prepare such analysis at least in simplified approach in the next submission and looking forward to methodology guidance, assumptions, default values and methodology for evaluating country specific values.

Mineral soils

Estimation of different soil types area (high activity soils, low activity soils, sandy and wetland) is based on area of forest habitat types (Table 7.5). Next the percentage fractions of all soil types in forest management were calculated (Table 7.6).

Table 7.5. Forest habitant types in Poland by 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 7.6. Percentage share of soil types by land use system (for time t and t–20)

Soil types by IPCC	2009 (t)	1989 (t-20)
High Activity Soils	44,5	32,0
Low Activity Soils	18,1	19,8
Sandy	32,9	44,5
Wetland	4,4	3,8
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 1.0 [IPCC 2003],
- adjustment factor reflecting the effect of management intensity or practices on forest in state i, j 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 1.0 [IPCC 2003].

Table 7.7. 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	Default IPCC
Forest management	High Activity Soils	95	110.0
	Low Activity Soils	85	70.0
	Sandy	71	30.0
	Wetland	87	230.0

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 histosol areas was applied between 1995 and 2015.

Total organic soils area in 2009 was estimated for 242 740 ha, with the following split for subcategories: forest land remaining forest land – 233 274 ha, land converted to forest land – 11 646 ha.

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 is increasing, from 12% at the beginning of 1970-ties to 16,5 % in 1990-ties.
Emissions from organic soils at forest land was not estimated because in Poland only cultivated organic soils are drained.

CH_4, N_2O, CO and NOx emissions from forest fires

CH_4, N_2O, CO and NOx emissions from forest fires were calculated using following equation (IPCC 2003, page 3.49, equation 3.2.20):

$$L_{fire} = A*B*C*D*10^{-6}$$

where:

Lfire – quantity of GHG released due to fire, [tonnes of GHG] – (equation 3.2.20 page 3.49 IPCC 2003)
A – area burnt [ha],
B – mass of 'available' fuel [kg d.m./ha],
C – combustion efficiency – equal 0.3 [IPCC],
D – emission factor [g/kg d.m.] – see table 7.8

Table 7.8. Emissions ratios for calculation CH_4, N_2O, CO and NOx emissions from forests fires.

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]

In this subcategory emission of other than CO_2 GHGs is reported from forest fires only. Assumption is made that woody biomass is not burnt entirely during fires (only canopies and underwood are damaged) so if there is a need for moving out damaged or dead wood it is included into total wood harvest. Controlled burning of forests is not practiced in Poland. In years 1992 and 2003 emissions from forest fires increased significantly which was caused by unexpected large area of forest fires.

7.3. Cropland (CRF sector 5.B.).

In accordance with the Eurostat methodology, an additional division of arable land has been adopted since 2007.

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).

7.3.1. Cropland remaining Cropland (CRF sector 5.B.1.)

Areas classified to Cropland:

- Arable land includes land which is cultivated, i.e. sowed and fallow land. Arable landshould 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).

In 2009 this category was a net CO_2 emissions and accounted for about 9 254 Gg CO_2.

7.3.2. Land converted to Cropland (CRF sector 5.B.2.)

Emissions/removals from this subcategory was not estimated, because in Poland cropland area is decreasing. Only in years 2002 and 2004 area was increasing – converted from grassland.

7.3.3. Methodological issues.

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 as 0.16 [t C/ha*year].
GHG balance in this category is a net sink. In 2009 net CO_2 sink was about 197 Gg CO_2.

Mineral soils

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 7.9). Then percentage fraction of all soil types in croplands were calculated.

Table 7.9. Agricultural land by soil valuation classes in Poland.

Soil type	Soil valuation 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.

Carbon stock rates in agriculture soils were taken as default factors from [IPCC 2003] and corrected to domestic conditions by experts (Table 7.10).

Table. 7.10. 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	Country specific factors
Agricultural crops	High Activity Soils	95	51.5
	Low Activity Soils	85	44.1
	Sandy	71	18.4
	Wetland	87	88.2

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) = 0.80, [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)=1.00 [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)=1.1 [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)= 0.81[IPCC 2003 tab. 3.3.4. page 3.77],
- Stock change factor for management regime in current inventory year –F_{MG}(0)=1.05, [IPCC 2003 tab. 3.3.4. page 3.77],
- Stock change factor for input of organic matter in current inventory year – F_I(0) = 1.1[IPCC 2003 tab. 3.3.4. page 3.77].

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.

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 – 0.122 [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 2009 from agricultural lime application was 338.1 Gg CO_2. Emission from lime application is decreasing. Emission from agricultural lime application is reported together with lime application in Grassland.

Due to the lack of data of the Ca and Ca-Mg fertilizers consumption for 2009, the latest applicable data was used to calculate the value or 2009. Presented data will be publicized on the basis of Agricultural Census for 2010 and will be available in late November / December 2011.

CH_4, N_2O, CO and NOx emissions from cropland fires are reported in subcategory 5.C.1.

7.4. Grassland (CRF sector 5.C.)

7.4.1. Grassland remaining Grassland (CRF sector 5.C.1.)

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.

Data presented in the official statistics are published every year, however generalized results of the sample survey on land use are available periodically.

Annual CO_2 emission in 2008 from this category was over 136 Gg CO_2.

7.4.2. Land converted to Grassland (CRF sector 5.C.2.)

7.4.3. Methodological issues.

Living organic matter

Emissions/ removals from this subcategory was not estimated, because in Poland there is no perennial woody biomass.

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.
Carbon emission from lime application

Carbon emission from grassland lime application is reported together with cropland lime application in subcategory 5.B.1.

CH_4, N_2O, CO and NOx emissions from fires

CH_4, N_2O, CO and NOx emissions from fires were calculated using following equation (IPCC 2003, page 3.49, equation 3.2.20):

$$L_{fire} = A*B*C*D*10^{-6}$$

where:

Lfire – quantity of GHG released due to fire, [tonnes of GHG] – (equation 3.2.20 page 3.49 IPCC 2003)
A – area burnt [ha],
B – mass of 'available' fuel 3.6 [t dm./ha],
C – combustion efficiency – equal 0.9 (90%) [IPCC 2003],
D – emission factor [g/kg d.m.] – see table 7.9

In this subcategory non-CO_2 emission from crop area, meadows and stubbles fires is reported. In Poland there is no controlled burning of grasslands.

7.4.3. Land converted to Grassland (CRF sector 5.C.2.)

Living organic matter.

Emissions/ removals from this subcategory was not estimated, because in Poland only croplands without perennial woody biomass are converted to grasslands.

Mineral soils

Carbon stock rates in grassland soils were taken as default factors from [IPCC 2003] and corrected to domestic conditions by experts (Table 7.11).

Table 7.11. 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	Country specific factors
Grassland/Rangeland	High Activity Soils	95	99.0
	Low Activity Soils	85	66.0
	Sandy	71	27.5
	Wetland	87	132.0

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 $F_{MG(0-T)}$ = 1.00 [IPCC 2003 tab. 3.3.4. page 3.77],
- stock change factor for input of organic matter in the beginning of inventory year $F_{I(0-T)}$ = 1.2 [IPCC 2003 tab. 3.3.4. page 3.77].
- stock change factor for land use or land-use change type in the current of inventory year $F_{LU(0)}$ = 0.81 [IPCC 2003 tab. 3.3.4. page 3.77],
- stock change factor for management regime in the beginning of current year $F_{MG(0)}$ = 1.00 [IPCC 2003 tab. 3.3.4. page 3.77],
- stock change factor for input of organic matter in the beginning of current year $F_{I(0)}$ = 1.2 [IPCC 2003 tab. 3.3.4. page 3.77].

Organic soils

CO_2 emission from cultivated organic soils converted to grassland is reported in subcategory 5.C.1.

Carbon emission from lime application

Carbon emission from grassland lime application is reported together with cropland lime application in subcategory 5.B.1.

CH_4, N_2O, CO and NOx emissions from fires

CH_4, N_2O, CO and NOx emissions from crop areas, meadows and stubbles fires are reported in subcategory 5.C.1.

7.5. Wetlands (CRF sector 5.D.)

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.

7.5.1 Wetlands remaining wetlands (CRF sector 5.D.1.)

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 2009 was 1 200 ha and area of flooded land was 881 000 ha.

Area of organic soils managed for peat extraction was estimated based on literature data and is presented in table 7.12:

Table 7.12. Area of organic soils managed for peat extraction in Poland.

Year	1960[1]	1985[2]	1999[2]
Area of organic soils managed for peat extraction [ha]	78 341	4931	1200
in it:			
nutrient rich organic soils, in it:	67 120	4 225	1 028
low peat deposit	67 120	4 225	1 028
nutrient poor organic soils, in it:	11 220	706	172
transition peat deposit	2 116	930	226
high peat deposit	5 136	2 257	549
mix-typical peat deposit	3 055	1 343	327
other peat deposit	913	401	98
data sources:			
[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.			

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.

7.5.1.1. Methodological issues.

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:

Symbol	Unit	Emission factor	Source
$EF_{peatNrich}$	[t C/ha*year]	1.1	table 3A.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 3A.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 there were used default emission factors for cold climate as below:

Symbol	Unit	Emission factor	Source
$E(CO_2)diff$	[kg CO_2/ha*day]	9.3	table 3A.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:

Symbol	Unit	Emission factor	Source
$E(CH_4)diff$	[kg CH_4/ha*day]	0.2	table 3A.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 3A.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.]

7.5.2. Land converted to Wetlands (CRF sector 5.D.2.)

In 2009 annual carbon stock change in living biomass was estimated on 0.007 Gg CO_2. Calculations are based on equation 3.5.6, page 3. 140, IPCC 2003.

7.5.2.1. Methodological issues.

For calculations were used default emission factors as 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} = 0.0036 t dm/ha [CENOWSKI factor used in EMEP inventory]
- Living biomass immediately following conversion to flooded land B_{After} = 0 t dm/ha [IPCC 2003, page 3.140]

Emission from organic soils managed for peat extraction was not estimated because in Poland area of these lands is decreasing.

7.6. Settlements (CRF sector 5.E.)

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 centres, children playgrounds, beaches, arranged parks, squares, lawns (outside street lanes);
  - areas of historical significance: ruins of castles, strongholds, etc.
  - sport grounds: stadiums, football fields, ski-jumping take-offs, toboggan-run, sports rifle-ranges, public baths etc.
  - area for entertainment purposes: amusement, grounds, funfairs etc.,
  - zoological and botanical gardens;
  - areas of non-arranged greenery, not listed under woodlands or land planted with trees or shrubbery
- transport areas including land put under:
  - roads: 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

7.6.1. Settlements remaining Settlements (CRF sector 5.E.1.)

GHG balance in this category is a net sink. In 2009 net CO_2 sink was about 77 Gg CO_2.

7.6.1.1. Methodological issues.

Living organic matter

Calculations for carbon stock changes in living biomass were based on crown cower area method (urban green area – GUS 2009 Environmental Protection).

Carbon stock changes in living biomass was calculated based on equation 3.a.4.1., page 3.295 [IPCC 2003,].

For calculations were used default crown cover area-based growth rate CRF=1.8 t C/ha crown cover*year [IPCC 2003, page 3.297].

7.6.2. Land converted to Settlements (CRF sector 5.E.2.)

Carbon stock changes in living biomass were indicated as included in carbon stock changes in living biomass under the subcategory 5.A. GHG emissions and removals balance from soils were estimated with the same factors as described in the chapter 7.2.

7.7. Other land (CRF sector 5.F)

Carbon pools would not need to be assessed for this category, but it is included for checking overall consistency of land area. this category includes bare soil, rock and all unmanaged land areas do not fall into any of the other categories.

Emissions/ removals from this subcategory was not estimated.

7.8. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2009 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 1988-2009 ensured consistency for whole time-series.

Table 7.13. Results of the sectoral uncertainty analysis in 2009

2009	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	**-39516.54**	**111.18**	**0.02**	19.3%	99.7%	88.0%
A. Forest Land	-51943.87	1.53	0.01	15.0%	100.0%	100.0%
B. Cropland	9253.56			15.0%		
C. Grassland	136.04	0.05	0.00	15.0%	100.0%	100.0%
D. Wetlands	3002.30	109.61	0.01	15.0%	100.0%	100.0%
E. Settlements	35.42			15.0%		
F. Other Land						

7.9. 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 the of Forest Management and Geodesy Bureau. In case of deviations from the trend, carried out more detailed checks of input data. 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.

7.10. Recalculations.

Fallowing recalculation in the inventory for year 2009 in land use, land use change and forestry sector were made:

- correction of BEF_2 factor (5.A),
- adjustment of the basic wood density with relation to the latest in-country research data (5.A) ,
- adjustment of the increment in growing stock of merchantable timber (5.A),
- updata of activity data in forest soils (5.A) for years 2008 and 2009 (persentage share of forest habitat types)
- update of area of organic soil on Cropland for the following years 1996-2009 (5.B.),
- inclusion of CO2 emissions as a result of wood harvesting from plantings in subcategory 5.B.1

7.11. Planned improvements.

With the connection to the first cycle of National Forest Inventory of all ownership forms, executed in a 5-year cycle (2005-2009), made a continuous analysis of the conventional statistics and indicators 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.

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 (CH4 emission), share in total GHG emission 1.7%

Total emission of GHG as carbon dioxide equivalent amounted to 8 865.8 Gg in 2009 and decreased since 1988 by 5.3% (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.

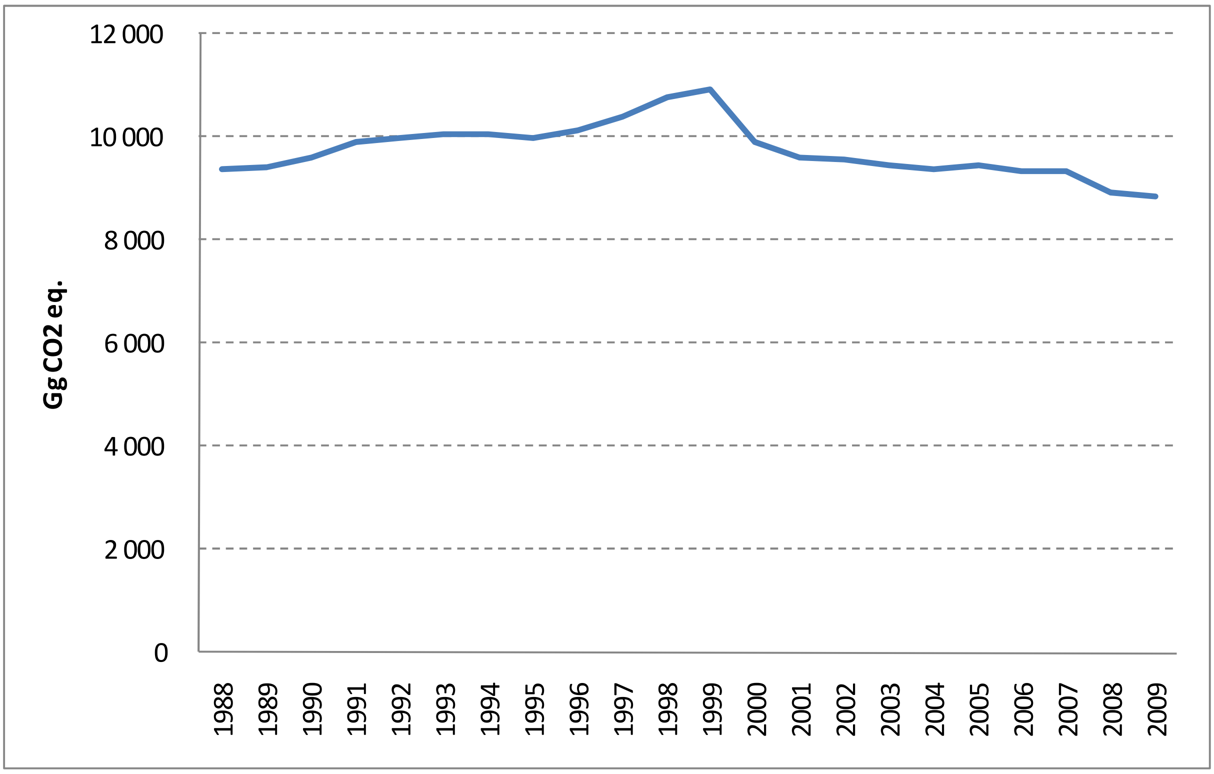

Figure 8.1. GHG emissions from waste sector in 1988-2009.

Between years 1988 and 2009 decrease of GHG emissions appeared in subcategory 6.B (by 23.2%) and 6.C (by 59.1%). Only subcategory 6.A increased since 1988 (by 8.6%) (Figure 8.2).

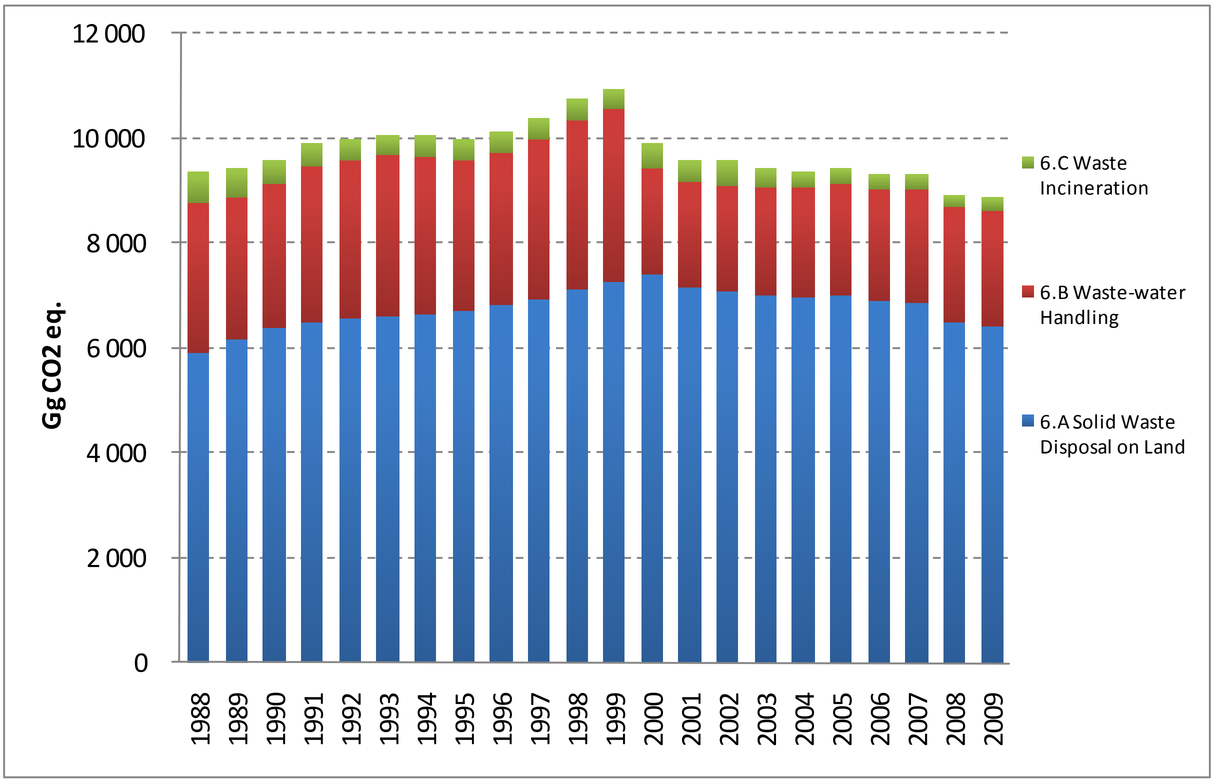

Figure .8.2. GHG emissions from waste sector divided to subcategories.

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 72% and it involves methane emissions from Managed Waste Disposal on Land (13.2% share of 6.A), Unmanaged Waste Disposal on Land deep (80.8% share of 6.A) and Industrial Waste Disposal on Land (6% share of 6.A). The biggest change in trend emissions was in years 2000-2001 (Figure 8.2). This is due to decrease of number of wastes going to landfills in 2001 (by 1 250 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 establish multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH4 is diminished by recapturing of this gas.

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 2010].

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
DOCf		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

Activities used for estimation of CH_4 emissions from solid waste disposals contain:

- Population – number of population was taken from [GUS 2010]
- 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.

Table 8.4. Data sources for amount of municipal waste

Years	[Gg]	Data source
1970	4 113.98	[GUS 1987]
1971	4 624.65	interpolation
1972	5 135.31	interpolation
1973	5 645.98	interpolation
1974	6 156.64	[GUS 1974d]
1975	6 788.96	[GUS 1986d]
1976	7 397.99	interpolation
1977	8 007.03	[GUS 1981d]
1978	8 702.83	[GUS 1981d]
1979	9 052.63	[GUS 1981d]
1980	9 868.72	[GUS 1986d]

Years	[Gg]	Data source
1981	10 014.42	[GUS 1986d]
1982	10 329.07	[GUS 1986d]
1983	10 541.91	[GUS 1986d]
1984	10 864.54	[GUS 1986d]
1985	11 086.95	[GUS 1986d]
1986	11 546.86	[GUS 1987]
1987	11 877.45	[GUS 1989d]
1988	12 084.18	[GUS 1989d]
1989	12 000.95	[GUS 1990d]
1990	11 098.28	[GUS 1996]
1991	10 637.98	[GUS 1996]
1992	10 621.00	[GUS 1996]
1993	10 644.66	[GUS 1996]
1994	11 014.64	[GUS 1996]
1995	10 985.00	[GUS 2005d]
1996	11 621.22	[GUS 1997d]
1997	12 183.44	[GUS 1998d]
1998	12 275.77	[GUS 1999d]
1999	12 316.90	[GUS 2000d]
2000	12 226.00	[GUS 2005d]
2001	11 109.00	[GUS 2005d]
2002	10 508.70	[GUS 2005d]
2003	9 925.00	[GUS 2005d]
2004	9 759.00	[GUS 2005d]
2005	9 354.00	[GUS 2006d]
2006	9 877.00	[GUS 2007d]
2007	10 083.00	[GUS 2008d]
2008	10 036.00	[GUS 2009d]
2009	10 054.00	[GUS 2010d]

In 2009, according to statistical data [GUS 2010d], collected municipal solid wastes goes to four different pathways:

- 1% goes to incineration,
- 5% goes to biological treatment,
- 85% goes to landfills,
- 9% is recycled.

The percentage of waste generated, which goes to solid waste disposal sites was assumed according to the GUS Statistical Yearbook, Environment. For the years 1970-1976 it was assumed as in 1977 – 96%. In years 1981-1990 there was no combustion of waste and the composting was on level of 0.1%. Because of the lack of data for years 1979, 1980, 1991 and 1992 this value was assumed on level of 0.1%. After 1992 there are statistical information on number of waste, which goes to solid waste disposal sites. Distribution of solid waste disposal sites for managed and unmanaged ones was made in accordance to elaboration [Gworek 2003]. According to this publication 14% of disposal sites are managed, 86% are unmanaged deep.

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). Composition from [Rosik-Dulewska Cz. 2000]. Based on those data, on data from [KPGO 2003] for 2001, and data from [KPGO 2010] for 2004 interpolation for the other years was made (table 8.5).

Table 8.5. Composition of 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	24%	2%	20%	2%	2%	50%
2009	24%	2%	20%	2%	2%	50%

Recovery of methane was assumed on the basis of [GUS OZE 2010].

Following the ERT 2009 recommendations emission from sewage sludge sent to landfills was assumed for years 1995-2009.
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 8.6. 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 2009 from [GUS 2010d], for years 1998, 1999 and 2001 there was a lack of data and interpolation had to be done).

Table 8.7. Sewage sludge activity data

	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

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 two times – once to calculate municipal waste and second time to calculate 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 1975-2009. Before year 1975 there were no data on industrial waste.

Table 8.8. Composition of industrial wastes [Gg]

Gg	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]
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]

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 8.9. Composition of industrial wastes [%]

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%
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%

All of the input parameters are default based on 2006 IPCC Guidelines [IPCC 2006].

Table 8.10. 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
DOCf		0.5	0.5

Table 8.11. 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 8.12. 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

8.3. Waste Water Handling (CRF sector 6.B)

8.3.1. Source category description

The 6.B subcategory share in total waste sector is 25% and it involves methane emission from industrial wastewater (9% share of 6.B), methane emission from domestic and commercial wastewater (40% share of 6.B) and N_2O emission from human sewage (51% 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 2010d]. Data on employment and production from some branches were taken from [GUS 2010].

Table 8.13. Amount of industrial wastewater in [million m^3]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Mining and quarrying	548	426.5	519	470	453	392	382	378	362	340	336
Iron and steel	94.2	119.6	99.8	73.1	51.4	47	45.8	44.4	43	43.9	25.3
Non-iron metals	48.7	86.1	39.7	67.8	66.2	59.7	128	134	142	172	188
Synthetic fertilizers	123	118.3	92.5	58.4	53.5	48.5	51.3	41.5	48.5	51.9	52.3
Food products: Meat & Poultry	3.3	3	2.7	3.2	5.4	4.6	3.9	4	4.2	4.2	3.9
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
Food products: Vegetables & Fruits	14.2	12	10	8.5	7.4	8	7.4	8.3	7.8	7.7	9.4

Food products: Vegetable Oils	3.7	2.5	1.5	1	0.5	2.1	1.2	1	3.6	4.8	2.5
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
Food products: Sugar	23.7	21	20.4	13.9	10	11	7.9	7.7	6.5	5.7	6.1
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
Food products: Beer & Malt	4	4	4.3	4	4	3.6	2.7	2.1	1.7	1.7	1.6
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
Textiles	14.2	13.86	11.1	8.2	9	7.8	7.3	6.4	5.7	5.2	4.7
Leathers	6.3	5.666	4.7	4.2	3	2.6	1.7	1.6	1.3	1.1	0.7
Wood and Paper	195	199.1	184	168	146	132	129	121	117	114	106
Petroleum Refineries	43.2	43.38	38.7	40	36.6	33.6	32.6	33.2	28.1	25.1	24.3
Organic Chemicals	126	224.1	107	120	108	97.7	101	98.6	94.3	81.5	63.1
Plastics & Resins	17.4		17.6	15.8	15.7	15.1	14.6	12.6	6.7	9.2	10.3
Other non-metallic	58.2	59.6	53.3	43.9	31	28	29.6	29.3	28.8	32.9	27.9
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
Other	90.9	91.32	95.2	89.8	79.8	82.7	104	94.5	115	110	161
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Mining and quarrying	362.3	350	332	293	272	261	267	272	271	242.6	252.9
Iron and steel	13.2	14.2	14.8	13.3	9.6	8.2	6.5	7.4	10.8	8.3	12.8
Non-iron metals	184.8	184	187	184	155	135	132	132	133	130.8	128.4
Synthetic fertilizers	52.6	51.7	49.7	50.3	46	49.4	48.6	50.7	52.6	176.3	121.3
Food products: Meat & Poultry	4	3.6	3.4	3.4	3.5	4.1	4.3	4.6	4.8	5	5.8
Food products: Fish Processing	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0	0	0
Food products: Vegetables & Fruits	7.5	7.5	7.2	6.4	7.8	6.8	6.6	7	6.8	6	6.1
Food products: Vegetable Oils	3.2	2.4	0.7	0.3	0.2	0.3	0.3	0.4	0.4	0.6	0.8
Food products: Dairy Products	11.4	11.3	11.7	11.3	11.5	13	13.5	13.8	14.4	14.2	14.2
Food products: Sugar	4.9	4	2.9	2.7	2.7	2.2	1.8	1.4	1.9	2.7	3.2
Food products: Soft Drinks	2.6	2.5	2.1	2.2	3.1	2	2.1	2.1	1.9	1.6	1.8
Food products: Beer & Malt	1.4	1.3	1.3	1.4	1.2	1.2	1.3	1.7	1.4	1.4	1.1
Food products: Other	0.5	0.8	0.7	0.7	0.8	3.3	2.8	2.3	2.4	2.6	2.1
Textiles	3.1	2.6	2.1	1.7	1.6	1.5	1.6	1.3	0.7	0.6	0.4
Leathers	0.7	1.1	1.2	0.9	0.8	0.6	0.7	0.6	0.6	0.4	0.5
Wood and Paper	90.3	81.7	76.9	77.1	71.5	70.9	68.9	69.7	67.6	64.7	66.8
Petroleum Refineries	20.3	17.8	18.1	16.8	17.4	19.6	19.3	20.7	23	20.9	21.3
Organic Chemicals	55.9	47.7	42.4	42	38.3	36	38.4	38.6	39.1	35.5	29.4
Plastics & Resins	8.4	7.8	4.7	2.7	2.5	2.5	2.4	2.2	2.3	1.9	1.8
Other non-metallic	29.8	32.3	34.2	38	31.9	37.4	36.3	43.2	39.4	46.1	39.9
Manufacturing of Machinery and Transport Equipment	22	12	10.4	9.1	8.1	6.8	7	4.4	4.2	3.7	2.1
Other	116.7	121	130	126	120	129	128	128	148	141.7	168.4

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 8.14. 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
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 was taken from expert opinion [Przewłocki, 2007]. In 2008 share of aerobic treatment of wastewater was 85.9% and anaerobic treatment was 14.1%.

Recovery of methane in industrial wastewater treatment is 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].

8.2.2.2. 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 for year 1988-2008 are presented in table 8.15. 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).

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 8.15. Activity data for domestic and commercial wastewater.

Year	Municipal waste discharged into collection system	% treated wastewater
	mln m^3	%
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

N_2O emission from humane sewage was calculated according to default method [IPCC 1997]. Country population was taken from [GUS 2009] and value of protein consumption per capita per year was taken from FAO database. For years 2008-2009 protein consumption was assumed on the level of 2007 data (lack of data in FAO database after 2007). Default values were used for fraction of nitrogen in protein and for N_2O emission factor [IPCC 2000].

8.4. Waste Incineration (CRF sector 6.C)

8.4.1. Source category description

The 6.C subcategory share in total waste sector is 3% 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 are not included in total emission and in 2009 amounts to 64.1 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 all types of wastes were taken from [Wielgosiński G. 2011].

Table 8.16. Activity data in 2009 [Gg]

Type of wastes	Amount of waste incinerated [Gg]
municipal	40.3
industrial	119.5
medical	28.6
sewage sludge	26.2

Table 8.17. Biogenic and non-biogenic content of waste

Type of wastes	content of waste
non-biogenic	
municipal	0.7
industrial	0.9
medical	0.4
biogenic	
municipal	0.3
industrial	0.1
medical	0.6
sewage sludge	1

Table 8.18. 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 (incl. hazardous 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

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 EFs used is included in NIR report under the Annex 2.

8.5. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2009 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 1988-2009 ensured consistency for whole time-series.

Table 8.19. Results of the sectoral uncertainty analysis in 2009

2009	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
6. Waste	**230.99**	**357.70**	**3.62**	51.0%	67.4%	51.8%
A. Solid Waste Disposal on Land		305.94			77.4%	
B. Wastewater Handling		51.76	3.59		87.4%	52.2%
C. Waste Incineration	230.99		0.03	51.0%		22.9%

8.6. 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.

8.7. Source-specific recalculations

6.A Solid waste disposal on land

For the years 2006-2008, according to methodology used for previous years, amount of wastes was replaced with the amount of wastes excluding the collected ones. This has no impact on emissions, because amount of waste going to SWDS (which is AD for estimating emission) is taken directly from statistical data (error occurred in generation of waste).

6.B.2 N_2O from human sewage

Protein consumption for years 2006-2008 was recalculated on the basis of data from FAO database

8.8. Source-specific planned improvements

- In Solid Waste Disposal Sites all emission factors are default. There is a need to conduct some research to determine country specific emission factors.
- The historical data on waste disposal before 1970 need to be extended.
- Recalculation of protein consumption for years 2008-2009 is planned.
- Activity data of incinerated wastes for years prior to 2001 need to be reviewed.

9. RECALCULATIONS AND IMPROVEMENTS

9.1. Explanations and justifications for recalculations

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:

Change = 100% x [(LS-PS)/PS]

where:

LS = Latest Submission (for 1988–2009 inventory submitted in NIR 2011)
PS = Previous Submission (for 1988–2008 inventory submitted in NIR 2010)

9.2. Implications for emission levels and trends

Detail analysis has been made for comparison of GHG emissions submitted presently in the NIR 2011 for 1988-2008 with the data provided in the previous submission revised following ERT recommendations made in 2010.

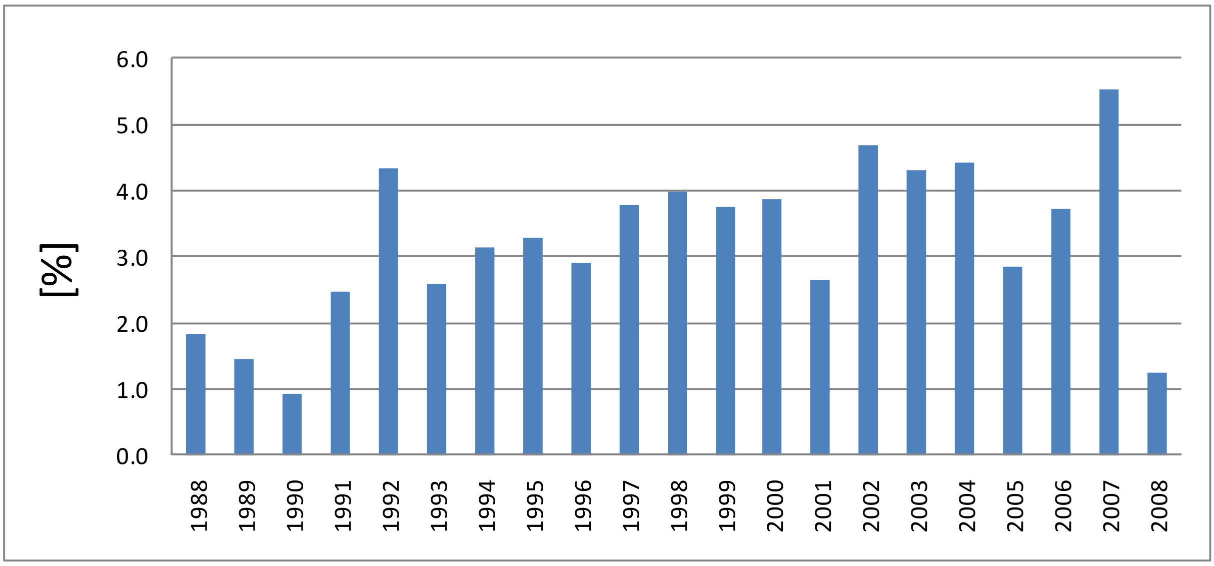

Figure 9.1. Recalculation of CO_2 for entire time series made in CRF 2011 comparing to CRF 2010 v.3.1

As concerns CO_2 emissions recalculations caused pretty smooth increase in emissions – but not exceeding 2%. The main reason for these recalculations was the update of the discounted value of the current increment in growing stock (including volume of thick bark) for all forest land ownership forms (see chapter 7.8).

In case of CH_4 emissions the changes caused by recalculations were insignificant, the biggest ones were observed in 2007–2008 and are related to update of *Energy* sector, especially in subsector 1.A.4.*Other sectors*, where increase in biomass use for energy purposes in 2007 as well as decrease of coal use in 2008 in households was observed.

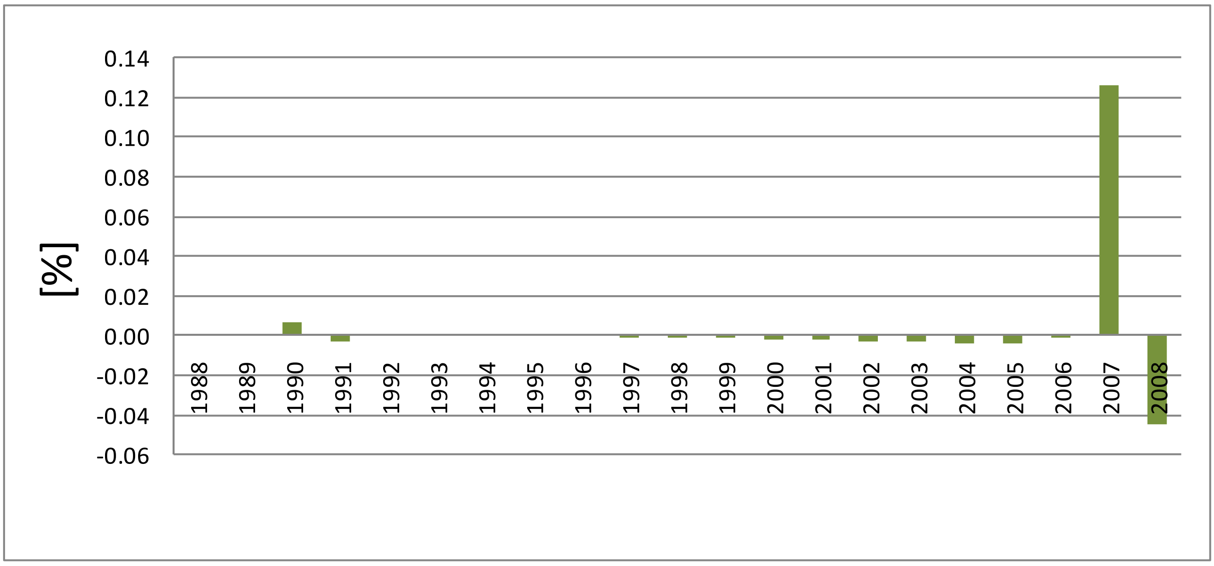

Figure 9.2. Recalculation of CH_4 for entire time series made in CRF 2011 comparing to CRF 2010 v.3.1

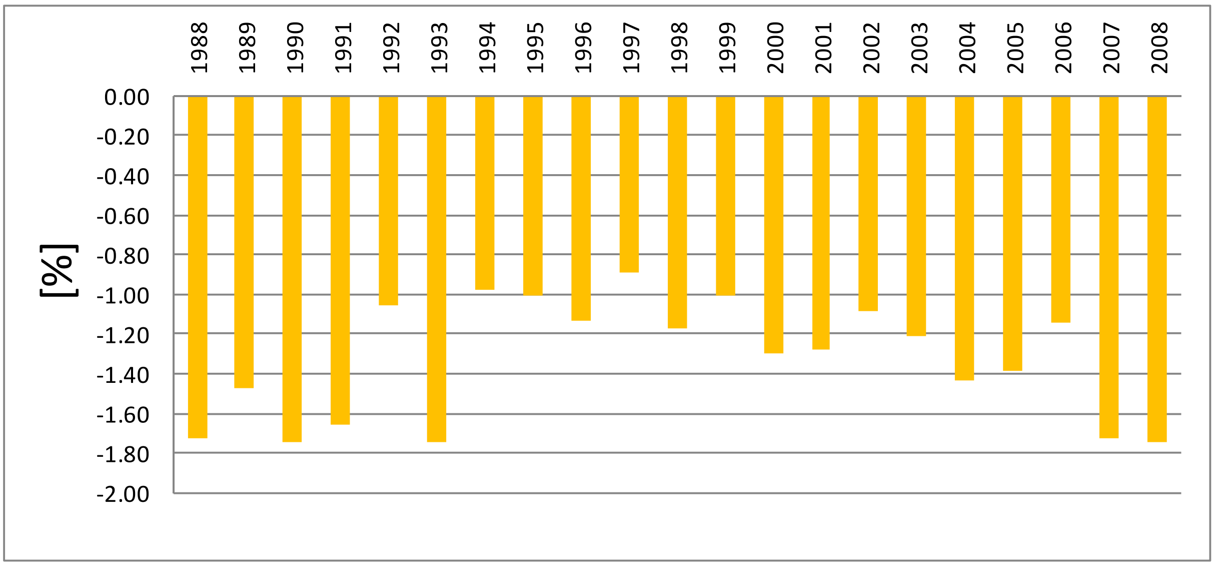

Figure 9.3. Recalculation of N_2O for entire time series made in CRF 2011 comparing to CRF 2010 v.3.1

Recalculations in N_2O emissions relate mostly to the *Agriculture* sector where activity data was corrected for maize production limiting the data to crop cultivated for seed excluding maize cultivated for fodder (see chapter 6.8).

PART II: SUPPLEMENTARY INFORMATION REQUIRED UNDER ARTICLE 7, PARAGRAPH 1

10. KP-LULUCF

10.1. 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).

10.1.1. 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[4]:

- minimum forest land area: 0,1 hectare
- minimum width of forests land area[5]: 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).

According to the Polish Forestry Law (Forest Act 1991) forest id defined a land with a homogenous area of at least 0.10 ha, covered with forest vegetation (wooded area), or temporarily devoid of forest vegetation(non-wooded area).These areas are designated for silviculture production, comprising portions of nature reserves and national parks registered as nature monuments. This category is in statistical terms referred to as “the forest area”(up to 1991 as “the wooded area”).Wooded area includes any land covered with crops, greenwoods and older wood stands, as well as poplars, seed, plantations and fast-growing tree species.

10.1.2. 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 other tree activities: Cropland Management, Grazing Land Management and revegetation.
The 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.

[4] These values are not in contradiction to forest definition in the Polish law(Law On Forests- text: last change 19 Sept.2005 Law Gazette 05.157.1315)
[5] 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)

10.1.3. 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 human activity.

Abandonment of agricultural land use as a conscious decision of owners of land resulting in a natural succession of agricultural land, which begins the natural development of forest habitat, are included in the total area of Afforestation. Increase in forest area from 1990 to 2009 is representing the total area of land being a subject of Afforestation.

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 human activity

c) Deforestation

Deforestation refers to the conversion of forest land to other categories of land use, within the national statistical studies that category, is presented 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 year
- transformation is directly caused by human activity.

Deforestation is prohibited by the National Law on forest (Farm and Woodland Conservation Act). Exceptions for transition forest to any other land use category need governmental authorization. The authorization documents are collected by Regional Direction's of the National Forest Holding and are annually reported to the Ministry of Environment and 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 practiced by The State Forests National Forests Holding results in biomass increase leading to growth of carbon sequestration. Increasing forest area as well as activities aiming at saving of 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 is considered as managed. In addition Forest management plans as a part of sustainable forest management prepared by National State Forest Holding are approved by Ministry of Environment.

10.1.4 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.

10.2. Land-related information

10.2.1. 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 will be identified using method Tier 1. Geographic boundaries encompassing units of land subject to multiple activities are indentified on published data based on Records of lands and buildings as well as information system containing digital maps and database operated by the National State Forest Holding (i.e. reporting method 1, GPG for LULUCF, IPCC 2003) performed by the Central Statistical Office and Forest Management and Geodesy Bureau.

10.2.2. Methodology used to develop the land transition matrix

Annually updated data from National Record of land and buildings are related only to directly caused by human intervention in land use activities 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 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.

10.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

The main sources of information used in preparation of the annual inventory reports to the Kyoto Protocol are the publications of the Central Statistical Office in the yearbooks ,,Forestry". Presented data is/are having high level of aggregation, as well as nationwide coverage. In addition, result of first cycle of National Forest Inventory for all ownership forms are related to the main geographical units (natural-forest lands regions), administrative (provinces) or administrative-economic units (Regional Directorates of State Forests., there is no potential opportunities to present estimates of the balance of greenhouse gas emissions, more than in a national scale due to given the current high level of the forest land data aggregation. The KP LULUCF reporting of Poland is based on the annually updated administrative data and maps from the National Record of Lands and Buildings, data from database of Agriculture Real Estate Agency and also system containing digital maps and database operated by the Polish State Forest Holding as a part of management system in polish governmental forests.

10.3. Activity-specific information

10.3.1. 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 in statistical studies by the Central Statistical Office. From 2010 results of National Forest inventory for all ownership forms became an official source of forest resources information. Date used for estimation is published by the Central Statistical Office in the yearbook ,, Forestry 2010". In addition results of National Forest Inventory for all ownership forms provided information with average thickness of dead wood on forest land (about 5,7 m^3/ha for all ownership form of forests). Presented thickness of dead wood is an average volume for the following five-year period 2005-2009 of sampling scheme (as a result of measurements on sample plots for the entire time of first cycle of NFI) . As a result of this situation is assumed that the carbon stock change in dead wood in the following years 2008 and 2009 is constant and is equal to zero.

10.3.2. 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 Polish Forestry Act (1991.45.435) "... 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 land subjected to AR, D, and FM activities, therefore carbon pools for these activities were filled with notation keys NO in NIR 1. However methods of GHG emissions estimation from wildfires on forest land as a results of natural disasters were provided in the suitable chapter of NIR 2011 (7.2).

In addition, process of dewatering of organic soils on forest land was limited consists with good practices related to sustainable forest management. Moreover, actions carried out currently aim at regulation of water level , allowing to stop the process of lowering the soils groundwater level on forest land. To keep correctness in CRF tables notation keys NO (not occurring) were used in the table NIR1 and connected tables for all indicated activities for organic soils on forest land.

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 connected litter pools for all activities on forest land

10.3.3. 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.

10.3.4. Changes in data and methods since the previous submission (recalculations)

The following changes for the years 2008-2009 in relation to the previous inventory report for the year 2008:

- Summarized area of Afforestation was updated. Land not fulfilling definition of forest converted to forest land as a process fulfilling definition of Afforestation. Abandonment of agricultural land use as a conscious decision of land owners resulting in a natural succession of agricultural land, which begins natural development of forest habitat an conversion to forest land as a part of cadastral changes. Therefore, the total area of land being a subject of Afforestation is represented by increment of forest area from 1990 to 2009.
- Update of the total area of deforestation, land area of his category is represented by the summarized area of forest land exemptions for non-forest purposes in the period 1990-2009,
- Estimation of area of organic soils on lands other than forest land converted to forest was estimated (including primary type of use)(subject to Afforestion/Reforestation actvieties)
- correction of factor BEF_2 ,
- adjustment of the basic wood density with relation to the latest in-country research data,
- adjustment of the increment in growing stock of merchantable timber.

10.3.5. Uncertainty estimates

Uncertainty analysis in GHG emissions to the air for the IPCC sector 5.LULUCF under the Kyoto Protocol in 2009 have been prepared on the basis of uncertainty of the whole sector 5 LULUCF, allowing mapping of the problems of national statistics – including consideration of the uncertainty associated with the activity data (areas) and the emission factors in different subsectors. Table given below is summarizing the results of this analysis, and accurate information about the accuracy of the data and complete analysis of uncertainty can be found in Annex 6 to this report. Recalculation of data based on updated values for the years 2008-2009 provided consistency for the entire time series allowing for a summary and comparison of the trend in emissions.

Table 10.1. The results of the analysis of uncertainty for sector 5 LULUCF under the Kyoto Protocol in the year:

2009	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Uncertainty CO_2	Uncertainty CH_4	Uncertainty N_2O
LULUCF Sector	-39 516.54	111.18	0.02	19.3%	99.7%	88.0%
Forest land	-51 943.87	1.53	0.01	15.0%	100%	100%

10.3.6. 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.

10.3.7. The year of the onset of an activity, if after 2008

Not applicable.

10.4. Article 3.3.

10.4.1. 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

10.4.2 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.

10.4.3. 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 Farm and Woodland Conservation Act (2004.121.1266) 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.

10.5. Article 3.4.

10.5.1. 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 Forestry Act (Journal of Laws 91.101.444).

10.5.2. 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)

10.5.3. Information relating to Forest Management.

All operations related to Forest management are conducted under strict provisions contained in the framework of the Forestry Act of 28 September 1991 (Journal of Laws 1991.101.444).

10.6. Other information

10.6.1. 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 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 the results to be expected in the results of ongoing work related to the successive stages of National Forest Inventory for all ownership forms.

10.7. Information relating to Article 6

There are no Article 6 activities concerning the LULUCF sector in Poland.

11. Information on accounting of Kyoto units

11.1 Background information

In order to meet Annex I Parties obligations of reporting on holdings and transactions with Kyoto units within the National Registry of Poland, the following chapters present relevant data on the topic.

11.2 Summary of information reported in the SEF tables

The SEF report was attached to the NIR document in Annex 6. It contains information on ERUs, tCERs, lCERs, AAUs and RMUs held and transferred into and/ or outside of the registry in year 2010 (reference: SEF_PL_2011_1_10-37-20 15-2-2011.xls).

11.3 Discrepancies and notifications

In accordance with respective paragraphs of the annex I.E to Decision 15/CMP.1 additional information on KP units were indicated:

a) *paragraph 12: List of discrepant transactions*

There were ten discrepant transactions identified in the registry during year 2010.
(reference: SIAR Reports 2010-PL v.1_2011.02.15.xls, Report R-2)

b) *paragraph 13 & 14: List of CDM notifications*

No CDM notifications occurred in 2010.
(reference: SIAR Reports 2010-PL v.1_2011.02.15.xls; Report R-3)

c) *paragraph 15: List of non-replacements*

No non-replacements occurred in 2010.
(reference: SIAR Reports 2010-PL v.1_2011.02.15.xls; Report R-4)

d) *paragraph 16: List of invalid units*

No invalid units exist as at 31st December 2010.
(reference: SIAR Reports SIAR Reports 2010-PL v.1_2011.02.15.xls; Report R-5)

e) *paragraph 17: Actions and changes to address discrepancies*

In the end of year 2010 the Seringas application provider – CDC Climat company – delivered functionality – New Message Flow. The functionality was created in accordance with the Data Exchange Standards document and its aim is to reduce number of occurrence of discrepancies between Polish registry and ITL.

At the time of preparation of this NIR report the New Message Flow was implemented on the production environment of Polish registry.

The details of the change are provided in annex 7 in a document "New Message Flow_specification". The results of implementation of the change should be documented in the next year submission of National Inventory Report.

No changes were made to the readiness documentation. The above functionality is an automated one and fully in line with DES, therefore, it has no impact on the registry procedures.

11.4 Publicly accessible information

Pursuant to part E of the annex to Decision 13/ CMP.1 following information were made publicly available directly from the registry website (https://rejestr.kashue.pl/):

a) *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 (Article 6) project information.*
(reference: http://formularze.kashue.pl/raporty/Public_ART46.htm)

b) *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: http://formularze.kashue.pl/raporty/Public_ART47_a.pdf)

Information on the total quantity of ERUs, CERs, AAUs and RMUs held in *each account* is considered to be confidential (in accordance with point 7(a) of the annex XVI to the Commission Regulation (EC) No 2216/2004 of 21st December 2004). This information shall be displayed from 15 January onwards of year (X+5).

   - *paragraph 47 (b): The total quantity of AAUs issued on the basis of the assigned amount pursuant to Article 3*

(reference: http://formularze.kashue.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: http://formularze.kashue.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: http://formularze.kashue.pl/raporty/Public_ART47_d_f.pdf)

Information on the transferring accounts is considered to be confidential (in accordance with point 7(d) of the annex XVI to the Commission Regulation (EC) No 2216/2004 of 21st December 2004). This information shall be displayed from 15 January onwards of year (X+5).

   - *paragraph 47 (e): The total quantity of RMUs issued on the basis of each activity under Article 3*

(reference: http://formularze.kashue.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: http://formularze.kashue.pl/raporty/Public_ART47_d_f.pdf)

Information on the accounts in acquiring registry is considered to be confidential (in accordance with point 7(f) of the annex XVI to the Commission Regulation (EC) No 2216/2004 of 21st December 2004). This information shall be displayed from 15 January onwards of year (X+5).

   - *paragraph 47 (g): The total quantity of ERUs, CERs, AAUs and RMUs cancelled on the basis of activities under Article 3*

(reference: http://formularze.kashue.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: http://formularze.kashue.pl/raporty/Public_ART47_b_h_k.pdf)

   - *paragraph 47 (i): The total quantity of other ERUs, CERs, AAUs and RMUs cancelled*

(reference: http://formularze.kashue.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

   - *paragraph 47 (j): The total quantity of ERUs, CERs, AAUs and RMUs retired*

(reference: http://formularze.kashue.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: http://formularze.kashue.pl/raporty/Public_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: http://formularze.kashue.pl/raporty/Public_ART47_l.pdf
The report detail is limited to information related to subtotals per account type.
In accordance with point 7(m) of the annex XVI to the Commission Regulation (EC) No 2216/2004 of 21st December 2004 this information is considered to be confidential and it shall be displayed from 15 January onwards of year (X+5).
Till then more detail information should be treated as confidential.

c) *paragraph 48: List of legal entities authorized by Party*

These information is available in the report – *List of legal entities holding an account in the national registry.*
(reference: go to section 'Download Public reports' in the left menu on the registry website)

Due to a change of *COMMISSION REGULATION (EC) No 2216/2004 of 21 December 2004 for a standardised 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* 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, mailing address, telephone number, facsimile number and email address became confidential. As a result the report – *paragraph 45: Account information* – is no longer available on the Polish registry website.

11.5 Calculation of the commitment period reserve (CPR)

The national Commitment Period Reserve (CPR) as indicated in the registry (state on 15 February 2011) is 1,985,230,315 tonnes of CO_2 eq. It was calculated based on 2008 emissions verified by the Expert Review Team in 2010 and multiplied by 5:

5 * 397,046,063 tonnes of CO_2 eq. = 1,985,230,315 tonnes CO_2 eq.

11.6 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.

12. Information on changes in national system

There were no changes in the national system for GHG inventories in Poland since the last NIR 2010 was issued.

13. Information on changes in national registry

This section serves to submit changes which occurred within the national registry in the reported year 2010 since the previous NIR report.

With reference to following paragraphs of the annex II.E to Decision 15/ CMP.1:

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*

No change of cooperation arrangement occurred during the reported period.

c) paragraph 32.(c): Change to the database or the capacity of National Registry

No change to the database or to the capacity of the national registry occurred during the reported period.

d) paragraph 32.(d): Change of conformance to technical standards

Due to requirements set out by the European Commission Polish registry application was upgraded to new release from Seringas version 4.2 to 5.0 on 26th of May 2010. The upgraded version enabled the registry to communicate particular information to the CITL via WebServices instead of sending an XML file.

The following documents concerning the application upgrade were attached in annex 7:

- Test plan of conformity test against CITL/ ITL conducted between 19-23 of April 2010 – Test Plan v. 1.2 updated 01102009.doc,
- Email sent by EC representative, confirming successful finalization of the conformity test – Confirmation on positive test result_from EC.doc.

There was no change to the registry procedures made.

e) paragraph 32.(e): Change of discrepancies procedures

No change of discrepancies procedures occurred during the reported period.

f) paragraph 32.(f): Change of Security

No change of security measures occurred during the reporting period.

g) paragraph 32.(g): Change of list of publicly available information

Pursuant to part E of the annex to Decision 13/CMP.1 (paragraphs 44, 46, 47 and 48) publicly available information is accessible directly from PL Registry website – https://rejestr.kashue.pl/.

The information referred to in *paragraph 45: Account information* of part E of the annex to Decision 13/CMP.1 is no longer available on the Polish registry website. This is due to an amendment of Commission Regulation (EC) No 2216/2004 of 21 December 2004 where information on account representatives became confidential by default.

For more details please see the section 11.4 Publicly accessible information of present NIR.

h) paragraph 32.(h): Change of Internet address

No change of the registry Internet address occurred during the reporting period.

i) paragraph 32.(i): Change of data integrity measure

No change of data integrity measures occurred during the reporting period.

j) paragraph 32.(j): Change of test results

No change of test results occurred during the reporting period.

14. Information on minimization of adverse impacts in accordance with Article 3.14

Below Poland provides information 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.

As a Member State, Poland is obligated to accomplish EU environmental, energy and science policy activities. One of the EU main target is to limit negative influence on environment of energy sector by – among others – reduction of carbon dioxide and other substances emissions, also in developing countries, using clean development mechanisms of the Kyoto Protocol. Poland is also involved in economic cooperation with many developing countries. In frames of this cooperation there are number of contracts realized, for example concerning delivery of low-carbon equipments and technologies, modern mining machinery, electro−machine and chemical equipment. There are also economic and science cooperation programs, including education of students in developing countries.

Poland, in its energy policy, cares on efficient and ecologically most favourable conditions for production and to make use of fuels and energy. Following the EU legislation, market facilitation of fuel and energy prices occurred, as well as an energy efficiency improvement instruments have been introduced into the economy, for example equipment and buildings certification programs, termomodernization of buildings, also introducing of white certificates is expected soon on the basis of new legislation on energy efficiency.

As a country with energy balance based on coal, with aim to evolve to a low-emission economy, Poland attempts to develop low carbon technologies with renewable energy sources, biofuels, nuclear energy, among others. Part of technologies developed in Poland is on early stage of development. In the next level these technologies will become a subject of cooperation also with developing countries. In the scope of CCS technologies (Carbon Capture and Storage) Poland is going to start projects in pilot phase on the basis of EU Demonstration Program, which will co-finance 10-12 objects of this type across EU. Present activities aim at identifying potential financial support sources for realization of these objects. One of solution is to get the financing from auction of reserve of allowances established for new installations (so called NER 300) which will be assigned in the first half of year 2012.

It is also important, that in the scope of preparing geological CO_2 storage, Ministry of Environment began in 2008 program called *Identifying of geological structures for safety carbon storage.* The aim of above mentioned program is to give essential knowledge on the potential of carbon storage in Poland. Conclusion of this program is planned on the end of year 2012.

Low−carbon technologies are of big importance for Poland because app. 90% of electrical energy needs and app. 80% of centralized heat needs are satisfied based upon coal. Adopted by the Government on 2009 „Energy Policy for Poland until 2030" assumes that for the next 20 years coal will play the role of stabilizer of Poland's energy security. One of the conditions of its implementation (in light of climate-energy packet) is the application of low-emission technologies of energy acquiring, i.e. Clean Coal Technologies (CCT).

This subject was taken up earlier in „Strategy of hard coal mining sector in Poland in 2007-2015", where it was noticed that in light of depleting world resources of crude oil and increasing world prices of that raw material, it is necessary to search for alternative energy sources. One of them is production of liquid and gaseous fuels based on hard coal. The Ministry of Economy was assigned the task to prepare a feasibility study for the installation that would produce liquid and gaseous fuels based on hard coal. The study should help specify advantages and disadvantages for various technological solutions.

The Ministry of Economy commissioned to prepare a feasibility study for the installation that would produce liquid and gaseous fuels based on hard coal. The conclusions of this study showed, that presently the production of diesel oil using Fisher-Tropsch synthesis is unprofitable. The project is expected not to accomplish the demand level of reimbursement in any projected development scenario. The main reasons are very high initial investment expenses to build a factory and to start production process. Study showed also, that producing hydrogen and methanol in only one installation will provide all chemical plants in Poland with fuel. This project will allow the chemical industry to become independent from natural gas unstable delivery and prices.

The Minister of Economy decided to present in public the study results at the conference what completed activities related to statutory delegation concerning the commission of study feasibility of installation that would produce liquid and gaseous fuels based on hard coal. Information contained in the study are also used during further meetings with stakeholders. The study is publicly available through the website of the Ministry of Economy.

One should also note research on CCT conducted by Polish research and development institutes. The leading role in this research is played by: Central Mining Institute (GIG) in Katowice and Institute for Chemical Processing of Coal at Zabrze. These two institutes – based on an agreement – began to develop the Centre for Clean Coal Technologies. The aim of the Centre is to create in Poland a EU leading research centre and know – how centre for commercialization of innovative CCT. Unique research infrastructure of the Centre, that will include i.e. demonstration installations, will allow for carrying out basic research as well as development and demonstration studies concerning promising technologies of coal use. The development of the Centre is co-financed from Operational Program Innovative Economy, years 2007-2013, Priority 2. Infrastructure areas B+R, Activity 2.1 Development of centres of high research potential. It is worth to mention that GIG participates in the European program on underground coal gasification – HUGE (*Hydrogen Oriented Underground Coal Gasification for Europe*).

Poland intends to develop the nuclear energy with the coal as the main energy source still. In 2020 first reactor is planned for initialisation. Following the "Programme of the Polish nuclear energy" accepted by the government the process started of capacity building for implementation nuclear technology within the country. In the future Poland would share its experience in this issue with developing countries demanding for building nuclear reactors for its own, or regional, demands. Poland as the country attending in the decision bodies of the international finance institutions will be able to support initiatives aiming at ensuring finance for projects related to nuclear energy in developing countries.

One of the example of EU legislation on trade that has or can have influence on developing countries is the COUNCIL REGULATION (EC) No 732/2008 of 22 July 2008 applying a scheme of generalized tariff preferences for the period from 1 January 2009 to 31 December 2011 – so called UE GSP system (because of the close date of termination of this system the works are planned for its modification at the EU forum. According to the Regulation, developing countries that plan to apply for being covered by generalized tariff preferences when accessing EU market within the so called GSP+ mechanism, independently of necessity to fulfil specified economic criteria, are obliged to ratify and effectively implement a number of international conventions (described in the Annex II to the GSP regulation No 732/2008), of which some relate to the environmental protection and good governance rules. The conventions listed cover:

- the Kyoto Protocol to the Framework Convention on Climate Change,
- the Montreal Protocol on Substances That Deplete the Ozone Layer,

- the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal,
- the Stockholm Convention on Persistent Organic Pollutants.

Providing of effective implementation of conventions mentioned in Annex II to the GSP regulation No 732/2008 is monitored by EU. In case, when certain convention is not being implemented, after conducting required checking procedure on EU forum, there is possibility of excluding developing country from beneficiary list of GSP+ generalized tariff preferences. Other trade ground, where environmental protection issue occur are trade negotiations conducted by EC on the basis of negotiation mandate, given EU by Member States. This concerns both, multilateral negotiations (held under the auspices of World Trade Organisation – WTO) and bilateral and plurilateral negotiations in frames of free trade zones (FTZ) agreements.

With respect to trade issues, the multilateral WTO negotiations within the DDA round, cover inter alia activities that aim at liberalization of trade of environmental goods and services EGS. The main goal of the negotiations in this respect is to identify barriers that limit trade exchange of these products. The issue of lowering or removing the barriers both in form of tariffs and non-tariffs that concern environmental goods and services, was specified in para. 31(iii) of Ministerial Declaration of Doha[6]. Negotiations in this respect as well as the entire DDA WTO round have not been finalized yet.

In the context of bilateral and multilateral negotiations on agreements on free trade zones (FTZ), the key role is played by Commission Communication of 2006 „Global dimension of Europe – Competing on global market” [7] and Commission Communication “Growth and World Policy”. Trade policy is also a key element of Europe 2020[8] strategy, which states how EU trade policy should support European economic and employment growth. According to these documents, one of proposed activities was negotiating by EU complex agreements on free trade zones (FTZ) with selected Third Parties. More attention will also be paid on incorporation part of effect assessment into EU trade policy making process. Assessment of effects will cover all new trade initiatives with potentially important economic, social and environment effects for EU and its trade partners, including developing countries.

In scope of this communications, EU trade policy still should support realization of environmental development targets and climate change combat, especially CO_2 emission reduction. European Commission states also, that EU must take care of EU industry, to compete effectively in balanced future economy. EC indicates also that EU agriculture and fishery will undergo further reforms. In climate change context, EC declare that purchasing global agreement stating aims concerning emission reduction for each country in the world remains priority. Support from EU trade policy for climate change combat should be realized by barrier elimination for ecologically friendly products and services. European Commission also sustains opinion, that option of implementing ecological border duties, creates number of problems, which are laid down in Commission Communication *Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage*[9].
In scope of mentioned Communicates, in broader view trade policy should support and prom environmental growth all over the world in other areas, such as energy, effective resource management or biodiversity protection. Commission declares also that will still pay particular attention on presence of chapters concerning fulfilling sustainable development in EU trade agreements with Third Parties.

[6] Paragraphs 31-33 and 51 of the Ministerial Declaration of Doha
[7] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the committee of the regions Global Europe: competing in the world. A *Contribution to the EU's Growth and Jobs Strategy.* (COM(2006)567)
[8] *Vide* footnote No 1
[9] Communication from the Commission COM(2010) 265 from 26 May 2010.

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 element of the Copenhagen Accord on December 2009 concerning financial support provided by the developed countries in 2010−2012 of 30 billion USD to the developing countries for the implementation of their climate policies.

The decision was then undertaken in co-operation of the ministries: Foreign Affairs, Environment and Finance regarding the implementation of the *fast start* obligation to submit, as the Polish part of the fast start, selected projects implemented so far within the Polish development assistance as bilateral enterprises. These projects amount for 3.2 million EUR and the beneficiary countries are:

China	2.089 million EUR
Afghanistan	0.566 million EUR
Ukraine	0.372 million EUR
Georgia	0.152 million EUR
Belarus	0.025 million EUR

Mentioned above projects were submitted by Poland to the Belgian Presidency report on progress in realisation of obligations concerning fast star financing made by the European Union and its Member States. Still there is a need to elaborate comprehensive system of implementation the Polish segment of obligations resulting from fast start financing.

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 2009

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,
- 1.A.3.b Transport Road Transportation,
- Stationary combustion Gaseous Fuels.

Emission from these sources made up 71.3% 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 64.4% of the total GHG emissions. Combustion of solid fuels in stationary sources alone, made up 53.4% of the total GHG emissions.

The most important source categories in level assessment are:
- Stationary combustion Solid Fuels,
- 1.A.3.b Transport Road Transportation,
- Stationary combustion Gaseous Fuels.

Share of these sources in national total made up 71.3%.

7.A1 - 7.A3 IPCC Good Practice Guidance tables, concerning level and trend assessment are listed below.

Level Assessment without category 5

		IPCC Source Categories	Direct GHG	Emission in 2009	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	204 806.16	0.5344	0.53
2	1.A.3.b	1.A.3.b Transport Road Transportatio	CO2	44 773.51	0.1168	0.65
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuel	CO2	23 560.89	0.0615	0.71
4	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	18 247.42	0.0476	0.76
5	4.D.1	4.D.1. Direct Soil Emissions	N2O	12 907.24	0.0337	0.79
6	4.A	4.A. Enteric Fermentation	CH4	9 194.37	0.0240	0.82
7	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	7 281.85	0.0190	0.84
8	6.A	6.A. Solid Waste Disposal on Land	CH4	6 424.75	0.0168	0.85
9	2.A.1	2.A.1 Cement Production	CO2	5 757.24	0.0150	0.87
10	2.C1	2.C.1. Iron and Steel Production	CO2	5 640.77	0.0147	0.88
11	4.B	4.B. Manure Management	N2O	5 041.89	0.0132	0.90
12	4.D.3	4.D.3. Indirect Soil Emissions	N2O	4 769.88	0.0124	0.91
13	1.B.2.b.	1.B.2.b. Natural Gas	CH4	4 255.57	0.0111	0.92
14	2.B.1.	2.B.1. Ammonia Production	CO2	3 493.08	0.0091	0.93
15	2.F.1	2.F.1. Refrigeration and Air Condition	HFC	3 377.36	0.0088	0.94
16	2.F.9	2.F.9. Potential emissions as a proxy	HFC	3 170.46	0.0083	0.95

Level Assessment with category 5

		IPCC Source Categories	Direct GHG	Emission in 2009	Absolut Value of Current Year Estimate	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	204 806.16	204 806.16	0.4550	0.46
2	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	44 773.51	44 773.51	0.0995	0.55
3	5.A.1	5.A.1 Forest Land remaining Forest Land	CO2	-44 604.70	44 604.70	0.0991	0.65
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	23 560.89	23 560.89	0.0523	0.71
5	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	18 247.42	18 247.42	0.0405	0.75
6	4.D.1	4.D.1. Direct Soil Emissions	N2O	12 907.24	12 907.24	0.0287	0.78
7	5.B.1	5.B.1 Cropland remaining Cropland	CO2	9 253.56	9 253.56	0.0206	0.80
8	4.A	4.A. Enteric Fermentation	CH4	9 194.37	9 194.37	0.0204	0.82
9	5.A.2	5.A.2 Land converted to Forest Land	CO2	-7 339.17	7 339.17	0.0163	0.83
10	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	7 281.85	7 281.85	0.0162	0.85
11	6.A	6.A. Solid Waste Disposal on Land	CH4	6 424.75	6 424.75	0.0143	0.86
12	2.A.1	2.A.1 Cement Production	CO2	5 757.24	5 757.24	0.0128	0.88
13	2.C1	2.C.1. Iron and Steel Production	CO2	5 640.77	5 640.77	0.0125	0.89
14	4.B	4.B. Manure Management	N2O	5 041.89	5 041.89	0.0112	0.90
15	4.D.3	4.D.3. Indirect Soil Emissions	N2O	4 769.88	4 769.88	0.0106	0.91
16	1.B.2.b.	1.B.2.b. Natural Gas	CH4	4 255.57	4 255.57	0.0095	0.92
17	2.B.1.	2.B.1. Ammonia Production	CO2	3 493.08	3 493.08	0.0078	0.93
18	2.F.1	2.F.1. Refrigeration and Air Conditioning Equip	HFC	3 377.36	3 377.36	0.0075	0.93
19	2.F.9	2.F.9. Potential emissions as a proxy for actua	HFC	3 170.46	3 170.46	0.0070	0.94
20	4.B	4.B. Manure Management	CH4	3 106.76	3 106.76	0.0069	0.95

Trend Assessment without category 5

		IPCC Source Categories	Direct GHG	Base Year Estimate	Emission in 2009	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	384 148.28	204 806.16	0.5344	0.2167	37.65235	0.38
2	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	16 068.28	44 773.51	0.1168	0.1298	22.56586	0.60
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	15 813.67	23 560.89	0.0615	0.0491	8.53787	0.69
4	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	18 580.41	18 247.42	0.0476	0.0215	3.74045	0.72
5	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	18 455.82	7 281.85	0.0190	0.0202	3.51432	0.76
6	2.F.1	2.F.1. Refrigeration and Air Conditioning Equi	HFC	10.52	3 377.36	0.0088	0.0129	2.24708	0.78
7	2.F.9	2.F.9. Potential emissions as a proxy for actua	HFC	0.00	3 170.46	0.0083	0.0122	2.11390	0.80
8	6.A	6.A. Solid Waste Disposal on Land	CH4	4 934.38	6 424.75	0.0168	0.0118	2.04601	0.82
9	4.D.1	4.D.1. Direct Soil Emissions	N2O	14 526.08	12 907.24	0.0337	0.0116	2.01848	0.84
10	1.A.3.c	1.A.3.c Transport Railways	CO2	3 853.56	410.97	0.0011	0.0085	1.47353	0.86
11	2.B.2	2.B.2. Nitric Acid Production	N2O	4 386.47	870.74	0.0023	0.0081	1.40865	0.87
12	2.C1	2.C.1. Iron and Steel Production	CO2	10 888.61	5 640.77	0.0147	0.0068	1.17688	0.88
13	2.G	2.G. Other	CO2	0.00	1 523.20	0.0040	0.0058	1.01559	0.90
14	4.A	4.A. Enteric Fermentation	CH4	15 706.86	9 194.37	0.0240	0.0057	0.99253	0.91
15	1.B.2.b.	1.B.2.b. Natural Gas	CH4	4 111.11	4 255.57	0.0111	0.0056	0.97305	0.91
16	4.B	4.B. Manure Management	N2O	9 335.10	5 041.89	0.0132	0.0050	0.87168	0.92
17	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 460.68	1 866.83	0.0049	0.0045	0.77816	0.93
18	2.A.2	2.A.2. Lime Production	CO2	3 477.55	1 315.24	0.0034	0.0040	0.70009	0.94
19	2.A.1	2.A.1 Cement Production	CO2	7 028.18	5 757.24	0.0150	0.0037	0.65144	0.94
20	4.B	4.B. Manure Management	CH4	3 419.72	3 106.76	0.0081	0.0030	0.52063	0.95

Trend Assessment with category 5

		IPCC Source Categories	Direct GHG	Base Year Estimate	Absolut Value of Base Year Estimate	Emission in 2009	Absolut Value of Current Year Estimate	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	384 148.28	384 148.28	204 806.16	204 806.16	0.4550	0.2249	36.4768	0.36
2	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	16 068.28	16 068.28	44 773.51	44 773.51	0.0995	0.1017	16.4994	0.53
3	5.A.1	5.A.1 Forest Land remaining Forest Land	CO2	-42 705.20	42 705.20	-44 604.70	44 604.70	0.0991	0.0420	6.8161	0.60
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	15 813.67	15 813.67	23 560.89	23 560.89	0.0523	0.0372	6.0307	0.66
5	5.A.2	5.A.2 Land converted to Forest Land	CO2	0.00	0.00	-7 339.17	7 339.17	0.0163	0.0225	3.6537	0.69
6	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	18 455.82	18 455.82	7 281.85	7 281.85	0.0162	0.0187	3.0258	0.73
7	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	18 580.41	18 580.41	18 247.42	18 247.42	0.0405	0.0147	2.3884	0.75
8	2.F.1	2.F.1. Refrigeration and Air Conditioning Equip	HFC	10.52	10.52	3 377.36	3 377.36	0.0075	0.0103	1.6776	0.77
9	5.B.1	5.B.1 Cropland remaining Cropland	CO2	8 165.26	8 165.26	9 253.56	9 253.56	0.0206	0.0103	1.6642	0.78
10	2.F.9	2.F.9. Potential emissions as a proxy for actua	HFC	0.00	0.00	3 170.46	3 170.46	0.0070	0.0097	1.5784	0.80
11	5.C.1	5.C.1 Grassland remaining Grassland	CO2	4 530.69	4 530.69	136.04	136.04	0.0003	0.0096	1.5650	0.81
12	5.D.1	5.D.1 Wetlands remaining Wetlands	CO2	0.00	0.00	3 002.30	3 002.30	0.0067	0.0092	1.4947	0.83
13	6.A	6.A. Solid Waste Disposal on Land	CH4	4 934.38	4 934.38	6 424.75	6 424.75	0.0143	0.0088	1.4203	0.84
14	4.D.1	4.D.1. Direct Soil Emissions	N2O	14 526.08	14 526.08	12 907.24	12 907.24	0.0287	0.0073	1.1909	0.85
15	1.A.3.c	1.A.3.c Transport Railways	CO2	3 853.56	3 853.56	410.97	410.97	0.0009	0.0073	1.1841	0.87
16	2.B.2	2.B.2. Nitric Acid Production	N2O	4 386.47	4 386.47	870.74	870.74	0.0019	0.0071	1.1473	0.88
17	5.D.2	5.D.2 Land converted to Wetlands	CH4	0.00	0.00	2 301.71	2 301.71	0.0051	0.0071	1.1459	0.89
18	2.C1	2.C.1. Iron and Steel Production	CO2	10 888.61	10 888.61	5 640.77	5 640.77	0.0125	0.0069	1.1158	0.90
19	4.A	4.A. Enteric Fermentation	CH4	15 706.86	15 706.86	9 194.37	9 194.37	0.0204	0.0067	1.0830	0.91
20	5.E.1	5.E.1 Settlements remaining Settlements	CO2	-2 925.46	2 925.46	-76.94	76.94	0.0002	0.0063	1.0160	0.92
21	4.B	4.B. Manure Management	N2O	9 335.10	9 335.10	5 041.89	5 041.89	0.0112	0.0053	0.8541	0.93
22	2.G	2.G. Other	CO2	0.00	0.00	1 523.20	1 523.20	0.0034	0.0047	0.7583	0.94
23	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 460.68	4 460.68	1 866.83	1 866.83	0.0041	0.0042	0.6781	0.94
24	1.B.2.b.	1.B.2.b. Natural Gas	CH4	4 111.11	4 111.11	4 255.57	4 255.57	0.0095	0.0039	0.6370	0.95

	IPCC Source Categories	Direct GHG	Level Assessement - L, Trend Assessment - T	
	ENERGY			
1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO_2	L	T
1.A.1, 2, 4	Stationary combustion Solid Fuels	CO_2	L	T
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO_2	L	T
1.A.1, 2, 4	Stationary combustion Liquid Fuels	CH_4		
1.A.1, 2, 4	Stationary combustion Solid Fuels	CH_4		T
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CH_4		
1.A.1, 2, 4	Stationary combustion Biomass	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.3.a	1.A.3.a Transport Civil Aviation	CO_2		
1.A.3.b	1.A.3.b Transport Road Transportation	CO_2	L	T
1.A.3.c	1.A.3.c Transport Railways	CO_2		T
1.A.3.d	1.A.3.d Transport Navigation	CO_2		
1.A.3.e	1.A.3.e Transport Other	CO_2		
1.A.3.a	1.A.3.a Transport Civil Aviation	CH_4		
1.A.3.b	1.A.3.b Transport Road Transportation	CH_4		
1.A.3.c	1.A.3.c Transport Railways	CH_4		
1.A.3.d	1.A.3.d Transport Navigation	CH_4		
1.A.3.e	1.A.3.e Transport Other	CH_4		
1.A.3.a	1.A.3.a Transport Civil Aviation	N_2O		
1.A.3.b	1.A.3.b Transport Road Transportation	N_2O		
1.A.3.c	1.A.3.c Transport Railways	N_2O		
1.A.3.d	1.A.3.d Transport Navigation	N_2O		
1.A.3.e	1.A.3.e Transport Other	N_2O		
1.A.5.b	1.A.5.b Other Mobile	CO_2		
1.A.5.b	1.A.5.b Other Mobile	CH_4		
1.A.5.b	1.A.5.b Other Mobile	N_2O		
1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH_4	L	T
1.B.1.c.	1.B.1.c. Other	CO_2		
1.B.1.c.	1.B.1.c. Other	CH_4		
1.B.2.a.	1.B.2.a. Oil	CO_2		
1.B.2.a.	1.B.2.a. Oil	CH_4		
1.B.2.b.	1.B.2.b. Natural Gas	CO_2		
1.B.2.b.	1.B.2.b. Natural Gas	CH_4	L	T
1.B.2.c.	1.B.2.c. Venting and Flaring	CH_4		
1.B.2.c.	1.B.2.c. Venting and Flaring	N_2O		
	INDUSTRIAL PROCESSES			
2.A.1	2.A.1 Cement Production	CO_2	L	
2.A.2	2.A.2. Lime Production	CO_2		
2.A.3	2.A.3. Limestone and Dolomite Use	CO_2		
2.A.4	2.A.4. Soda Ash (production)	CO_2		
2.A.7	2.A.7. Other (ETS Data; Bricks, Tiles And Ceramics Materials	CO_2		
2.B.1.	2.B.1. Ammonia Production	CO_2	L	
2.B.1.	2.B.1. Ammonia Production	CH_4		
2.B.2	2.B.2. Nitric Acid Production	N_2O		T
2.B.3	2.B.3. Adipic Acid Production	N_2O		
2.B.4	2.B.4. Carbide Production (calcium carbide)	CO_2		
2.B.5	2.B.5. Other	CO_2		
2.B.5	2.B.5. Other	CH_4		
2.B.5	2.B.5. Other	N_2O		
2.C1	2.C.1. Iron and Steel Production	CO_2	L	T
2.C1	2.C.1. Iron and Steel Production	CH_4		
2.C1	2.C.1. Iron and Steel Production	N_2O		
2.C2	2.C.2. Ferroalloys Production	CO_2		

2.C3	2.C.3. Aluminium Production	CO_2		
2.C3	2.C.3. Aluminium Production	PFC		
2.C4	2.C.4. SF6 Used in Aluminium and Magnesium Foundries	SF_6		
2.C5	2.C.5. Other	CO_2		
2.D	2.D. Other Production	CO_2		
2.G	2.G. Other	CO_2		T
2.F.1	2.F.1. Refrigeration and Air Conditioning Equipment	HFC	L	T
2.F.2	2.F.2. Foam Blowing	HFC		
2.F.3	2.F.3. Fire Extinguishers	HFC		
2.F.3	2.F.3. Fire Extinguishers	PFC		
2.F.4	2.F.4. Aerosols/ Metered Dose Inhalers	HFC		
2.F.8	2.F.8. Electrical Equipment	SF_6		
	SOLVENT AND OTHER PRODUCT USE			
3.A	3.A. Paint Application	CO_2		
3.B	3.B. Degreasing and Dry Cleaning	CO_2		
3.C	3.C. Chemical Products, Manufacture and Processing	CO_2		
3.D	3.D. Other	CO_2		
3.D	3.D. Other	N_2O		
	AGRICULTURE			
4.A	4.A. Enteric Fermentation	CH_4	L	T
4.B	4.B. Manure Management	CH_4	L	
4.B	4.B. Manure Management	N_2O	L	T
4.D.1	4.D.1. Direct Soil Emissions	N_2O	L	T
4.D.2	4.D.2. Animal Production	N_2O		
4.D.3	4.D.3. Indirect Soil Emissions	N_2O	L	
2.F.9	2.F.9. Potential emissions as a proxy for actual emissions	N_2O	L	
4.F	4.F. Field Burning of Agricultural Residues	CH_4		
4.F	4.F. Field Burning of Agricultural Residues	N_2O		
	LAND USE CHANGE AND FORESTRY			
5.A.1	5.A.1 Forest Land remaining Forest Land	CO_2	L	T
5.A.1	5.A.1 Forest Land remaining Forest Land	CH_4		
5.A.1	5.A.1 Forest Land remaining Forest Land	N_2O		
5.A.2	5.A.2 Land converted to Forest Land	CO_2	L	T
5.B.1	5.B.1 Cropland remaining Cropland	CO_2	L	T
5.C.1	5.C.1 Grassland remaining Grassland	CO_2		T
5.C.1	5.C.1 Grassland remaining Grassland	CH_4		
5.C.1	5.C.1 Grassland remaining Grassland	N_2O		
5.D.1	5.D.1 Wetlands remaining Wetlands	CO_2		T
5.D.2	5.D.2 Land converted to Wetlands	CO_2		
5.D.2	5.D.2 Land converted to Wetlands	CH_4		T
5.D.2	5.D.2 Land converted to Wetlands	N_2O		
5.E.1	5.E.1 Settlements remaining Settlements	CO_2		T
5.E.2	5.E.2 Land converted to Settlements	CH_4		
5.E.2	5.E.2 Land converted to Settlements	N_2O		
	WASTE			
6.A	6.A. Solid Waste Disposal on Land	CH_4	L	T
6.B	6.B. Wastewater Handling	CH_4		
6.B	6.B. Wastewater Handling	N_2O		
6.C	6.C. Waste Incineration	CO_2		

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
hard coal	1822.106	1788.457	1529.054	1527.341	1465.860	1352.647	1302.699	1202.181	1260.146	1214.123	1149.841
lignite	569.854	576.649	554.888	561.066	548.381	550.556	539.099	529.015	532.967	530.630	535.211
hard coal briquettes (patent fuels)	5.016	3.900	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
brown coal briquettes	0.354	0.247	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
natural gas	21.274	21.900	21.641	16.329	9.562	3.107	4.094	4.738	7.157	7.949	10.768
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
biogas	0.004	0.006	0.014	0.000	0.024	0.000	0.006	0.125	0.137	0.088	0.204
industrial wastes	3.741	3.873	5.265	8.914	7.354	6.658	6.877	3.878	3.393	3.267	3.809
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
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
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
petroleum coke	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	12.939	10.944	8.864	7.524	7.239	6.954	5.301	4.104
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
motor gasoline	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
diesel oil	0.780	0.737	0.597	0.597	0.554	0.426	0.383	0.341	1.150	1.661	1.534
fuel oil	73.433	71.102	65.360	61.280	56.400	55.080	55.600	25.840	27.720	27.280	17.600
feedstocks	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
coke oven gas	5.568	6.565	7.125	7.555	8.863	8.144	13.147	12.828	13.975	16.450	13.697
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
gas works gas	0.659	0.579	0.167	0.129	0.335	0.085	0.037	0.021	0.004	0.000	0.001
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
Gaseous fuels	21.274	21.900	21.641	16.329	9.562	3.107	4.094	4.738	7.157	7.949	10.768
Solid fuels	2449.580	2419.961	2131.502	2130.741	2055.115	1937.193	1882.573	1761.067	1820.657	1773.077	1709.723
Biomass	16.699	15.129	14.585	14.384	17.289	13.783	14.057	1.447	2.793	3.381	3.877
Total	**2563.017**	**2529.984**	**2234.675**	**2224.074**	**2139.564**	**2010.431**	**1957.945**	**1793.483**	**1859.477**	**1813.394**	**1743.686**

Table 1. (cont.) Fuel consumption [PJ] in 1.A.1.a category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	1120.714	1113.803	1125.802	1084.005	1137.703	1116.588	1097.787	1154.565	1140.042	1056.696	1028.691
lignite	521.058	504.984	506.892	494.324	518.249	514.275	533.979	525.817	501.140	521.178	494.027
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	0.001
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	16.210	21.627	28.242	38.700	45.496	53.667	57.039	52.808	49.653	51.711	51.760
fuel wood and wood waste	3.398	3.461	4.886	4.809	5.799	8.905	17.500	21.180	25.434	38.251	55.082
biogas	0.349	0.443	0.563	0.615	0.734	1.293	1.820	2.021	2.305	3.038	3.123
industrial wastes	3.082	3.273	3.369	4.628	3.008	4.112	5.219	5.205	4.783	4.711	5.094
municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.192	0.184
municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.192	0.184
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.044
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	2.850	1.995	1.710	1.197	0.912	0.599	0.342	0.171	0.143	0.086	0.066
liquid petroleum gas (LPG)	0.230	0.184	0.184	0.184	0.046	0.138	0.000	0.000	0.000	0.000	0.007
motor gasoline	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
diesel oil	1.577	1.960	2.045	2.300	2.173	1.534	1.193	1.150	0.724	0.809	0.927
fuel oil	16.720	13.360	14.240	12.840	11.920	9.800	8.080	7.960	7.280	7.360	6.683
feedstocks	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	0.347	0.000	0.000	0.000	0.000
coke oven gas	16.076	17.094	17.079	16.420	18.032	16.955	14.373	18.322	19.907	21.739	17.487
blast furnace gas	3.286	4.317	4.976	4.783	5.715	6.665	4.146	8.323	5.965	9.766	7.443
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
Fuels											
Liquid fuels	18.527	15.504	16.469	15.324	14.139	11.472	9.620	9.110	8.004	8.169	7.661
Gaseous fuels	16.210	21.627	28.242	38.700	45.496	53.667	57.039	52.808	49.653	51.711	51.760
Solid fuels	1667.066	1645.466	1659.828	1605.357	1683.619	1659.194	1655.846	1712.403	1671.980	1614.368	1552.993
Biomass	3.747	3.904	5.449	5.424	6.533	10.198	19.320	23.201	27.739	41.481	58.389
Total	**1705.550**	**1686.501**	**1709.988**	**1664.805**	**1749.787**	**1734.531**	**1741.825**	**1797.522**	**1757.376**	**1715.729**	**1670.802**

Table 2. Fuel consumption [PJ] in 1.A.1.b category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	0.114	0.113	0.046	0.091	0.072	0.266	0.071	1.409	1.487	1.394	0.652
lignite	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
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
crude oil	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
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
biogas	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	2.506	0.350	0.163	0.438
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
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
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.780	1.620	1.992
petroleum coke	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	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
liquid petroleum gas (LPG)	0.000	0.000	0.000	0.092	0.092	0.046	0.046	0.000	0.000	0.046	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
jet kerosene	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	0.043	0.043	0.000	0.085	0.043	0.256	0.170	0.213	0.341
fuel oil	14.872	13.867	11.440	10.560	15.760	12.800	11.960	32.400	40.520	32.200	39.840
feedstocks	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	7.425	12.029	8.960	10.197	6.287
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
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
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
Fuels											
Liquid fuels	23.490	22.919	18.958	18.318	24.366	22.188	19.474	44.685	50.430	44.276	48.552
Gaseous fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244
Solid fuels	7.865	7.627	5.268	0.363	0.754	0.268	0.330	3.915	1.837	1.557	1.171
Biomass	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**	**20.220**	**26.628**	**24.064**	**21.395**	**50.162**	**54.016**	**48.362**	**57.967**

Table 2. (cont.) Fuel consumption [PJ] in 1.A.1.b category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	0.604	0.216	0.072	0.024	0.000	0.000	0.000	0.000	0.000	0.000	0.019
lignite	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
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	10.832	12.110	11.354	10.124	12.770	15.454	14.482	14.900	20.816	18.816	17.381
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
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
industrial wastes	0.310	0.219	0.000	0.000	0.176	0.221	0.285	0.224	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
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
other petroleum products	2.748	0.084	0.060	0.060	0.144	1.638	1.188	1.602	1.632	2.244	3.362
petroleum coke	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
liquid petroleum gas (LPG)	0.184	0.276	0.000	0.046	0.092	0.000	0.000	0.000	0.000	0.000	0.002
motor gasoline	0.088	0.132	0.000	0.000	0.132	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
diesel oil	0.085	1.363	0.383	0.852	0.341	0.980	0.298	0.724	0.170	0.426	0.237
fuel oil	35.600	36.160	42.280	42.560	43.520	43.120	42.560	49.695	44.080	43.560	44.059
feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
refinery gas	6.386	9.059	10.445	10.049	10.049	11.633	10.346	12.969	16.583	17.424	15.249
coke oven gas	0.051	0.069	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
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
Fuels											
Liquid fuels	45.091	47.074	53.168	53.567	54.278	57.371	54.392	64.990	62.465	63.654	62.909
Gaseous fuels	10.832	12.110	11.354	10.124	12.770	15.454	14.482	14.900	20.816	18.816	17.381
Solid fuels	0.965	0.504	0.072	0.024	0.176	0.221	0.285	0.224	0.000	0.000	0.019
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**56.888**	**59.688**	**64.594**	**63.715**	**67.224**	**73.046**	**69.159**	**80.114**	**83.281**	**82.470**	**80.309**

Table 3. Fuel consumption [PJ] in 1.A.1.c category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	12.314	10.347	10.509	8.000	6.474	25.447	60.345	63.483	60.980	60.042	58.023
lignite	0.416	0.057	0.067	0.119	0.069	0.291	0.257	0.280	0.320	0.310	0.249
hard coal briquettes (patent fuels)	0.023	0.000	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	0.018	0.018	0.000	0.036	0.018	0.018	0.036	0.036	0.018
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.084	0.084	0.084
natural gas	13.736	15.364	13.382	14.099	16.757	14.880	18.735	15.926	25.112	22.518	18.653
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
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.028	0.023
industrial wastes	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.151
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
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
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120	0.120	0.060
petroleum coke	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	0.627	0.570	0.285	0.513	1.226	0.884	0.599	0.143	0.086
liquid petroleum gas (LPG)	0.095	0.095	0.092	0.000	0.000	0.000	0.000	0.046	0.046	0.000	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
jet kerosene	0.000	0.000	0.043	0.043	0.043	0.043	0.043	0.086	0.000	0.000	0.043
diesel oil	2.167	1.993	1.746	2.130	2.300	4.345	3.535	3.748	3.238	2.812	2.215
fuel oil	0.241	0.040	0.040	0.040	0.080	0.360	0.280	0.160	0.160	0.080	0.520
feedstocks	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
coke oven gas	50.866	50.938	43.557	38.488	39.121	34.604	40.740	37.038	35.105	37.000	33.709
blast furnace gas	5.632	4.440	3.848	1.831	1.202	1.853	2.343	1.837	1.383	1.746	1.599
gas works gas	0.005	0.008	0.005	0.180	0.010	0.120	0.004	0.006	0.061	0.019	0.017
Fuels											
Liquid fuels	2.592	2.218	2.009	2.301	2.511	4.924	4.166	4.304	3.736	3.184	3.012
Gaseous fuels	13.736	15.364	13.382	14.099	16.757	14.880	18.735	15.926	25.112	22.518	18.653
Solid fuels	70.511	66.331	58.631	49.206	47.161	63.175	105.168	103.730	98.642	99.434	93.852
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004	0.014	0.031	0.026
Total	**86.857**	**83.914**	**74.028**	**65.606**	**66.433**	**82.987**	**128.080**	**123.964**	**127.504**	**125.167**	**115.543**

Table 3. (cont.) Fuel consumption [PJ] in 1.A.1.c category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	48.992	38.603	37.629	23.268	27.546	24.091	21.386	15.039	28.494	12.573	8.862
lignite	0.249	0.375	0.283	0.907	0.577	0.522	0.175	0.204	1.380	1.760	0.883
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
brown coal briquettes	0.018	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
crude oil	0.084	0.042	0.000	0.042	0.127	0.127	0.000	0.000	0.000	0.000	0.000
natural gas	20.198	20.032	14.053	13.325	9.103	10.278	11.121	13.566	10.101	9.343	19.545
fuel wood and wood waste	0.005	0.006	0.039	0.029	0.008	0.004	0.002	0.010	0.057	0.020	0.134
biogas	0.022	0.027	0.012	0.018	0.127	0.000	0.012	0.015	0.028	0.017	0.003
industrial wastes	0.155	0.010	0.283	0.711	0.437	0.132	0.159	0.034	0.068	0.051	0.036
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
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
other petroleum products	0.120	0.120	0.000	0.138	0.900	0.900	0.876	0.060	0.060	0.060	0.099
petroleum coke	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	0.171	0.029	0.000	0.114	0.057	0.029	0.000	0.029	0.656	0.007
liquid petroleum gas (LPG)	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.046	0.000	0.041
motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.025
jet kerosene	0.043	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.003
diesel oil	1.789	1.746	1.534	1.235	1.192	1.107	1.320	1.278	1.235	1.704	1.471
fuel oil	0.160	0.240	0.080	0.720	0.240	0.160	0.280	0.040	0.160	0.000	0.061
feedstocks	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
coke oven gas	29.871	32.634	33.213	32.345	36.592	36.810	33.544	36.472	40.442	39.605	28.051
blast furnace gas	0.768	0.781	2.171	4.493	5.771	6.135	4.673	1.114	5.229	0.008	0.000
gas works gas	0.013	0.004	0.004	0.004	0.000	0.004	0.003	0.004	0.005	0.006	0.000
Fuels											
Liquid fuels	2.242	2.148	1.614	2.135	2.459	2.294	2.519	1.424	1.501	1.764	1.699
Gaseous fuels	20.198	20.032	14.053	13.325	9.103	10.278	11.121	13.566	10.101	9.343	19.545
Solid fuels	80.095	72.596	73.612	61.728	71.037	67.751	59.969	52.867	75.647	54.659	37.840
Biomass	0.027	0.033	0.051	0.047	0.135	0.004	0.014	0.025	0.085	0.037	0.138
Total	**102.562**	**94.809**	**89.330**	**77.235**	**82.734**	**80.327**	**73.623**	**67.882**	**87.334**	**65.803**	**59.222**

Table 4. Fuel consumption [PJ] in 1.A.2.a category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	2.367	1.278	1.138	1.243	1.494	9.159	8.513	25.320	28.919	23.729	21.083
lignite	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
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
crude oil	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	51.839	32.306	24.476	23.036	24.152	23.163	24.055	26.915	23.119
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
biogas	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
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
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
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
petroleum coke	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	10.475	22.311	28.045	34.238	32.898	26.514	24.274	28.611	23.596
liquid petroleum gas (LPG)	0.000	0.000	0.000	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
jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
diesel oil	0.130	0.130	0.170	0.128	0.170	0.341	0.554	0.767	0.895	0.554	0.298
fuel oil	18.208	15.474	11.000	7.800	5.280	4.280	2.960	2.040	0.960	4.720	1.600
feedstocks	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
coke oven gas	32.570	30.997	26.038	22.090	22.567	21.604	25.167	27.686	24.024	24.087	24.742
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
gas works gas	4.316	3.219	2.174	1.462	0.718	0.613	0.067	0.067	0.080	0.058	0.007
Fuels											
Liquid fuels	18.338	15.604	11.170	7.928	5.450	4.621	3.514	2.807	1.855	5.274	1.898
Gaseous fuels	73.507	63.332	51.839	32.306	24.476	23.036	24.152	23.163	24.055	26.915	23.119
Solid fuels	98.404	88.673	80.388	81.765	85.230	95.562	98.752	120.138	112.000	112.605	98.948
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006
Total	**190.249**	**167.610**	**143.397**	**121.999**	**115.156**	**123.235**	**126.432**	**146.113**	**137.916**	**144.798**	**123.971**

Table 4. (cont.) Fuel consumption [PJ] in 1.A.2.a category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	19.055	18.268	12.755	7.969	8.598	10.674	4.998	3.643	3.158	0.567	2.893
lignite	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	0.006
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	20.699	21.482	17.261	14.652	14.637	19.696	16.622	19.796	20.861	19.655	15.864
fuel wood and wood waste	0.004	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
industrial wastes	0.008	0.000	0.002	0.000	0.771	1.522	0.806	1.010	1.287	0.993	0.474
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
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
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	22.254	22.065	20.081	21.291	22.515	22.886	3.429	3.099	5.676	2.199	2.836
liquid petroleum gas (LPG)	0.046	0.184	0.184	0.230	0.184	0.138	0.000	0.000	0.000	0.046	0.051
motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
jet kerosene	0.000	0.129	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
diesel oil	0.341	0.511	0.170	0.128	0.128	0.128	0.085	0.128	0.085	0.085	0.060
fuel oil	1.800	1.040	0.640	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
refinery gas	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	15.875	17.574	16.892	14.804	15.634	14.968	7.653	7.875	6.821	4.453	5.216
blast furnace gas	24.034	31.874	24.625	19.383	19.511	20.974	14.327	19.258	23.165	18.660	10.066
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
Fuels											
Liquid fuels	2.187	1.864	0.994	0.358	0.312	0.266	0.085	0.128	0.085	0.131	0.121
Gaseous fuels	20.699	21.482	17.261	14.652	14.637	19.696	16.622	19.796	20.861	19.655	15.864
Solid fuels	81.226	89.781	74.355	63.447	67.029	71.024	31.213	34.885	40.106	26.872	21.490
Biomass	0.004	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001
Total	**104.116**	**113.130**	**92.616**	**78.460**	**81.982**	**90.990**	**47.922**	**54.810**	**61.053**	**46.659**	**37.475**

Table 5. Fuel consumption [PJ] in 1.A.2.b category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	1.411	1.323	0.455	0.565	0.850	1.916	1.771	4.172	4.286	3.924	3.331
lignite	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
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
crude oil	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
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
biogas	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
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
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
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
petroleum coke	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	6.527	6.584	6.384
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
motor gasoline	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
diesel oil	0.043	0.043	0.043	0.043	0.128	0.085	0.128	0.170	0.213	0.213	0.256
fuel oil	0.643	0.764	0.760	0.800	0.800	0.760	0.800	0.720	0.680	0.640	0.520
feedstocks	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
coke oven gas	0.461	0.437	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
gas works gas	0.375	0.341	0.000	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	0.853	0.776
Gaseous fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.639
Solid fuels	12.871	11.551	6.908	6.264	3.644	5.438	9.007	12.649	13.224	12.869	11.879
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026
Total	**19.195**	**17.827**	**12.310**	**11.740**	**5.785**	**8.029**	**15.257**	**18.986**	**19.420**	**19.188**	**18.320**

Table 5. (cont.) Fuel consumption [PJ] in 1.A.2.b category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	3.117	3.052	3.644	2.531	2.205	1.107	0.000	0.024	0.477	0.000	0.003
lignite	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
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	5.660	5.814	5.700	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.851
fuel wood and wood waste	0.010	0.011	0.005	0.001	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
industrial wastes	2.070	2.268	2.551	2.739	2.539	1.800	1.003	1.004	0.982	1.252	1.119
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
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
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	5.928	6.071	6.156	6.156	5.928	5.957	5.814	6.042	6.441	6.641	6.193
liquid petroleum gas (LPG)	0.000	0.046	0.092	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.034
motor gasoline	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
diesel oil	0.170	0.256	0.170	0.170	0.128	0.170	0.170	0.170	0.170	0.170	0.175
fuel oil	0.560	0.560	0.520	0.400	0.320	0.400	0.400	0.400	0.160	0.160	0.158
feedstocks	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
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
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
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
Fuels											
Liquid fuels	0.730	0.862	0.782	0.616	0.494	0.616	0.616	0.616	0.376	0.376	0.369
Gaseous fuels	5.660	5.814	5.700	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.851
Solid fuels	11.115	11.391	12.351	11.426	10.672	8.864	6.817	7.070	7.900	7.893	7.316
Biomass	0.010	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**17.515**	**18.078**	**18.838**	**17.632**	**17.034**	**15.885**	**13.901**	**14.570**	**15.019**	**14.811**	**13.536**

Table 6. Fuel consumption [PJ] in 1.A.2.c category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	9.197	9.059	7.216	6.623	4.550	13.125	7.945	70.221	71.203	64.180	55.002
lignite	0.056	0.038	0.039	0.038	0.027	0.047	0.029	0.428	0.460	0.389	0.429
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
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
crude oil	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
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
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
industrial wastes	12.255	14.915	16.712	18.586	17.039	18.003	22.591	20.959	11.596	14.356	8.653
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
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
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.900	4.320	5.160
petroleum coke	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
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
motor gasoline	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	0.043	0.000	0.258	0.344	0.172	0.086
diesel oil	1.430	1.387	0.980	0.852	0.767	0.724	0.724	0.937	1.065	1.065	1.406
fuel oil	6.109	6.150	2.720	1.880	2.760	2.480	3.600	8.160	9.320	9.360	17.560
feedstocks	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	5.198	4.455	3.564	1.584	6.584	9.653	18.513
coke oven gas	1.053	0.993	0.701	0.522	0.440	1.548	0.276	0.729	0.784	0.310	0.174
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
gas works gas	0.190	0.230	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	11.054	9.414	4.096	6.197	8.725	7.748	7.888	10.939	21.213	24.570	42.725
Gaseous fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408
Solid fuels	24.661	29.901	27.394	27.746	23.915	34.615	32.793	95.837	87.011	80.702	65.801
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.000
Total	**42.469**	**45.949**	**36.897**	**38.322**	**37.082**	**52.441**	**45.223**	**113.139**	**114.415**	**116.296**	**117.934**

Table 6. (cont.) Fuel consumption [PJ] in 1.A.2.c category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	50.532	50.133	48.495	45.472	29.150	29.124	30.159	27.683	28.785	46.733	40.561
lignite	0.138	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
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	9.041	9.464	8.481	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762
fuel wood and wood waste	0.000	0.000	0.000	0.001	0.153	0.102	0.165	0.000	0.121	0.000	0.058
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
industrial wastes	9.808	10.332	10.968	10.093	9.914	8.749	6.901	7.851	6.875	7.233	7.931
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
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
other petroleum products	3.780	0.720	0.360	0.420	0.360	0.000	0.060	0.060	0.000	0.060	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
coke	1.625	0.029	1.710	1.739	1.568	1.881	2.676	2.846	1.938	1.169	0.821
liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.609
motor gasoline	0.000	0.000	0.000	0.000	0.044	0.000	0.000	0.000	0.000	0.000	0.079
jet kerosene	0.043	0.000	0.000	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.001
diesel oil	1.321	1.022	5.325	4.217	4.303	3.877	3.749	4.047	3.706	3.664	4.512
fuel oil	15.680	13.520	7.360	7.640	7.080	7.320	3.920	3.920	3.600	0.640	1.105
feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
refinery gas	19.602	23.315	20.543	20.741	21.830	22.424	18.266	21.335	22.473	19.157	20.898
coke oven gas	0.130	0.049	0.150	0.285	0.634	0.606	0.608	0.547	0.658	0.654	0.483
blast furnace gas	0.007	0.011	0.008	0.004	0.013	0.019	0.006	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
Fuels											
Liquid fuels	40.426	38.577	33.588	33.061	33.617	33.621	25.995	29.362	29.779	23.521	31.204
Gaseous fuels	9.041	9.464	8.481	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762
Solid fuels	62.240	60.554	61.331	57.593	41.279	40.379	40.350	38.927	38.256	55.789	49.796
Biomass	0.000	0.000	0.000	0.001	0.153	0.102	0.165	0.000	0.121	0.000	0.058
Total	**111.707**	**108.595**	**103.400**	**97.854**	**81.506**	**81.600**	**74.614**	**77.342**	**76.927**	**87.347**	**90.820**

Table 7. Fuel consumption [PJ] in 1.A.2.d category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	1.639	1.940	1.548	1.741	1.379	4.524	3.836	22.318	22.236	24.079	18.940
lignite	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
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
crude oil	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
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
biogas	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
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
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
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
petroleum coke	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
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
motor gasoline	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
diesel oil	0.087	0.087	0.043	0.085	0.043	0.043	0.085	0.128	0.596	0.980	1.108
fuel oil	1.246	1.166	1.280	1.200	1.320	1.560	1.400	2.360	1.040	1.040	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
refinery gas	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	0.000	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
gas works gas	0.003	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	1.380	1.300	1.369	1.331	1.409	1.649	1.531	2.534	1.682	2.112	2.612
Gaseous fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563
Solid fuels	1.976	2.192	1.805	2.026	1.636	4.838	4.121	22.603	22.493	24.222	19.026
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476
Total	**3.811**	**3.858**	**3.276**	**3.418**	**3.071**	**8.133**	**7.512**	**40.806**	**40.873**	**43.902**	**38.677**

Table 7. (cont.) Fuel consumption [PJ] in 1.A.2.d category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	17.532	15.701	15.581	14.321	14.649	13.996	13.436	11.592	9.452	7.962	8.511
lignite	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
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	1.007	1.211	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.902
fuel wood and wood waste	15.545	15.938	15.138	16.622	17.950	18.957	18.611	30.369	30.877	19.729	19.171
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018
industrial wastes	0.000	0.004	0.011	0.106	0.109	0.150	0.125	0.123	0.118	0.137	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
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
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
petroleum coke	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	0.029	0.029	0.029	0.057	0.029	0.029	0.029	0.029	0.029	0.010
liquid petroleum gas (LPG)	0.092	0.138	0.092	0.046	0.046	0.092	0.046	0.092	0.184	0.046	0.097
motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.011
jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
diesel oil	0.809	0.596	0.469	0.426	0.469	0.469	0.341	0.383	0.426	0.298	0.272
fuel oil	1.320	1.360	1.480	1.560	1.600	1.680	1.600	1.600	1.720	1.640	1.585
feedstocks	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
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
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
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
Fuels											
Liquid fuels	2.221	2.094	2.041	2.032	2.115	2.241	1.987	2.075	2.330	1.984	1.965
Gaseous fuels	1.007	1.211	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.902
Solid fuels	17.532	15.734	15.621	14.456	14.815	14.175	13.590	11.744	9.599	8.128	8.676
Biomass	15.545	15.938	15.138	16.622	17.950	18.957	18.611	30.369	30.877	19.729	19.189
Total	**36.305**	**34.977**	**34.245**	**34.571**	**36.974**	**38.030**	**36.476**	**47.164**	**46.893**	**34.663**	**34.732**

Table 8. Fuel consumption [PJ] in 1.A.2.e category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	25.199	31.694	31.914	35.940	32.724	55.643	53.801	73.024	88.785	78.496	64.670
lignite	0.085	0.104	0.058	0.019	0.018	0.369	0.195	0.265	0.380	0.250	0.317
hard coal briquettes (patent fuels)	0.023	0.023	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
crude oil	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
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
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
industrial wastes	0.003	0.002	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
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
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
petroleum coke	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
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
motor gasoline	0.448	0.269	0.132	0.088	0.132	0.176	0.132	0.176	0.176	0.044	0.088
jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086	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
fuel oil	1.849	1.648	1.640	1.480	1.320	3.280	3.920	6.120	2.720	2.400	2.680
feedstocks	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
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
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
gas works gas	0.027	0.032	0.000	0.000	0.000	0.000	0.000	0.000	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	8.490	7.783	9.817
Gaseous fuels	1.965	1.910	1.970	1.985	2.339	3.171	7.180	3.839	15.051	12.927	10.694
Solid fuels	29.282	35.544	35.418	39.020	35.517	59.363	56.707	75.879	92.361	81.596	67.068
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.104
Total	**35.829**	**41.084**	**40.532**	**43.735**	**40.321**	**67.380**	**69.152**	**87.215**	**115.996**	**102.381**	**87.683**

Table 8. (cont.) Fuel consumption [PJ] in 1.A.2.e category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	46.337	43.427	40.062	41.815	40.688	36.617	35.911	30.864	31.183	27.994	27.196
lignite	0.237	0.191	0.149	0.192	0.175	0.129	0.092	0.074	0.000	0.000	0.005
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
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.951
fuel wood and wood waste	0.069	0.049	0.062	0.060	0.323	0.373	0.214	0.239	0.164	0.365	0.192
biogas	0.020	0.063	0.042	0.037	0.063	0.074	0.068	0.072	0.084	0.094	0.109
industrial wastes	0.000	0.001	0.014	0.000	0.000	0.000	0.005	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
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
other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	1.710	0.029	1.368	1.539	1.340	1.226	0.969	0.855	0.912	0.656	0.643
liquid petroleum gas (LPG)	0.460	0.690	0.874	1.426	1.380	1.564	1.426	1.196	0.920	1.012	0.986
motor gasoline	0.044	0.132	0.044	0.088	0.088	0.000	0.044	0.044	0.044	0.044	0.023
jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
diesel oil	7.412	7.285	7.199	6.816	6.816	6.134	5.368	4.473	4.047	6.177	3.108
fuel oil	2.280	2.520	2.720	2.960	3.040	3.280	3.160	2.920	2.760	2.000	1.411
feedstocks	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
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
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
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
Fuels											
Liquid fuels	10.196	10.627	10.837	11.290	11.324	10.978	9.998	8.633	7.771	9.233	5.528
Gaseous fuels	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.951
Solid fuels	48.284	43.648	41.593	43.546	42.203	37.972	36.977	31.793	32.095	28.650	27.845
Biomass	0.089	0.112	0.104	0.097	0.386	0.447	0.282	0.311	0.248	0.459	0.302
Total	**67.824**	**64.881**	**63.897**	**67.423**	**68.988**	**65.561**	**64.713**	**59.360**	**60.728**	**59.067**	**54.625**

Table 9. Fuel consumption [PJ] in 1.A.2.f category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	158.685	147.564	111.152	109.155	98.584	157.660	157.182	160.662	192.017	173.013	131.878
lignite	1.052	0.841	0.331	0.733	0.274	0.815	0.392	0.783	0.749	0.583	0.470
hard coal briquettes (patent fuels)	0.233	0.139	0.069	0.027	0.000	0.163	0.162	0.046	0.046	0.000	0.000
brown coal briquettes	0.123	0.089	0.053	0.055	0.036	0.036	0.036	0.036	0.036	0.036	0.036
crude oil	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	40.220	34.460	36.058	39.907	38.844	40.695	40.861	41.717	44.737
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
biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.001	0.003
industrial wastes	0.464	0.504	0.090	0.035	0.432	0.551	1.740	2.491	2.819	1.180	2.300
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
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
other petroleum products	1.527	0.965	0.000	0.000	0.000	0.000	0.000	0.000	0.300	2.880	2.640
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	39.594	37.976	26.731	21.345	22.115	21.118	18.040	15.732	16.842	12.624	12.112
liquid petroleum gas (LPG)	0.189	0.142	0.138	0.092	0.092	0.092	0.230	0.184	0.184	0.552	0.690
motor gasoline	1.747	1.613	1.100	1.276	0.880	0.924	0.528	1.012	0.616	2.288	0.748
jet kerosene	0.000	0.000	0.000	0.000	0.000	0.129	0.000	0.645	0.258	0.946	0.172
diesel oil	29.520	26.858	22.294	19.506	16.485	17.029	15.284	17.832	30.404	28.742	23.004
fuel oil	9.767	10.008	6.320	4.640	5.960	7.280	8.040	11.120	6.960	7.400	10.440
feedstocks	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
coke oven gas	5.183	4.599	4.174	2.986	2.264	1.755	0.539	0.937	0.531	0.363	0.999
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
gas works gas	5.382	4.817	4.312	3.819	3.054	2.541	2.262	1.875	1.093	0.503	0.330
Fuels											
Liquid fuels	42.750	39.585	29.852	25.514	23.417	25.454	24.082	30.793	38.722	42.808	37.694
Gaseous fuels	52.767	50.455	40.220	34.460	36.058	39.907	38.844	40.695	40.861	41.717	44.737
Solid fuels	210.857	196.647	147.013	138.261	126.838	184.747	180.473	182.615	214.186	188.338	148.135
Biomass	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.980	6.530	8.200	8.240
Total	**316.488**	**296.155**	**224.066**	**204.208**	**191.390**	**255.136**	**246.813**	**259.083**	**300.299**	**281.063**	**238.806**

Table 9. (cont.) Fuel consumption [PJ] in 1.A.2.f category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	109.924	94.022	73.164	60.848	57.737	55.044	51.268	49.569	60.523	51.577	41.771
lignite	0.316	0.267	0.158	0.125	0.055	0.009	0.009	0.019	0.000	0.071	0.169
hard coal briquettes (patent fuels)	0.000	0.046	0.023	0.046	0.023	0.000	0.000	0.023	0.000	0.000	0.313
brown coal briquettes	0.036	0.036	0.035	0.017	0.035	0.035	0.035	0.035	0.053	0.105	0.093
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	40.269	46.522	50.178	52.506	56.740	60.828	62.287	65.056	66.426	66.573	64.617
fuel wood and wood waste	8.606	10.111	10.991	12.592	11.999	12.445	12.028	11.167	13.030	13.999	14.035
biogas	0.000	0.000	0.000	0.000	0.004	0.000	0.004	0.000	0.000	0.000	0.003
industrial wastes	2.045	2.572	2.337	2.596	3.984	3.491	4.413	8.840	6.906	8.560	9.108
municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.002	0.007	0.359	0.811	0.892	0.190	2.225
municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.002	0.007	0.359	0.811	0.892	0.190	2.225
other petroleum products	1.140	0.360	0.420	0.000	0.120	0.240	7.059	0.240	0.120	0.060	0.243
petroleum coke	0.000	0.000	0.000	0.000	4.333	3.171	0.000	3.517	1.539	1.601	0.000
coke	10.887	12.310	7.210	6.326	6.639	5.784	1.997	2.512	5.329	3.361	2.678
liquid petroleum gas (LPG)	1.104	1.978	1.840	2.714	2.622	2.990	2.208	1.610	1.472	1.564	1.427
motor gasoline	0.352	0.308	0.176	0.132	0.308	0.176	0.176	0.220	0.132	0.088	0.187
jet kerosene	0.129	0.172	0.129	0.086	0.043	0.043	0.086	0.129	0.086	0.043	0.116
diesel oil	18.791	17.945	16.651	16.644	17.287	17.985	17.933	18.141	17.261	17.871	18.051
fuel oil	9.480	7.480	7.400	7.440	7.240	7.360	7.000	5.520	3.600	3.680	3.221
feedstocks	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
coke oven gas	0.811	0.418	0.917	0.783	0.863	1.940	1.480	1.528	1.673	1.570	1.266
blast furnace gas	0.005	0.011	0.003	0.003	0.000	0.013	0.013	0.000	0.000	0.000	0.007
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
Fuels											
Liquid fuels	30.996	28.243	26.616	27.016	31.953	31.965	34.462	29.377	24.210	24.907	23.245
Gaseous fuels	40.269	46.522	50.178	52.506	56.740	60.828	62.287	65.056	66.426	66.573	64.617
Solid fuels	124.024	109.682	83.847	70.744	69.337	66.323	59.574	63.337	75.376	65.434	57.629
Biomass	8.606	10.111	10.991	12.592	12.005	12.452	12.391	11.978	13.922	14.189	16.262
Total	**203.895**	**194.558**	**171.632**	**162.858**	**170.035**	**171.567**	**168.713**	**169.748**	**179.933**	**171.102**	**161.754**

Table 10. Fuel consumption [PJ] in 1.A.4.a category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	207.331	163.252	83.730	113.074	91.520	64.295	37.059	37.245	25.227	19.734	16.992
lignite	0.540	0.390	0.000	0.000	0.000	0.017	0.091	0.025	0.026	0.009	0.009
hard coal briquettes (patent fuels)	5.748	1.581	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
brown coal briquettes	0.548	0.476	0.374	0.000	0.000	1.605	1.622	1.729	0.218	0.480	0.107
crude oil	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
fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	2.548	0.000	11.560	10.046	9.028	8.437
biogas	0.084	0.123	0.379	0.187	0.206	0.062	0.249	0.423	0.579	0.599	0.648
industrial wastes	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003
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
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
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
petroleum coke	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	34.742	28.272	40.071	33.402	27.332	25.878	26.220	28.643	13.481
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
motor gasoline	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
diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.980	4.260	6.177
fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	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
refinery gas	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	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
gas works gas	0.937	0.330	0.312	0.553	0.576	0.091	0.013	0.014	0.013	0.072	0.040
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
Gaseous fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769
Solid fuels	299.156	244.760	119.662	141.980	132.178	99.762	66.206	64.891	51.828	48.938	30.632
Biomass	0.084	0.123	0.379	0.187	0.206	2.610	0.249	11.983	10.625	9.627	9.085
Total	**312.319**	**257.484**	**133.828**	**153.144**	**143.574**	**113.920**	**77.362**	**90.916**	**82.986**	**88.909**	**80.227**

Table 10. (cont.) Fuel consumption [PJ] in 1.A.4.a category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	16.331	14.458	14.761	23.459	22.451	21.460	25.405	29.320	25.291	28.229	30.831
lignite	0.009	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
brown coal briquettes	0.464	0.341	0.000	0.017	0.000	0.000	0.000	0.000	0.000	0.000	0.039
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	37.697	38.567	49.971	61.001	67.057	69.570	68.410	62.880	64.850	70.682	75.024
fuel wood and wood waste	8.553	8.514	5.736	5.747	5.752	6.028	6.171	4.580	5.482	5.012	7.098
biogas	0.663	0.678	0.860	0.683	0.700	0.586	0.343	0.505	0.291	2.367	0.847
industrial wastes	0.004	0.004	0.091	0.092	0.060	0.002	0.022	0.000	0.000	0.000	0.093
municipal waste - non-biogenic fraction	0.000	0.020	0.000	0.010	0.011	0.007	0.015	0.014	0.015	0.023	0.000
municipal waste – biogenic fraction	0.000	0.020	0.000	0.010	0.011	0.007	0.015	0.014	0.015	0.023	0.000
other petroleum products	0.960	1.320	4.500	0.000	2.580	3.000	0.000	0.000	0.000	0.000	0.016
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	12.227	8.265	3.819	8.123	8.180	5.928	2.679	2.879	2.594	2.081	2.049
liquid petroleum gas (LPG)	2.070	2.300	3.266	0.000	5.566	5.014	4.600	5.244	4.922	4.462	3.717
motor gasoline	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	0.001
diesel oil	7.583	13.249	15.080	19.042	16.912	19.213	13.249	23.217	18.531	18.872	16.916
fuel oil	0.000	0.000	0.000	0.000	6.000	1.000	0.000	1.280	0.000	0.000	0.107
feedstocks	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
coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002
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
gas works gas	0.005	0.005	0.004	0.003	0.004	0.003	0.003	0.003	0.013	0.018	0.000
Fuels											
Liquid fuels	10.613	16.869	22.846	19.042	31.058	28.227	17.849	29.741	23.453	23.334	20.757
Gaseous fuels	37.697	38.567	49.971	61.001	67.057	69.570	68.410	62.880	64.850	70.682	75.024
Solid fuels	29.040	23.093	18.675	31.704	30.706	27.400	28.124	32.216	27.913	30.351	33.015
Biomass	9.216	9.212	6.596	6.440	6.463	6.621	6.529	5.099	5.788	7.402	7.945
Total	**86.566**	**87.740**	**98.088**	**118.186**	**135.284**	**131.817**	**120.912**	**129.936**	**122.003**	**131.768**	**136.742**

Table 11. Fuel consumption [PJ] in 1.A.4.b category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	543.550	489.779	251.236	327.769	335.127	399.004	331.315	332.268	321.867	288.432	224.465
lignite	2.911	1.180	0.527	0.042	0.000	2.955	4.403	4.279	3.420	2.626	1.772
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
brown coal briquettes	1.627	1.427	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
natural gas	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268
fuel wood and wood waste	33.615	32.351	34.335	27.721	33.969	123.084	123.154	105.000	101.000	100.000	100.700
biogas	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
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
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
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
petroleum coke	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	14.877	12.113	26.733	30.752	27.788	27.503	28.044	32.775	19.950
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
motor gasoline	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
diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.130	6.390	8.520
fuel oil	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
refinery gas	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	15.749	14.828	11.334	7.208	3.559	1.723	0.226	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
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
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
Gaseous fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268
Solid fuels	617.865	546.681	285.477	356.059	373.933	440.350	367.483	366.031	353.779	324.014	246.351
Biomass	33.615	32.351	34.335	27.721	33.969	123.084	123.154	105.000	101.000	100.000	100.700
Total	**761.015**	**694.315**	**443.718**	**518.466**	**550.954**	**711.096**	**651.278**	**643.424**	**616.066**	**598.826**	**512.239**

Table 11. (cont.) Fuel consumption [PJ] in 1.A.4.b category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	241.580	179.828	202.691	185.952	171.418	167.587	203.593	236.664	216.419	230.337	234.000
lignite	1.286	1.169	1.373	1.482	1.605	2.034	2.006	2.168	1.972	2.566	2.221
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
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
crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
natural gas	135.995	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857
fuel wood and wood waste	95.000	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500
biogas	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
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
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
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
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	18.525	11.685	11.970	8.550	8.550	7.125	2.993	3.278	1.425	1.140	1.120
liquid petroleum gas (LPG)	19.320	20.240	20.700	21.390	25.300	25.300	25.300	20.700	21.160	20.700	20.246
motor gasoline	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
diesel oil	9.713	17.040	21.300	22.791	22.791	23.430	19.170	19.170	19.170	12.780	12.774
fuel oil	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
refinery gas	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
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
gas works gas	0.163	0.157	0.151	0.134	0.128	0.113	0.095	0.099	0.081	0.071	0.000
Fuels											
Liquid fuels	29.033	37.280	42.000	44.181	48.091	48.730	44.470	39.870	40.330	33.480	33.020
Gaseous fuels	135.995	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857
Solid fuels	261.554	192.839	216.185	196.118	181.701	176.859	208.687	242.209	219.897	234.114	237.341
Biomass	95.000	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500
Total	**521.582**	**452.730**	**496.422**	**471.892**	**460.496**	**455.325**	**488.968**	**525.265**	**494.849**	**501.544**	**507.718**

Table 12. Fuel consumption [PJ] in 1.A.4.c category.

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
hard coal	38.607	38.489	27.420	45.325	55.315	56.618	64.722	63.675	61.688	55.571	48.369
lignite	1.581	1.139	0.844	1.019	0.911	0.814	1.642	1.698	1.299	1.292	1.419
hard coal briquettes (patent fuels)	0.598	0.527	0.506	0.114	0.065	0.047	0.045	0.000	0.000	0.000	0.000
brown coal briquettes	0.106	0.106	0.036	0.018	0.018	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
natural gas	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.869
fuel wood and wood waste	0.039	0.113	0.039	0.278	0.583	12.737	11.647	18.500	17.567	17.000	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
industrial wastes	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
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
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
petroleum coke	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
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
motor gasoline	0.000	0.000	0.000	0.000	0.000	0.660	1.100	1.100	1.100	1.188	1.100
jet kerosene	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	40.612	39.804	48.534	62.808	69.031	72.476	77.952	93.978	82.975
fuel oil	10.277	9.481	8.431	7.459	6.173	18.066	22.052	13.957	8.242	10.974	8.862
feedstocks	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
coke oven gas	0.012	0.010	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
gas works gas	0.001	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	65.094	62.348	49.043	47.263	54.707	81.534	92.642	88.223	88.444	107.519	94.318
Gaseous fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.869
Solid fuels	42.690	42.027	30.374	47.645	56.993	58.049	70.428	69.392	67.091	61.993	55.488
Biomass	0.039	0.113	0.039	0.278	0.583	12.737	11.647	18.500	17.567	17.000	17.100
Total	**108.330**	**104.933**	**79.904**	**95.461**	**112.338**	**152.452**	**174.929**	**176.358**	**173.530**	**187.083**	**167.775**

Table 12. (cont.) Fuel consumption [PJ] in 1.A.4.c category.

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
hard coal	53.172	35.989	40.562	33.376	30.950	30.259	35.673	42.074	37.748	40.949	41.600
lignite	1.097	0.939	1.236	1.395	1.528	2.211	2.188	2.489	2.125	2.771	2.486
hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.023	0.000	0.000	0.000	0.000	0.046	0.028
brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.035	0.000	0.035	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
natural gas	0.476	0.536	0.777	0.914	1.197	1.182	1.084	1.493	1.841	1.901	1.578
fuel wood and wood waste	17.100	17.100	19.043	19.010	19.017	19.878	19.038	19.977	19.060	19.024	19.031
biogas	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
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
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
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
petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
coke	5.130	3.420	3.705	2.850	2.850	1.995	1.140	1.425	0.855	0.827	1.211
liquid petroleum gas (LPG)	1.610	1.840	2.300	2.760	3.220	3.220	3.220	2.300	2.300	2.346	2.071
motor gasoline	1.320	1.364	0.924	0.264	0.308	0.220	0.264	0.308	0.220	0.220	0.219
jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
diesel oil	87.753	98.620	91.293	90.955	91.932	93.934	96.064	68.374	60.840	57.183	54.120
fuel oil	8.674	8.428	8.221	6.805	8.355	7.766	9.575	3.606	3.397	3.474	4.347
feedstocks	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
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
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
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
Fuels											
Liquid fuels	99.357	110.252	102.738	100.784	103.816	105.140	109.123	74.588	66.757	63.223	60.756
Gaseous fuels	0.476	0.536	0.777	0.914	1.197	1.182	1.084	1.493	1.841	1.901	1.578
Solid fuels	59.399	40.348	45.503	37.621	35.351	34.465	39.001	46.023	40.728	44.628	45.326
Biomass	17.100	17.100	19.043	19.010	19.017	19.878	19.038	19.977	19.060	19.024	19.031
Total	**176.332**	**168.236**	**168.061**	**158.329**	**159.381**	**160.665**	**168.246**	**142.081**	**128.386**	**128.776**	**126.690**

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
Hard coal	95.35	95.33	95.51	95.28	95.12	95.02	95.01	94.99	94.99	94.98	94.93
Lignite	111.39	110.82	109.92	109.80	109.30	109.92	110.05	108.96	109.04	108.90	108.41
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.94	94.99	94.98	94.98	94.96	95.01	94.99	94.94	95.00	94.98	94.91
Lignite	108.32	108.73	108.62	108.62	108.56	108.84	107.83	107.88	107.54	107.20	107.53

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
Hard coal	94.70	94.76	94.64	94.70	94.43	94.39	94.50	94.45	94.51	94.42	94.40
Lignite											
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.39	94.43	94.43	94.43							94.07
Lignite											

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
Hard coal	95.30	95.37	94.66	94.68	94.43	94.40	94.47	94.45	94.51	94.42	94.40
Lignite	111.39	110.71	109.52	108.93	108.35	108.66	109.93	109.00	108.25	108.42	108.53
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.40	94.43	94.46	94.46	94.47	94.58	94.20	94.22	94.24	94.64	93.91
Lignite	108.53	108.82	108.58	107.92	109.00	107.37	105.87	105.81	106.15	107.00	107.30

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
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.56	94.58
Lignite											
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.55	94.62	94.56	94.55	94.33	94.52	94.32	94.41	94.53	94.78	95.81
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
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.56	94.58
Lignite											
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.55	94.62	94.56	94.55	94.33	94.52	0.00	94.43	94.46	0.00	94.20
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
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.56	94.58
Lignite	105.16	104.93	103.84	104.75	106.72	105.13	104.14	108.94	109.02	105.66	108.41
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.55	94.62	94.56	94.55	94.33	94.52	94.33	94.52	94.45	94.63	95.21
Lignite	103.47										

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
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.56	94.58
Lignite											
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.55	94.62	94.56	94.55	94.33	94.52	94.34	94.52	94.45	94.63	94.76
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
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.56	94.58
Lignite	105.14	104.92	104.14	104.75	106.72	104.90	103.84	108.94	109.02	105.67	108.41
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.55	94.62	94.56	94.55	94.33	94.52	94.34	94.52	94.44	94.60	94.48
Lignite	103.40	104.57	105.47	104.38	105.87	105.85	105.91	105.71			107.52

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
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.56	94.58
Lignite	105.15	104.93	103.89	105.14	106.18	104.84	103.66	108.94	103.02	105.70	108.41
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.55	94.62	94.56	94.55	94.33	94.52	94.34	94.52	94.45	94.64	94.20
Lignite	103.40	104.62	105.54	104.33	106.04	106.72	106.72	104.75		107.25	106.67

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
Hard coal	94.70	94.76	94.66	94.68	94.43	94.40	94.47	94.45	94.51	94.42	94.40
Lignite	111.07	110.71				108.93	110.02	109.72	108.16	106.72	106.72
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.39	94.43	94.46	94.46	94.47	94.58	94.14	93.99	94.20	94.12	94.14
Lignite	106.72										

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
Hard coal	94.70	94.76	94.66	94.68	94.43	94.40	94.47	94.45	94.51	94.42	94.40
Lignite	111.07	110.71	109.57	109.40	0.00	108.63	109.92	108.97	108.20	108.42	108.46
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.39	94.43	94.46	94.46	94.47	94.58	94.14	93.99	94.20	94.12	94.05
Lignite	108.59	108.78	108.55	107.94	108.96	107.39	108.09	108.14	108.93	107.48	107.23

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
Hard coal	94.70	94.76	94.66	94.68	94.43	94.40	94.47	94.45	94.51	94.42	94.40
Lignite	111.07	110.71	109.61	108.97	108.12	108.61	109.92	108.97	108.19	108.41	108.47
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Hard coal	94.39	94.43	94.46	94.46	94.47	94.58	94.14	93.99	94.20	94.12	94.05
Lignite	108.60	108.76	108.54	107.93	108.98	107.38	108.09	108.14	108.93	107.48	107.23

Table 25. CO_2 EFs [kg/GJ] applied for other fuels in the years 1988-2009 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 gas	55,82
fuel wood and wood waste	*109,76*
biogas	*54,33*
industrial wastes	*140,14*
municipal waste - non-biogenic fraction	*140,14*
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
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 1988-2009 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 gas	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
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 1988-2009 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 gas	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
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
natural gas	[10^3 m3]	2 184 552	2 230 523	1 447 064	1 447 326	1 337 619	1 401 804	1 688 887	1 942 704	1 907 689	1 937 127	1 789 006
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
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
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
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
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
Activity data	**Unit**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
natural gas	[10^3 m3]	1 587 228	1 965 162	1 873 685	1 455 329	2 122 465	2 177 127	2 310 818	2 197 622	2 186 299	2 221 406	1 814 589
natural gas	TJ	56 105	70 483	68 096	52 144	76 053	77 817	82 219	78 591	78 072	79 351	63 478
coke oven gas	[10^3 m3]											
coke oven gas	TJ											
CO_2 emission from natural gas use	Gg	3 055	3 783	3 607	2 802	4 086	4 191	4 448	4 230	4 209	4 276	3 493
CO_2 emission from coke oven gas use	Gg											
Total CO2 emission	Gg	3 055	3 783	3 607	2 802	4 086	4 191	4 448	4 230	4 209	4 276	3 493
Ammonia production	Gg	1784.726	2243.108	2103.805	1594.797	2246.505	2451.557	2523.790	2326.621	2417.543	2485.148	3 493.084
Implied EF of CO_2 process emission	[MgCO2/ Mg NH3]	1.71	1.69	1.71	1.76	1.82	1.71	1.76	1.82	1.74	1.72	1.74

Annex 4. Energy balance data for main fuels in 2009

Energy balances in 2009 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	
	10^3 Mg	TJ
In	57 138	510 247
From national sources	57 108	509 986
1) Indigenous production	57 108	509 986
2) Transformation output or return	0	0
3) Stock decrease	0	0
Import	30	261
Out	57 138	510 247
National consumption	56 709	499 806
1) Transformation input	56 059	494 027
a) input for secondary fuel producti	0	0
b) fuel combustion	56 059	494 027
2) Direct consumption	651	5 779
Non-energy use	2	14
Combusted directly	649	5 765
Combusted in Poland	56 708	499 792
Stock increase	-14	-121
Export	68	606
Losses and statistical differences	375	9 956
Net calorific value	MJ/kg	8.81

Natural gas consumption

National fuel balance	Natural gas
	TJ
In	495 487
From national sources	153 980
1) Indigenous production	153 980
2) Transformation output or return	0
3) Stock decrease	0
Import	341 507
Out	495 487
National consumption	510 143
1) Transformation input	61 899
a) input for secondary fuel producti	0
b) fuel combustion	61 899
2) Direct consumption	448 244
Non-energy use	65 575
Combusted directly	382 669
Combusted in Poland	444 568
Stock increase	-19 904
Export	1 399
Losses and statistical differences	3 849

Coke oven gas consumption

National fuel balance	Coke Oven Gas
	TJ
In	53 806
From national sources	53 806
1) Indigenous production	0
2) Transformation output or return	53 806
3) Stock decrease	0
Import	0
Out	53 806
National consumption	53 114
1) Transformation input	17 487
a) input for secondary fuel producti	0
b) fuel combustion	17 487
2) Direct consumption	35 627
Non-energy use	0
Combusted directly	35 627
Combusted in Poland	53 114
Stock increase	0
Export	0
Losses and statistical differences	692

Blast furnace gas consumption

National fuel balance	Blast furnace gas
	TJ
In	17 610
From national sources	17 610
1) Indigenous production	0
2) Transformation output or return	17 610
3) Stock decrease	0
Import	0
Out	17 610
National consumption	17 610
1) Transformation input	7 465
a) input for secondary fuel producti	22
b) fuel combustion	7 443
2) Direct consumption	10 145
Non-energy use	0
Combusted directly	10 145
Combusted in Poland	17 588
Stock increase	0
Export	0
Losses and statistical differences	0

National energy balance 2009 – EUROSTAT

Original units	Hard coal	Patent fuels	Coke	Total lignite	Old Lignite	Lignite recent	Brown coal briquettes	Tar, benzol	Coke-oven gas	Blast-furn. gas	Gasworks gas	Total Derived Gas
	1000 t							1000 t	TJ (GCV)			
Primary production	77 478			57 108		57 108						
Recovered products	586											
Imports	10 792	27	55	30		30	7	1				
Stock change	-4 732	-2	360	14		14	0	-8				
Exports	8 395	0	4 813	68		68	0	302				
Bunkers												
Gross inland consumption	75 730	25	-4 399	57 084		57 084	7	-309				
Transformation input	56 444	0	695	56 059		56 059			19 430	7 465		26 895
Classic thermal Power Stations	41 518		1	56 026		56 026			18 524	7 443		25 967
Public thermal power stations	40 350			56 026		56 026			9 365	5 787		15 152
Autoprod. thermal power stations	1 168		1						9 160	1 656		10 815
Nuclear power stations												
Patent fuel and briquetting plants												
Coke-oven plants	9 373		68							22		22
Blast-furnace plants			624									
Gas works												
Refineries												
District heating plants	5 553	0	2	32		32			906			906
Transformation output			7 091					398	59 784	17 610		77 395
Classic thermal Power Stations												
Public thermal power stations												
Autoprod. thermal power stations												
Nuclear power stations												
Patent fuel and briquetting plants												
Coke-oven plants			7 091					398	59 784			59 784
Blast-furnace plants										17 610		17 610
Gas works												
Refineries												
District heating plants												
Exchanges and transfers, returns												
Interproduct transfers												
Products transferred												
Returns from petrochem. industry												
Consumption of the energy branch	332		0	100		100			31 168			31 168
Production and distribution of electricity	1		0	76		76			12			12
Pumped storage stations												
District heating plants	30								0			0
Extraction and agglo. of solid fuels	292		0	23		23			140			140
Coke-oven and gas works plants	8		0						31 016			31 016
Oil and Nat. Gat extraction plants			0									
Oil & Gas pipelines												
Oil refineries	1											
Nuclear fuel fabrication plants												
Distribution losses												
Available for final consumption	18 955	15	1 997	926		926	7	89	9 186	10 145		19 332
Final non-energy consumption	38		0	2		2		59				
Chemical industry								59				
Other sectors	38		0	2		2						
Final energy consumption	17 184	15	1 546	549		549	7		8 418	10 145		18 563
Industry	5 375	14	1 401	19		19	5		8 415	10 145		18 560
Iron & steel industry	234	0	1 031						6 472	10 138		16 610
Non-ferrous metal industry	0		220									
Chemical industry	1 956		31						537			537
Glass, pottery & building mat. industry	1 175	14	80	0		0			1 370	1		1 371
Ore-extraction industry	23		1	0		0	0					
Food, drink & tobacco industry	1 145		23	0		0						
Textile, leather & clothing industry	36	0	0	0		0						
Paper and printing	378		0									
Engineering & other metal industry	129		5						37	6		43
Other industries	298	0	9	18		18	5					
Transport												
Railways												
Road transport												
Air transport												
Inland navigation												
Households, commerce, pub. auth., etc.	11 809	1	145	530		530	2		3	0		3
Households	9 000		40	250		250						
Agriculture	1 600	1	30	280		280						
Fisheries	0											
Other	1 209		75				2		3	0		3
Statistical difference	1 733		452	375		375		30	769			769

Original units	Natural gas	Crude oil	Feedstock	Total pet. products	Refinery gas	LPG	Motor spirit	Kerosenes, jet fuels	Naphtha	Gas / diesel oil	Residual fuel oil	Other pet. products
	TJ (GCV)	1000 t					1000 t		1000 t			
Primary production	171 089	687										
Recovered products			5	32								
Imports	379 452	20 098	1 371	5 470		2 015	492	1	3	2 196	50	133
Stock change	22 116	-277		-295		-14	-155	6	4	-248	21	96
Exports	1 554	226		2 552		18	376	227	69	118	998	227
Bunkers				-254						-64	-190	
Gross inland consumption	571 102	20 282	1 376	2 400		1 983	-39	-219	-61	1 766	-1 116	2
Transformation input	68 777	20 304	1 981	548	30	2				27	489	1
Classic thermal Power Stations	45 552			513	30					16	468	
Public thermal power stations	43 739			149						11	138	
Autoprod. thermal power stations	1 813			364	30					5	329	
Nuclear power stations												
Patent fuel and briquetting plants												
Coke-oven plants												
Blast-furnace plants												
Gas works				2		2						
Refineries	11 266	20 304	1 981									
District heating plants	11 958			33		0				11	21	1
Transformation output				21 906	848	298	4 051	692	1 150	9 773	2 599	507
Classic thermal Power Stations												
Public thermal power stations												
Autoprod. thermal power stations												
Nuclear power stations												
Patent fuel and briquetting plants												
Coke-oven plants												
Blast-furnace plants												
Gas works												
Refineries				21 906	848	298	4 051	692	1 150	9 773	2 599	507
District heating plants												
Exchanges and transfers, returns			605	-605	-118	-36			-287	-34	-34	-64
Interproduct transfers												
Products transferred			67	-67		-1					-34	
Returns from petrochem. industry			538	-538	-118	-35			-287	-34		-64
Consumption of the energy branch	53 923			1 159	278	1	1	0		36	781	43
Production and distribution of electricity	76			9		0	0	0		5	1	1
Pumped storage stations												
District heating plants	15			2		0				1	0	
Extraction and agglo. of solid fuels	470			25		0	0	0		19		1
Coke-oven and gas works plants	14 387			1		1	0			0		0
Oil and Nat. Gat extraction plants	6 768			9		0	0			8		
Oil & Gas pipelines	12 895			2		0	1			1		
Oil refineries	19 312			1 110	278	0	0			1	780	42
Nuclear fuel fabrication plants												
Distribution losses	1 521											
Available for final consumption	446 881	-22	0	21 995	422	2 242	4 011	473	801	11 442	178	401
Final non-energy consumption	72 861			3 026				0	815			262
Chemical industry	72 861			1 056					815			214
Other sectors				1 970				0				48
Final energy consumption	371 264	0		19 080	422	2 375	4 011	474	0	11 442	220	7
Industry	136 311			1 357	422	157	7	3		446	187	6
Iron & steel industry	18 441			3		1	0	0		1		0
Non-ferrous metal industry	6 502			9		1	0	0		4	4	0
Chemical industry	10 847			658	422	100	2	0		106	28	0
Glass, pottery & building mat. industry	46 025			234		10	0	0		46	48	0
Ore-extraction industry	1 086			68		3	0	0		60	0	5
Food, drink & tobacco industry	23 278			130		21	1			73	35	0
Textile, leather & clothing industry	1 791			13		1	0			11	1	
Paper and printing	5 447			48		2	0			6	40	0
Engineering & other metal industry	12 988			37		9	2	0		25	0	0
Other industries	9 906			156		8	2	2		112	31	1
Transport				14 727		1 653	3 999	471		8 604		
Railways				129		0		0		129		
Road transport				14 121		1 653	3 995	0		8 473		
Air transport				475			4	471				
Inland navigation				3						3		
Households, commerce, pub. auth., etc.	234 953	0		2 996		566	5	0	0	2 392	33	0
Households	149 841			740		440				300		
Agriculture	1 752			1 775		45	5			1 695	30	
Fisheries	0			0			0			0		
Other	83 360	0		481		81		0	0	397	3	0
Statistical difference	2 756	-22	0	-111		-133		-1	-14	0	-42	132

Original units	White spirit	Lubricants	Bitumen	Petroleum coke	Nuclear heat	Total Renewables	Solar heat	Geothermal heat	Biomass	Wood	MSW	Biogas, biofuels
	1000 t				TJ	TJ						
Primary production						248 238	83	600	244 102	217 302	4 817	21 983
Recovered products		32										
Imports	38	146	266	129		10 141			10 141			10 141
Stock change	1	3	-10			94			94			94
Exports	23	244	252			320			320			320
Bunkers												
Gross inland consumption	16	-63	4	129		258 152	83	600	254 017	217 302	4 817	31 898
Transformation input						58 605			58 605	55 082	368	3 155
Classic thermal Power Stations						56 643			56 643	53 147	368	3 128
Public thermal power stations						47 264			47 264	47 232		32
Autoprod. thermal power stations						9 379			9 379	5 915	368	3 096
Nuclear power stations												
Patent fuel and briquetting plants												
Coke-oven plants												
Blast-furnace plants												
Gas works												
Refineries												
District heating plants						1 962			1 962	1 935		27
Transformation output	124	296	1 568									
Classic thermal Power Stations												
Public thermal power stations												
Autoprod. thermal power stations												
Nuclear power stations												
Patent fuel and briquetting plants												
Coke-oven plants												
Blast-furnace plants												
Gas works												
Refineries	124	296	1 568									
District heating plants												
Exchanges and transfers, returns		-32				-3 452						
Interproduct transfers												
Products transferred		-32				-3 452						
Returns from petrochem. industry												
Consumption of the energy branch	9	7	0			138			138	134		3
Production and distribution of electricity	0	1				42			42	41		1
Pumped storage stations												
District heating plants		0				8			8	6		2
Extraction and agglo. of solid fuels	0	5	0			87			87	87		
Coke-oven and gas works plants		0										
Oil and Nat. Gat extraction plants		0										
Oil & Gas pipelines		0										
Oil refineries	9											
Nuclear fuel fabrication plants												
Distribution losses												
Available for final consumption	130	194	1 571	129		195 958	83	600	195 275	162 086	4 449	28 740
Final non-energy consumption	134	244	1 571									
Chemical industry	18	9										
Other sectors	116	234	1 571									
Final energy consumption				129		195 958	83	600	195 275	162 086	4 449	28 740
Industry				129		38 037			38 037	33 457	4 449	130
Iron & steel industry						1			1	1		
Non-ferrous metal industry												
Chemical industry						58			58	58		
Glass, pottery & building mat. industry				129		4 733			4 733	285	4 449	
Ore-extraction industry												
Food, drink & tobacco industry						302			302	192		109
Textile, leather & clothing industry												
Paper and printing						19 189			19 189	19 171		18
Engineering & other metal industry						49			49	49	0	
Other industries						13 704			13 704	13 701		3
Transport						27 762			27 762			27 762
Railways												
Road transport						27 762			27 762			27 762
Air transport												
Inland navigation												
Households, commerce, pub. auth., etc.						130 159	83	600	129 476	128 629	0	847
Households						102 960		460	102 500	102 500		
Agriculture						19 031			19 031	19 031		
Fisheries												
Other						8 168	83	140	7 945	7 098	0	847
Statistical difference	-4	-50										

Original units	Wind energy	Hydro energy	Other fuels	Derived heat	Electrical energy
	GWh		TJ		GWh
Primary production	1 077	2 375	10 089		
Recovered products			14 565		
Imports					7 403
Stock change					
Exports					9 594
Bunkers					
Gross inland consumption	1 077	2 375	24 654		-2 191
Transformation input			5 094		
Classic thermal Power Stations			5 089		
Public thermal power stations			4 249		
Autoprod. thermal power stations			841		
Nuclear power stations					
Patent fuel and briquetting plants					
Coke-oven plants					
Blast-furnace plants					
Gas works					
Refineries					
District heating plants			5		
Transformation output				312 213	147 668
Classic thermal Power Stations				197 370	147 668
Public thermal power stations				184 163	140 788
Autoprod. thermal power stations				13 207	6 880
Nuclear power stations					
Patent fuel and briquetting plants					
Coke-oven plants					
Blast-furnace plants					
Gas works					
Refineries					
District heating plants				114 843	
Exchanges and transfers, returns	-1 077	-2 375			3 452
Interproduct transfers					
Products transferred	-1 077	-2 375			3 452
Returns from petrochem. industry					
Consumption of the energy branch			36	45 155	24 038
Production and distribution of electricity			0	16 549	14 812
Pumped storage stations					281
District heating plants				9 045	1 133
Extraction and agglo. of solid fuels			21	5 011	6 053
Coke-oven and gas works plants			15	5 330	662
Oil and Nat. Gat extraction plants				24	86
Oil & Gas pipelines					350
Oil refineries				9 197	662
Nuclear fuel fabrication plants					
Distribution losses					12 533
Available for final consumption			19 524	267 058	112 359
Final non-energy consumption			643		
Chemical industry			643		
Other sectors					
Final energy consumption			18 880	267 058	112 359
Industry			18 787	59 414	39 801
Iron & steel industry			474	4 451	5 005
Non-ferrous metal industry			1 119	2 452	2 316
Chemical industry			7 931	34 196	8 035
Glass, pottery & building mat. industry			7 715	1 210	4 162
Ore-extraction industry			0	1 633	1 389
Food, drink & tobacco industry				2 298	4 947
Textile, leather & clothing industry			0	438	572
Paper and printing			155	3 676	3 415
Engineering & other metal industry			1	6 522	4 917
Other industries			1 392	2 537	5 042
Transport					2 861
Railways					2 861
Road transport					
Air transport					
Inland navigation					
Households, commerce, pub. auth., etc.			93	207 644	69696
Households				177 500	27534
Agriculture				1 035	1606
Fisheries				15	4
Other			93	29 094	40552
Statistical difference				0	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* 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)

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 methods

Categories checked following the Tier 1 procedure	Categories checked following the Tier 2 procedure
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.1,2,4,5.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

<table>
<tr><th colspan="2">Action within inventory frames for specific categories</th><th>internal QC (KOBiZE)</th><th>External check (outside of KOBiZE)</th></tr>
<tr><td rowspan="6">Activity data:
Collection
Introduction
Reference description
Emission factors:
Choice
Calculation
Verification
Emission calculation</td><td>1. Energy</td><td>experts on energy and industrial processes
expert on energy and industrial processes for LRTAP
expert on transport
expert on waste</td><td>ARE
ITS
IETU</td></tr>
<tr><td>2. Industrial processes</td><td>expert on energy and industrial processes</td><td>IchP
IETU</td></tr>
<tr><td>3. Solvent and other product use</td><td>expert on waste</td><td>IETU</td></tr>
<tr><td>4. Agriculture</td><td>expert on agriculture</td><td>IZoo, IMUZ</td></tr>
<tr><td>5. LULUCF</td><td>expert on LULUCF</td><td>IBL, DGLP</td></tr>
<tr><td>6. Waste</td><td>expert on waste</td><td>PŁ</td></tr>
<tr><td colspan="2">Elaboration of key categories</td><td>expert on waste</td><td>---</td></tr>
<tr><td colspan="2">Elaboration of uncertainties</td><td>expert on database</td><td>---</td></tr>
<tr><td colspan="2">Inserting data into CRF Reporter and data generation</td><td>expert on database</td><td>---</td></tr>
<tr><td colspan="2">Check of data processed by CRF Reporter against calculated data</td><td>expert for given category</td><td>MŚ</td></tr>
<tr><td colspan="2">NIR preparation
in Polish and English (including automatization)</td><td>experts on energy and industrial processes
expert on agriculture
expert on transport
expert on waste
expert on database
expert on register</td><td>MŚ</td></tr>
<tr><td colspan="2">Documentation & archiving of documentation</td><td>expert on database</td><td>---</td></tr>
</table>

Abbreviations:

ARE – Agencja Rynku Energii (Agency of Energy Market)
DGLP – Dyrekcja Generalna Lasów Państwowych (State Forests)
GUS – Główny Urząd Statystyczny (Central Statistical Office)
HIPH – Hutnicza Izba Przemysłowo–Handlowa (Polish Stell Association)
IChP – Instytut Chemii Przemysłowej (Institute of (Industrial Chemistry Research Institute)
IETU – Instytut Ekologii Terenów Uprzemysłowionych (Institute for Ecology of Industrial Areas)
IMUZ – Instytut Melioracji i Użytków Zielonych (Institute for Land Reclamation and Grassland Forming)
MŚ – Ministerstwo Środowiska (Ministry of Environment)
IOŚ – Instytut Ochrony Środowiska (Institute of Environmental Protection)
ITS – Instytut Transportu Samochodowego (Motor Transport Institute)
IZoo – Instytut Zootechniki (National Research Institute of Animal Production)
PŁ – Politechnika Łódzka (Technical University of Łódź)

Annex 6. Uncertainty assessment of the 2009 inventory

Uncertainty analysis for the revised year 2009 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 reviews and latest centralized review in October 2011 were taken into account.
Latest changes applied directly 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 step 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 – 4.6%	CH_4 – 19.8%	N_2O - 48.4%
HFC - 50.9%	PFC - 85.8%	SF6 – 89.7%

Activities
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 at low level.

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 in *1.A Fuel Combustion* (1-2%).
Low level of uncertainty of national total of CO_2 (4.6%) 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. 19.8% which is result of share of agriculture and waste sectors in national totals – emission factors in those sectors have high uncertainty.

N_2O emission factors
Most uncertain values for N_4O 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 (48.4%) 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 – uncertainty assumptions were applied directly to emission values of each pollutant. Results are HFC – 50.9%, PFC – 85.8%, SF6 – 89.7%. 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

Inventory team is planning to improve uncertainty estimates in few parallel process.

- collection of new data needed to finalize analysis based on Monte Carlo simulations
- changing description of assumptions and procedures of uncertainty analysis to cover more details than in previous reports
- deeper 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 2009 – Uncertainty analysis, part 1, sectors 1-3

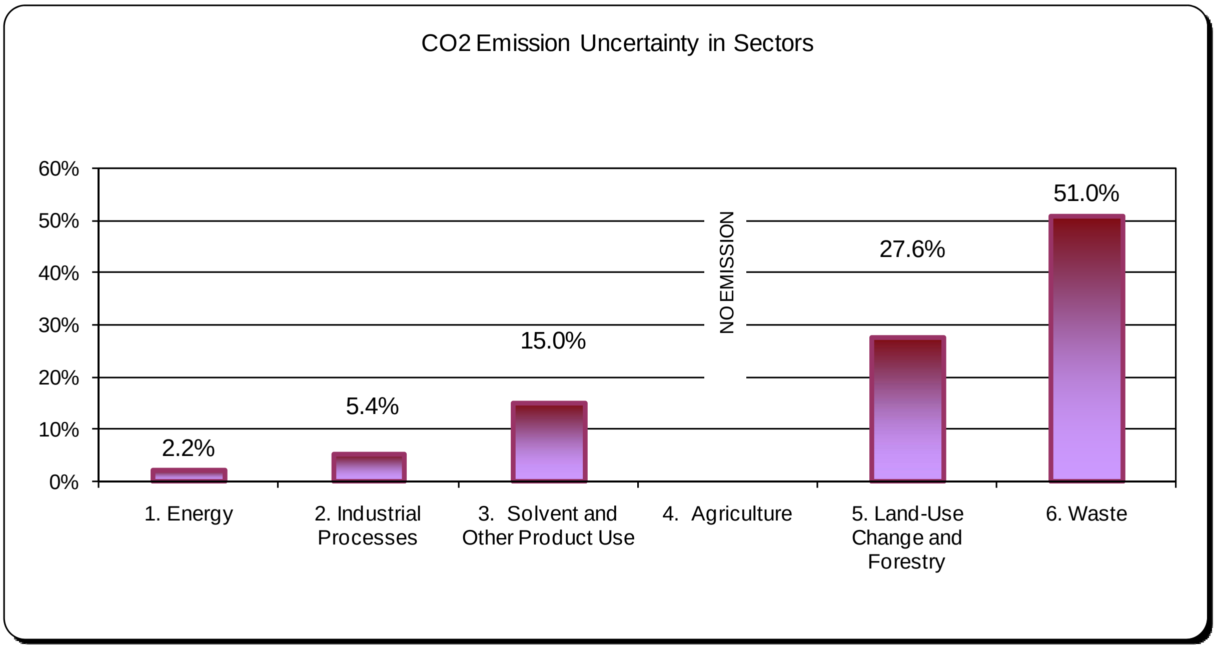
2009	Activity [TJ]	Activity uncertainty [%]	EF CO_2 [t/TJ]	EF CH_4 [kg/TJ]	EF N_2O [kg/TJ]	EF CO_2 Uncertainty [%]	EF CH_4 Uncertainty [%]	EF N_2O Uncertainty [%]	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]	CO_2 Emission absolute uncertainty [Gg]	CH_4 Emission absolute uncertainty [Gg]	N_2O Emission absolute uncertainty [Gg]
TOTAL									**274 205.09**	**1 765.52**	**88.92**	**4.6%**	**19.8%**	**48.4%**	12 717.42	350.34	43.05
1. Energy									**293 462.48**	**693.48**	**6.56**	2.2%	25.1%	22.9%	**6478.17**	**174.25**	**1.50**
A. Fuel Combustion									**293 273.61**	**138.19**	**6.56**	2.2%	11.8%	22.9%	6478.15	16.25	1.50
1. Energy Industries									166 693.39	3.68	2.59	3.4%	14.8%	11.2%	5641.90	0.55	0.29
Liquid Fuels	72 270	2.0%	74.05	2.58	0.49	2.0%	75.0%	75.0%	5 351.29	0.19	0.04	2.8%	75.0%	75.0%	151.36	0.14	0.03
Solid Fuels	1 590 851	2.0%	98.31	1.10	1.46	3.0%	13.5%	11.7%	156 391.74	1.74	2.33	3.6%	13.6%	11.9%	5638.78	0.24	0.28
Gaseous Fuels	88 685	2.0%	55.82	1.00	0.10	1.0%	17.0%	20.0%	4 950.36	0.09	0.01	2.2%	17.1%	20.1%	110.69	0.02	0.00
Biomass	58 527	15.0%	106.76	28.45	3.79		24.0%	37.0%	6 248.41	1.67	0.22	15.0%	28.3%	39.9%		0.47	0.09
2. Manufacturing Industries and Construction									30 191.73	3.33	0.68	2.5%	12.5%	28.0%	751.99	0.41	0.19
Liquid Fuels	62 431.64	3.0%	76.57	2.22	3.81	1.0%	41.8%	75.0%	4 780.22	0.14	0.24	3.2%	41.9%	75.1%	151.16	0.06	0.18
Solid Fuels	172 751.86	3.0%	107.69	11.54	1.67	2.0%	13.5%	11.7%	18 604.50	1.99	0.29	3.6%	13.8%	12.1%	670.79	0.28	0.03
Gaseous Fuels	121 946.81	4.0%	55.82	1.00	0.10	2.0%	17.0%	20.0%	6 807.01	0.12	0.01	4.5%	17.5%	20.4%	304.42	0.02	0.00
Biomass	35 812.03	15.0%	108.83	29.89	3.99		24.0%	37.0%	3 897.34	1.07	0.14	15.0%	28.3%	39.9%		0.30	0.06
3. Transport									46 659.13	5.69	1.91	5.8%	10.5%	74.4%	2720.67	0.60	1.42
Liquid Fuels	646 246.46	3.0%	71.10	8.65	2.92	5.0%	10.2%	75.0%	45 945.24	5.59	1.89	5.8%	10.6%	75.1%	2679.04	0.59	1.42
Solid Fuels	NA,NO	3.0%	NA	NA	NA	5.0%	13.5%	11.7%				5.8%	13.8%	12.1%			
Biomass	12 895.07	4.0%	55.36	1.00	0.10	2.0%	24.0%	37.0%	713.89	0.01	0.00	4.5%	24.3%	37.2%	31.93	0.00	0.00
Other Fuels	27 760.00	15.0%	70.80	3.00	0.60		50.0%	50.0%	1 965.41	0.08	0.02	15.0%	52.2%	52.2%	294.81	0.04	0.01
4. Other Sectors									49 729.36	125.49	1.38	3.0%	12.9%	25.4%	1472.37	16.22	0.35
Liquid Fuels	114 533.36	4.0%	70.86	6.00	3.24	1.0%	41.8%	75.0%	8 115.91	0.69	0.37	4.1%	42.0%	75.1%	334.63	0.29	0.28
Solid Fuels	315 682.19	4.0%	94.43	269.76	1.50	2.0%	13.5%	11.7%	29 809.92	85.16	0.47	4.5%	14.1%	12.4%	1333.14	11.99	0.06
Gaseous Fuels	211 458.76	4.0%	55.82	5.00	0.10	2.0%	17.0%	20.0%	11 803.52	1.06	0.02	4.5%	17.5%	20.4%	527.87	0.18	0.00
Biomass	129 476.18	15.0%	109.40	298.07	3.97		24.0%	37.0%	14 164.33	38.59	0.51	15.0%	28.3%	39.9%		10.92	0.21
5. Other																	
Liquid Fuels	NO	5.0%	NA	NA	NA	1.0%	100.0%	75.0%	IE	IE	IE	5.1%	100.1%	75.2%			
Solid Fuels	IE	5.0%	NA	NA	NA	2.0%	80.0%	11.7%	IE	IE	IE	5.4%	80.2%	12.7%			
Gaseous Fuels	IE	5.0%	NA	NA	NA	2.0%	90.0%	20.0%	IE	IE	IE	5.4%	90.1%	20.6%			
Biomass	IE	20.0%	NA	NA	NA		95.0%	37.0%	IE	IE	IE	20.0%	97.1%	42.1%			
B. Fugitive Emissions from Fuels									**188.871**	**555.29**	**0.00**	6.4%	31.2%		12.13	173.49	
1. Solid Fuels									1.18	350.08		10.2%	49.5%		0.12	173.15	
1. B. 1. a. Coal Mining and Handling																	
i. Underground Mines [Activity in Mt, EF in kg/t]	70.50	2.0%		4.90820			50.0%			346.03			50.0%			173.15	
ii. Surface Mines [Activity in Mt, EF in kg/t]	57.06	2.0%		0.01273			50.0%			0.73			50.0%			0.36	
1. B. 1. c. Other [CO2 Emisson from Coking Gas Subsystem]	0.54	2.0%	2 192 303	6 161 377.66		10.0%	50.0%		1.18	3.32		10.2%	15.0%		0.12	0.50	
2. Oil and Natural Gas									187.69	205.21	0.00	6.5%	5.3%	100.1%	12.13	10.82	0.00
1. B. 2. a. Oil																	
ii. Production [Activity in PJ, EFs in kg/PJ]	29.01	0.5%	6 315 000	61 800.00		6.6%	8.1%		183.18	1.79		6.6%	8.1%		12.12	0.15	
iii. Transport [Activity in Gg]	20 784.67	0.5%	0.569106	6.271777		6.6%	8.1%		0.01	0.13		6.6%	8.1%		0.00	0.01	
iv. Refining/storage [Gg]	862.83	0.5%		745.00		6.6%	8.1%		NA	0.64			8.1%			0.05	
1. B. 2. b. Natural Gas																	
i. Production / Processing [Activity in PJ, EFs in kg/PJ]	153.98	0.5%	23 521.90	96 971.81		6.6%	8.1%		3.62	14.93		6.6%	8.1%		0.24	1.21	
ii. Transmission [Activity in PJ, EFs in kg/PJ]	513.99	0.5%	521.60	53 204.94		6.6%	8.1%		0.27	27.35		6.6%	8.1%		0.02	2.22	
iv. Distribution [Activity in PJ, EF in kg/PJ]	513.99	0.5%	1 166.76	310 713.43		6.6%	8.1%		0.60	159.70		6.6%	8.1%		0.04	12.96	
v. Other Leakage [Activity in PJ, EFs in kg/PJ]	513.99	0.5%	9.91	1 290.30		6.6%	8.1%		0.01	0.66		6.6%	8.1%		0.00	0.05	
1. B. 2. c. Venting and Flaring	577.30	5.0%	12.00			6.6%		100.0%	0.01		0.000649	8.3%		100.1%	0.00		0.00
2. Industrial Processes									**19 409.86**	**15.94**	**3.54**	5.3%	14.2%	29.7%	1023.97	2.26	1.05
A. Mineral Products									8 442.59			11.0%			932.06		
1. Cement Production [Activity in kt, EF in t/t]	10 659.20	5.0%	0.54011914			15.0%			5 757.24			15.8%			910.30		
2. Lime Production [Activity in kt, EF in t/t]	1 715.90	10.0%				10.0%			1 315.24			14.1%			186.00		
3. Limestone and dolomite Use [activitz in kt, EFs in t/t]	NA		NA						706.71			10.0%					
4. Soda Ash (production) [Activity in kt, EF in t/t]	532.22	10.0%	0.415						220.87			10.0%			22.09		
7. Other (ETS Data; Bricks, Tiles, Ceramic Materials and Glass production) [emission data only]									442.53			1.0%			4.43		
B. Chemical Industry									3 495.75	11.16	3.50	7.1%	19.1%	30.1%	247.18	2.13	1.05
1. Ammonia Production [Activity in kt, EF in t/t]	2 010.89	5.0%	1.73708282	0.0049		5.0%	20.0%		3 493.08	9.85		7.1%	20.6%		247.00	2.03	
2. Nitric Acid Production [Activity in kt, EF in t/t]	2 139.42	2.0%			0.00			30.0%			2.81			30.1%			0.84
3. Adipic Acid Production [Activity in kt, EF in t/t]	NO	5.0%						10.0%	NO					11.2%			
4. Carbide Production (calcium carbide) [Activity in kt, EF in t/t]	1.15	5.0%				5.0%			2.51			7.1%					
5. Other (Carbon Black) [Activity in kt, EF in t/t]	25.81	5.0%		0.01			20.0%			0.28			20.6%			0.06	
5. Other (Ethylene) [Activity in kt, EF in t/t]	516.29	5.0%	0.0003	0.00100		5.0%	20.0%		0.15	0.52		7.1%	20.6%		0.01	0.11	
5. Other (N2O for Medical Use) [Activity in kt, EF in t/t]	127.20	5.0%			IE	10.0%		20.0%		0.51	IE						IE
5. Other (Methanol) [Activity in kt, EF in t/t]	0.30	5.0%		0.00200			20.0%			0.00			20.6%			0.00	
5. Other (Caprolactam) [Activity in kt, EF in t/t]	144.97	5.0%			0.0047			20.0%			0.69						
C. Metal Production									5 939.69	4.77	0.04	5.7%	15.6%	18.8%	335.97	0.74	0.01
1. Iron and Steel Production																	
Sinter [Activity in kt, EF in t/t]	4 362.55	5.0%	0.26	0.000076	0.0000008	10.0%	20.0%	20.0%	1 151.10	0.33	0.00	11.2%	20.6%	20.6%	128.70	0.07	0.00
Coke [Activity in kt, EF in t/t]	7 091.32	5.0%	0.22	0.000500		10.0%	20.0%		1 531.42	3.55		11.2%	20.6%		171.22	0.73	
Open-heart Steel [Activity in kt, EF in t/t]		5.0%															
Electric Furnace Steel [Activity in kt, EF in t/t]	3 892.82	5.0%	0.08096	0.000120	0.0000000	10.0%	20.0%	20.0%	315.15	0.47	0.00	11.2%	20.6%	20.6%	35.23	0.10	0.00
Pig Iron [Activity in kt, EF in t/t]	2 983.50	5.0%	0.75732	0.000086	0.0000130	10.0%	20.0%	20.0%	2 259.47	0.26	0.04	11.2%	20.6%	20.6%	252.62	0.05	0.01
Iron Cast [Activity in kt, EF in t/t]	805.08	5.0%	0.006	0.000200		10.0%	20.0%		4.85	0.16		11.2%	20.6%		0.54	0.03	
Steel Cast [Activity in kt, EF in t/t]	123.54	5.0%	0.046			10.0%			5.71			11.2%			0.64		
Basic Oxygen Furnace Steel [Activity in kt, EF in t/t]	3 235.67	5.0%	0.11530	0.000000	0.0000000	10.0%	20.0%	20.0%	373.07	0.00	0.00	11.2%	20.6%	20.6%	41.71	0.00	0.00
2. Ferroalloys Production [Activity in kt, EF in t/t]	9.69	5.0%	3.9	0.001000		5.0%	20.0%		37.77	0.01		7.1%	20.6%		2.67	0.00	
3. Aluminium Production [Activity in kt, EF in t/t]	16.85	5.0%	1.8			5.0%			30.33			7.1%			2.14		
5. Other (Zinc Production) [Activity in kt, EF w t/t]	79.15	5.0%	0.5			5.0%			41.16			7.1%			2.91		
5. Other (Lead Production) [Activity in kt, EF w t/t]	110.27	5.0%	1.7			5.0%			189.66			7.1%			13.41		
D. Other Production									8.62			5.0%			0.43		
G. Other									1 523.20			5.0%			76.16		
3. Solvent and Other Product Use	130.09		NA						618.31		0.4	15.0%		50.0%	92.75		0.20

GHG inventory 2009 – Uncertainty analysis, part 2, sector 4-6

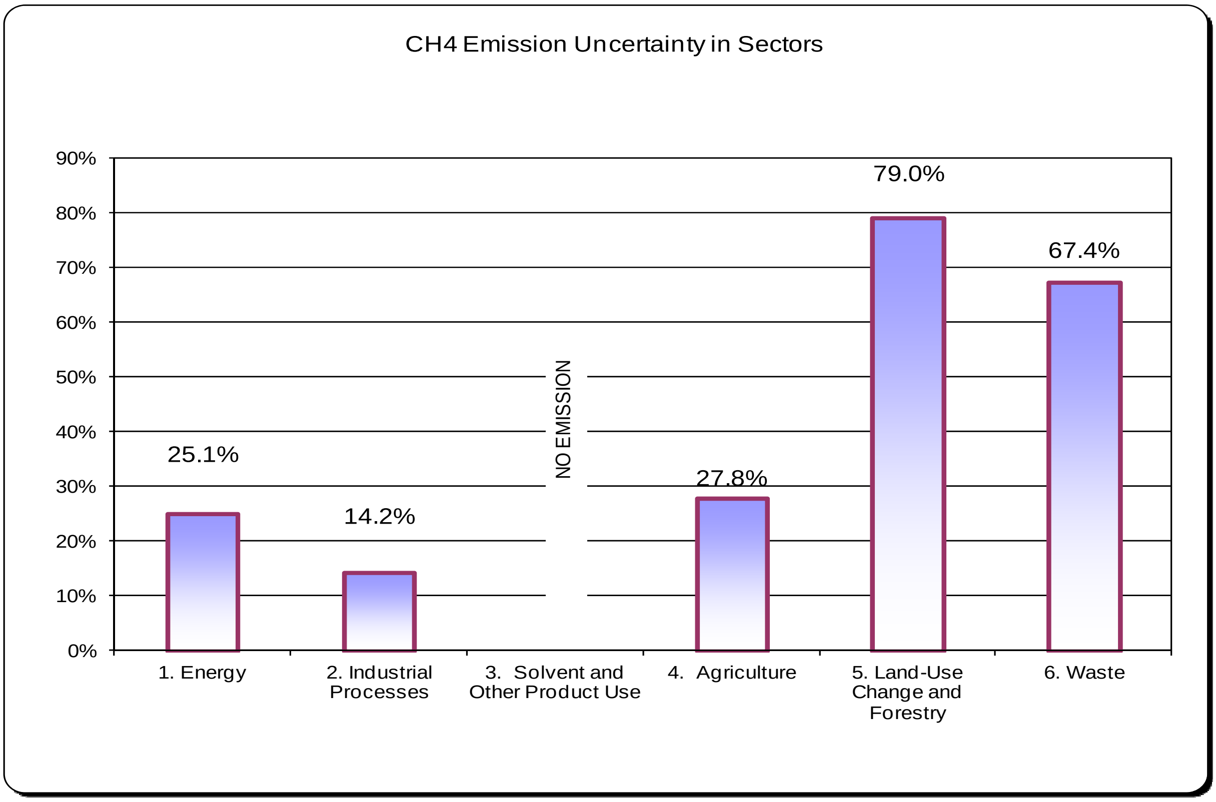
2009	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
4. Agriculture										**587.22**	**74.78**		27.8%	57.5%		163.04	42.96
A. Enteric Fermentation										**437.83**			34.5%			150.93	
1. Cattle																	
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2 687.90	5.0%		97.03204311			50.0%			260.81			50.2%			131.06	
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	3 012.1	5.0%		48.90			50.0%			147.30			50.2%			74.02	
3. Sheep [Activity in 1000 heads, EF in kg/head]	286.4	5.0%		8.16			50.0%			2.34			50.2%			1.17	
4. Goats [Activity in 1000 heads, EF in kg/head]	118.9	5.0%		5.00			50.0%			0.59			50.2%			0.30	
6. Horses [Activity in 1000 heads, EF in kg/head]	297.9	5.0%		18.00			50.0%			5.36			50.2%			2.69	
8. Swine [Activity in 1000 heads, EF in kg/head]	14 278.6	5.0%		1.50			50.0%			21.42			50.2%			10.76	
9. Poultry [Activity in 1000 heads, EF in kg/head]	140 826.0	5.0%					50.0%						50.2%				
B. Manure Management										147.94	16.26		41.7%	148.6%		61.68	24.17
1. Cattle																	
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2 688	5.0%		10.529604			50.0%			28.30			50.2%			14.22	
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	3 012	5.0%		4.93			50.0%			14.84			50.2%			7.46	
3. Sheep [Activity in 1000 heads, EF in kg/head]	286	5.0%		0.17			50.0%			0.05			50.2%			0.02	
4. Goats [Activity in 1000 heads, EF in kg/head]	119	5.0%		0.12			50.0%			0.01			50.2%			0.01	
6. Horses [Activity in 1000 heads, EF in kg/head]	298	5.0%		1.39			50.0%			0.41			50.2%			0.21	
8. Swine [Activity in 1000 heads, EF in kg/head]	14 279	5.0%		6.54			50.0%			93.33			50.2%			46.90	
9. Poultry [Activity in 1000 heads, EF in kg/head]	140 826	5.0%		0.08			50.0%			10.98			50.2%			5.52	
11. Liquid Systems [Activity in 1000 heads, EF in kg N2O-N/kg N]		5.0%			0.00100233			150.0%			0.16			150.1%			0.25
12. Solid Storage and Dry Lot [Activity in 1000 heads, EF in kg N2O-N/kg N]		5.0%			0.020000			150.0%			16.10			150.1%			24.16
D. Agricultural Soils											58.46			60.8%			35.52
1. Direct Soil Emissions																	
Synthetic Fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	985 860 000	5.0%			0.0125			150.0%			19.37			150.1%			29.06
Animal Wastes Applied to Soils [Activity in kg N, EF in kg N2O-N/kg N]	492 999 653	5.0%			0.01			150.0%			9.68			150.1%			14.53
N-fixing Crops [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	20 417 297	5.0%			0.01			150.0%			0.40			150.1%			0.60
Crop Residue [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	163 136 878	5.0%			0.01			150.0%			3.20			150.1%			4.81
Cultivation of Histosols [Activity in ha, EF in kg N2O-N/ha]	706 700	5.0%			8.00			150.0%			8.88			150.1%			13.33
2. Animal Production [Activity in kg N, EF in kg N2O-N/kg N]	4 961 610	5.0%			0.01			150.0%			0.10			150.1%			0.15
3. Indirect Emissions [Activity in kg N/yr, EF in kg N2O/kg N]	45 632 980	20.0%			0.31			150.0%			1.43			151.3%			2.17
4. Sewage sludge aplied to fields								150.0%			15.39						
F. Field Burning of Agricultural Residues										1.45	0.06		24.0%	101.4%		0.35	0.06
1. Cereals																	
Wheat [Activity in t of crop production, EF in kg/t dm]	9 790 000	30.0%		0.18155073	0.00041938		20.0%	150.0%		0.18	0.00		36.1%	153.0%		0.06	0.01
Barley [Activity in t of crop production, EF in kg/t dm]	3 984 000	30.0%		0.1473	0.0004		20.0%	150.0%		0.06	0.00		36.1%	153.0%		0.02	0.00
Maize [Activity in t of crop production, EF in kg/t dm]	1 706 000	30.0%		0.0129	0.0000		20.0%	150.0%		0.00	0.00		36.1%	153.0%		0.00	0.00
Oats [Activity in t of crop production, EF in kg/t dm]	1 415 000	30.0%		0.1506	0.0004		20.0%	150.0%		0.02	0.00		36.1%	153.0%		0.01	0.00
Rye [Activity in t of crop production, EF in kg/t dm]	3 713 000	30.0%		0.2004	0.0004		20.0%	150.0%		0.07	0.00		36.1%	153.0%		0.03	0.00
Other Cereals [Activity in t of crop production, EF in kg/t dm]	9 211 000	30.0%		0.1658	0.0004		20.0%	150.0%		0.15	0.00		36.1%	153.0%		0.06	0.01
2 Pulses (Other non-specified)	272 000	30.0%		0.0403	0.0003		20.0%	150.0%		0.00	0.00		36.1%	153.0%		0.00	0.00
3 Tuber and Root																	
Potatoes [Activity in t of crop production, EF in kg/t dm]	9 703 000	30.0%		0.1796	0.0014		20.0%	150.0%		0.17	0.01		36.1%	153.0%		0.06	0.02
Other Tuber and Root [Activity in t of crop production, EF in kg/t dm]		30.0%					20.0%	150.0%					36.1%	153.0%			
5 Other																	
Fruits, Veget., Rape, Tabacco, Hop, Hey [Activity in t of crop prod., EF in kg/ t of cro	8 373 000	30.0%		0.0940	0.0037		20.0%	150.0%		0.79	0.03		36.1%	153.0%		0.28	0.05
5. Land-Use Change and Forestry									-39 516.54	111.18	0.02	27.6%	79.0%	57.5%	-10894.73	87.86	0.01
A. Forest Land	**9 296.00**	**5.0%**	**-5.5877654**	**0.000164292**	**1.42964716**	**20.0%**	**80.0%**	**80.0%**	**-51 943.87**	**1.53**	**0.01**	20.6%	80.2%	80.2%	-10708.50	1.22	0.011
B. Cropland	12 940.00	5.0%	0.71511286			20.0%			9 253.56			20.6%	5.0%	5.0%	1907.67		
C. Grassland	3 180.00	5.0%	0.0427798	1.48803E-05	0.23053925	20.0%	80.0%	80.0%	136.04	0.05	0.00	20.6%	80.2%	80.2%		0.04	0.001
D. Wetlands	882.00	5.0%	3.40397034	0.124268844	7.76496659	20.0%	80.0%	80.0%	3 002.30	109.61	0.01	20.6%	80.2%	80.2%	618.94	87.86	0.005
E. Settlements	2 080.00	5.0%	0.01702928			20.0%			35.42			20.6%	5.0%	5.0%	7.30		
F. Other Land	2 891.00	5.0%										5.0%	5.0%	5.0%			
6. Waste									230.99	357.70	3.62	51.0%	67.4%	51.8%	117.78	240.96	1.876
A. Solid Waste Disposal on Land										**305.94**			77.4%			236.68	
1 Managed Waste Disposal on Land [Activity in Gg, EF in t/t MSW]	1 100.26	23.0%		0.036573674			100.0%			40.24			102.6%			41.29	
2 Unmanaged Waste Disposal Sites - deep (>5 m) [Activity in Gg, EF in t/t MSW]	6 758.74	23.0%		0.036573674			100.0%			247.19							
3 Other - Total Waste Disposal on Land (Draft Guidlines 2006) [Activity in Gg, EF in t/t MS	63.52	23.0%		0.291371061			100.0%			18.51			102.6%			18.99	
B. Wastewater Handling										51.76	3.59		87.4%	52.2%		45.23	1.88
Industrial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	327.22			0.025992304			100.0%			9.39			100.0%			9.39	
Domestic and Commercial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	536.91	30.0%		0.08			100.0%			42.38			104.4%			44.24	
N2O from human sewage [Activity in 1000s of population, EF in kg N2O-N/kg sewage N pr	38 167.33	15.0%			9.4157E-05			50.0%			3.59			52.2%			1.88
C. Waste Incineration									230.99		0.03	51.0%		22.9%	117.78		0.01
biogenic [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			64.13		0.01	51.0%		30.0%	32.70		0.00
plastics and other non-biogenic waste [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			230.99		0.02	51.0%		30.0%	117.78		0.01

Industrial gases inventory 2009 – Uncertainty analysis for HFC, PFC and SF_6.

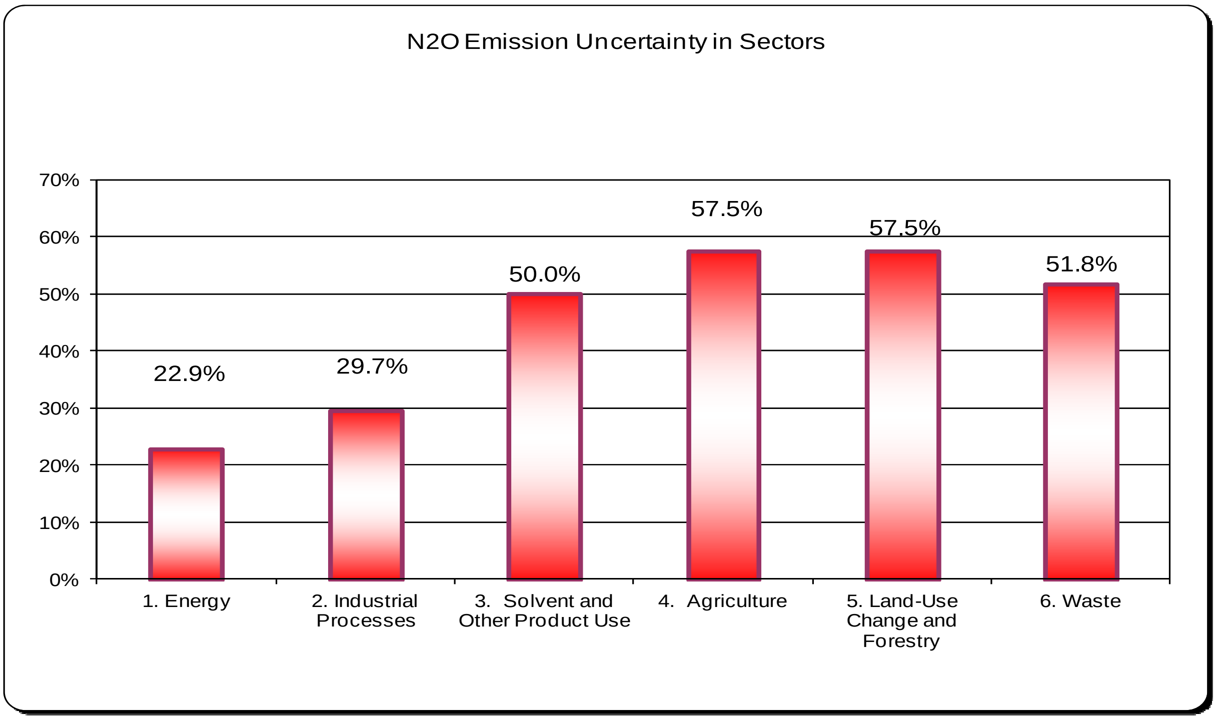
	HFC Emission [Gg of CO_2 eq.]	PFC Emission [Gg of CO_2 eq.]	SF_6 Emission [Gg of CO_2 eq.]	HFC Emission uncertainty [%]	PFC Emission uncertainty [%]	SF_6 Emission uncertainty [%]	HFC Emission absolute uncertainty [Gg of CO_2 eq.]	PFC Emission absolute uncertainty [Gg of CO_2 eq.]	SF_6 Emission absolute uncertainty [Gg of CO_2 eq.]
TOTAL	7 073.32	90.47	39.42	50.9%	85.8%	89.7%	3 597.06	90.47	35.07
2. Industrial Processes	7 073.32	90.47	39.42	50.9%	85.8%	89.7%	3 597.06	90.47	35.07
C. Metal Production		76.27	4.35		100.0%	100.0%		76.27	
3. Aluminium Production		76.27	4.35		100.0%	100.0%		76.27	4.35
F. Consumption of Halocarbons and SF6	7 073.32								
1. Refrigeration and Air Conditioning Equipment	3 377.36								
2. Foam Blowing	330.67								
3. Fire Extinguishers	16.60	14.20	35.07	50.9%	100.0%	100.0%	3 597.06	14.20	35.07
4. Aerosols/ Metered Dose Inhalers	178.23			50.0%			1 688.68		
8. Electrical Equipment				50.0%					
9. Other - Potential emissions as a proxy for actual emissions	3 170.46								



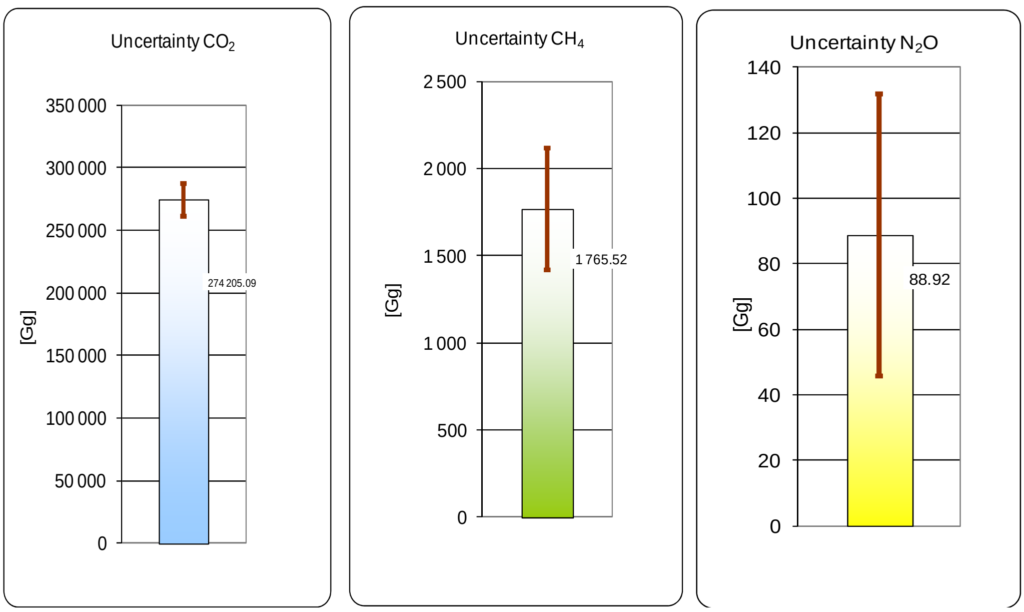
Results of uncertainty analysis in percents for CO_2 with sectoral split.



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.

CHANGE REQUEST

New message flow

Date: 18/09/2009

I. SUMMARY

II. INTRODUCTION

CHANGE REQUEST ORIGIN

The origin of this change request comes from one of the CAB issues, namely “Revised Transaction Message Flow” (ref. RSNCM-13), submitted to CAB members 23 June 2009.
The origin of the CAB issue is:

- Analysis of manual intervention incidents for the Q1 of 2009 which shows that 45% of manual interventions are the result of failures in finalising the transaction between the transferring registry and the ITL
- Statistic showing that up to March 2009, 4010 and 7945 inconsistencies arising from transactions from the French registry constitute a large proportion of the ITL’s 4010 and 7945 errors from all registries (929 of 1309).[1]
- Certain number of deficiencies that impacts the robustness of ITL transference transactions (see RSNCM-13 for more details)

Solution proposed by the UNFCCC ITL team is to change the message flow between the registry, ITL and CITL in order to finalise transaction first of all in the ITL, then in the CITL and afterwards in both registries.

PURPOSE OF THIS DOCUMENT

This document provides a solution description in response to the change request regarding the new message flow in the registry, namely the way of finalisation of outgoing and incoming transactions.

This document provides as well an approximate estimation of time and cost necessary for the change request realisation.

TERMS AND ABBREVIATIONS USED

ITL	International Transaction Log
CITL	Community International Transaction Log
Registry	Electronic system to track a party’s compliance with its Kyoto target
RA/SA	Users having “Registry administrator” or “System administrator” profiles

[1] One of the reasons for this is that the French registry allows its clients to do automated chained transactions – when a transaction is finalised in the registry, its units may be immediately proposed in another transaction. It is expected that **as other registries move to automated processing, they might experience the same problems.**

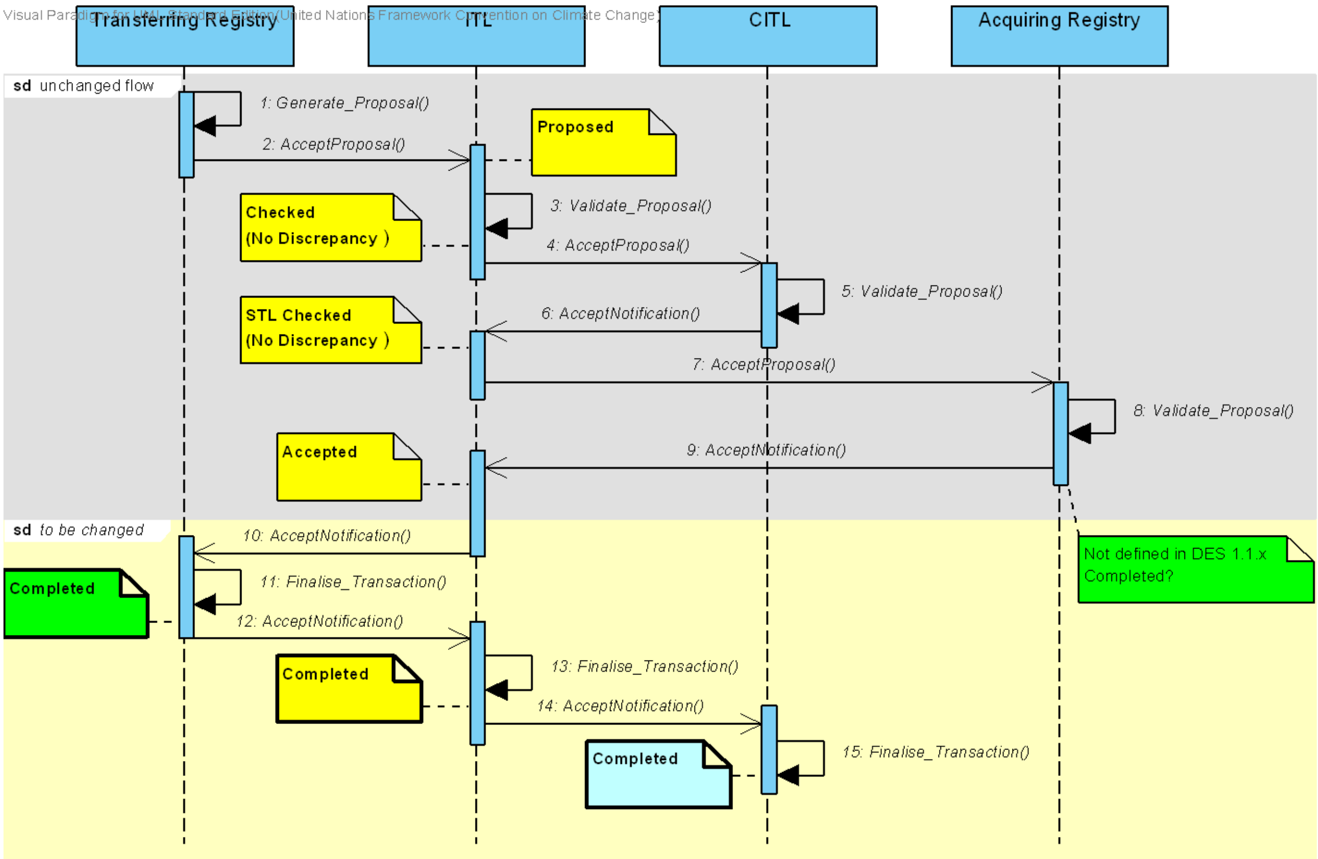
III. ACTUAL SITUATION

TRANSACTION FINALISATION

Actually transferring registry finalizes transaction immediately after reception of the technical ACK on sent to the ITL/CITL AcceptNotification message (ref: 12) with status 4 (Completed) or 5 (Terminated), which is often long before the transaction gets finalized on the ITL and CITL sides.

Same thing for the acquiring registry: transaction gets completed on reception of the technical ACK on sent to the ITL/CITL AcceptNotification message (ref: 9) with status 8 (Accepted) or 6 (Rejected), which is often long before the transaction gets finalized on the ITL, CITL and transferring registry's sides.

Here's the actual message flow:



GET TRANSACTION STATUS WS

It happens quite often that the registry doesn't get a technical ACK on the last AcceptNotification message sent on the CITL/CITL, thus it is not able to finalize transaction in the automatic way. There're two reasons for that:

- ITL/CITL hasn't received the last AcceptNotification message from the registry, thus transaction is pending on the ITL and CITL sides as well
- Registry hasn't received the technical ACK even it had been sent, thus transaction is finalized in the ITL/CITL, but pending in the registry

"Get transaction status" WS gives a possibility to finalize transaction without getting technical ACK on the last AcceptNotification message. But it remains possible only if transaction is already finalized on the ITL and CITL sides. That means that ITL/CITL has received the last AcceptNotification message from the registry, in other words the message flow was completed.

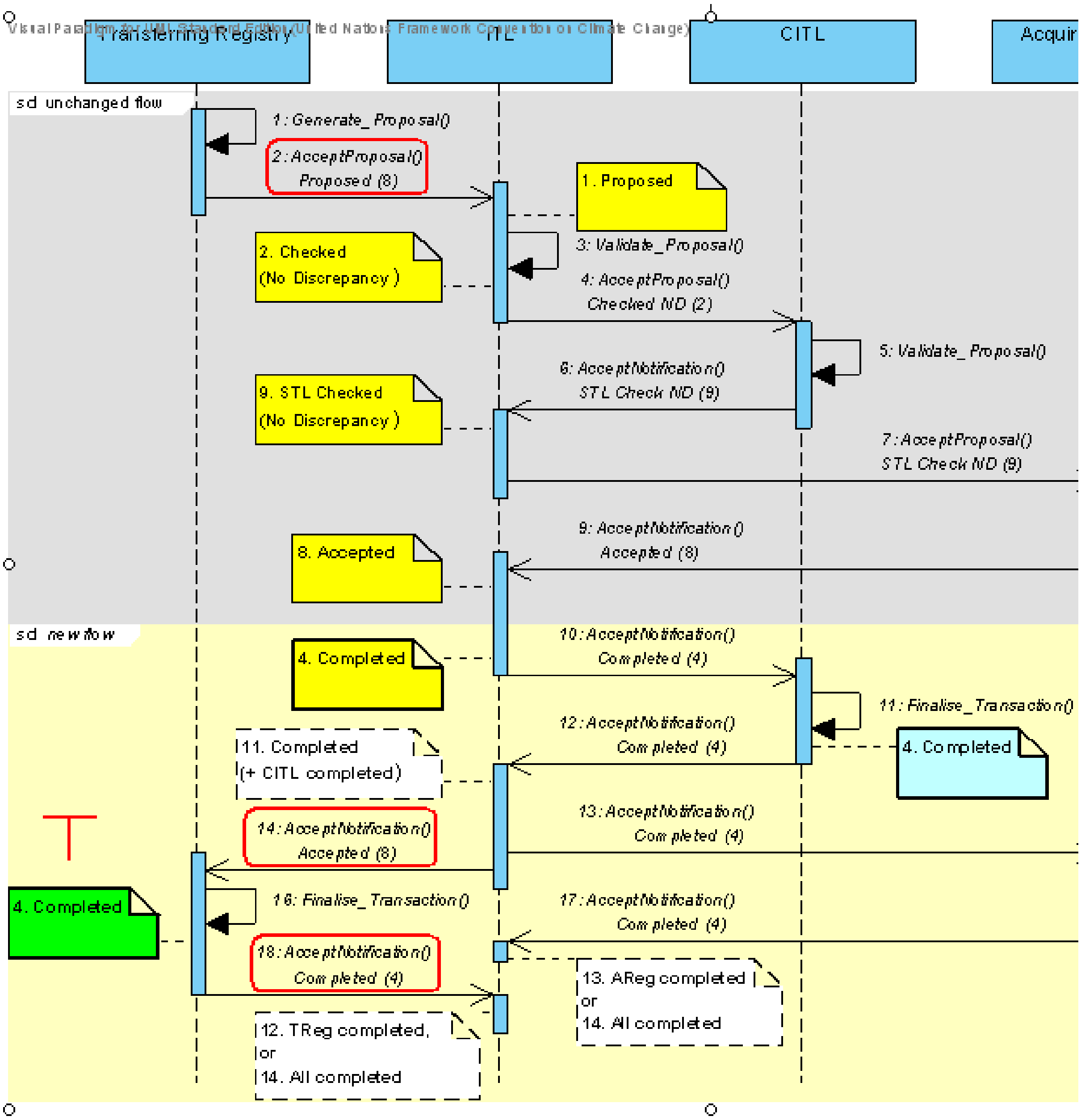
IV. IMPACT ON SERINGAS

TRANSACTION FINALISATION

There're two main changes for the transaction finalization process according to the new message flow:

- the moment transaction gets finalized (all types of transfers are impacted)
- supplementary messages to be managed on sending and reception (only incoming international transfer is impacted)

Outgoing international transfers



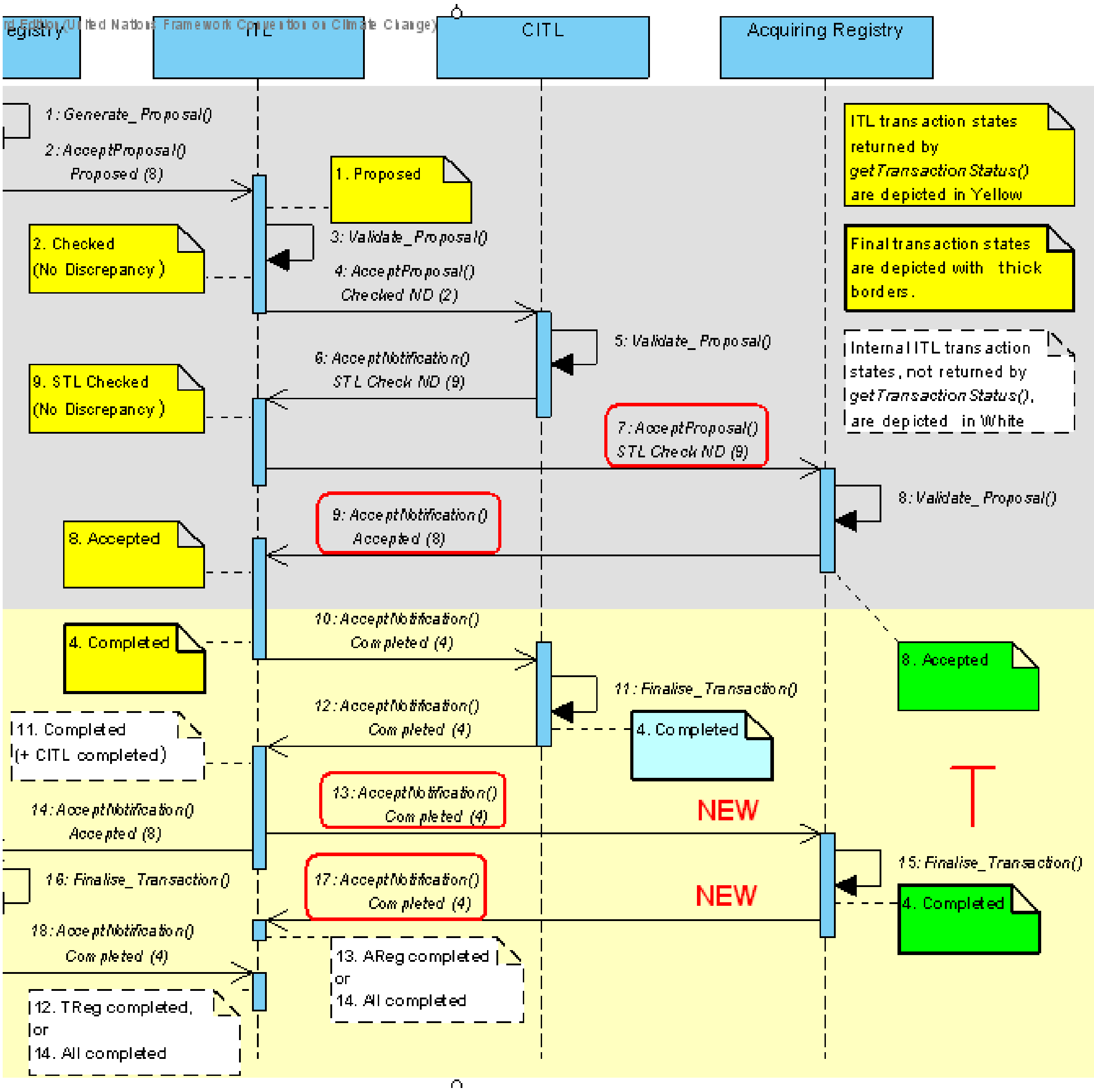
According to the new message flow, the only change for the outgoing international transfer finalization is the moment it gets finalized.

Instead of finalizing it after reception of the ACK on the last AcceptNotification message (18) sent to the ITL/CITL, outgoing international transfer must be finalized now after reception of the last AcceptNotification message (14) from the ITL/CITL (status 8 – "T", status 6 – "A").

Nevertheless, in spite of immediate finalisation after reception of the last AcceptNotification message (14) from the ITL/CITL, system should respond with the last AcceptNotification message (18) to the ITL/CITL ("T" – status 4, "A" – status 5) in order to complete the "usual" message flow.
Thus, message flow remains unchanged.

Registries which would not apply the new message flow (finalization after reception of the AcceptNotification message (14)) should be able to finalize outgoing international transfer as they used to do: after reception of the ACK on the last AcceptNotification message (18) sent to the ITL/CITL (status 4 for "T", status 5 for "A").

Incoming international transfers



According to the new message flow, there're two changes for the international incoming transfer finalization:

- the moment it gets finalized
- new messages to manage

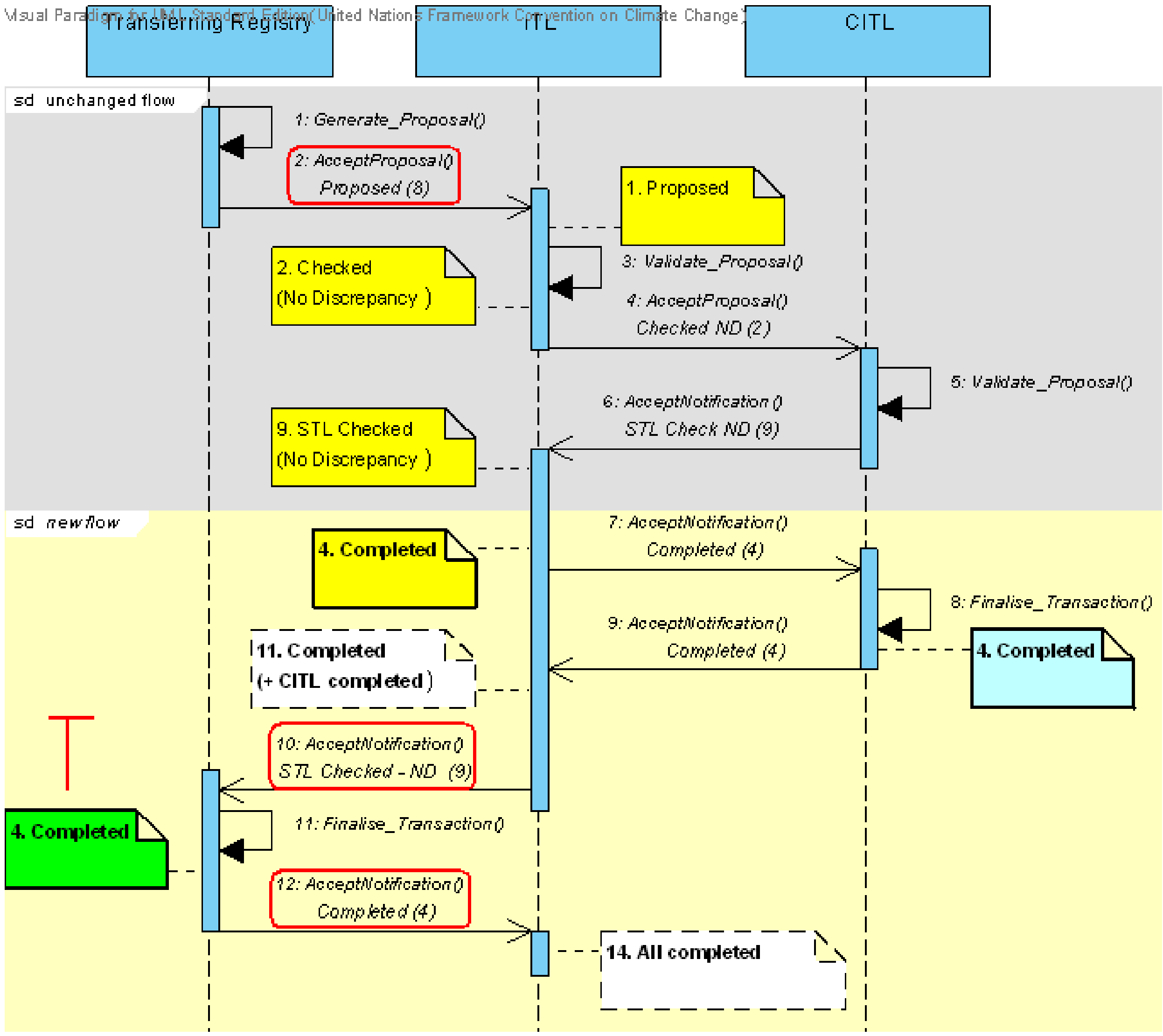
Instead of finalizing it after reception of the ACK on the last AcceptNotification message (9) sent to the ITL/CITL (status 8 for "T", status 6 for "A"), incoming international transfer must be finalized now after reception of the new AcceptNotification message (13) from the ITL/CITL (status 4 – "T", status 5 – "A").

In spite of immediate finalisation after reception of the new AcceptNotification message (13) from the ITL/CITL, system should respond with the last AcceptNotification message (17) to the ITL/CITL ("T" – status 4, "A" – status 5) in order to complete the new message flow.

Thus, message flow is definitely changed: ITL/CITL send additional AcceptNotification message (13) and Seringas needs to respond with an additional AcceptNotification message (17) too.

Nevertheless, registries which would not apply the new message flow (finalization after reception of the new AcceptNotification message (13) and responding with a new AcceptNotification message (17)) should be able to finalize incoming international transfer as they used to do: after reception of the ACK on the last AcceptNotification message (9) sent to the ITL/CITL (status 8 for "T", status 6 for "A") and ignoring any other messages from the ITL/CITL for that transaction (13).

Internal transfers



According to the new message flow, the only change for the internal transfer finalization is the moment it gets finalized.

Instead of finalizing it after reception of the ACK on the last AcceptNotification message (12) sent to the ITL/CITL, internal transfer must be finalized now after reception of the last AcceptNotification message (10) from the ITL/CITL (status 9 – "T", status 10 – "A").

Nevertheless, in spite of immediate finalisation after reception of the last AcceptNotification message (10) from the ITL/CITL, system should respond with the last AcceptNotification message (12) to the ITL/CITL (“T” – status 4, “A” – status 5) in order to complete the “usual” message flow.
Thus, message flow remains unchanged.

Registries which would not apply the new message flow (finalization after reception of the AcceptNotification message (10)) should be able to finalize internal transfer as they used to do: after reception of the ACK on the last AcceptNotification message (12) sent to the ITL/CITL (status 4 for “T”, status 5 for “A”).

GET TRANSACTION STATUS WS

The new message flow impacts the actual functioning of the “Get transaction status” WS only from the point of view of transaction finalization.

In fact, there’s no need any more to update transaction status according to the answer from the ITL/CITL got while using “Get transaction status” WS as such update can perturb the normal message flow in any registry, whether it has applied the new message flow or practising the old one.
It happens because transaction gets finalised in the ITL/CITL before reception of the first AcceptNotification message from the CITL/ITL. In other words, “Get transaction status” WS allows receiving the final status of transaction (status 4 – “T”, status “5” – “A”) even before making any treatment in the system of the first AcceptNotification message which will be considered then as an out-of-sequence message if an automatic update of transaction status via “Get transaction status” WS takes place.

Thus all registries, independently of the message flow they are going to practise, should get an update where there’ll be no more possible to change transaction status via “Get transaction status” WS. This is an obligatory patch for all registries. Thus it should be

- included in the main solution for those registries which apply for the new message flow in order to profit from the new DES;
- provided as a separate patch for those registries which don’t apply for the new message flow, but should be compatible with a new DES.

24-HOURS CLEAN-UP RPOCESS

There’s no impact on the message flow while the 24-hours clean-up process.

V. CHANGE REQUEST SUMMARY

NEW MESSAGE FLOW: IMPROVEMENTS

- New transaction finalisation procedure for all types of transfer
- New messages for incoming international transfer
- Update of the "Get transaction status" WS

NEW MESSAGE FLOW: BACKWARD COMPATIBILITY

- Update of the "Get transaction status" WS
- Backward compatibility assurance

CHANGE REQUEST SCHEDULE

Beginning of the developments: 01/01/2010
Expected Delivery Date to Licensees: 14/02/2010

From: Cecile.Pierce@ec.europa.eu [mailto:Cecile.Pierce@ec.europa.eu]
Sent: Tuesday, April 20, 2010 7:43 PM
To: Sędziwa Małgorzata
Cc: Jędrysiak Przemysław; Mzyk Paweł; Helpdesk.Kyoto@trasys.be
Subject: RE: Implementation of new application version on PRODUCTION environment for Poland

Dear Malgorzata,
I have examined the test report from the ETS compliance test performed on 19 April 2010.
The registry of Poland has successfully completed all mandatory tests and may release into Production. Please note that the functionality corresponding to the tests not performed (because it is not available in Seringas version 5.0.2) will be disabled in the CITL until such time as the tests have been completed successfully.
This confirmation e-mail is sufficient certification to go into production.
Please communicate to the CITL Helpdesk the date on which you intend going into production - I copy in the CITL Helpdesk so that the required functions can be enabled in the CITL.
Kind regards,
Cécile.

Cécile Pierce
European Commission
Directorate General Climate Action
Unit: CLIM.B.1: Implementation of ETS
Office: BU-5, 02/25
B-1049 Bruxelles, Belgium
Tel. +32 2 295 55 64
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e-mail: Cecile.Pierce@ec.europa.eu <<mailto:Cecile.Pierce@ec.europa.eu>>

EUROPEAN COMMISSION
DIRECTORATE-GENERAL
ENVIRONMENT
Directorate C - Climate Change & Air
ENV.C.2 - Market based instruments including Greenhouse gas emissions trading

Brussels,
ENV C2/

ETS Testing Plan

Table of content

1. INTRODUCTION

1.1. Purpose

The purpose of this document is to define the Test Specifications for the verification of Member States registries applications.

This plan documents the testing activities to be conducted by the MS registry administrator or the assigned testing coordinator in order to demonstrate the ability of the registry to perform the processes required under the ETS and its good functioning in conjunction with the Community Independent Transaction Log.

The test cases are mainly based on prior work including:

- The *Commission Regulation (EC)* No 2216/2004 for a standardised ans secured system of registries pursuant to Directive 2003/87/EC of the European Parliament and of the Council and Decision 280/2004/EC of the European Parliament and of the Council. This document contains the detailed specifications of the technical aspects of the system, including the details of the WSDL and the definitions of the process flows to be tested;
- The *Data Exchange Standards for registry systems under the Kyoto Protocol - TECHNICAL SPECIFICATIONS (Version 1.1)*, document containing the description of the processes, transaction types and supplementary transaction types applicable to the EC registry system (Downloadable from https://quickplace.unfccc.int/QuickPlace/itl-rsa).

1.2. Guiding principles and Assumptions

The purpose of process testing is to verify that (i) data acceptance, processing, and retrieval is achieved properly, and (ii) both the UNFCCC Data Exchange Standards and EC Data Exchange Standards have been implemented properly.

The process testing will be achieved through the definition of test cases covering all categories of test as summarized in the table below:

Category (code)	Description
Transaction Specific Tests (“xx-yy”)	Validation of the transaction processes by performing a complete life cycle of transaction testing.
Management Tests: • clAcc • crAcc • uAcc • uVE	Registry Management Tests: • Close Account • Create Account • Update Account • Update Verified Emissions

Reconciliation Tests ("RECO")	Validation of the reconciliation process.
Upload of Nap tests (NAP)	Validation of the Nap upload functions
Transaction Status (TXST)	Validation of the GetTransactionStatus function

Test cases will be identified by the following attributes:

- Test ID: Test case unique identifier, which will consist of a category code followed by a unique identification number;
- Test Name: Name of the test case;
- Test Description : Description of the purpose of the test case;
- Pre-Requisites: Description of the situation within the CITL before the test case has been initiated; this describes the accounts involved in the test case as well as their relation to the unit blocks before the test case has been initiated;
- Expected Results: Description of the situation within the CITL once the test case will have been completed; this describes the accounts involved in the test case as well as their relation to the unit blocks after the test case has been completed;
- Response codes: List of response codes expected from the test case;
- The parameters: Information submitted by the MS Registry to the CITL[1].

1.3. Prerequisites

- The database has to be reset so all old data is deleted.
- The XML-files for the NAP have to be created in advance

1.4. Expected result

After each test case it is expected that the balance on the accounts is equal to the balance given in the test case. The National Registry Administrator have to provide a screenshot of this after each case.

[1]It is expected that transaction IDs and serial block IDs generated by the registry software may be different from those described in the test cases.

2. ETS REGISTRIES TEST CASES

2.1. Overview

The following table gives an overview of the processes to be tested and the related test cases

Tx ID	Process description	Test case
01-00	Issue of AAUs and RMUs	5-1
03-00	External transfer (2008-2012 onwards)	7-1, 7-2, 7-3
04-00	Cancellation (2008-2012 onwards)	8-1
05-00	Retirement	13-5
05-01	retirement of surrendered allowances	13-2
05-02	retirement of unallocated allowances	13-4
10-00	Internal transfer	6-1, 6-2, 6-3, 6-4, 6-5, 6-6, 6-7, 6-8
10-52	Allowance issue (2008-2012 onwards)	5-1
10-53	Allowance allocation	5-3, 5-4, 12-4
10-61	Conversion of surrendered allowances	13-1
10-62	Conversion of none-allocated allowances	13-3
10-02	Allowance surrender	11-2, 11-3
clAcc	Close Account	10-2
crAcc	Create Account	2-1, 2-2, 12-1
uAcc	Update Account	9-1, 9-2, 9-3
uVE	Update Verified Emissions	11-1, 11-4
RECO	Reconciliation	14-1, 14-2, 14-3, 14-4
NAP	Nap upload	3-1, 3-2, 3-3, 3-4
AddNEInstallation	Adding new entrant new installations to the national allocation plan table	12-2
IncreaseAllocation	Increasing the allocation in the national allocation plan table of existing installations that are new entrants	15-1, 15-3
RemoveNAPallocation	Removing the allocation from the national allocation plan table of installations that are closing	10-1
TXST	Transaction Status	

2.2. Test cases – Account Creation

Test case 2-1

Name	Create Party Holding Accounts
Description	Creation, in the National Registry of XX a Party Holding Account, a National Cancellation Account for Commitment Period 1, a National Retirement Account for Commitment Period 1 and a National Retirement Account for Commitment Period 2.
Pre-condition	The national registry of XX has been created. The Database is empty for data
Expected result	The follow accounts have been created Party Holding Account, type 100 Cancelation Account for CP1, type 230 Retirement Account for CP1 and CP2, Type 300
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	1 - 4

Test case 2-2

Name	Create Operator and Personal Holding Accounts
Description	Creation, in the National Registry of XX of three Operator Holding Accounts, as well as their related installations and two Personal Holding Accounts -Przycisk merge and compare nie działa – operatorzy nie łączą się z instalacjami - Brak przycisku download (po zatwierdzeniu należy przeładować stronę – działa np. zmiana języka)
Pre-condition	The national registry of XX has been created. The Database only contains the data of the Party Holding Accounts.
Expected result	The follow accounts have been created 3 Operator Holding Accounts, type 120 3 Installations, one related to each of the OHA **The permit date have to be 01/01/2008 for the first 2 and 01/06/2009 for the third installation**

	2 Personal Holding Accounts, type 121 → Set all (or at least the address and phone number of the SAR of the second OHA) to visible at the opening of the accounts
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	5 – 10

2.3. Test cases – NAP Upload

Test case 3-1

Name	Upload NAP for CP1
Description	Upload of a National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12). The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000
Pre-condition	The national registry of XX has been created. The Database contain the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts,
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 105,000 allowances to the reserve and Inst. | 2008 | 2009 | 2010 | 2011 | 2012 #1 | 15000 | 15000 | 15000 | 15000 | 50000 #2 | 10000 | 10000 | 10000 | 10000 | 10000 Total amount of allowances is 265000 The assigned amount for the national registry of XX is set to 1000000 AAU's and the CPR to 450000
Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	CPR + 500000
CPR	Given by ITL
NAP Reserve	105000
Web service	NAP XML
Action	"Add"

2.4. Test cases – Amendment to the NAP

Test case 4-1

<table>
<tr><td>Name</td><td>Upload an amended NAP for CP1</td></tr>
<tr><td>Description</td><td>Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) including allocation for installation #3.</td></tr>
<tr><td>Pre-condition</td><td>Przed dodaniem instalacji należy zmienić datę na 1 sty 2009

Zmienić rezerwę na 25000

The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.</td></tr>
<tr><td>Expected result</td><td>The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 25,000 allowances to the reserve and

<table>
<tr><td>Inst.</td><td>2008</td><td>2009</td><td>2010</td><td>2011</td><td>2012</td></tr>
<tr><td>#1</td><td>15000</td><td>15000</td><td>15000</td><td>15000</td><td>50000</td></tr>
<tr><td>#2</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td><td>10000</td></tr>
<tr><td>#3</td><td></td><td>20000</td><td>20000</td><td>20000</td><td>20000</td></tr>
</table>

The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000</td></tr>
<tr><td>Response code</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Originating Registry:</td><td>XX</td></tr>
<tr><td>Commitment Period:</td><td>1</td></tr>
<tr><td>Assigned amount</td><td>CPR + 500000</td></tr>
<tr><td>CPR</td><td>Given by ITL</td></tr>
<tr><td>NAP Reserve</td><td>25000</td></tr>
<tr><td>Web service</td><td>AddNEInstallationtoNAP</td></tr>
<tr><td>Correlation ID</td><td>11</td></tr>
</table>

Test case 4-2

Name	Upload an amended NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) including installation 3 with amended allocation for installation 3 in year 2012

	Wybrać update przed validacją CITL
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 15,000 allowances to the reserve and Inst. / 2008 / 2009 / 2010 / 2011 / 2012 #1 / 15000 / 15000 / 15000 / 15000 / 50000 #2 / 10000 / 10000 / 10000 / 10000 / 10000 #3 / / 20000 / 20000 / 20000 / 30000 The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000
Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	CPR + 500000
CPR	Given by ITL
NAP Reserve	15000
Web service	IncreaseNAPallocationtoNEInstallation
Correlation ID	12

Nested table in "Expected result":

Inst.	2008	2009	2010	2011	2012
#1	15000	15000	15000	15000	50000
#2	10000	10000	10000	10000	10000
#3		20000	20000	20000	30000

2.5. Test cases - Issuing and allocation

Test case 5-1

Name:	**Issuance of AAU's for Commitment Period 1 (2008-12).**
Description:	**Issuance, in the National Registry of XX of 500000 AAU's having 1 as both original and applicable Commitment Period.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **The assigned amount of AAUs and Allowances has been set.**
Expected Results:	(see table below)
Response Code:	**None**
Parameters	(see tables below)

Expected Results:

Account ID	1	10	11
Type	100	120	120
Installation		1	2
Balance after Amount	CPR+500000 CPR+500000	0 0	0 0

Parameters:

Transaction	ID	Type	Supp. Type
	XX0001	01	00

	Registry	Account type	Account ID
Transferring	XX		
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	0	1

Normally the issuance is 950 000 AAUs

Here after are all balances of AAUs for the account type 100 the mentioned amount+ the CPR

Test case 5-2

Name:	**Issuance of Allowances for Commitment Period 1 (2008-12).**
Description:	**Issuance, in the National Registry of XX 265000 Allowances having 1 as both original and applicable Commitment Period.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10,11and 12**

	and their Installation 1, 2 and 3 have been created. **The assigned amount of AAUs and Allowances has been set and there has been issued AAUs.**
Expected Results:	(see table below)
Response Code:	**None**
Parameters	(see tables below)

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 265000	0 0	0 0	1-0 1-1
Transferred amount	265000			1-1

Parameters:

Transaction	ID	Type	Supp. Type
	XX0002	01	52

	Registry	Account type	Account ID
Transferring	XX		
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 5-3

Name:	**Allocation of Allowances to Operators during Commitment Period 1 (2008-12).**
Description:	**Allocation for year 2008, within the National Registry XX, of 25,000 Allowances having 1 as both original and applicable commitment period, to operator holding accounts, according to the National Allocation Plan that has been uploaded for Commitment Period 1.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1**
Expected Results:	(see table below)

Account ID	1	10		Unit type/supp. type

			11	
Type	100	120	120	
Installation		1	2	
Balance after Transferred amount	235000 240000 -25000	0 15000 15000	0 10000 10000	1-0 1-1 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0003	10	53

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring Acquiring	XX XX	120 120	10 11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 5-4

Name: **Allocation of Allowances to Operators during Commitment Period 1 (2008-12).**

Description: **Allocation for year 2009, within the National Registry XX, of 25,000 Allowances having 1 as both original and applicable commitment period, to operator holding accounts, according to the National Allocation Plan that has been uploaded for Commitment Period 1.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	

Installation		1	2	
Balance after Transferred amount	235000 215000 -25000	0 30000 15000	0 20000 10000	1-0 1-1 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0004	10	53

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring Acquiring	XX XX	120 120	10 11

Unit	Type	Supp. Type	CP
	1	1	1

2.6. Test cases - Internal Transaction

Test case 6-1

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, from a Party Holding Account to Operator Holding Account 10 of 25,000 Allowances having 1 as both original and applicable commitment period.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	see table below
Response Code:	**None**
Parameters	see tables below

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 190000	0 55000	0 20000	1-0 1-1
Transferred amount	-25000	25000		1-1

Parameters:

Transaction	ID	Type	Supp. Type
	XX0005	10	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	10

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-2

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the operator holding account having 10 as account unique identification number to the operator holding account having 11 as unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	see table below

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	

	Balance after Transferred amount	235000 190000	0 45000 -10000	0 30000 10000	1-0 1-1 1-1
Response Code:	**None**				
Parameters					

Transaction	ID	Type	Supp. Type
	XX0006	10	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-3

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the operator holding account having 11 as account unique identification number to the personal holding account having 14 as unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	

Account ID	1	11	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after Transferred amount	235000 190000	0 20000 -10000	0 10000 10000	1-0 1-1 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0007	10	

	Registry	Account type	Account ID
Transferring	XX	120	11
Acquiring	XX	121	14

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-4

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the personal holding account having 14 as account unique identification number to the Party holding account having 1 as unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	(see table below)
Response Code:	**None**
Parameters	(see tables below)

Expected Results:

Account ID	1	14		Unit type/supp. type
Type	100	121		
Installation		1		
Balance after	235000	0		1-0
	200000	0		1-1
Transferred amount	10000	-10000		1-1

Parameters:

Transaction	ID	Type	Supp. Type
	XX0008	10	

	Registry	Account type	Account ID
Transferring	XX	121	14
Acquiring	XX	100	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-5

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, of 10,000 Allowances having 1 as both original and applicable commitment period from the Party holding account having 1 as account unique identification number to the operator holding account having 11 as unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	(see table below)

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000	0	0	1-0
	190000	45000	30000	1-1

Transferred amount	-10000		10000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0009	10	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1

Test case 6-6

Name: **Internal transfer**

Description: **Internal transfer, within the National Registry of XX, of 5,000 Allowances and 10000 AAUs having 1 as both original and applicable commitment period from the Party holding account having 1 as account unique identification number to the operator holding account having 10 as unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	225000 185000	10000 50000	0 30000	1-0 1-1
Transferred amount	-10000 -5000	10000 5000		1-0 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00010	10	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	11

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

Test case 6-7

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, of 5,000 Allowances and 10000 AAUs having 1 as both original and applicable commitment period from the Operator holding account having 10 as account unique identification number to the Personal holding account having 14 as unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	(see table below)
Response Code:	**None**
Parameters	(see tables below)

Expected Results:

Account ID	1	10	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after	225000 185000	0 45000	10000 5000	1-0 1-1
Transferred amount		-10000 -5000	10000 5000	1-0 1-1

Parameters:

Transaction	ID	Type	Supp. Type
	XX00011	10	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	121	14

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

Test case 6-8

Name:	**Internal transfer**
Description:	**Internal transfer, within the National Registry of XX, of 5,000 Allowances and 10000 AAUs having 1 as both original and applicable commitment period from the Personal holding account having 14 as account unique identification number to the Party holding account having 1 as unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected Results:	(see table below)

Account ID	1	10	14	Unit type/supp. type
Type	100	120	121	
Installation		1		

Balance after	235000 190000	0 45000	0 0	1-0 1-1
Transferred amount	10000 5000		-10000 -5000	1-0 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00012	10	

	Registry	Account type	Account ID
Transferring	XX	121	14
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

2.7. Test cases - External Transactions

Test case 7-1

Name:	**External transfer**
Description:	**External transfer of 10000 allowances having 1 as both the original and applicable commitment period from the party holding account within the National Registry of XX having 1 as account unique identification number, to the party holding account within the national Registry of YY.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.**
Expected Results:	(see table below)
Response Code:	**None**
Parameters	(see tables below)

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 180000	0 45000	0 30000	1-0 1-1
Transferred amount	-10000			1-1

Parameters:

Transaction	ID	Type	Supp. Type
	XX00013	03	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	YY	120	11

Unit	Type	Supp. Type	CP
	1	1	1

The total amount of units in the XX registry is 490000

Test case 7-2

Name:	**External transfer**
Description:	**External transfer of 8000 allowances and 10000 AAUs having 1 as both the original and applicable commitment period from the Party holding account within the National Registry of XX having 1 as account unique identification number, to the party holding account within the national Registry of YY.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.**
Expected	(see table below)

Account ID	1	10		Unit type/supp.

Results:				11	type
	Type	100	120	120	
	Installation		1	2	
	Balance after Transferred amount	225000 172000 -10000 _-8000	0 45000	0 30000	1-0 1-1 1-0 1-1
Response Code:	**None**				
Parameters					

Transaction	ID	Type	Supp. Type
	XX00014	03	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	YY		

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

Test case 7-3

Name: External transfer

Description: External transfer of 8000 allowances and 10000 AAUs having 1 as both the original and applicable commitment period from Party Holding Account in the National Registry of YY to the party holding account having 1 as account identification number within the national Registry of XX.

Pre-Requisites: The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 have taken place.

Test case 7-2 has been done

Expected Results:

Account ID	1	10	14	Unit type/supp. type
Type	100	120	121	
Installation		1		
Balance after Transferred amount	235000 180000 10000 _8000	0 45000	0 30000	1-0 1-1 1-0 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00015	03	

	Registry	Account type	Account ID
Transferring	YY	100	
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1
	1	0	1

2.8. Test cases - Cancellation

Test case 8-1

Name:	**Cancellation of Allowances having 1 as both original and applicable Commitment Period from an operator holding account to an adequate cancellation account.**
Description:	**Cancellation, within the National Registry of XX, of 15,000 Allowances having 1 as both original and applicable commitment period from the operator holding account having 10 as account identifier to the voluntary cancellation account having 2 as account identifier.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.**
Expected Results:	(see table below)
Response Code:	**None**
Parameters	(see tables below)

Expected Results:

Account ID	1	10	11	2	Unit type/supp. type
Type	100	120	120	230	
Installation		1	2		
Balance after	235000 180000	0 30000	0 20000	15000	1-0 1-1
Transferred amount		_15000		15000	1-1

Parameters:

Transaction	ID	Type	Supp. Type
	XX00016	04	

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	230	2

Unit	Type	Supp. Type	CP
	1	1	1

2.9. Test cases – Update Account

Test case 9-1

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. For Operator Account 10 let the person who is SAR be PAR and versa versus.
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	The SAR has become the PAR and the PAR has become the SAR
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	13

Test case 9-2

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. For Operator Account 11 the phone number of the SAR will be changed and the address and phone information will no longer be visible
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	For Operator Account 11 the phone number of the SAR has been changed and the address and phone information is no longer be visible
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	14

Test case 9-3

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. For Operator Account 11 the phone number of the SAR will be changed and the address information will be visible
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	For Operator Account 11 the phone number of the SAR has been changed and the address information is visible but not the phone number.
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	15

Test case 9-4

Name	Update Operator Holding Account
Description	Modification of information related to an operator holding account within the national registry of Greece, and its contact people. If possible, for Operator Account 10 the permit number have to be updated. If not possible (due to for example national legislation), change the start date of the permit op the third installation (from 01/06/2009 to 01/08/2009). If neither of the two can be performed, skip this test case.
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.
Expected result	For Operator Account 11 the permit number, respectively start date has been changed
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1

Minor Version:	1
Correlation ID:	16

2.10. Test cases - Close Account

Test case 10-1

Name	Update NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) for closing installation 3.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 105,000 allowances to the reserve and Inst. / 2008 / 2009 / 2010 / 2011 / 2012 #1 / 15000 / 15000 / 15000 / 15000 / 50000 #2 / 10000 / 10000 / 10000 / 10000 / 10000 The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000
Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	105000
Web service	RemoveNAPallocationofclosingInstallation
Correlation ID	17

Expected result allocation table:

Inst.	2008	2009	2010	2011	2012
#1	15000	15000	15000	15000	50000
#2	10000	10000	10000	10000	10000

Test case 10-2

Name	Closure of Account
Description	Closure of the Operator holding account within the national registry of Greece, having 12 as account unique identification number. (You have to enter 0 VEs for the year 2009 in order to avoid check 7117)
Pre-condition	The national registry of XX has been created. The Operator Holding Account 10, 11 and 12 and their Installation 1, 2 and 3 have been created.

Expected result	The Operator Account 12 is closed and can not be used
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	18

2.11. Test cases - Compliance data

Test case 11-1

Name:	**Verify Emission**
Description:	**Update of verified emissions table for installation 1 and 2 for year 2009.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.**
Expected Results:	see table below
Response Code:	**None**
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	19

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after	235000 180000	0 30000	0 20000	1-0 1-1
Verified Emission		9500	10000	1-1

Test case 11-2

Name:	**Surrendering**
Description:	**Surrendering, within the National Registry of XX, of 8,500 Allowances having 1 as both original and applicable commitment period by transferring them from the operator holding account having 10 as account unique identification number to the party holding account having 1 as account unique identification number.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.**
Expected Results:	see table below

Account ID	1	10	11	Unit type/supp. type

Type	100	120	120	
Installation		1	2	
Balance after Transferred amount	235000 188500 8500	0 21500 -8500	0 20000	1-0 1-1 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00017	10	02

	Registry	Account type	Account ID
Transferring	XX	120	10
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 11-3

Name: **Surrendering**

Description: **Surrendering, within the National Registry of XX, of 9000 Allowances having 1 as both original and applicable commitment period by transferring them from the operator holding account having 11 as account unique identification number to the party holding account having 1 as account unique identification number.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.**

There has been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.

Expected Results:

Account ID	1	10	11	Unit type/supp. type
Type	100	120	120	
Installation		1	2	
Balance after Transferred amount	235000 197500 9000	0 21500	0 11000 -9000	1-0 1-1 1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX00018	10	02

	Registry	Account type	Account ID
Transferring	XX	120	11
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP

		1	1	1	

Test case 11-4

Name:	**Update Verify Emission**
Description:	**Update of verified emissions table for installation 2 for year 2009.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.**
Expected Results:	(see table below)
Response Code:	**None**
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	20

Expected Results:

Account ID	1	10	11	Unit type/supp. Type
Type	100	120	120	
Installation		1	2	
Balance after	235000 197500	0 21500	0 11000	1-0 1-1
Verified Emission before		9500	10000	1-1
Verified Emission after		9500	9000	

Test case 11.5

Name:	**Upload Compliance XML**
Description:	**For the year 2009 the compliance status of the installations need to be updated.**
Pre-Requisites:	**The NAP for CP1 has been uploaded and Operator Holding Account 10 and 11 and their Installation 1 and 2 have been created.** **There have been issued AAUs and Allowances to Party Holding Account 1, and the allocation to installation 1 and 2 has taken place.**

<table>
<tr><td>Expected Results:</td><td>
<table>
<tr><th>Installation</th><th>VE</th><th>Computed compliance</th><th>Compliance Status</th></tr>
<tr><td>1</td><td>9500</td><td>-0</td><td>D</td></tr>
<tr><td>2</td><td>9000</td><td>-500</td><td>E</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td></td></tr>
</table>
</td></tr>
<tr><td>Response Code:</td><td>None</td></tr>
<tr><td colspan="2">PARAMETRE</td></tr>
<tr><td>Message From:</td><td>XX</td></tr>
<tr><td>Message To:</td><td>ITL/CITL</td></tr>
<tr><td>Major Version:</td><td>1</td></tr>
<tr><td>Minor Version:</td><td>1</td></tr>
<tr><td>Correlation ID:</td><td>21</td></tr>
</table>

2.12. Test cases – New entrance

Test case 12-1

Name	Create Operator Holding Accounts
Description	Creation, in the National Registry of XX of one new Operator Holding Accounts, as well as their related **installation.**
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts and • 3 Operator Holding Accounts, type 120 • 3 Installations, one related to each of the OHA • 2 Personal Holding Accounts, type 121
Expected result	Operator Account No 13 has been created together with Installation 4 **→ The permit start date of installation 4 is 01/06/2009**
Response code	None
PARAMETRE	
Message From:	XX
Message To:	ITL/CITL
Major Version:	1
Minor Version:	1
Correlation ID:	22

Test case 12-2

Name	Upload an amended NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) including allocation for installation #4.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 45,000 allowances to the reserve and (see table below) The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000
Response code	None

Inst.	2008	2009	2010	2011	2012
#1	15000	15000	15000	15000	50000
#2	10000	10000	10000	10000	10000
#4	0	15000	15000	15000	15000

PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	45000
Web service	AddNEInstallationtoNAP
Correlation id	23

Test case 12-3

Name: **Allocation of Allowances to Installation 4 during Commitment Period 1 (2008-12).**

Description: **Allocation for year 2009, within the National Registry XX, of 15,000 Allowances having 1 as both original and applicable commitment period, to operator holding account13, according to the National Allocation Plan that has been uploaded for Commitment Period 1.**

Pre-Requisites: **The NAP for CP1 has been uploaded and Operator Holding Account 10, 11 and 13 and their Installation 1, 2 and 4 has been created.**

There has been issued AAUs and Allowances to Party Holding Account 1

Expected Results:

Table 2-2

Account ID	1	10	11	13	Unit type/supp. Type
Type	100	120	120	120	
Installation		1	2	4	
Balance after	235000	0	0	0	1-0
	182500	21500	21000	15000	1-1
Transferred amount	-15000			15000	1-1

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0019	10	53

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	120	13

Unit	Type	Supp. Type	CP

			1	1	1	

2.13. Test cases – Retirement

Test case 13-1

Name: **Conversion of surrendered allowances into AAUs for retirement**

Description: **Conversion, within the National Registry XX, of 17500 Surrendered Allowances into AAUs having 1 as both original and applicable commitment period.**

Pre-Requisites: **The surrendering for Installation 1 and 2 have taken place**

Expected Results:

Table 2-3

Account ID	1	10	11	13	Unit type/supp. Type
Type	100	120	120	120	
Installation		1	2	4	
Balance after	217500 200000	0 21500	0 21000	0 15000	1-0 1-1
Transferred amount	-17500 17500			15000	1-1 1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0020	10	61

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 13-2

Name: **Retirement of surrendered allowances (2008-2012 onwards)**

Description: **Retirement, within the National Registry XX, of 17500 AAUs having 1 as both original and applicable commitment period equivalent to the surrendering for 2008**

Pre-Requisites: **The surrendering for Installation 1 and 2 have taken place and allowances equivalent to the surrendering has been converted into AAUs.**

Expected Results:

Account ID	1	10	11	4	Unit type/supp. Type
Type	100	120	120	300	
Installation		1	2		
Balance after	200000 200000	0 21500	0 21000	17500	1-0 1-1
Transferred amount	-17500			17500	1-0

Response Code:	**None**
Parameters	

Transaction	ID	Type	Supp. Type
	XX0021	05	01

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	300	4

Unit	Type	Supp. Type	CP
	1	0	1

Test case 13-3

Name:	**Conversion of none allocated allowances into AAUs for retirement**
Description:	**Conversion, within the National Registry XX, of 165000 Allowances into AAUs having 1 as both original and applicable commitment period.**
Pre-Requisites:	**The surrendering for Installation 1 and 2 have taken place**
Expected Results:	

Account ID	1	10	11	13	Unit type/supp. Type
Type	100	120	120	120	
Installation		1	2	4	
Balance after Transferred amount	400000 0 -200000 200000	0 21500	0 21000	0 15000	1-0 1-1 1-1 1-0

Response Code:	**None**
Parameters	

Transaction	ID	Type	Supp. Type
	XX0022	10	62

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	100	1

Unit	Type	Supp. Type	CP
	1	1	1

Test case 13-4

Name:	**Retirement of unallocated allowances (2008-2012 onwards)**
Description:	**Retirement, within the National Registry XX, of 150000 AAUs having 1 as both**

	original and applicable commitment period equivalent to the surrendering for 2008
Pre-Requisites:	**The surrendering for Installation 1 and 2 have taken place and allowances equivalent to the surrendering has been converted into AAUs.**
Expected Results:	

Account ID	1	10	11	4	Unit type/supp. Type
Type	100	120	120	300	
Installation		1	2		
Balance after	200000	0 21500	0 21000	217500	1-0 1-1
Transferred amount	-200000			200000	1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0023	05	02

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	300	4

Unit	Type	Supp. Type	CP
	1	0	1

Test case 13-5

Name:	**Retirement AAUs (2008-2012 onwards)**
Description:	**Retirement, within the National Registry XX, of 6000 AAUs having 1 as both original and applicable commitment period equivalent to the surrendering for 2008**
Pre-Requisites:	**The AAUs has been issued to account type 100 and account type 300 has been created**
Expected Results:	Table 2-4

Account ID	1	10	11	4	Unit type/supp. Type
Type	100	120	120	300	
Installation		1	2		
Balance after	194000	0 21500	0 21000	223500	1-0 1-1
Transferred amount	-6000			6000	1-0

Response Code: **None**

Parameters

Transaction	ID	Type	Supp. Type
	XX0024	05	

	Registry	Account type	Account ID
Transferring	XX	100	1
Acquiring	XX	300	4

Unit	Type	Supp. Type	CP
	1	0	1

2.14. Test cases – Reconciliation

Test case 14-1

Name:	**Reconciliation**
Description:	**Reconciliation process tested in order to check that the registry and the CITL are consistent.**
Pre-Requisites:	**The national registry of XX has been created and the scenario has been performed.**
Expected Results:	**Account Holdings**

Account ID	Account Type	Holdings	Unit Type/ Supp Unit Type
1	100	194500	1-0
2	230	15000	1-1
3	300	223500	1-0
10	120	21500	1-1
11	120	21000	1-1
13	120	15000	1-1

Test case 14-2

Name:	**Negative Reconciliation**
Description:	**Reconciliation process tested in order to check that the registry is able to handle manual intervention**
Pre-Requisites:	**The national registry of XX has been created and the scenario has been performed. In the database one unit block has been moved from Operator Account 10 to Operator Account 11**
Expected Results:	**STL Inconsistent Unit Blocks**

Test case 14-3

Name:	**Manual Intervention**
Description:	**Reconciliation process tested in order to check that the registry is able to handle manual intervention. The Reconciliation has failed and the unit block has to be moved from Operator Account 11 to Operator Account 10**
Pre-Requisites:	**The Reconciliation status is STL Inconsistent Unit Blocks.**
Expected Results:	**Account Holdings**

Account ID	Account Type	Holdings	Unit Type/ Supp Unit Type
1	100	194500	1-0
2	230	15000	1-1
3	300	223500	1-0
10	120	21500	1-1
11	120	21000	1-1
13	120	15000	1-1

Test case 14-4

Name: **Reconciliation**

Description: **Reconciliation process tested in order to check that the registry and the CITL are consistent.**

Pre-Requisites: **The national registry of XX has been created and the scenario has been performed.**

Expected Results: **Account Holdings**

Account ID	Account Type	Holdings	Unit Type/ Supp Unit Type
1	100	194500	1-0
2	230	15000	1-1
3	300	223500	1-0
10	120	21500	1-1
11	120	21000	1-1
13	120	15000	1-1

2.15. Test cases – Replenishment

Test case 15-1

Name	Update NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) increasing the numbers of allowances.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 225,000 allowances to the reserve and Inst. | 2008 | 2009 | 2010 | 2011 | 2012 #1 | 10000 | 10000 | 10000 | 10000 | 10000 #2 | 15000 | 15000 | 15000 | 15000 | 15000 #4 | 0 | 15000 | 15000 | 15000 | 15000 The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000
Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	225000
Web service	
Correlation ID	14

Test case 15-2

Name	Update NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) increasing the numbers of allowances to installation 1 and 2.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned

	amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 140,000 allowances to the reserve and Inst. / 2008 / 2009 / 2010 / 2011 / 2012 #1 / 10000 / 10000 / 30000 / 30000 / 15000 #2 / 15000 / 25000 / 25000 / 25000 / 25000 #4 / 0 / 15000 / 15000 / 15000 / 15000 The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000
Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	140000
Web service	
Correlation ID	15

Test case 15-3

Name	Update NAP for CP1
Description	Upload of an amended National Allocation Plan from the National Registry of XX for Commitment Period 1 (2008-12) decreasing the numbers of allowances.
Pre-condition	The national registry of XX has been created. The Database contains the data of the Party Holding Accounts, Operator Holding Accounts including their installations and 2 Personal Holding Accounts. The initial Nap for CP1 has been loaded and the assigned amount been set.
Expected result	The National Allocation Plan from the National Registry of XX for Commitment Period 1 has been loaded and has allocated the amount of 125,000 allowances to the reserve and Inst. / 2008 / 2009 / 2010 / 2011 / 2012 #1 / 10000 / 10000 / 30000 / 30000 / 15000 #2 / 15000 / 25000 / 25000 / 25000 / 25000 #4 / 0 / 15000 / 15000 / 15000 / 15000 The assigned amount for the national registry of XX is set to 500000 AAU's and the CPR to 450000

Response code	None
PARAMETRE	
Originating Registry:	XX
Commitment Period:	1
Assigned amount	500000
CPR	450000
NAP Reserve	125000
Web service	
Correlation ID	16