KASHUE

INSTYTUT OCHRONY ŚRODOWISKA
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NATIONAL ADMINISTRATION OF THE EMISSIONS TRADING SCHEME

NATIONAL EMISSION CENTRE

Poland's
National Inventory Report 2009

Submission under

the United Nations Framework Convention on Climate Change and its Kyoto Protocol

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September 2009

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Executive Summary

S.1 Background information on greenhouse gas emission inventories

This report - National Inventory Report (NIR) - presents the results of the national emission inventory of greenhouse gases (GHGs) in Poland in 2007. The inventory covers the following GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), 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}). The following GHG precursors are also reported: carbon monoxide - CO, nitrogen oxides (NO + NO_2) - 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 two basic publications of Intergovernmental Panel on Climate Change - IPCC, namely *Revised 1996 Guidelines for National Greenhouse Gas Inventories*, and *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*. According to these guidelines country specific methods have been used where appropriate giving more accurate emission data.

S.2 National GHG emissions and trends

The GHG emissions in base year 1988 and 2007, expressed as CO_2 equivalents, are presented in table S.1. In 2007 the total national emission of GHG were about 398.91 million tones 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 2007 emissions have decreased by 29.3%. The emissions given here for the base year 1988 differ from those accepted for the purpose of estimation of Assigned Amount under Kyoto Protocol obligations for 2008–2012 [IRR 2007], which amounted 563 442.77 Gg CO_2 eq. while emission reduction in 2007 referring to this value was 28.7% (see chapter 1.9.1).

Table S.1 National emissions of greenhouse gases for the base year 1988 and 2007. [Gg CO_2 eq.]

Pollutant	Base year	2007	(2007-base)/base [%]
	Emission in CO_2 eq. [Gg]	Emission in CO_2 eq. [Gg]	
CO2 – net emission (with LULUCF)	436 669.74	285 287.30	-34.7
CO2 – without LULUCF.	469 604.46	328 172.10	-30.1
CH4 - net emission (with LULUCF)	54 143.10	39 450.99	-27.1
CH4 - without LULUCF	54 135.62	37 065.69	-31.5
N2O - net emission (with LULUCF)	40 665.57	30 034.50	-26.1
N2O - without LULUCF	40 664.81	30 032.08	-26.1
HFCs		3 327.01	
PFCs		276.65	
SF_6		31.92	
TOTAL net emission (with LULUCF)	531 478.41	358 408.37	-32.6
TOTAL without LULUCF	564 404.89	398 905.45	-29.3

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 entire inventoried period indicate dramatic decrease between 1988 and 1990 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. In 2007 small decrease in GHG emissions was noted (tables S.2, S.3 and figure S.1).

Table S.2 National emissions of greenhouse gases for 1988–2007 according to gases [Gg CO_2 eq.]

GHG	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]
CO2 (with LULUCF)	436 669.74	411 866.24	343 541.84	336 788.16	329 218.48	342 204.56	337 862.55	343 259.51	350 895.95	343 289.11
CO2 (without LULUCF)	469 604.46	447 358.34	368 728.98	368 208.64	359 633.22	366 078.93	361 582.72	366 185.88	375 228.11	369 176.40
CH4 (with LULUCF)	54 143.10	53 113.54	49 870.69	48 295.03	46 097.90	45 854.85	46 004.37	45 847.60	45 326.43	45 512.05
CH4 (without LULUCF)	54 135.62	53 109.66	47 715.24	46 133.78	43 911.90	43 673.15	43 812.15	43 649.19	43 117.11	43 280.56
N2O (with LULUCF)	40 665.57	42 083.39	37 876.70	32 430.34	30 203.78	29 881.37	30 018.12	30 824.76	30 221.85	30 415.17
N2O (without LULUCF)	40 664.81	42 083.00	37 869.65	32 424.21	30 194.28	29 875.64	30 012.77	30 820.24	30 216.94	30 411.45
HFCs								15.72	37.67	114.56
PFCs								252.24	235.68	248.92
SF6								30.53	24.93	24.02
TOTAL (with LULUCF)	**531 478.41**	**507 063.17**	**431 289.23**	**417 513.53**	**405 520.16**	**417 940.78**	**413 885.03**	**420 230.35**	**426 742.52**	**419 603.82**
TOTAL (without LULUCF)	**564 404.89**	**542 551.00**	**454 313.88**	**446 766.63**	**433 739.40**	**439 627.72**	**435 407.64**	**440 953.79**	**448 860.44**	**443 255.91**

GHG	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]
CO2 (with LULUCF)	315 437.52	302 785.36	294 090.92	291 029.51	273 628.21	283 831.81	280 860.94	280 490.89	286 716.67	285 287.30
CO2 (without LULUCF)	341 255.10	329 445.66	320 588.24	317 216.50	305 692.58	317 003.44	317 296.81	318 215.84	329 599.11	328 172.10
CH4 (with LULUCF)	44 582.96	44 191.29	41 261.39	39 885.21	39 107.27	39 567.48	39 171.00	39 411.28	39 604.66	39 450.99
CH4 (without LULUCF)	42 360.78	41 952.25	39 003.81	37 608.87	36 823.22	37 247.75	36 838.83	37 062.73	37 229.82	37 065.69
N2O (with LULUCF)	30 018.30	29 070.04	28 891.98	29 007.16	27 515.30	27 659.78	27 699.12	28 255.27	29 474.60	30 034.50
N2O (without LULUCF)	30 015.29	29 067.05	28 889.12	29 004.67	27 512.62	27 655.30	27 696.58	28 252.48	29 471.79	30 032.08
HFCs	172.01	217.52	603.40	1 018.17	1 486.04	1 912.03	2 146.66	3 018.32	2 844.22	3 327.01
PFCs	251.26	239.74	248.87	269.93	286.59	278.39	285.08	259.95	269.75	276.65
SF6	25.08	24.64	24.18	23.96	24.42	21.72	23.43	28.09	30.02	31.92
TOTAL (with LULUCF)	**390 487.13**	**376 528.58**	**365 120.74**	**361 233.95**	**342 047.83**	**353 271.21**	**350 186.24**	**351 463.81**	**358 939.92**	**358 408.37**
TOTAL (without LULUCF)	**414 079.52**	**400 946.86**	**389 357.63**	**385 142.10**	**371 825.47**	**384 118.63**	**384 287.40**	**386 837.42**	**399 444.72**	**398 905.45**

Table S.3 National emissions of greenhouse gases for 1988–2007 according to IPCC categories [Gg CO_2 eq.]

IPCC sector	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]
1. Energy	469 594.85	446 200.03	369 702.62	372 071.63	363 115.71	371 303.75	365 511.30	368 778.84	379 351.66	371 796.62
2. Industrial Processes	33 197.34	32 330.26	24 333.57	20 603.38	19 984.69	19 948.97	21 400.30	23 847.74	22 384.90	23 319.68
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	51 225.04	53 631.68	50 043.01	43 572.64	40 100.35	37 771.46	37 907.66	37 817.46	36 512.20	37 312.81
5. Land-Use, Land-Use Change and Forestry	-32 926.48	-35 487.83	-23 024.65	-29 253.10	-28 219.24	-21 686.94	-21 522.61	-20 723.44	-22 117.93	-23 652.08
6. Waste	9 381.19	9 442.88	9 605.45	9 910.76	9 980.07	10 084.17	10 067.33	9 984.95	10 064.57	10 284.07
TOTAL net emission (with LULUCF)	**531 478.41**	**507 063.17**	**431 289.23**	**417 513.53**	**405 520.16**	**417 940.78**	**413 885.03**	**420 230.35**	**426 742.52**	**419 603.82**

IPCC sector	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]	CO2 eq. [Gg]
1. Energy	344 348.55	333 470.87	321 520.51	319 954.66	308 607.73	318 728.30	318 651.81	314 808.75	323 933.62	320 882.11
2. Industrial Processes	20 887.76	19 839.12	23 031.06	21 036.78	19 598.14	22 665.71	23 546.81	29 423.30	31 539.69	33 299.29
3. Solvent and Other Product Use	543.39	535.04	616.09	637.21	664.25	647.39	704.67	705.75	705.75	733.04
4. Agriculture	37 726.43	36 416.35	34 595.44	34 227.47	33 710.48	32 978.42	32 376.32	32 947.60	34 504.18	35 039.64
5. Land-Use, Land-Use Change and Forestry	-23 592.39	-24 418.28	-24 236.89	-23 908.15	-29 777.64	-30 847.42	-34 101.15	-35 373.61	-40 504.79	-40 497.08
6. Waste	10 573.40	10 685.49	9 594.53	9 285.98	9 244.88	9 098.81	9 007.79	8 952.01	8 761.48	8 951.38
TOTAL net emission (with LULUCF)	**390 487.13**	**376 528.58**	**365 120.74**	**361 233.95**	**342 047.83**	**353 271.21**	**350 186.24**	**351 463.81**	**358 939.92**	**358 408.37**

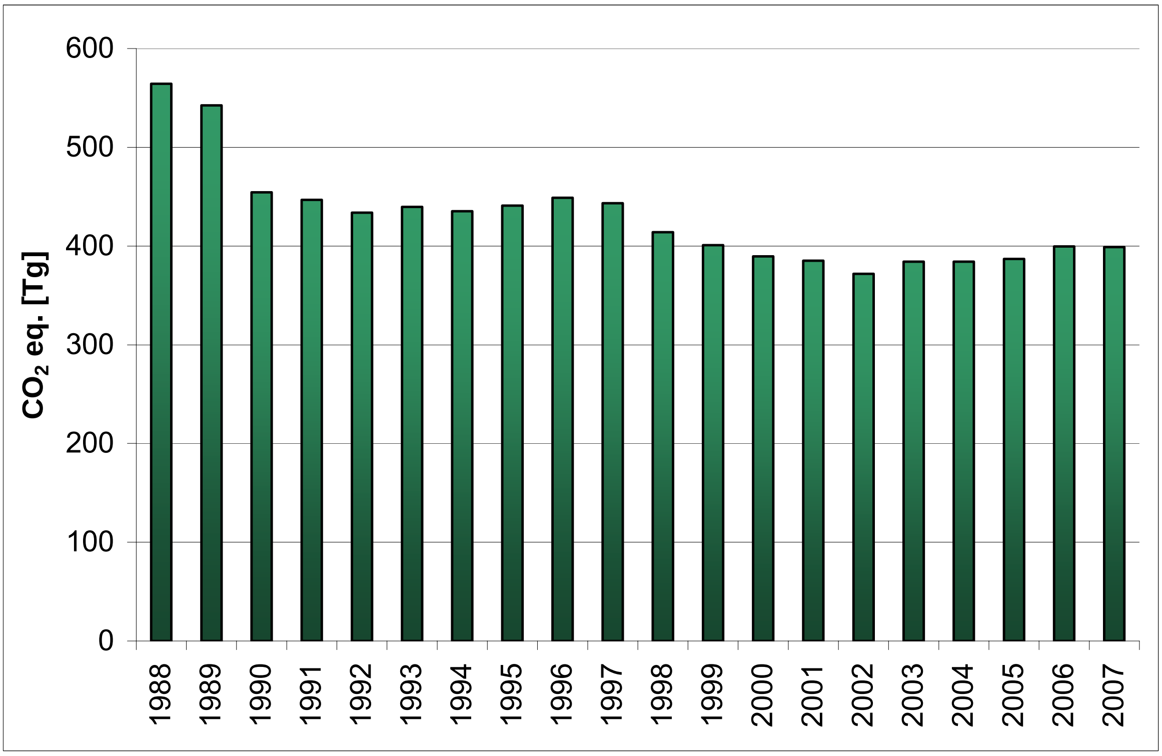

Figure S.1. Trend of aggregated GHGs emissions excluding category 5 for 1988–2007 [Tg CO_2 eq.]

S.3 Overview of source and sink category emission estimates

Carbon dioxide emissions

The CO_2 emissions (excluding category 5) in 2007 were estimated as 328.17 million tones. This is 30.1% lower than in the base year. CO_2 emission (excluding category 5) accounted for 82.3% of total GHG emissions in Poland in 2007. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission by 92.3% in 2007. The shares of the main subcategories were as follows: *Energy industries* – 55.5%, *Manufacture Industries and Construction* – 10.6%, *Transport* – 11.6% and *Other Sectors* – 14.6%. *Industrial Processes* contributed to the total CO_2 emission by 7.4% in 2007. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 removal in LULUCF sector in 2007, was calculated to be approximately 42.9 million tones. It means that app. 10.8% 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 1 765.03 Gg in 2007 i.e. 37.07 million tones of CO_2 equivalents. Compared to the base year, the emission in 2007 was lower by 31.5%. The contribution of CH_4 to the national total GHG emission was 9.3% in 2007. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed 36.3%, 35.0% and 20.3% to the national methane emission in 2007, respectively. The emission from the first mentioned sector was covered by emission from Underground Mines (23.2% of total CH_4 emission) and Oil and Natural Gas system (13.1% of total CH_4 emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 25.1% of total CH_4 emission in 2007. Waste disposal sites contributed to 17.5% of the methane emission from total CH_4 emission and Wastewater Handling contributed to 2.9% of total CH_4 emission.

Nitrous oxide emissions

The nitrous oxide emissions (excluding category 5) in 2007 were 96.88 Gg i.e. 30.03 million tonnes of CO_2 equivalents. The emission was app. 26.1% lower than the respective figure for the base year. The contribution of N_2O to the national total GHG emission was 7.5% in 2007. The main N_2O emission sources and its shares in total N_2O emission in 2007 are as follow: *Agricultural Soils* – 53.2%, *Manure Management* – 20.2%, *Chemical Industry* – 15.9% and *Fuel Combustion* – 6.4%.

Emissions of industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2007 was 3 635.58 Gg CO_2 eq. what accounts for 0.9% of total GHG emissions share in 2007. Industrial gases emissions were about 1118.0% higher comparing to the year 1995 (table S2). Share of HFCs, PFCs and SF_6 in total 2007 emissions was as follows: 0.83%, 0.07% and 0.008%.

S.4 Trends of greenhouse gas precursors (CO, NO_x, NMVOC 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 1131.0 Gg in 2007 and decreased by about 72% between 1980 and 2007, and 65% between 1990 and 2007. 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 2007 amounted 884.7 Gg and decreased by about 28% between 1980 and 2007, and 31% between 1990 and 2007. 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 traffic contribute to the national total, and cause comparatively lower emission reductions than in case of SO_2. Similarly emissions of NMVOC decreased by 43% between 1980–2007 amounting 596.4 Gg in 2007 and by 29% between 1990–2007 and CO emissions dropped by about 65% between 1990–2007 amounting to 2603.1 Gg in 2007.

1. Introduction

Underlying report has been elaborated for fulfilling Poland's obligations under Article 3.1 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, as well as for UNFCCC and its Kyoto Protocol. The ultimate goal of the Protocol is to reduce the overall greenhouse gas emissions by at least 5 per cent below 1990 levels in the commitment period 2008–2012 by Parties included in Annex I to the UN Framework Convention on Climate Change (UNFCCC).

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.

1.1 Background information on greenhouse gas inventories

The report and underlying CRF tables have been prepared of 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). The GHG precursors, in turn, are: carbon monoxide - CO, nitrogen oxides ($NO + NO_2$) - NO_X, non-methane volatile organic compounds - NMVOC and sulphur dioxide - SO_2.

The base year for fulfilling obligations resulting from the UNFCCC is 1990. However, Poland has chosen 1988 as a base year for three main greenhouse gases (CO_2, CH_4, N_2O) and 1995 as a base year for industrial gases (HFCs, PFCs, SF_6).

1.2 A description of institutional arrangement for inventory preparation

National GHG inventory is compiled annually by the National Emission Centre (NEC) located in the Institute of Environmental Protection in Warsaw. Since 2000, the NEC has been commissioned by the Ministry of Environment (MoE) on a yearly basis contracts to carry out national emission inventories for the GHGs and other air pollutants. Since 2006, NEC is located within the National Administrator of Emission Trading Scheme (NAETS-KASHUE) established also in the Institute of Environmental Protection based on *Ordinance of 13 September 2005* to the *Act of 22 December 2004 on emission allowance trading system for greenhouse gases and other substances*. The tasks of the NEC as compiling and submitting GHG inventories are defined in the agreement with the Ministry of Environment and National Fund for Environmental Protection and Water Management (NFOŚiGW) in Warsaw signed in 2000 and updated in analogous agreement between KASHUE/IOŚ, NFOŚiGW and Ministry of Environment signed in 2006.

The emission calculation, choices of activity data, emission factors and methodology are performed by the NEC staff. The NEC is also 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 NEC, as a subunit of the NAETS, has access to the individual data of entities participating in the European Union Emission Trading Scheme (EU-ETS). This ensures availability of data for major sources in emissions from stationary combustion sectors (1.A.1, 1.A.2) as well as from specific industrial processes. Such data are successively included into GHG inventory where possible after verification.

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

1.3 Brief description of the process for 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 UN ECE/EMEP [IPCC 1997, IPCC 2000, IPCC 2003, EEA 2004]. Wherever necessary and possible, domestic methodologies and emission factors have been developed to reflect specific national 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) 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. N_2O emissions from animal waste in agriculture, and 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 NEC database, 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 General description of methodologies and data sources used

The GHG emissions and removals inventory presented in this report follow the recommended Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories [IPCC 1997], and the IPCC Good Practice Guidance and Uncertainty Management [GPG 2000]. 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.

In the GHG emission inventory for the years: 2005–2007, data on CO_2 emissions from installations covered by the EU Emissions Trading Scheme (ETS) have been used. In the respective IPCC sub-categories, that cover the plants included into ETS i.e. in: 1.A.1.a-c, 1.A.2.a, 1.A.2.c-f and in selected sub-categories of 2. *Industrial Processes* and sub-category 1.A.4 *Other,* CO_2 emission was estimated based on verified annual emission reports elaborated by the installations. The emissions in the respective IPCC sub-categories were supplemented by adding the emissions from installations outside the EU ETS. The CO_2 emissions in 1.A for installations not included into EU ETS, was estimated based on estimated fuel consumption (disaggregated into fuel type, type of source and sub-categories) and the respective emission factors.

The non-CO_2 GHG emissions from fuel combustion 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 GUS and reported to Eurostat.

One of the main steps of emission inventorying from the 1.A. *Energy* category, is preparation of energy budgets for each fuel (energy carrier). 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 2. For each fuel, balance data are given both in natural units and in common (energy) units.

Table 1.1 Hard coal consumption

Evaluation of fuel consumption in national combustion processes	Hard coal - Eurostat	
	10^3 Mg	TJ
In	94 236	2 273 283
From national sources	88 312	2 116 623
1) Indigenous production	87 406	2 095 821
2) Transformation output or return	906	20 802
3) Stock decrease	0	0
Import	5 924	156 660
Out	94 236	2 273 283
National consumption	84 698	1 989 547
1) Transformation input	66 486	1 539 124
a) input for secondary fuel production	13 534	399 294
b) fuel combustion	52 952	1 139 830
2) Direct consumption	18 212	450 423
Non-energy use	93	2 220
Combusted directly	18 119	448 203
Combusted in Poland	71 071	1 588 033
Stock increase	-3 000	-69 540
Export	11 900	327 607
Losses and statistical differences	638	25 669
Net calorific value	MJ/kg lub MJ/m3	22.34

The data on quantity of the fuel combusted in whole country in a given year are used for calculation of the average net calorific value of the fuel. This calculated net calorific value provides then the basis for the estimation of country specific CO_2 emission factor for the given fuel (hard coal and lignite). The calculations of these CO_2 emission factors for main fuels are based on empirical formulas that apply the relationship between net calorific values and elemental carbon content. The maximum (potential) CO_2 emission from combustion of a given fuel is, in turn, calculated based on the estimated emission factor. It is one of the ways of checking the CO_2 emission value, estimated according to 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 3). The data on fuel consumption in *Transport* subcategory, including the fuel consumption data for various types of vehicles, are worked out routinely by experts from the Motor Transport Institute, as well as the emission factors for road transport.

1.5 Brief description of key categories methodologies

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

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. No changes in QA/QC plan has been done since NIR submission in 2008.

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 entity – National Emission Centre (NEC) – which is responsible for preparation of GHG inventories (see Chapter 1.2), is also responsible for coordination and implementing the QA/QC activities. QA/QC Plan elaborated by NEC was approved by the Ministry of Environment in 2007.

1.7 General uncertainty evaluation of the inventory

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

In Annex 5, the estimate of emission uncertainty for the year 2007 using *Tier 1* approach is given. The uncertainty ranges varied significantly among various source categories. More details, including sectoral information on uncertainty ranges, are given in Annex 5, so no additional information is presented within sectoral chapters.

1.8 General assessment of the completeness of the inventory

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 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* (CRF 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 gaps in estimation of the 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)

1.9 Supplementary information relating to Article 7.1 of the Kyoto Protocol in accordance with decision 15/CMP.1

1.9.1 Assigned amount and CPR information for the Kyoto Protocol purpose

According to the Kyoto Protocol Poland is obliged to reduce its greenhouse gases emissions in 2008–1012 by 6% comparing to the base year, 1988 (and 1995 year for fluorinated industrial gases). Poland's assigned amount for 2008–2012 was calculated based on GHG emissions for 1988 estimated in 2006 and reviewed in course of review of the initial report of Poland under Kyoto Protocol made in 2007 which accounted for 563,442.77 Gg CO_2 eq., so the Poland's AAU is **2,648,181,038 tonnes CO_2 eq.** [IRR 2007].

The national Commitment Period Reserve estimated on the basis of 2007 emissions 398,905,454 Mg multiplied by 5, as reviewed in 2009, is **1,994,527,271 tonnes CO_2 eq.**

1.9.2 Changes in national system

No changes has been done to the national inventory system as reported within NIR in 2008.

1.9.3 Changes in national registry

One of the main responsibilities of the National Administrator of Emission Trading Scheme established in the Institute of Environmental protection in 2006 is to create and maintain the national registry to track Polish holdings and transactions of the Kyoto Protocol units. As the registering system, the French software SERINGAS has been chosen, created by computer science department of Caisse des Dépôts et Consignations. Detail information on national registry is given in Annex 4.

1.9.4 Information on activities under arts 3.3 and 3.4 of the Kyoto Protocol

Definition of a forest for reporting under Articles 3.3 and 3.4 of the Kyoto Protocol

For the needs of reporting to Articles 3.3 and 3.4 of the Kyoto Protocol , Poland selected the following minimum values for the forest definition[1]:

- minimum forest land area: 0.1 hectare
- minimum width of forest land area[2]: 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.

This forest definition is in line with the submission made by Poland to FAO (for Global Forest Resource Assessment 2000 and 2005).

[1] 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)

[2] Excluding small private properties, private land given to State Forest (Lasy Państwowe) or land belonging to Agriculture Real Estate Agency (Agencja Nieruchomości Rolnych)

Selection of activities under Article 3.4 of the Kyoto Protocol

Poland elected to include forest management under Article 3.4 in its accounting for the first commitment period, but did not elect other three activities: cropland management, grazing land management and revegetation.

Definition of a forest management under Article 3.4 of the Kyoto Protocol

Forest management is defined in the Decision 16/CMP.1 Annex par. 1(f) as "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 a sustainable manner".

Sustainable forest management practiced by The State Forests 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 State Forests:

- increasing the area of undergrowth plants,
- change of species structure from monoculture to multi-species stands – stands rebuilding,
- introducing second storey into one storey stands,
- using the maximum age for cutting main species of trees,
- if it is advisable not harvesting some parts of stands above their normal cutting age,
- if it is advisable using selective cutting instead of clear cutting method,
- leaving residues on the cutting area,
- developing of natural regeneration,
- enhancing forest fire prevention.

Method for identification of land areas associated with LULUCF activities

According to description given in chapter 4.2.2.2 of the GPG for LULUCF (2003) land areas associated with LULUCF activities in Poland will be identified using method 1. Geographic boundaries encompassing units of land subject to multiple activities under art. 3.3 and 3.4 will be identified based on Record of lands and buildings[3] as well as information system containing digital maps and database operated by The State Forests National Forest Holding.

Accounting for activities under Article 3.3 and 3.4 of the Kyoto Protocol

The accounting of net emissions and removals for activities under Articles 3.3 and 3.4 will be done for the entire commitment period 2008–2012. This way of reporting will enable a more detailed assessment of activities due to periodic nature of measurements and research carried out in the Polish forestry sector.

[3] Ordinance of the Minister of Regional Development and Construction of 29 March 2001 on the registry of lands and buildings (Law Gazette, 2001 No 38, item 454)

2. Analysis of greenhouse gas emissions and removals in 2007 and trends

2.1 Aggregated greenhouse gas emissions

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

For non-CO_2 gases, the inventory results can also be presented (table 2.1) in units of CO_2 equivalents by applying values of the so called Global Warming Potentials - GWP. GWP for methane is 21, and for nitrous oxide 310. Carbon dioxide is the main GHG in Poland with the 82.3% (excluding category 5) share in 2007, while the methane contributes with 9.3% (excluding category 5) to the national total. Nitrous oxide contribution is 7.5% (excluding category 5) and all industrial GHG together contribute 0.9%. Percentage share of GHG in national total emissions in 2007 is presented at Figure 2.1

Table 2.1 Greenhouse gas emissions in 2007 in CO_2 eq.

Pollutant	2007	
	Emission in CO_2 eq. [Gg]	Share [%]
CO2 – net emission (with LULUCF)	285 287.30	79.60
CO2 – without LULUCF.	328 172.10	82.27
CH4 - net emission (with LULUCF)	39 450.99	11.01
CH4 - without LULUCF	37 065.69	9.29
N2O - net emission (with LULUCF)	30 034.50	8.38
N2O - without LULUCF	30 032.08	7.53
HFCs	3 327.01	0.83
PFCs	276.65	0.07
SF_6	31.92	0.01
TOTAL net emission (with LULUCF)	358 408.37	100.00
TOTAL without LULUCF	398 905.45	100.00

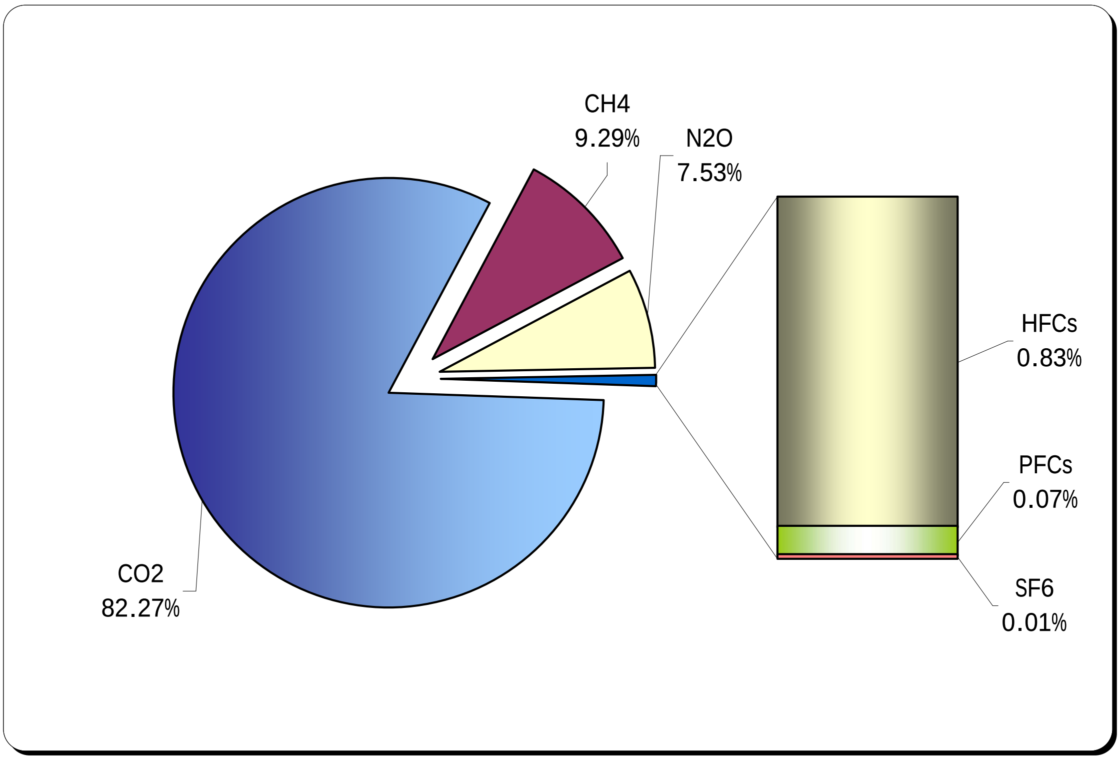

Figure 2.1 Percentage share of greenhouse gases in national total emission in 2007 (excluding category 5)

Emissions of main GHGs in 2007, 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 2007 [Gg]

[Gg]	CO_2	CH_4	N_2O
TOTAL without LULUCF	328 172.10	1 765.03	96.88
TOTAL with LULUCF	285 287.30	1 878.62	96.89
1. Energy	302 824.57	768.18	6.21
A. Fuel Combustion	302 626.10	127.74	6.21
1. Energy Industries	181 992.63	2.93	2.68
2. Manufacturing Industries and Construction	34 664.17	3.70	0.68
3. Transport	38 212.74	5.30	1.49
4. Other Sectors	47 756.56	115.81	1.36
5. Other	NO	NO	NO
B. Fugitive Emissions from Fuels	198.46	640.44	0.00
1. Solid Fuels	1.57	410.05	0.00
2. Oil and Natural Gas	196.89	230.39	0.00
2. Industrial Processes	24 426.94	20.29	15.52
A. Mineral Products	10 399.77	NO	NO
B. Chemical Industry	4 244.16	13.35	15.43
C. Metal Production	8 826.39	6.94	0.09
D. Other Production	0.08	NO	NO
G. Other	956.54	NO	NO
3. Solvent and Other Product Use	609.04	NO	0.40
4. Agriculture	NO	618.10	71.16
A. Enteric Fermentation	NO	443.13	NO
B. Manure Management	NO	173.78	19.61
D. Agricultural Soils	NO	NO	51.51
F. Field Burning of Agricultural Residues	NO	1.19	0.05
5. Land Use, Land-Use Change and Forestry	-42 884.81	113.59	0.008
A. Forest Land	-54 132.18	0.15	0.001
B. Cropland	8 419.60	NO	NO
C. Grassland	-201.00	0.18	0.00001
D. Wetlands	3 102.19	113.26	0.007
E. Settlements	-73.42	NO	NO
F. Other Land	NO	NO	NO
6. Waste	311.55	358.47	3.59
A. Solid Waste Disposal on Land	NO	308.17	NO
B. Wastewater Handling	NO	50.30	3.49
C. Waste Incineration	311.55	NO	0.09

Table 2.3 Emissions of industrial gases: HFCs, PFCs and SF_6 in 2007 [Gg eq. Gg]

2007	HFCs	PFCs	SF_6	Total in eq. CO_2
Total Industrial gases [Gg eq. CO_2]	3 327.01	276.65	31.92	3 635.58
C. Metal Production	NO	260.92	1.30	262.23
3. Aluminium Production	NO	260.92	1.30	262.23
F. Consumption of Halocarbons and SF_6	3 327.01	15.73	30.61	3 373.35
1. Refrigeration and Air Conditioning Equipment	2 676.06	NO	NO	2 676.06
2. Foam Blowing	292.16	NO	NO	292.16
3. Fire Extinguishers	13.28	15.73	NO	29.01
4. Aerosols	345.51	NO	NO	345.51
8. Electrical Equipment	NO	NO	30.61	30.61

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 2007 for CO_2, CH_4 and N_2O.

Table 2.4 Percentage shares of individual source sectors in 2007 emissions

Percentage share of emissions of source sectors in current year	Share [%]		
	CO2 without LULUCF	CH4 without LULUCF	N2O without LULUCF
TOTAL	100.00	100.00	100.00
1. Energy	92.28	43.52	6.41
A. Fuel Combustion	92.22	7.24	6.41
1. Energy Industries	55.46	0.17	2.77
2. Manufacturing Industries and Construction	10.56	0.21	0.71
3. Transport	11.64	0.30	1.53
4. Other Sectors	14.55	6.56	1.41
5. Other	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.06	36.28	0.00
1. Solid Fuels	0.00	23.23	0.00
2. Oil and Natural Gas	0.06	13.05	0.00
2. Industrial Processes	7.44	1.15	16.02
A. Mineral Products	3.17	0.00	0.00
B. Chemical Industry	1.29	0.76	15.93
C. Metal Production	2.69	0.39	0.09
D. Other Production	0.00	0.00	0.00
G. Other	0.29	0.00	0.00
3. Solvent and Other Product Use	0.19	0.00	0.41
4. Agriculture	0.00	35.02	73.45
A. Enteric Fermentation	0.00	25.11	0.00
B. Manure Management	0.00	9.85	20.24
D. Agricultural Soils	0.00	0.00	53.17
F. Field Burning of Agricultural Residues	0.00	0.07	0.05
5. Land Use, Land-Use Change and Forestry	-	-	-
A. Forest Land	-	-	-
B. Cropland	-	-	-
C. Grassland	-	-	-
D. Wetlands	-	-	-
E. Settlements	-	-	-
F. Other Land	-	-	-
6. Waste	0.09	20.31	3.70
A. Solid Waste Disposal on Land	0.00	17.46	0.00
B. Wastewater Handling	0.00	2.85	3.61
C. Waste Incineration	0.09	0.00	0.10

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 entire inventoried period indicate dramatic decrease between 1988 and 1990 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. In 2007, small decrease in GHG emissions was noted (figure 2.2 and tables 2.5 and 2.6).

Table 2.5. National emissions of greenhouse gases for 1988–2007 according to gases [Gg CO_2 eq.]

GHG	1988 CO2 eq. [Gg]	1989 CO2 eq. [Gg]	1990 CO2 eq. [Gg]	1991 CO2 eq. [Gg]	1992 CO2 eq. [Gg]	1993 CO2 eq. [Gg]	1994 CO2 eq. [Gg]	1995 CO2 eq. [Gg]	1996 CO2 eq. [Gg]	1997 CO2 eq. [Gg]
CO2 (with LULUCF)	436 669.74	411 866.24	343 541.84	336 788.16	329 218.48	342 204.56	337 862.55	343 259.51	350 895.95	343 289.11
CO2 (without LULUCF)	469 604.46	447 358.34	368 728.98	368 208.64	359 633.22	366 078.93	361 582.72	366 185.88	375 228.11	369 176.40
CH4 (with LULUCF)	54 143.10	53 113.54	49 870.69	48 295.03	46 097.90	45 854.85	46 004.37	45 847.60	45 326.43	45 512.05
CH4 (without LULUCF)	54 135.62	53 109.66	47 715.24	46 133.78	43 911.90	43 673.15	43 812.15	43 649.19	43 117.11	43 280.56
N2O (with LULUCF)	40 665.57	42 083.39	37 876.70	32 430.34	30 203.78	29 881.37	30 018.12	30 824.76	30 221.85	30 415.17
N2O (without LULUCF)	40 664.81	42 083.00	37 869.65	32 424.21	30 194.28	29 875.64	30 012.77	30 820.24	30 216.94	30 411.45
HFCs								15.72	37.67	114.56
PFCs								252.24	235.68	248.92
SF6								30.53	24.93	24.02
TOTAL (with LULUCF)	**531 478.41**	**507 063.17**	**431 289.23**	**417 513.53**	**405 520.16**	**417 940.78**	**413 885.03**	**420 230.35**	**426 742.52**	**419 603.82**
TOTAL (without LULUCF)	**564 404.89**	**542 551.00**	**454 313.88**	**446 766.63**	**433 739.40**	**439 627.72**	**435 407.64**	**440 953.79**	**448 860.44**	**443 255.91**

GHG	1998 CO2 eq. [Gg]	1999 CO2 eq. [Gg]	2000 CO2 eq. [Gg]	2001 CO2 eq. [Gg]	2002 CO2 eq. [Gg]	2003 CO2 eq. [Gg]	2004 CO2 eq. [Gg]	2005 CO2 eq. [Gg]	2006 CO2 eq. [Gg]	2007 CO2 eq. [Gg]
CO2 (with LULUCF)	315 437.52	302 785.36	294 090.92	291 029.51	273 628.21	283 831.81	280 860.94	280 490.89	286 716.67	285 287.30
CO2 (without LULUCF)	341 255.10	329 445.66	320 588.24	317 216.50	305 692.58	317 003.44	317 296.81	318 215.84	329 599.11	328 172.10
CH4 (with LULUCF)	44 582.96	44 191.29	41 261.39	39 885.21	39 107.27	39 567.48	39 171.00	39 411.28	39 604.66	39 450.99
CH4 (without LULUCF)	42 360.78	41 952.25	39 003.81	37 608.87	36 823.22	37 247.75	36 838.83	37 062.73	37 229.82	37 065.69
N2O (with LULUCF)	30 018.30	29 070.04	28 891.98	29 007.16	27 515.30	27 659.78	27 699.12	28 255.27	29 474.60	30 034.50
N2O (without LULUCF)	30 015.29	29 067.05	28 889.12	29 004.67	27 512.62	27 655.30	27 696.58	28 252.48	29 471.79	30 032.08
HFCs	172.01	217.52	603.40	1 018.17	1 486.04	1 912.03	2 146.66	3 018.32	2 844.22	3 327.01
PFCs	251.26	239.74	248.87	269.93	286.59	278.39	285.08	259.95	269.75	276.65
SF6	25.08	24.64	24.18	23.96	24.42	21.72	23.43	28.09	30.02	31.92
TOTAL (with LULUCF)	**390 487.13**	**376 528.58**	**365 120.74**	**361 233.95**	**342 047.83**	**353 271.21**	**350 186.24**	**351 463.81**	**358 939.92**	**358 408.37**
TOTAL (without LULUCF)	**414 079.52**	**400 946.86**	**389 357.63**	**385 142.10**	**371 825.47**	**384 118.63**	**384 287.40**	**386 837.42**	**399 444.72**	**398 905.45**

Table 2.6. National emissions of greenhouse gases for 1988–2007 according to IPCC categories [Gg CO_2 eq.]

IPCC sector	1988 CO2 eq. [Gg]	1989 CO2 eq. [Gg]	1990 CO2 eq. [Gg]	1991 CO2 eq. [Gg]	1992 CO2 eq. [Gg]	1993 CO2 eq. [Gg]	1994 CO2 eq. [Gg]	1995 CO2 eq. [Gg]	1996 CO2 eq. [Gg]	1997 CO2 eq. [Gg]
1. Energy	469 594.85	446 200.03	369 702.62	372 071.63	363 115.71	371 303.75	365 511.30	368 778.84	379 351.66	371 796.62
2. Industrial Processes	33 197.34	32 330.26	24 333.57	20 603.38	19 984.69	19 948.97	21 400.30	23 847.74	22 384.90	23 319.68
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	51 225.04	53 631.68	50 043.01	43 572.64	40 100.35	37 771.46	37 907.66	37 817.46	36 512.20	37 312.81
5. Land-Use, Land-Use Change and Forestry	-32 926.48	-35 487.83	-23 024.65	-29 253.10	-28 219.24	-21 686.94	-21 522.61	-20 723.44	-22 117.93	-23 652.08
6. Waste	9 381.19	9 442.88	9 605.45	9 910.76	9 980.07	10 084.17	10 067.33	9 984.95	10 064.57	10 284.07
TOTAL net emission (with LULUCF)	**531 478.41**	**507 063.17**	**431 289.23**	**417 513.53**	**405 520.16**	**417 940.78**	**413 885.03**	**420 230.35**	**426 742.52**	**419 603.82**

IPCC sector	1998 CO2 eq. [Gg]	1999 CO2 eq. [Gg]	2000 CO2 eq. [Gg]	2001 CO2 eq. [Gg]	2002 CO2 eq. [Gg]	2003 CO2 eq. [Gg]	2004 CO2 eq. [Gg]	2005 CO2 eq. [Gg]	2006 CO2 eq. [Gg]	2007 CO2 eq. [Gg]
1. Energy	344 348.55	333 470.87	321 520.51	319 954.66	308 607.73	318 728.30	318 651.81	314 808.75	323 933.62	320 882.11
2. Industrial Processes	20 887.76	19 839.12	23 031.06	21 036.78	19 598.14	22 665.71	23 546.81	29 423.30	31 539.69	33 299.29
3. Solvent and Other Product Use	543.39	535.04	616.09	637.21	664.25	647.39	704.67	705.75	705.75	733.04
4. Agriculture	37 726.43	36 416.35	34 595.44	34 227.47	33 710.48	32 978.42	32 376.32	32 947.60	34 504.18	35 039.64
5. Land-Use, Land-Use Change and Forestry	-23 592.39	-24 418.28	-24 236.89	-23 908.15	-29 777.64	-30 847.42	-34 101.15	-35 373.61	-40 504.79	-40 497.08
6. Waste	10 573.40	10 685.49	9 594.53	9 285.98	9 244.88	9 098.81	9 007.79	8 952.01	8 761.48	8 951.38
TOTAL net emission (with LULUCF)	**390 487.13**	**376 528.58**	**365 120.74**	**361 233.95**	**342 047.83**	**353 271.21**	**350 186.24**	**351 463.81**	**358 939.92**	**358 408.37**

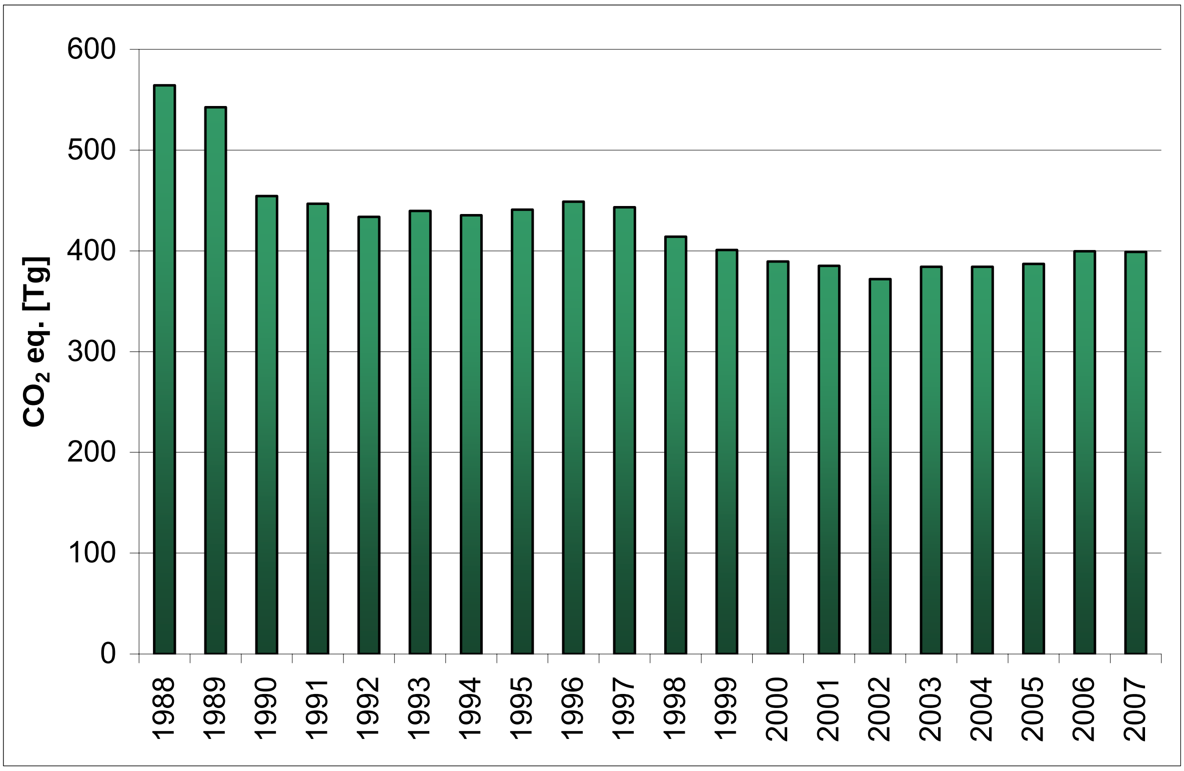

Figure 2.2. Trend of aggregated GHGs emissions (excluding category 5) for 1988–2007 [Tg CO_2 eq.]

2.2 GHG emissions by gas

Carbon dioxide (CO_2)

In 2007, the CO_2 emissions (without LULUCF) were estimated as 328.17 million tonnes, while when sector 5. LULUCF is included the figure reaches 285.29 million tones (table 2.1). CO_2 share in total GHG emissions in 2007 amounted to 82.3%. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission (without LULUCF) by 92.3% in 2007 (Fig. 2.3). The shares of the main subcategories in 1.A were as follows: *Energy industries* - 55.5%, *Manufacture Industries and Construction* – 10.6%, *Transport* – 11.6% and *Other Sectors* – 14.6%. Sector 2. *Industrial Processes* contributed to the total CO_2 emission by 7.4% in 2007. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 emission/removal in LULUCF sector in 2007, was calculated to be approximately 42.9 million tones. It means that app. 10.8% of the total CO_2 emissions are offset by CO_2 uptake by forests.

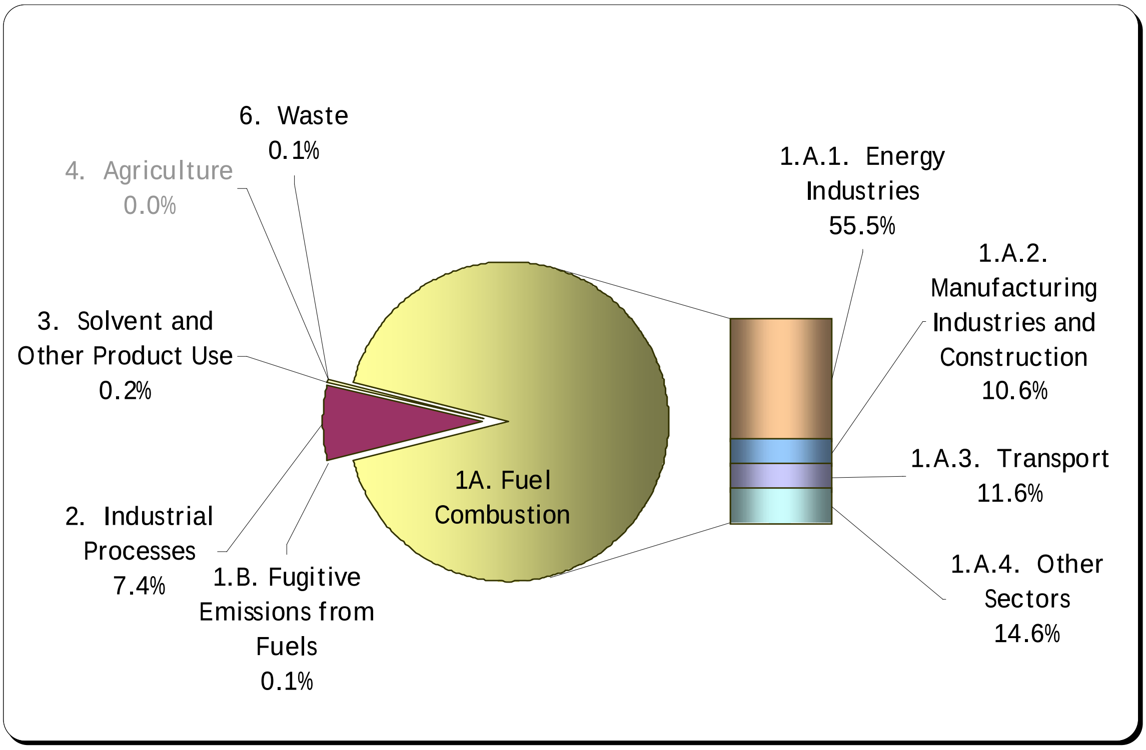

Figure 2.3 Carbon dioxide emission (excluding category 5) in 2007 by sector

Methane (CH_4)

The CH_4 emission (excluding category 5) amounted to 1 765.03 Gg in 2007 i.e. 37.07 million tones of CO_2 equivalents (table 2.1). CH_4 share in total GHG emissions in 2007 amounted to 9.3%. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed to 36.3%, 35.0% and 20.3% of the national methane emission in 2007, respectively. The emission from the first mentioned sector was covered by emission from *Underground Mines* (app. 23.2% of total CH_4 emission) and *Oil and Natural Gas* system (about 13.1% of total emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 25.1% of total methane emission in 2007. *Disposal sites* contributed to 17.5% of the methane emission and *Wastewater Handling* contributed to 2.9%.

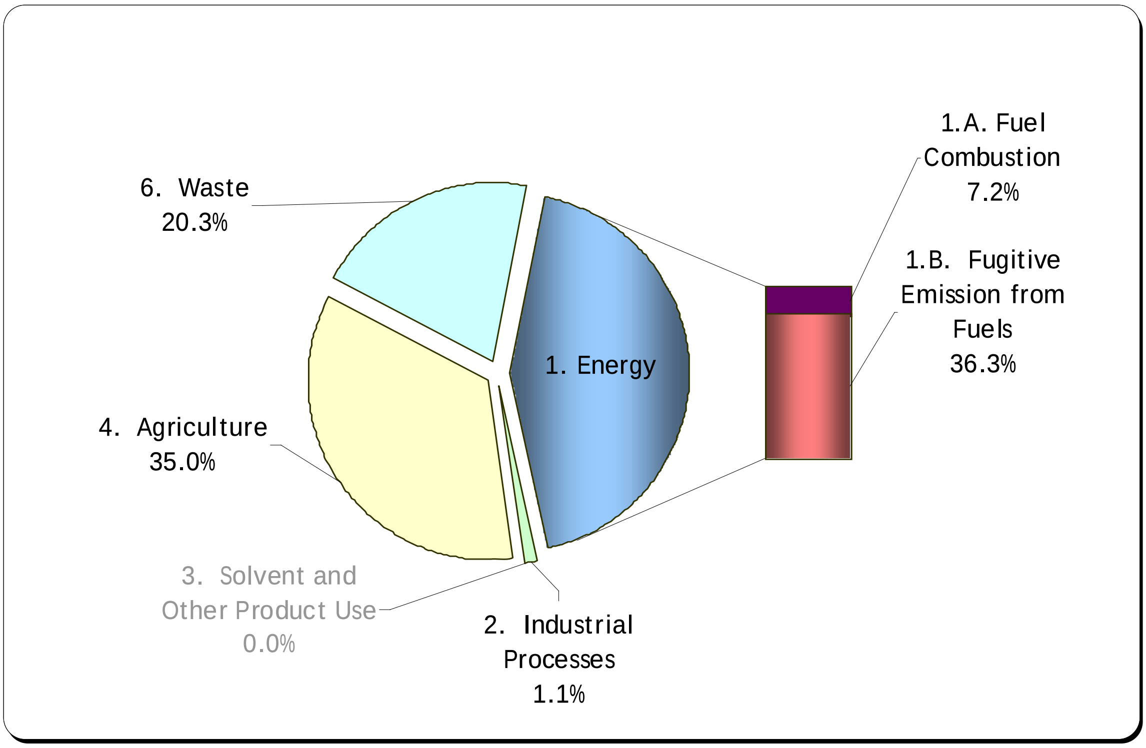

Figure 2.4 Methane emission (excluding category 5) in 2007 by sector

Nitrous oxide (N_2O)

The nitrous oxide emissions (excluding category 5) in 2007 were 96.88 Gg i.e. 30.03 million tonnes of CO_2 equivalents (table 2.2). N_2O share in total GHG emissions in 2007 amounted to 7.5%. The main N_2O emission sources and its shares in total N_2O emission in 2007 are: *Agricultural Soils* – 53.2%, *Manure Management* – 20.2%, *Chemical Industry* – 15.9% and *Fuel Combustion* – 6.4% (fig. 2.5).

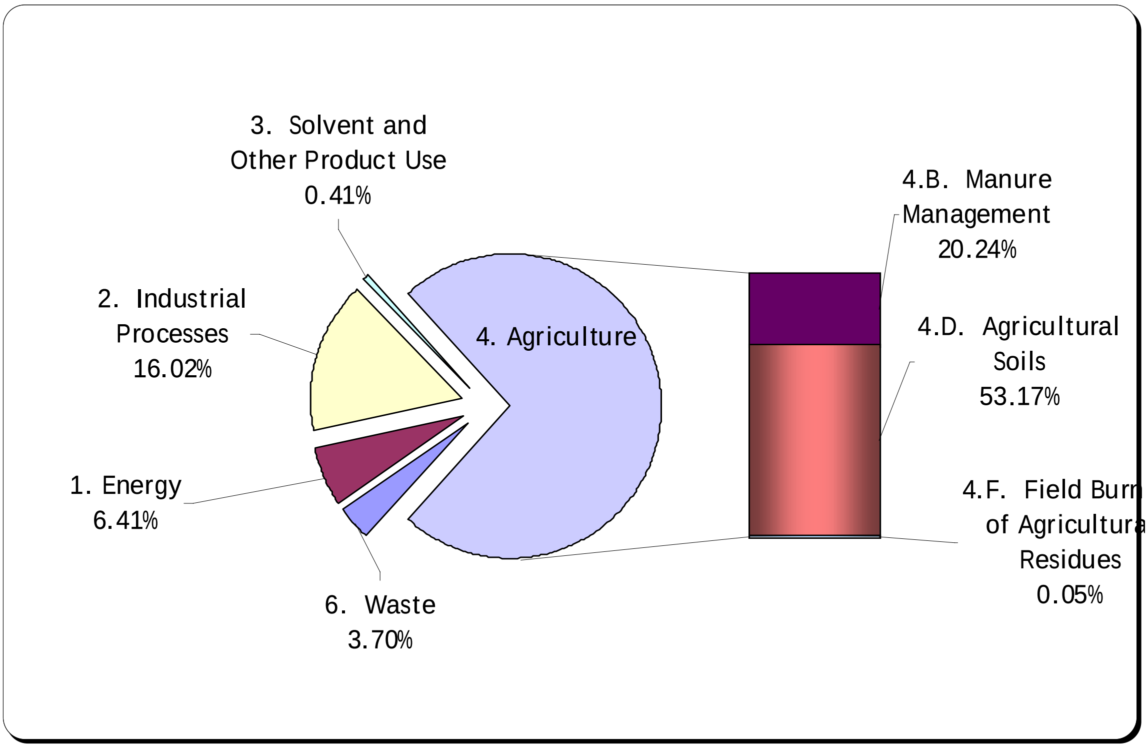

Figure 2.5 Nitrous oxide emission (excluding category 5) in 2007 by sector

Industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2007 was 3 635.58 Gg CO_2 eq. what accounts for 0.9% of total GHG emissions share in 2007 Shares of HFCs, PFCs and SF_6 in total 2007 GHG emissions was as follows: 0.83%, 0.07% and 0.008%.

The total emissions in 2007 according to groups of industrial gases are as follows: HFCs – 3.33 million tones of CO_2 equivalents, PFCs – 0.28 million tonnes of CO_2 equivalents and SF_6 – 0.03 million tones of CO_2 equivalents

2.3 GHG emissions by category

Table 2.5 includes emissions of greenhouse gases from all categories for the years: 1988 (base year) and 2007. The emissions given here for base year 1988 differ from 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. (excluding category 5) (see chapter 1.9.1).

Table 2.5. GHG emissions according to main sectors in base year (1988) and 2007

	Total [Gg eq. CO_2]		(2007-base)/base [%]
	Base year	2007	
TOTAL with LULUCF	531 478.4	358 408.37	-32.6
TOTAL without LULUCF	564 404.9	398 905.45	-29.3
1. Energy	469 594.9	320 882.11	-31.7
2. Industrial Processes	33 197.3	33 299.29	0.3
3. Solvent and Other Product Use	1 006.5	733.04	-27.2
4. Agriculture	51 225.0	35 039.64	-31.6
5. Land-Use Change and Forestry	-32 926.5	-40 497.08	23.0
6. Waste	9 381.2	8 951.38	-4.6

2.3.1 *Energy* (IPCC category 1)

The emission of GHGs from *Energy* sector in 2007 was 320.9 million tons of CO_2 equivalent. CO_2 emission share exceeded 94.4% of the total GHG emissions within 1.*Energy* category (table 2.6). The most emission intensive category was 1.A.1.*Fuel combustion activities* related mostly to heavy industry sector, highly energy consuming.

Table 2.6. GHG emissions from sub-sectors in category 1.*Energy* in 2007

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	320 882.11	100.0	94.4	5.0	0.6
A. Fuel Combustion	307 234.21	95.7	94.3	0.8	0.6
1. Energy Industries	182 884.58	57.0	56.7	0.0	0.3
2. Manufacturing Industries and Construction	34 953.93	10.9	10.8	0.0	0.1
3. Transport	38 785.05	12.1	11.9	0.0	0.1
4. Other Sectors	50 610.65	15.8	14.9	0.8	0.1
5. Other	0.00	0.0	0.0	0.0	0.0
B. Fugitive Emissions from Fuels	13 647.90	4.3	0.1	4.2	0.0
1. Solid Fuels	8 612.52	2.7	0.0	2.7	0.0
2. Oil and Natural Gas	5 035.38	1.6	0.1	1.5	0.0

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

Table 2.7 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 2007. CO_2 is dominating among GHGs – it's contribution exceeds 73.4%. 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 anesthesia (16.9%) and CO_2 emissions (recalculated from NMVOC) (83.1%).

Table 2.7. 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 2007

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	33 299.29	100.0	73.4	1.3	14.4	10.9
A. Mineral Products	10 399.77	31.2	31.2	0.0	0.0	
B. Chemical Industry	9 308.75	28.0	12.7	0.8	14.4	
C. Metal Production	9 260.79	27.8	26.5	0.4	0.1	0.8
D. Other Production	0.08	0.0	0.0	0.0	0.0	
F. Consumption of Halocarbons and SF6	3 373.35	10.1				10.1
G. Other	956.54	2.9	2.9	0.0	0.0	
Total Solvent and Other Product Use	733.04	100	83.1	0.0	16.9	

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 2.8). N_2O emission share was the largest in total GHG emission from 4.*Agriculture* in 2007 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 2.8. GHG emissions from sub-sectors in category 4.*Agriculture* in 2007

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	35 039.64	100.0	37.0	63.0
A. Enteric Fermentation	9 305.67	26.6	26.6	0.0
B. Manure Management	9 727.22	27.8	10.4	17.3
D. Agricultural Soils	15 967.77	45.6	0.0	45.6
F. Field Burning of Agricultural Residues	38.99	0.1	0.1	0.0

2.3.4 Waste (IPCC category 6)

As it can be seen in table 2.9, the emission of CH_4 dominated in this sector in 2007 (almost 84.1%). The main part of GHG emissions came from 6.A.*Solid waste disposal on land* and 6.B.*Wastewater handling*.

Table 2.9. GHG emissions from sub-sectors in category 6.*Waste* in 2007

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	8 951.38	100	3.5	84.1	12.4
A. Solid Waste Disposal on Land	6 471.52	72.3	0.0	72.3	0.0
B. Wastewater Handling	2 139.72	23.9	0.0	11.8	12.1
C. Waste Incineration	340.13	3.8	3.5	0.0	0.3

2.4 Comparison of GHG emissions to the base year (1988)

Percentage share of individual GHGs to national total in base year (1988) are presented in Table 2.10 and Figure 2.6. The emissions given here for base year differ from 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. while emission reduction in 2007 comparing to this value amounted for 28.7% (excluding category 5) (see chapter 1.9.1).

Table 2.10 Emissions of greenhouse gases in base year (1988) in CO_2 equivalent

Pollutant	base year 1988	
	Emission in CO_2 eq. [Gg]	Share [%]
CO2 – net emission (with LULUCF)	436 669.74	82.2
CO2 – without LULUCF.	469 604.46	83.2
CH4 - net emission (with LULUCF)	54 143.10	10.2
CH4 - without LULUCF	54 135.62	9.6
N2O - net emission (with LULUCF)	40 665.57	7.7
N2O - without LULUCF	40 664.81	7.2
HFCs		
PFCs		
SF_6		
TOTAL net emission (with LULUCF)	531 478.41	100.0
TOTAL without LULUCF	564 404.89	100.0

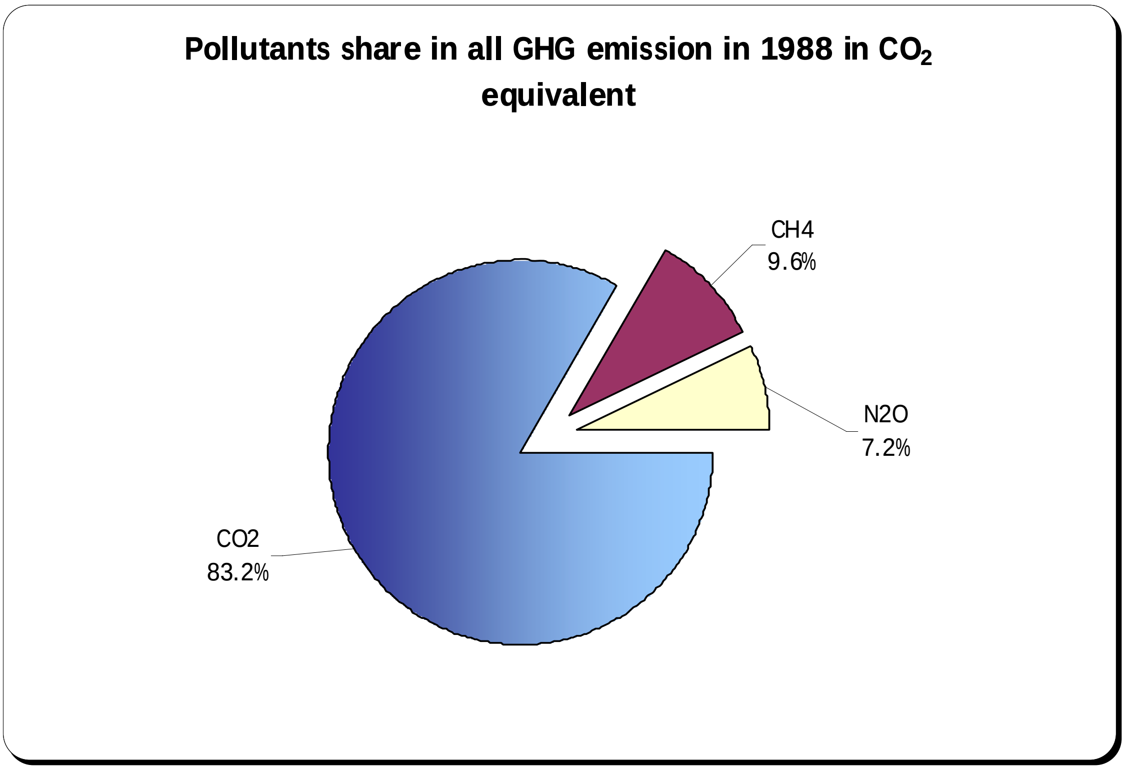

Figure 2.6 Percentage share of national greenhouse gas emissions in base year (1988) excluding emission from sector 5.

Compared to 1988, the percentage share of CO_2 (excluding category 5) in 2007 decreased from 83.2% to 82.3%.

The data for the GHGs and for the national total GHG emission for 2007 in comparison to the base year are given in table 2.11.

Table 2.11 Greenhouse gas emissions in 2007 with respect to base year 1988

Pollutant	Base year	2007	2007/base year [%]
	Emission in CO_2 eq. [Gg]	Emission in CO_2 eq. [Gg]	
CO2 – net emission (with LULUCF)	436 669.74	285 287.30	65.33
CO2 – without LULUCF.	469 604.46	328 172.10	69.88
CH4 - net emission (with LULUCF)	54 143.10	39 450.99	72.86
CH4 - without LULUCF	54 135.62	37 065.69	68.47
N2O - net emission (with LULUCF)	40 665.57	30 034.50	73.86
N2O - without LULUCF	40 664.81	30 032.08	73.85
HFCs		3 327.01	
PFCs		276.65	
SF_6		31.92	
TOTAL net emission (with LULUCF)	531 478.41	358 408.37	67.44
TOTAL without LULUCF	564 404.89	398 905.45	70.68

Carbon dioxide

CO_2 emission (excluding category 5) had decreased by app. 30.1% from the base year to 2007.

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

- share of solid fuels decreased from 87.7% in 1988 to 73.3% in 2007
- share of liquid fuels increased from 8.7% (1988) to 18.8% (2007)
- share of gaseous fuels increased from 3.6% (1988) to 8.0% (2007).

Methane

CH_4 emission (excluding category 5) had decreased by app. 31.5% from the base year to 2007. The reasons for that are as follow:

- the decrease in emission from *Enteric Fermentation* by 40.8%
- the decrease in *Fugitive Emission* by 38.9%
- the increase in emission from *Waste* by 1.4%.

Nitrous oxide

The nitrous oxide emissions (excluding category 5) in 2007 were app. 26.1% lower than the respective figure for the base year. The share in *Manure Management* decreased from 23.0% in 1988 to 20.2% in 2007, in *Agricultural Soils* decreased from 55.8% (1988) to 53.2% (2007) and in *Chemical Industry* increased from 12.3% in 1988 to 15.9% in 2007.

Industrial gases: HFCs, PFCs and SF_6

Industrial gases are compared to year 1995 because this is the first reporting year for those gases. Emissions of industrial gases in 1995 are given in table 2.5.

HFCs emissions in 2007 were 211.7 times higher than in 1995. This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment.

PFCs emissions in 2007 were 9.7% higher than in year 1995. The PFCs emission changes between 2007 and the preceding years depend on the aluminium production levels (main PFC source) and the use of C4F10 in fire extinguishers.

SF_6 emissions in 2007 were about 4.6% higher than in 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 year 1995, does not influence significantly the national total GHG emission trend, because all the fluorinated industrial gases together contributed merely app. 0.9% to the national total in 2007.

2.5 Comparison of greenhouse gas emissions 2007 and 2006

Changes of national emissions and sinks of GHGs in 2007 compared to 2006 were as follows:

CO2 (without LULUCF)	- emission fall to	99.57%
CH4 (without LULUCF)	- emission fall to	99.61%
N2O (without LULUCF)	- emission rise to	101.90%
HFC	- actual emission rise to	116.97%
PFC	- actual emission rise to	102.56%
SF_6	- actual emission rise to	106.30%

Below results are discussed separately for each greenhouse gas with respect to 2007 emissions and change between 2007 and 2006.

Carbon dioxide (CO_2)

In 2007, the CO_2 emissions (without LULUCF) was 0.4% lower than in 2006. The CO_2 emission in 2007 from category *Energy* was lower by 0.8% and from category *Industrial Processes* was higher by 4.8% than in 2006. In comparison to 2006 the CO_2 emission from category *Waste* in 2007 rise by 0.7%.

Table 2.12. Comparison of carbon dioxide emission in 2006 and 2007

Year	CO_2 [Gg]		2007/2006 [%]
	2006	2007	
TOTAL without LULUCF	329 599.1	328 172.1	99.6
1. Energy	305 396.5	302 824.6	99.2
A. Fuel Combustion	305 177.0	302 626.1	99.2
1. Energy Industries	182 536.9	181 992.6	99.7
2. Manufacturing Industries and Construction	32 699.2	34 664.2	106.0
3. Transport	38 140.8	38 212.7	100.2
4. Other Sectors	51 800.1	47 756.6	92.2
5. Other	NO	NO	NO
B. Fugitive Emissions from Fuels	219.5	198.5	90.4
1. Solid Fuels	1.3	1.6	117.2
2. Oil and Natural Gas	218.1	196.9	90.3
2. Industrial Processes	23 311.5	24 426.9	104.8
A. Mineral Products	9 147.4	10 399.8	113.7
B. Chemical Industry	4 276.7	4 244.2	99.2
C. Metal Production	8 743.2	8 826.4	101.0
D. Other Production	0.0	0.1	160.4
G. Other	1 144.1	956.5	83.6
3. Solvent and Other Product Use	581.8	609.0	104.7
4. Agriculture	NO	NO	NO
A. Enteric Fermentation	NO	NO	NO
B. Manure Management	NO	NO	NO
D. Agricultural Soils	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	-42 882.4	-42 884.8	100.0
A. Forest Land	-54 266.1	-54 132.2	99.8
B. Cropland	8 237.1	8 419.6	102.2
C. Grassland	130.5	-201.0	-154.0
D. Wetlands	3 090.5	3 102.2	100.4
E. Settlements	-74.5	-73.4	98.6
F. Other Land	NO	NO	NO
6. Waste	309.3	311.6	100.7
A. Solid Waste Disposal on Land	NO	NO	NO
B. Wastewater Handling	NO	NO	NO
C. Waste Incineration	309.3	311.6	100.7

Methane (CH_4)

The emission (excluding category 5) in 2007 was lower than in 2006 by 0.4%. The main sources are *Agriculture*, *Energy* and *Waste.* Emission from *Manure Management* in the *Agriculture* sector was lower by 2.4% in 2007 and from *Waste* sector was higher by 2.6% than in 2006. *Fugitive emission* in *Energy* sector was lower by 1.3% in 2007 compared to 2006.

Table 2.13 Comparison of methane emission in 2006 and 2007

Year	CH_4 [Gg]		2007/2006 [%]
	2006	2007	
TOTAL without LULUCF	1 772.85	1 765.03	99.6
1. Energy	788.22	768.18	97.5
A. Fuel Combustion	139.15	127.74	91.8
1. Energy Industries	2.85	2.93	102.7
2. Manufacturing Industries and Construction	3.58	3.70	103.5
3. Transport	5.49	5.30	96.6
4. Other Sectors	127.23	115.81	91.0
5. Other	NO	NO	NO
B. Fugitive Emissions from Fuels	649.07	640.44	98.7
1. Solid Fuels	441.54	410.05	92.9
2. Oil and Natural Gas	207.53	230.39	111.0
2. Industrial Processes	19.42	20.29	104.4
A. Mineral Products	NO	NO	NO
B. Chemical Industry	12.83	13.35	104.0
C. Metal Production	6.59	6.94	105.2
D. Other Production	NO	NO	NO
G. Other	NO	NO	NO
3. Solvent and Other Product Use	NO	NO	NO
4. Agriculture	615.70	618.10	100.4
A. Enteric Fermentation	436.59	443.13	101.5
B. Manure Management	178.01	173.78	97.6
D. Agricultural Soils	NO	NO	NO
F. Field Burning of Agricultural Residues	1.10	1.19	108.1
5. Land Use, Land-Use Change and Forestry	113.09	113.59	100.4
A. Forest Land	0.14	0.15	103.3
B. Cropland	NO	NO	NO
C. Grassland	0.12	0.18	153.8
D. Wetlands	112.83	113.26	100.4
E. Settlements	NO	NO	NO
F. Other Land	NO	NO	NO
6. Waste	349.51	358.47	102.6
A. Solid Waste Disposal on Land	300.24	308.17	102.6
B. Wastewater Handling	49.27	50.30	102.1
C. Waste Incineration	NO	NO	NO

Nitrous oxide (N_2O)

The emission of N_2O (excluding category 5) was higher in 2007 than in 2006 (by 1.9%). The main sources of N_2O emission are *Agricultural Soils* and *Manure Management*. Emission from *Agricultural Soils* was higher by 3.2% than in 2006 while emission from *Manure* was lower by 0.3% in 2007 (table 2.14).

Table 2.14. Comparison of nitrous oxide emission in 2006 and 2007

Year	N_2O [Gg]		2007/2006 [%]
	2006	2007	
TOTAL without LULUCF	95.07	96.88	101.9
1. Energy	6.40	6.21	97.0
A. Fuel Combustion	6.40	6.21	97.0
1. Energy Industries	2.70	2.68	99.1
2. Manufacturing Industries and Construction	0.66	0.68	103.6
3. Transport	1.42	1.49	104.6
4. Other Sectors	1.62	1.36	84.3
5. Other	NO	NO	NO
B. Fugitive Emissions from Fuels	0.00	0.00	100.1
1. Solid Fuels	NO	NO	NO
2. Oil and Natural Gas	0.00	0.00	100.1
2. Industrial Processes	15.08	15.52	102.9
A. Mineral Products	NO	NO	NO
B. Chemical Industry	15.00	15.43	102.9
C. Metal Production	0.09	0.09	96.6
D. Other Production	NO	NO	NO
G. Other	NO	NO	NO
3. Solvent and Other Product Use	0.40	0.40	100.0
4. Agriculture	69.60	71.16	102.2
A. Enteric Fermentation	NO	NO	NO
B. Manure Management	19.66	19.61	99.7
D. Agricultural Soils	49.89	51.51	103.2
F. Field Burning of Agricultural Residues	0.04	0.05	102.0
5. Land Use, Land-Use Change and Forestry	0.0091	0.0078	86.0
A. Forest Land	0.0022	0.0010	45.0
B. Cropland	NO	NO	NO
C. Grassland	0.0000	0.0000	100.0
D. Wetlands	0.0068	0.0068	99.3
E. Settlements	NO	NO	NO
F. Other Land	NO	NO	NO
6. Waste	3.59	3.59	99.9
A. Solid Waste Disposal on Land	NO	NO	NO
B. Wastewater Handling	3.49	3.49	100.0
C. Waste Incineration	0.09	0.09	97.9

Industrial gases

The total emission of all industrial gases was higher by about 15.6% in 2007 comparing to 2006. HFCs in 2007 was by 17.0% higher than in 2006. PFCs emissions in 2007 were by app. 2.6% higher than in 2006. SF_6 emissions in 2007 were by 6.3% higher than in 2006.

2.6 Emission trends for greenhouse gas precursors (CO, NO_x, NMVOC) and SO_2

Precursors of greenhouse gases like NO_x, CO and non-methane volatile organic compounds (NMVOC), through their influence on the greenhouse gases, have an indirect effect on climate. The presence of SO_2 in the atmosphere influences the climate by increasing the number of secondary aerosols, which have been found to have a cooling effect. Figures 2.7-2.10 shows trends of emissions of SO_2, NO_x, NMVOC (1980-2007) and CO (1990-2007). Emissions of SO_2 amounted to 1131.0 Gg in 2007 and decreased by about 72% between 1980 and 2007, and 65% between 1990 and 2006. 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 2007 amounted 884.7 Gg and decreased by about 28% between 1980 and 2007, and 31% between 1990 and 2007. 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 traffic contribute to the national total, and cause comparatively lower emission reductions than in case of SO_2. Similarly emissions of NMVOC decreased by 43% between 1980–2007 and by 29% between 1990–2007 and was 596.4 Gg in 2007. CO emissions in 2007 amounted 2603.1 Gg and dropped by about 65% between 1990–2007. The main reasons are the same as those described regarding emissions of SO_2 and NO_x.

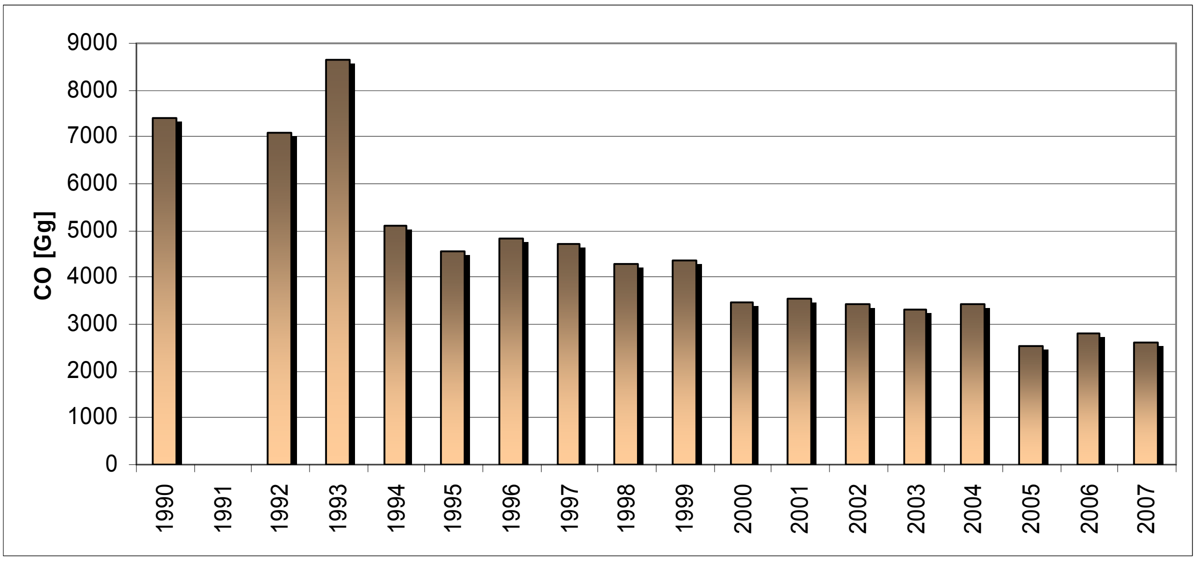

Figure 2.7 Emissions of CO (1990-2007)

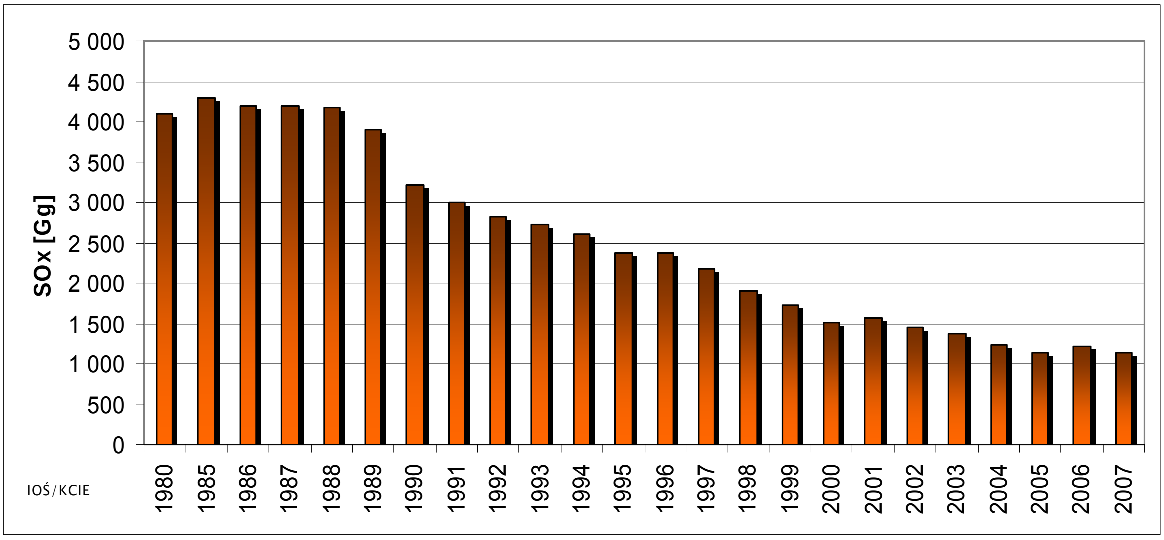

Figure 2.8 Emissions of SO_2 (1980-2007)

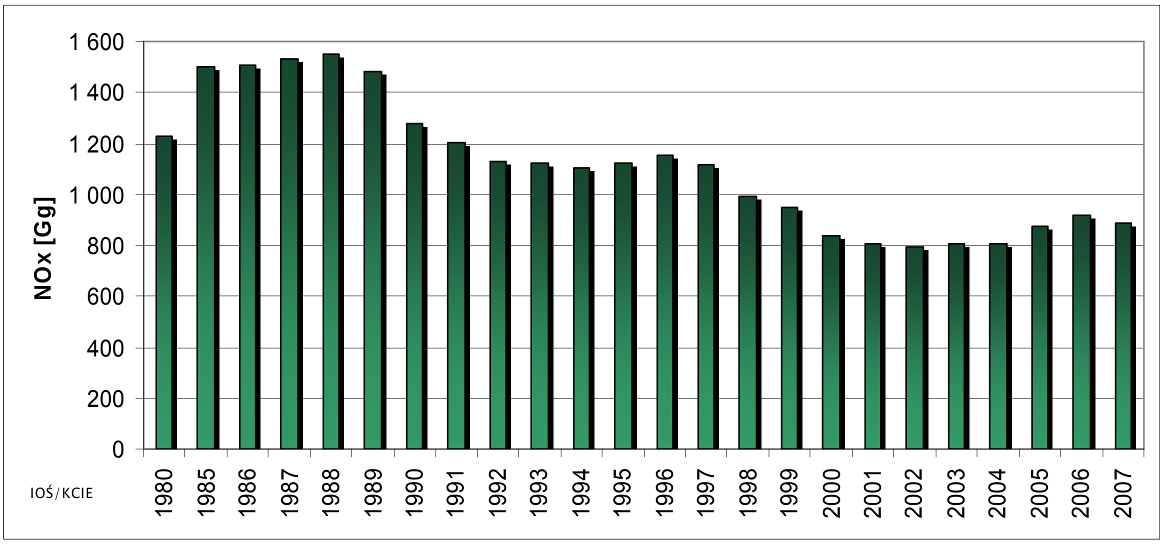

Figure 2.9 Emissions of NO_x (1980-2007)

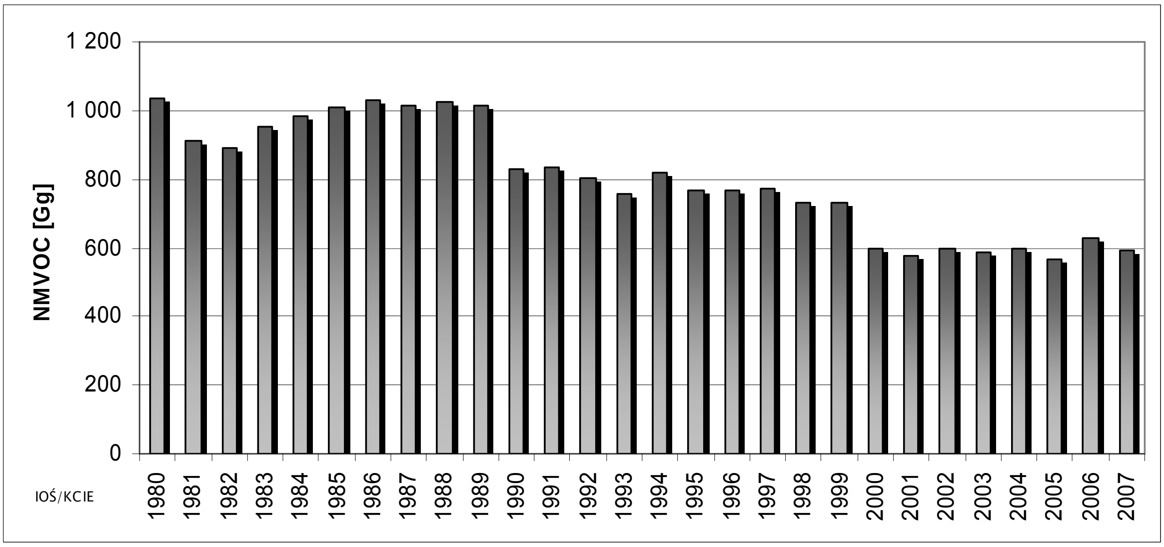

Figure 2.10 Emissions of NMVOC (1980-2007)

3. Energy (CRF sector 1)

3.1 Key categories

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 66.3%
- 1.A.3.b Transport Road Transportation (CO_2 emission), share in total GHG emission 9.1%
- 1.B.1.a. Coal Mining and Handling (CH_4 emission), share in total GHG emission 2.1%
- 1.B.2.b. Natural Gas (CH_4 emission), share in total GHG emission 1.2%

Share of these categories in total Poland's GHG emissions is 78.7%.

3.2 Sector overview and methodological issues

3.2.1 *Fuel combustion* – (CRF 1.A)

3.2.1.1 *Fuel combustion – Sectoral Approach* (CRF 1.A.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

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* (PKD[5] 40.1 and 40.3)

b) 1.A.1.b *Petroleum Refining* (PKD 23.2)
- Manufacture of refined petroleum products

c) 1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries*
- Manufacture of coke oven products (PKD 23.1)
- other energy industries (PKD 10.1 – hard coal mining and enrichment; 10.2 lignite mining and enrichment; 11.1 natural gas and oil extraction; 40.1 and 40.3 – production and distribution of electrical energy and heat – only direct consumption of fuels is included)

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

[5] PKD – (Polska Klasyfikacja Działalności) – Polish Classification of Economic Activities

a) *Iron and Steel* - 1.A.2.a (PKD 27 excluding activities included in 1.A.2.b *Non-Ferrous Metals sub-category* given below)
b) *Non-Ferrous Metals* - 1.A.2.b (PKD 27.4, 27.53, 27.54)
c) *Chemicals* - 1.A.2.c (PKD 24)
d) *Pulp, Paper and Print* - 1.A.2.d (PKD 21 and 22)
e) *Food Processing, Beverages and Tobacco* - 1.A.2.e (PKD 15 and 16)
f) *Other* - 1.A.2.f:

- construction (PKD – section F) and other industry branches not included elsewhere: (PKD 13-14, 17-20, 26, 28-37, 40.2, 41)
- 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) (PKD sections excluding sections included elsewhere, that means excluding sections A-F and I)
b) *Residential* (1.A.4.b)
c) *Agriculture/Forestry/Fisheries* (1.A.4.c) (PKD – sections A and B)

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

Stationary sources

Data on CO_2 emissions from fuel combustion in installations covered by the Community Emission Trading Scheme (EU ETS) were taken directly from the verified annual emission reports and then aggregated to the corresponding IPCC source categories. Emissions of CO_2 for installations covered by the EU ETS are estimated following the Ordinance of the Minister of Environment of 12 January 2006 on the way of monitoring of emission amounts of substances covered by the Community Emission Trading Scheme. The ordinance transposes to the Polish law the UE Monitoring and Reporting Guidelines for ETS (Commission Decision 2004/156/EC). The amount of CO_2 emissions from stationary sources outsider the EU ETS is estimated on the level determined as IPCC *Tier 2* and is 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 in sources outside the EU ETS was calculated on the basis of the difference between national energy related use of the given fuel included in the energy balance sheets submitted by GUS to Eurostat, and the fuel consumption reported by the installations covered by the EU ETS that are included in the given IPCC source category.

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

- 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, industrial wastes, municipal waste - (non-biogenic fraction) and gas works gas
- biomass: fuel wood and wood waste, biogas, municipal waste – biogenic fraction, biofuels: bioethanol and biodiesel

The emission factors for CO_2 emission estimation for fuel combustion in stationary sources outside the EU ETS 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:

$$C_{hc} = 10(2.4858*NCV + 3.3132)/NCV$$

where: C_{hc} emission factor/elemental 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,

the emission factor for elemental carbon for lignite (brown coal):

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

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)

- 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 – 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 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].

<u>Trend of fuel use and methodology over the years 1988-2007</u>

Estimation of CO_2 emissions for the years 1988-2004 is based on methodology used for the year 2007 for fuel combustion for stationary sources outside the EU ETS. Since 2005 data from the installations covered by the Community Emission Trading Scheme (EU ETS) were taken directly into GHG inventory and methodology corresponds to methodology described above for 2007. For the years: 1990-2004 and for calculations of fuel consumption for 2005-2007 in stationary sources outside the EU ETS, data 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 the GUS publication [GUS 1989a-1990a]. In the latter case, the fuel list is more disaggregated e.g. natural gas is divided into high-methane gas, nitrified gas and coal-bed methane. All emission factors for GHGs for fuel combustion in stationary sources, with the exception of CO_2 EFs for hard coal and lignite, are the IPCC default EFs – the same for the entire time series (references for the EFs have been described above when describing the inventory methodology for the year 2007). Emission factors for CO_2 for hard coal and lignite for the entire time series are based on the same empirical functions as for 2007. The values of CO2 EFs changed over the years following the changes of the respective net calorific values for hard coal and lignite.

Below the time series of fuel use and GHG emissions for the main subsectors are presented in the source category 1.A *Fuel combustion*

1.A.1.a *Public electricity and heat production*

Table 3.1 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 1988-2007 together with the estimation of the share of the installations covered by the EU ETS in 2007 in the respective IPCC source subcategory.

Table 3.1. Fuel consumption in 1988-2007 in subcategory 1.A.1.a [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	84.459	81.878	66.947	62.620	57.598	56.348	57.221
Gaseous Fuels	24.594	23.902	21.641	16.329	9.562	3.107	4.094
Solid Fuels	2491.483	2447.108	2131.211	2130.563	2054.985	1937.053	1882.447
Biomass	1.082	0.597	14.585	14.384	17.289	13.783	14.057
TOTAL	2601.618	2553.485	2234.384	2223.896	2139.434	2010.291	1957.819
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	26.231	28.870	28.987	19.318	18.527	15.504	16.469
Gaseous Fuels	4.738	7.157	7.949	10.768	16.210	21.627	28.242
Solid Fuels	1760.900	1820.506	1773.038	1709.529	1666.951	1645.374	1659.729
Biomass	1.447	2.793	3.381	3.877	3.747	3.904	5.449
TOTAL	1793.316	1859.326	1813.355	1743.492	1705.435	1686.409	1709.889
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	15.324	14.139	11.472	9.620	9.110	8.004	86.5
Gaseous Fuels	38.700	45.496	53.667	57.039	52.808	49.653	81.6
Solid Fuels	1605.372	1683.512	1659.101	1663.636	1712.400	1671.760	98.5
Biomass	5.424	6.533	10.198	19.320	23.201	27.739	60.5
TOTAL	1664.820	1749.680	1734.438	1749.615	1797.519	1757.156	97.3*

*) value in the last cell is the weighted mean of four values given above. It's a percentage share of total fuels combusted in 2007 from installations included in ETS, in total account of fuels combusted in this subcategory in 2007 in specific IPCC subcategory (this also concerns all further tables which include consumption of fuels and ETS share)

The data in table 3.1 show that the use of solid fuels is dominant in 1.A.1.a – mainly hard coal and lignite. In 2007, the use of hard coal was almost 1140 PJ i.e. app. 65% of the entire energy of all fuels used in that sub-sector. Lignite made app. 29% of the energy, accordingly. Despite the significant share of solid fuels (over 95%) 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. 98.1% in 1998 till 95.1% in 2007). At the same time, in last decade increased the share of gas as well as the share of biomass. Table 3.1 also shows that in 2007 almost entire fuel used in sub-category 1.A.1.a (app. 97%) took place in installations covered by EU ETS.

Figure 3.1 shows CO_2 emission changes over the period 1988-2007. A significant emission decrease took place over the years 1988-1995 followed by a period of emission stabilization. Data for the year 2007 show that over 98% of CO_2 emission in 1.A.1.a originated in EU ETS installations.

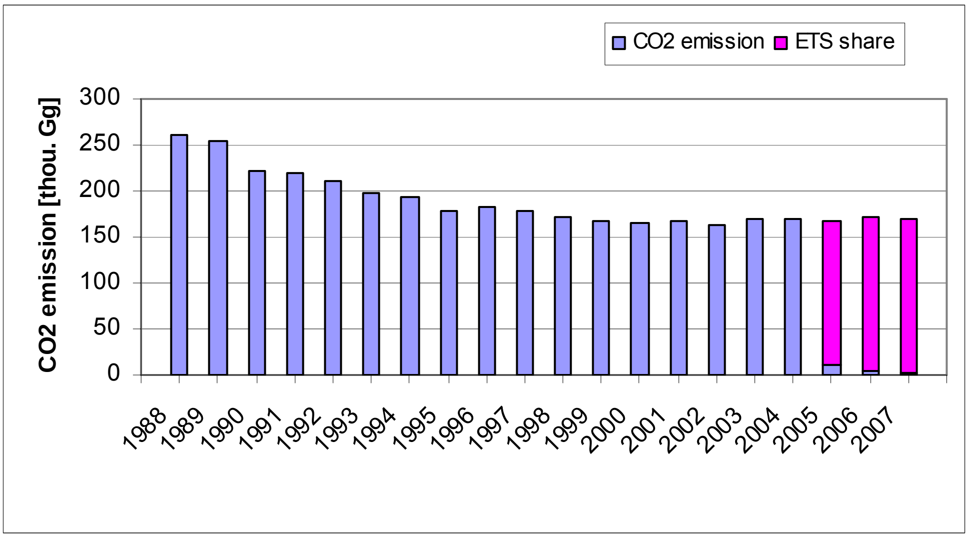

Figure 3.1. CO_2 emission for 1.A.1.a category in 1988-2007

Figure 3.2 shows emission trends for CH_4 and N_2O between the base year and 2007. Similarly to CO_2 a significant emission decrease for these gases happened in the period 1988-1995.

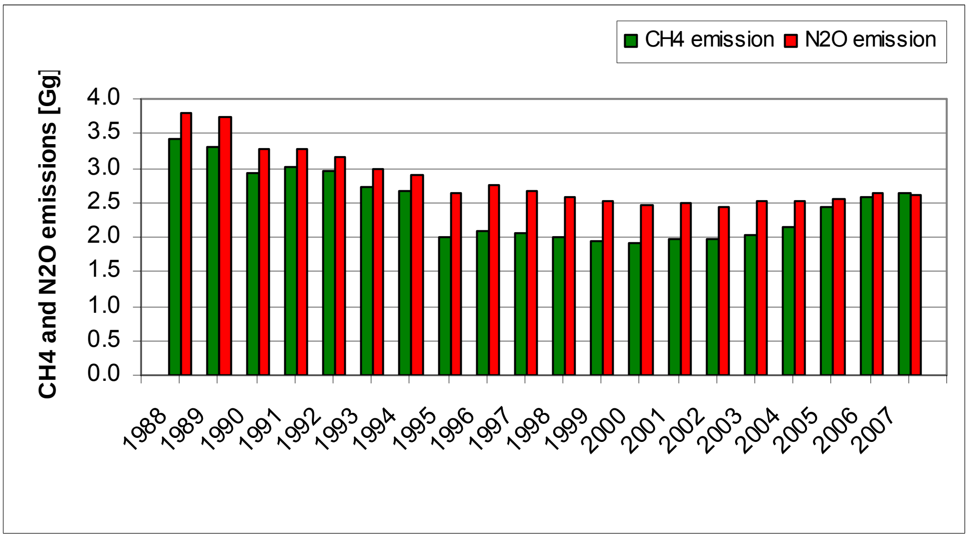

Figure 3.2. CH_4 and N_2O emissions for 1.A.1.a category in 1988-2007

1.A.1.b *Petroleum Refining*

Table 3.2 shows fuel consumption data in sub-category 1.A.1. b *Petroleum Refining* for the years 1988-2007 together with estimation of the share of EU ETS installation in 2007.

Table 3.2. Fuel consumption in 1988-2007 in subcategory 1.A.1.b [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	39.228	40.968	18.958	18.318	24.366	22.188	19.474
Gaseous Fuels	2.396	2.396	1.671	1.539	1.508	1.608	1.591
Solid Fuels	0.044	0.047	5.268	0.363	0.754	0.268	0.330
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	41.668	43.410	25.897	20.220	26.628	24.064	21.395
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	44.685	50.690	44.816	49.006	45.867	47.032	53.188
Gaseous Fuels	1.562	1.749	3.931	13.946	14.918	20.076	19.281
Solid Fuels	3.915	1.837	1.557	1.171	0.965	0.504	0.072
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	50.162	54.276	50.304	64.123	61.750	67.612	72.541
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	53.587	54.256	57.002	54.198	64.739	61.103	100
Gaseous Fuels	18.941	20.506	23.099	23.040	24.808	30.147	2.5
Solid Fuels	0.024	0.176	0.221	0.285	0.224	0.000	-
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	-
TOTAL	72.552	74.938	80.322	77.523	89.771	91.250	69.4

Figure 3.3 shows CO_2 emission changes in 1988-2007 in sub-category 1.A.1.b. Since mid-1990s emissions continue to grow in that sub-category. The share of EU ETS installations in 2007 CO_2 emission was app. 73%.

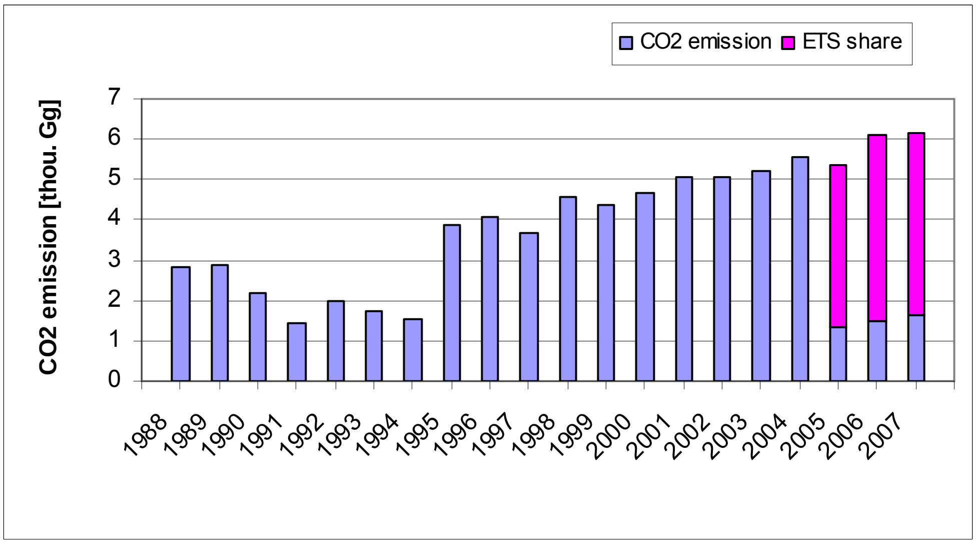

Figure 3.3. CO_2 emission for 1.A.1.b category in 1988-2007

Figure 3.4 shows the corresponding CH_4 and N_2O emission in that source sub-category between the base year and 2007.

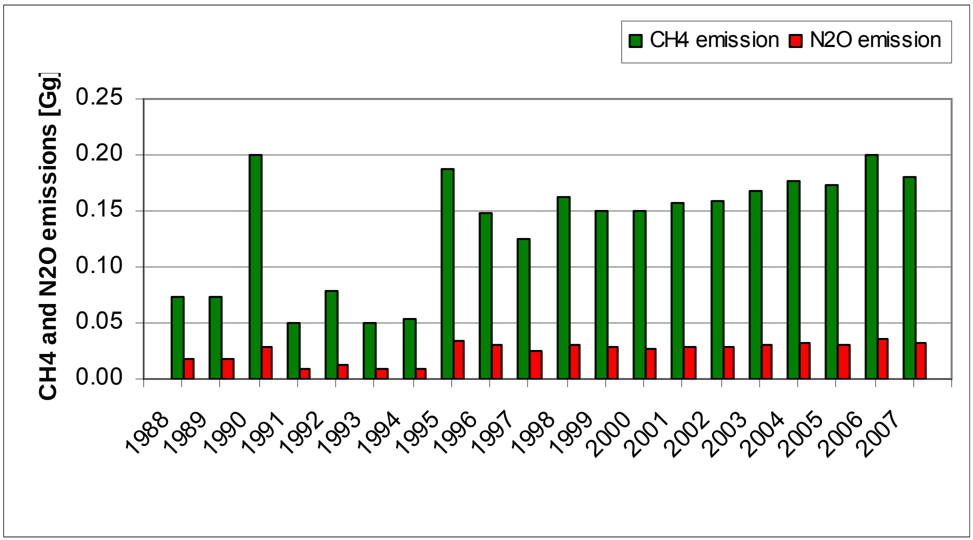

Figure 3.4. CH_4 and N_2O emissions for 1.A.1.b category in 1988-2007

1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries*

Table 3.3 shows the fuel use data in the sub-category 1.A.1.c over the period: 1988-2007. The table also shows the share of EU ETS installations (coke plants) in that sub-category 1.A.1.c in 2007.

Table 3.3. Fuel consumption in 1988-2007 in subcategory 1.A.1.c [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	4.180	0.063	2.009	2.301	2.511	4.924	4.166
Gaseous Fuels	2.649	3.240	12.371	12.432	14.665	12.354	17.401
Solid Fuels	72.473	64.823	58.619	49.200	47.158	63.171	105.149
Biomass	0.000	0.000	0.006	0.000	0.004	0.008	0.011
TOTAL	79.302	68.127	73.005	63.933	64.338	80.457	126.727
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	4.304	3.776	3.225	3.033	2.283	2.234	1.614
Gaseous Fuels	14.851	23.270	21.155	17.779	19.458	19.490	12.986
Solid Fuels	103.711	98.633	99.436	93.850	80.096	72.597	73.611
Biomass	0.004	0.014	0.031	0.026	0.027	0.033	0.051
TOTAL	122.870	125.693	123.847	114.688	101.864	94.354	88.262
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	2.116	2.198	1.895	2.181	1.444	1.471	0.0
Gaseous Fuels	12.514	8.912	10.005	8.838	13.061	15.577	0.3
Solid Fuels	61.728	71.036	67.751	59.370	51.988	75.647	40.2
Biomass	0.047	0.135	0.004	0.014	0.025	0.085	0.0
TOTAL	76.405	82.281	79.655	70.403	66.518	92.780	32.8

The emission trends of CO_2, CH_4 and N_2O in the 1988-2007 period are shown in figures 3.5 and 3.6.

The share of EU ETS installations in 2007 CO_2 emissions in that sub-category was app. 23%.

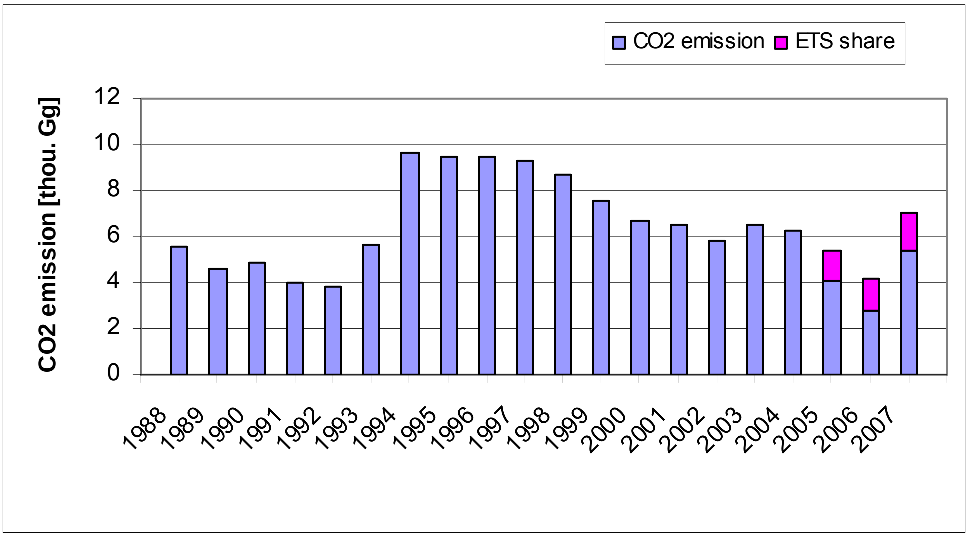

Figure 3.5. CO_2 emission for 1.A.1.c category in 1988-2007

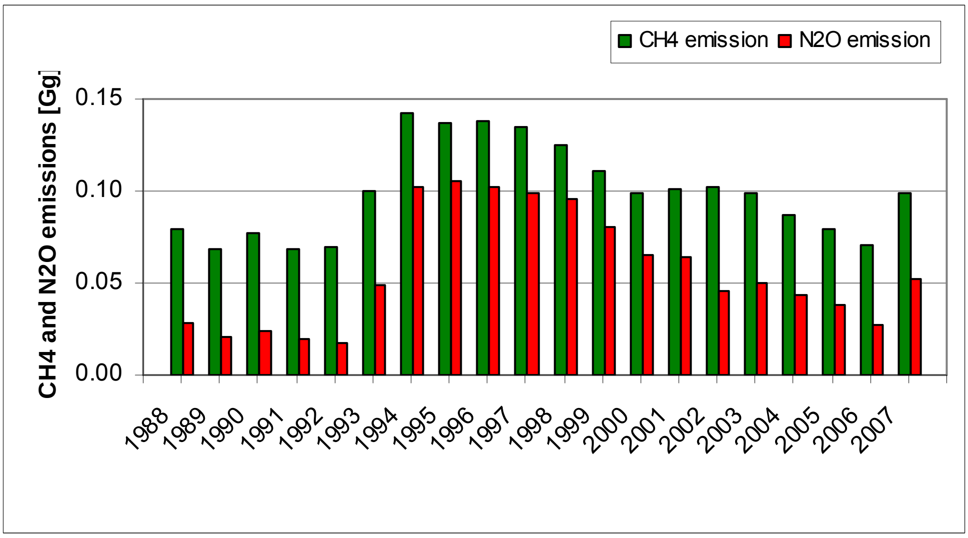

Figure 3.6. CH_4 and N_2O emissions for 1.A.1.c category in 1988-2007

1.A.2.a *Iron and Steal*

Table 3.4. shows the fuel use data in the sub-category 1.A.2.a *Iron and Steal* for the period: 1988-2007 and the estimated share of EU ETS installations in the overall fuel use in 2007 in that sub-category. As you can see in the table solid fuels is the dominant fuel type in that sub-category.

Table 3.4. Fuel consumption in 1988-2007 in subcategory 1.A.2.a [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	21.400	18.733	11.170	7.928	5.450	4.621	3.514
Gaseous Fuels	73.528	63.350	51.839	32.306	24.476	23.036	24.152
Solid Fuels	90.505	78.824	76.494	79.979	83.677	93.515	96.334
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014
TOTAL	185.433	160.907	139.503	120.213	113.603	121.188	124.014
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	2.807	1.855	5.274	1.898	2.187	1.864	0.994
Gaseous Fuels	23.163	24.055	26.915	23.119	20.699	21.482	17.261
Solid Fuels	116.887	109.348	111.626	97.501	79.250	87.325	70.252
Biomass	0.005	0.006	0.004	0.006	0.004	0.003	0.006
TOTAL	142.862	135.264	143.819	122.524	102.140	110.674	88.513
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	0.358	0.312	0.266	0.085	0.128	0.085	0.1
Gaseous Fuels	14.652	14.637	19.696	16.622	19.796	20.861	17.3
Solid Fuels	61.068	64.277	68.389	28.179	33.517	39.592	37.3
Biomass	0.003	0.004	0.004	0.002	0.001	0.001	0.0
TOTAL	76.081	79.230	88.355	44.888	53.442	60.539	30.4

Significant drop in fuel consumption in the period 2005-2007 is the result of subtraction of amount of fuel used in iron and steel industry, which were included in 2.C *Metal Production* category. There are the fuels consumed in EU ETS installations. 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**
Hard coal	1.329	4.839	4.509
Natural gas	3.369	0.707	1.443
Coke	47.550	53.738	51.916
Coke oven gas	4.242	4.832	6.460
Blast furnace gas	0.239	0.208	0.230

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

Figure 3.7 shows CO_2 emissions in the 1988-2007 period. Emissions of CH_4 and N_2O in the same time period are shown in figure 3.8. Emission trends for all three gases follow closely the trends in fuel use.

According to data for 2007, it was estimated that app. 32% of CO_2 emissions in 2007 in the sub-category 1.A.2.a came from installations covered by the EU ETS. It is worth to notice, that such low share of EU ETS installations in the overall CO_2 emission from this sub-category is the result of inclusion of part of emission from fuel combustion in EU ETS installations involved in iron and steel production into CO_2 emission in IPCC category 2.C.1.

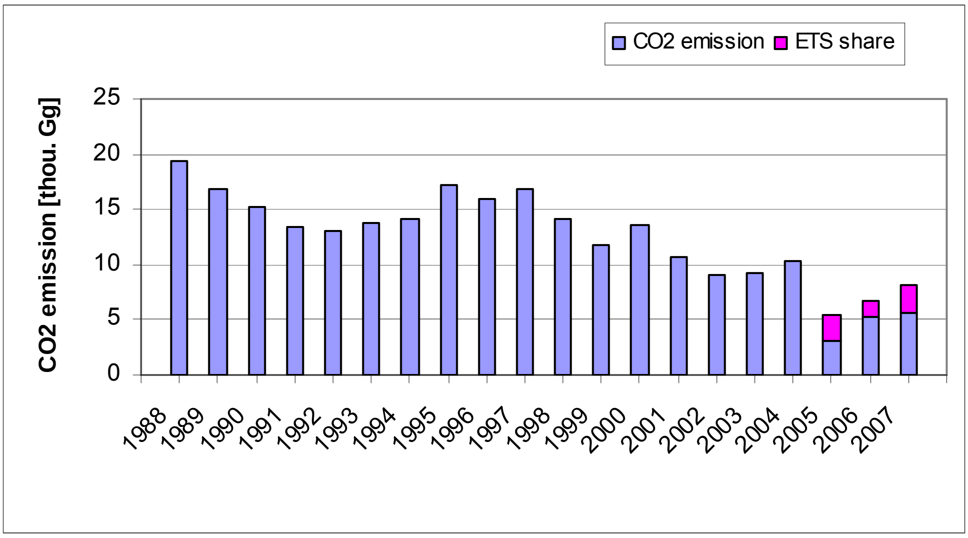

Figure 3.7. CO_2 emission for 1.A.2.a category in 1988-2007

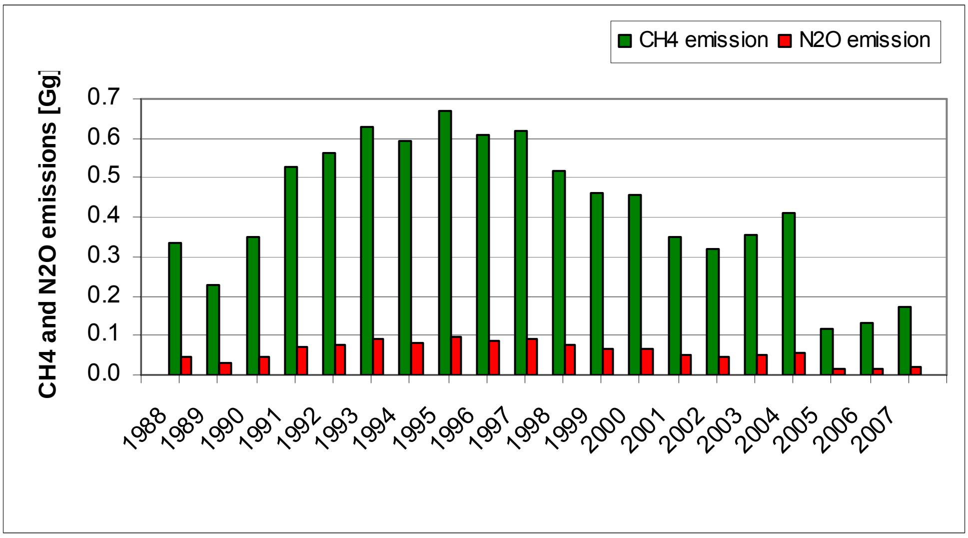

Figure 3.8. CH_4 and N_2O emissions for 1.A.2.a category in 1988-2007

1.A.2.b *Non-Ferrous Metals*

The data on fuel type use in the sub-category 1.A.2.b *Non-Ferrous Metals* over the 1988-2007 period are presented in table 3.5.

Table 3.5. Fuel consumption in 1988-2007 in subcategory 1.A.2.b [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	1.49	1.48	0.803	0.843	0.928	0.845	0.928
Gaseous Fuels	7.14	6.87	4.599	4.633	1.213	1.745	5.321
Solid Fuels	13.09	11.74	6.769	6.192	3.617	5.394	8.899
Biomass	0.00	0.00	0.000	0.000	0.000	0.001	0.001
TOTAL	21.72	20.08	12.171	11.668	5.758	7.985	15.149

	1995	1996	1997	1998	1999	2000	2001
Liquid Fuels	0.890	0.939	0.853	0.776	0.730	0.862	0.782
Gaseous Fuels	5.447	5.108	5.424	5.639	5.660	5.814	5.700
Solid Fuels	12.503	13.082	12.820	11.733	10.958	11.197	12.051
Biomass	0.000	0.149	0.042	0.026	0.010	0.011	0.005
TOTAL	18.840	19.278	19.139	18.174	17.358	17.884	18.538
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	0.616	0.494	0.616	0.616	0.616	0.376	-
Gaseous Fuels	5.589	5.868	6.405	6.468	6.884	6.743	-
Solid Fuels	11.233	10.464	8.672	6.494	6.973	7.391	-
Biomass	0.001	0.000	0.000	0.000	0.000	0.000	-
TOTAL	17.439	16.826	15.693	13.578	14.473	14.510	-

Emissions of the main greenhouse gases in 1.A.2.b between the base year and 2007 are shown in figures: 3.9 and 3.10.

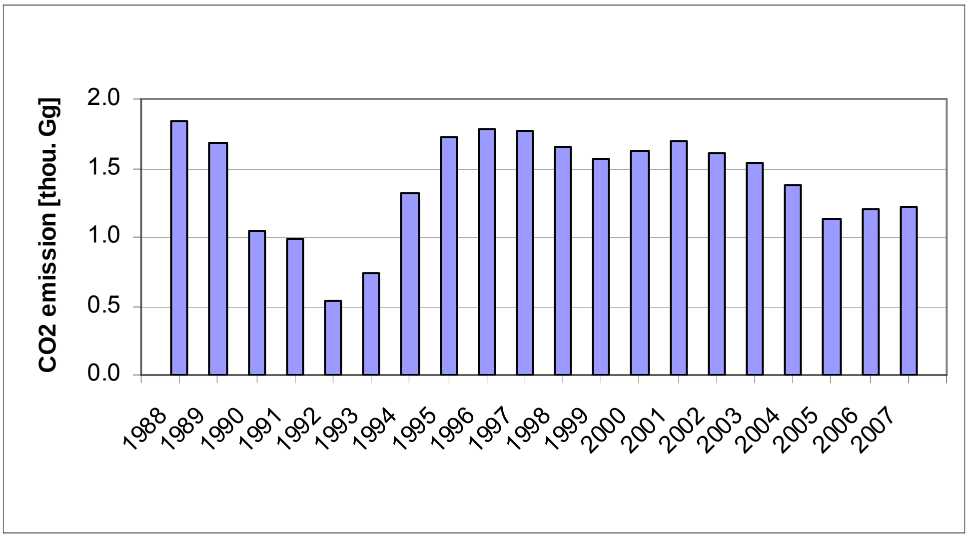

Figure 3.9. CO_2 emission for 1.A.2.b category in 1988-2007

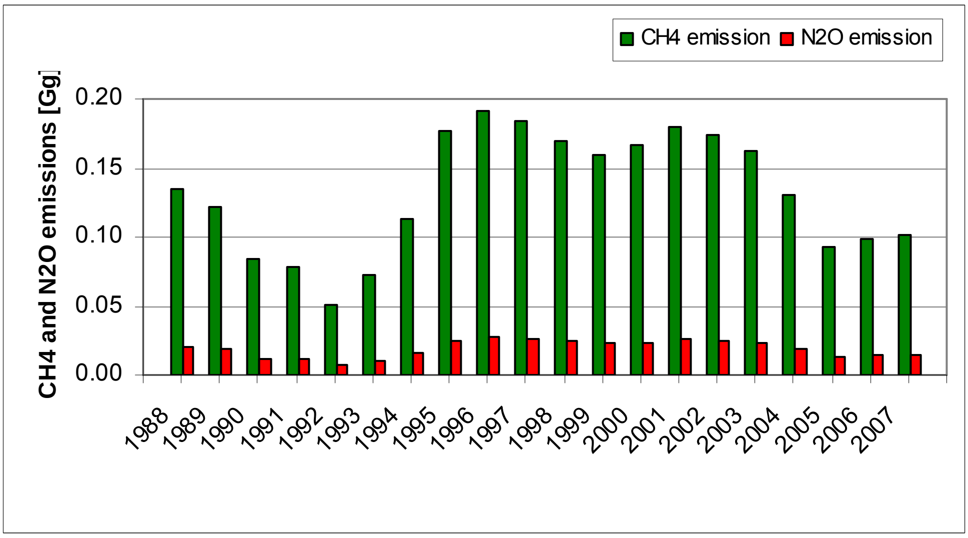

Figure 3.10. CH_4 and N_2O emissions for 1.A.2.b category in 1988-2007

1.A.2.c *Chemicals*

The data on fuel type use in the sub-category 1.A.2.c *Chemicals* over the 1988-2007 period are presented in table 3.6. For the year 2007, the share of EU ETS installations in total fuel consumption in this category was estimated at 59.1%.

Table 3.6. Fuel consumption in 1988-2007 in subcategory 1.A.2.c [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	5.891	5.364	4.096	7.071	8.725	7.748	7.888
Gaseous Fuels	9.381	9.540	5.289	4.340	4.432	10.075	4.507
Solid Fuels	6.871	9.399	27.332	27.719	23.892	34.585	32.760
Biomass	0.001	0.001	0.118	0.039	0.010	0.003	0.035
TOTAL	22.144	24.304	36.835	39.169	37.059	52.411	45.190
	1995	1996	1997	1998	1999	2000	2001
Liquid Fuels	10.939	22.513	26.010	44.445	41.686	41.853	37.894
Gaseous Fuels	6.356	6.191	11.024	9.408	9.041	9.464	8.481
Solid Fuels	95.757	86.947	80.691	65.766	62.196	60.553	61.248
Biomass	0.007	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	113.059	115.651	117.725	119.619	112.923	111.870	107.623
	2002	2003	2004	2005	2006	2007	ETS share for 2007 [%]
Liquid Fuels	37.479	37.417	36.933	29.005	33.568	33.827	51.4
Gaseous Fuels	7.199	6.457	7.498	8.104	9.053	8.771	21.4
Solid Fuels	57.538	41.224	40.319	40.225	38.927	38.723	74.5
Biomass	0.001	0.153	0.102	0.165	0.000	0.121	0.0
TOTAL	102.217	85.251	84.852	77.499	81.548	81.443	59.1

Figure 3.11 shows CO_2 emissions in the sub-category 1.A.2.c in the 1988-2007 period. Emissions of CH_4 and N_2O, in turn, are shown in figure 3.12. In 2007, app. 60% of CO_2 emissions in that sub-category came from installations covered by the EU ETS.

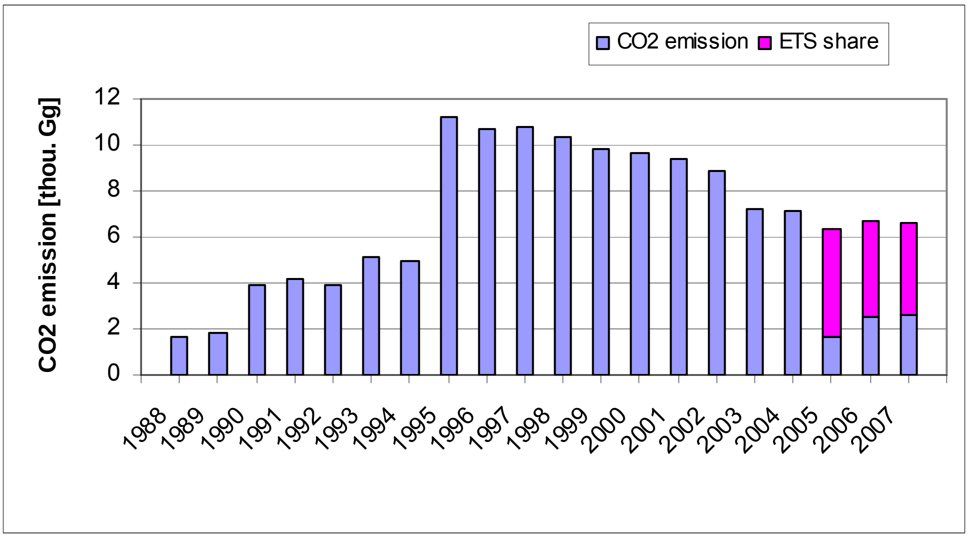

Figure 3.11. CO_2 emission for 1.A.2.c category in 1988-2007

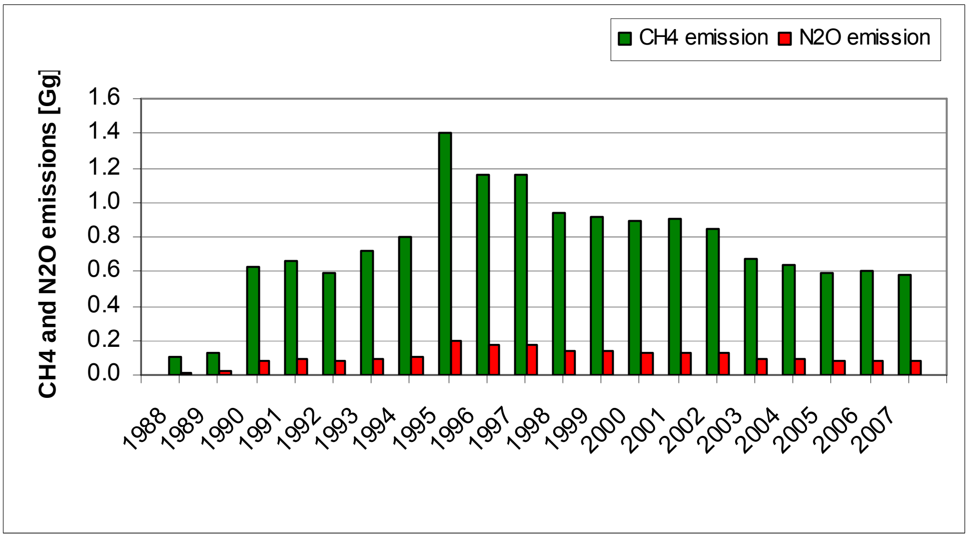

Figure 3.12. CH_4 and N_2O emissions for 1.A.2.c category in 1988-2007

1.A.2.d *Pulp, Paper and Print*

The data on fuel type use in the sub-category 1.A.2.d *Pulp, Paper and Print* over the 1988-2007 period are presented in table 3.7. Characteristic for that sub-sector is relatively large share of biomass in the total fuel use.
For the year 2007, the share of EU ETS installations was estimated for each fuel type and for the sum of fuels (55.4 %).

Table 3.7. Fuel consumption in 1988-2007 in subcategory 1.A.2.d [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	1.308	1.218	1.369	1.331	1.409	1.649	1.531
Gaseous Fuels	0.065	0.055	0.101	0.061	0.026	0.061	0.250
Solid Fuels	0.160	0.657	1.799	2.022	1.632	4.833	4.116
Biomass	0.000	0.001	0.001	0.000	0.000	1.585	1.610
TOTAL	1.533	1.931	3.270	3.414	3.067	8.128	7.507
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	2.534	1.682	2.112	2.612	2.221	2.094	2.041
Gaseous Fuels	0.232	0.455	1.096	0.563	1.007	1.211	1.445
Solid Fuels	22.596	22.487	24.220	19.024	17.532	15.733	15.619
Biomass	15.437	16.243	16.472	16.476	15.545	15.938	15.138
TOTAL	40.799	40.867	43.900	38.675	36.305	34.976	34.243
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	2.032	2.115	2.241	1.987	2.075	2.330	68.9
Gaseous Fuels	1.461	2.094	2.657	2.288	2.976	4.087	100
Solid Fuels	14.455	14.813	14.174	13.588	11.743	9.598	77.7
Biomass	16.622	17.950	18.957	18.611	30.369	30.877	40.0
TOTAL	34.570	36.972	38.029	36.474	47.163	46.892	55.4

Figures 3.13 and 3.14 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.2.d in the period: 1988-2007. The calculations show that in 2007 over 80% of CO_2 emissions in the sub-category 1.A.2.d came from installations covered by the EU ETS.

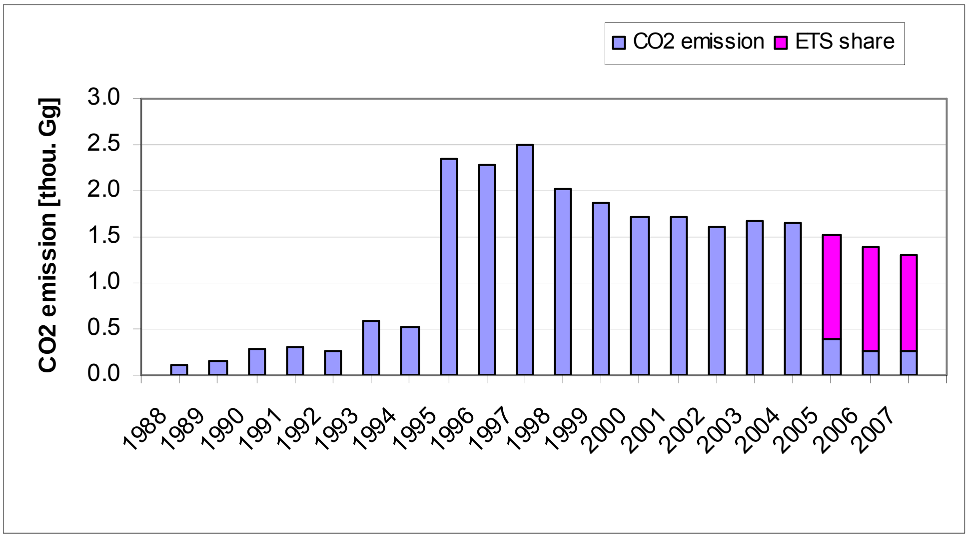

Figure 3.13. CO_2 emission for 1.A.2.d category in 1988-2007

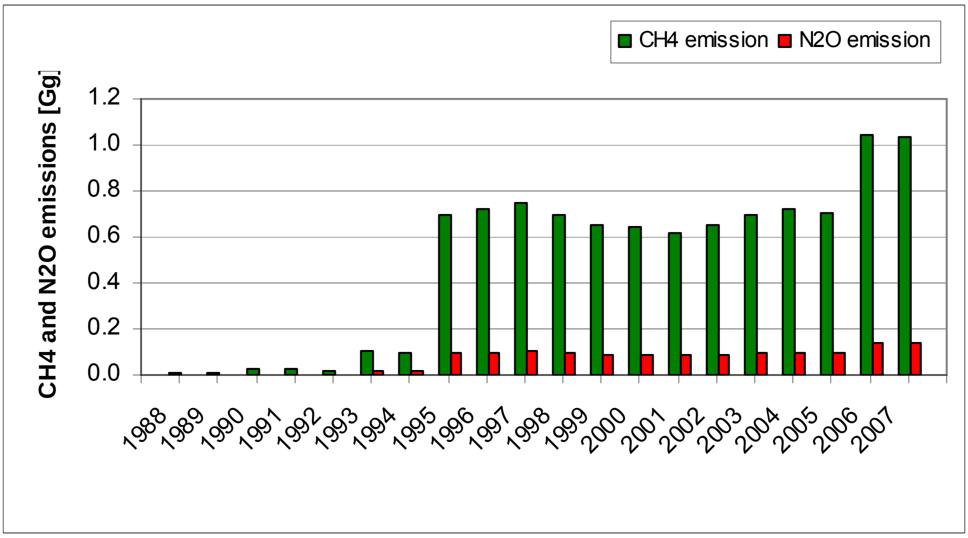

Figure 3.14. CH_4 and N_2O emissions for 1.A.2.d category in 1988-2007

1.A.2.e *Food Processing, Beverages and Tobacco*

The data on fuel type use in the sub-category 1.A.2.e *Food Processing, Beverages and Tobacco* over the 1988-2007 period are presented in table 3.8. For the year 2007, the share of EU ETS installations was estimated for each fuel type and for the sum of fuels (51.8 %).

Table 3.8. Fuel consumption in 1988-2007 in subcategory 1.A.2.e [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	3.236	3.318	3.053	2.636	2.393	4.695	5.209
Gaseous Fuels	1.061	0.996	1.970	1.985	2.339	3.171	7.180
Solid Fuels	7.933	7.302	35.341	38.979	35.485	59.312	56.661
Biomass	0.102	0.097	0.091	0.094	0.072	0.151	0.056
TOTAL	12.332	11.713	40.455	43.694	40.289	67.329	69.106
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	7.415	8.490	7.783	9.817	10.196	10.627	10.837
Gaseous Fuels	3.839	15.051	12.927	10.694	9.255	10.494	11.363
Solid Fuels	75.820	92.292	81.575	67.020	48.239	43.647	41.526
Biomass	0.082	0.094	0.075	0.104	0.089	0.112	0.104
TOTAL	87.156	115.927	102.360	87.635	67.779	64.880	63.830
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	11.290	11.324	10.978	9.998	8.633	7.771	22.0
Gaseous Fuels	12.490	15.075	16.164	17.456	18.623	20.614	27.8
Solid Fuels	43.498	42.156	37.932	36.919	31.779	31.984	74.6
Biomass	0.097	0.386	0.447	0.282	0.311	0.248	39.4
TOTAL	67.375	68.941	65.521	64.655	59.346	60.616	51.8

Figures 3.15 and 3.16 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.2.e in the period: 1988-2007. The calculations show that in 2007 app. 57% of CO_2 emissions in the sub-category 1.A.2.e came from installations covered by the EU ETS.

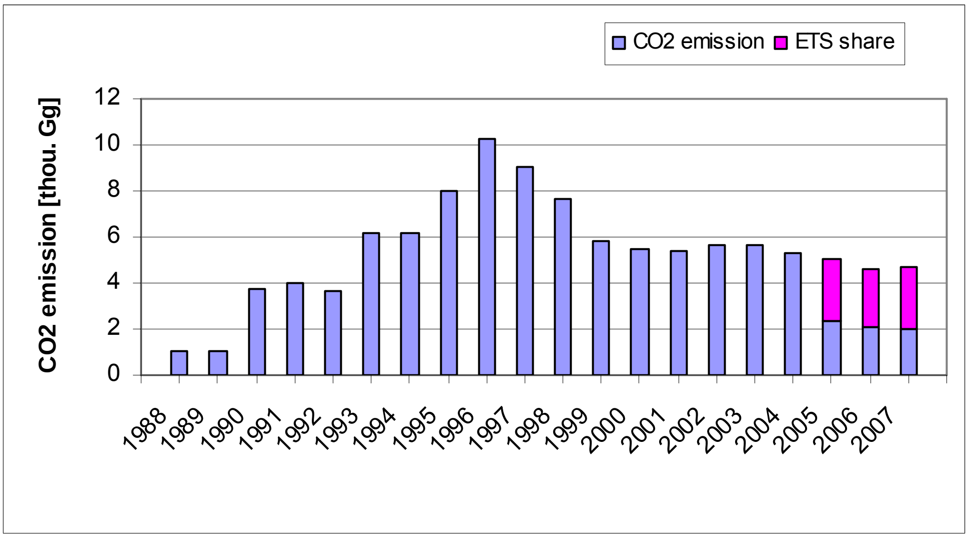

Figure 3.15. CO_2 emission for 1.A.2.e category in 1988-2007

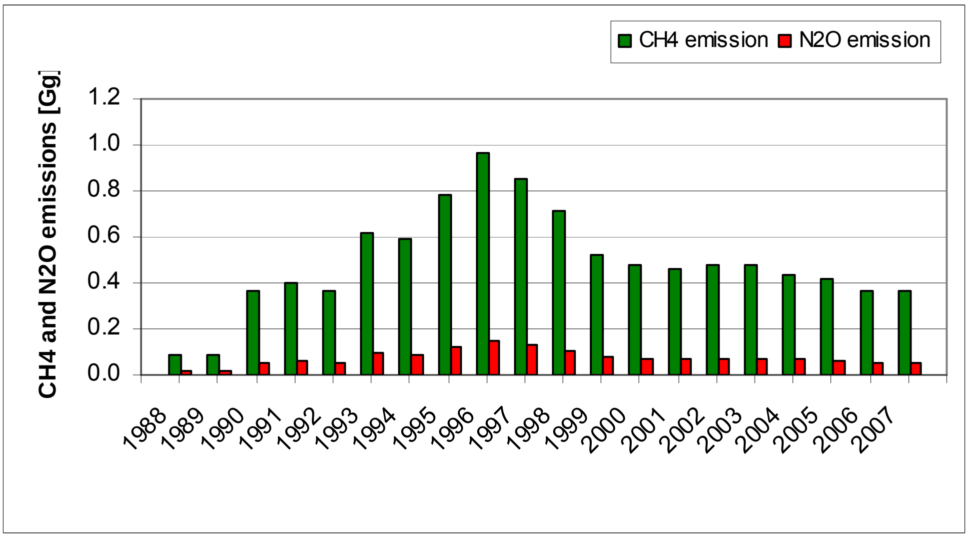

Figure 3.16. CH_4 and N_2O emissions for 1.A.2.e category in 1988-2007

1.A.2.f *Other* (stationary sources)

The data on fuel type use in stationary sources in the sub-category 1.A.2.f *Other* over the 1988-2007 period are presented in table 3.9. For the year 2007, the share of EU ETS installations in the respective IPCC subcategory was estimated for each fuel type and for the sum of fuels (63.9 %).

Table 3.9. Fuel consumption in 1988-2007 in subcategory 1.A.2.f [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	10.252	10.512	18.889	15.593	14.897	16.817	16.849
Gaseous Fuels	47.616	50.753	40.220	34.460	36.058	39.907	38.844
Solid Fuels	144.233	138.584	146.425	137.977	126.581	184.462	180.218
Biomass	0.313	0.237	6.981	5.973	5.077	5.028	3.414
TOTAL	202.414	200.086	212.515	194.003	182.613	246.214	239.325
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	22.503	28.611	33.258	30.693	25.664	22.730	21.863
Gaseous Fuels	40.695	40.861	41.717	44.737	40.269	46.522	50.178
Solid Fuels	182.268	213.838	188.250	147.860	123.739	109.306	83.509
Biomass	4.980	6.530	8.200	8.240	8.606	10.111	10.991
TOTAL	250.446	289.840	271.425	231.530	198.278	188.669	166.541
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	22.375	32.198	31.984	34.629	27.833	18.544	13.5
Gaseous Fuels	52.506	56.740	60.828	62.287	65.056	66.426	46.0
Solid Fuels	70.563	69.117	66.150	60.729	64.886	75.470	96.0
Biomass	12.592	12.006	12.458	12.370	11.988	13.921	41.9
TOTAL	158.036	170.061	171.420	170.015	169.763	174.362	63.9

Figures 3.17 and 3.18 show emissions of CO_2 and CH_4 and N_2O, respectively in the sub-category 1.A.2.f in the period: 1988-2007. The calculations show that in 2007 app. 67% of CO_2 emissions in the sub-category 1.A.2.f came from installations covered by the EU ETS.

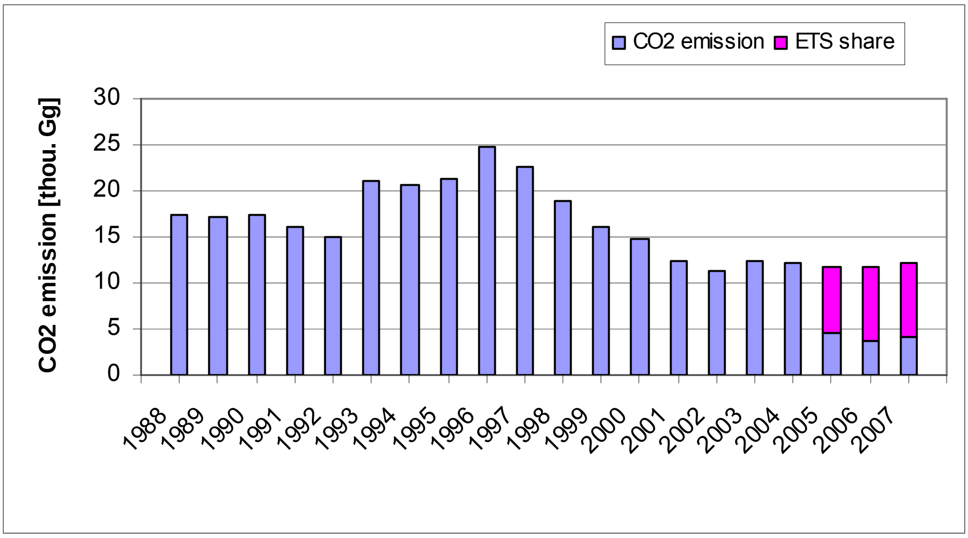

Figure 3.17. CO_2 emission for 1.A.2.f category in 1988-2007

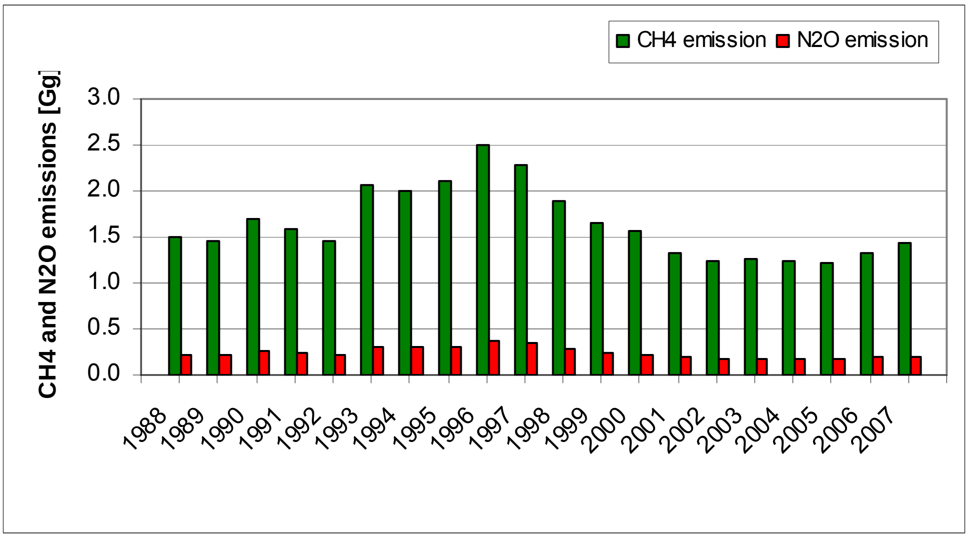

Figure 3.18. CH_4 and N_2O emissions for 1.A.2.f category in 1988-2007

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

1.A.4.a *Other Sectors – Commercial/Institutional*

The data on fuel type use in stationary sources in the sub-category 1.A.4.a *Other Sectors – Commercial/Institutional* over the 1988-2007 period are presented in table 3.10. For the year 2007, the share of EU ETS installations was estimated for each fuel type and for the sum of fuels (2%).

Table 3.10. Fuel consumption in 1988-2007 in subcategory 1.A.4.a [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	0.619	0.689	0.000	0.000	0.000	0.000	1.334
Gaseous Fuels	12.174	12.640	13.787	10.977	11.190	11.548	9.573
Solid Fuels	318.586	289.067	118.908	141.592	131.701	99.412	65.944
Biomass	7.008	6.726	0.379	0.187	0.206	2.610	0.249
TOTAL	338.387	309.123	133.074	152.756	143.097	113.570	77.100
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	0.782	1.762	6.088	7.741	10.933	17.309	24.346
Gaseous Fuels	13.260	18.771	24.256	32.769	37.697	38.567	49.971
Solid Fuels	64.505	51.281	48.785	30.075	29.023	23.089	18.635
Biomass	11.983	10.625	9.627	9.085	9.216	9.212	6.596
TOTAL	90.530	82.439	88.756	79.670	86.869	88.176	99.548
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share in 2007 [%]**
Liquid Fuels	19.042	31.918	29.227	21.849	14.831	23.027	0.2
Gaseous Fuels	61.001	67.057	69.570	70.224	62.941	64.850	0.2
Solid Fuels	31.628	30.637	27.355	28.054	32.148	30.244	7.7
Biomass	6.440	6.463	6.614	6.514	5.085	6.148	0.0
TOTAL	118.110	136.075	132.766	126.641	115.005	124.268	2.0

Figures 3.19 and 3.20 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.4.a in the period: 1988-2007. The calculations show that in 2007 app. 3% of CO_2 emissions in the sub-category 1.A.4.a came from installations covered by the EU ETS.

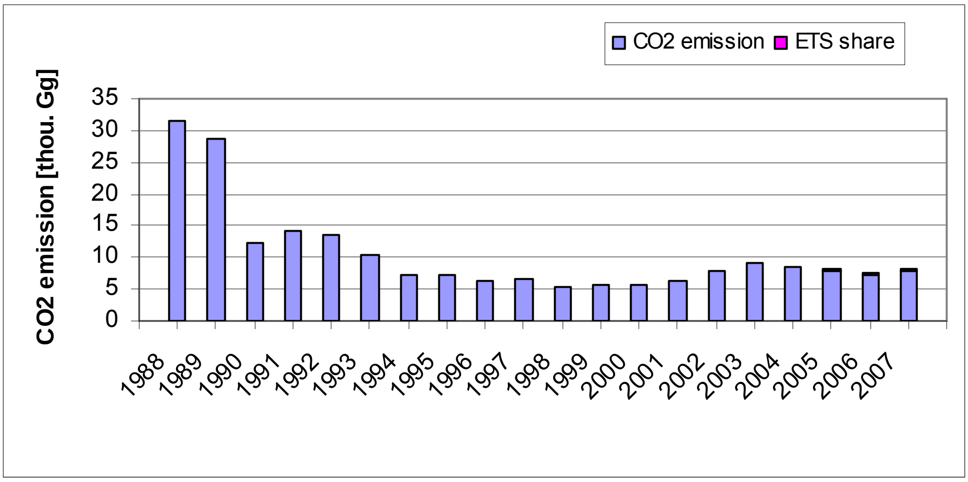

Figure 3.19. CO_2 emission for 1.A.4.a category in 1988-2007

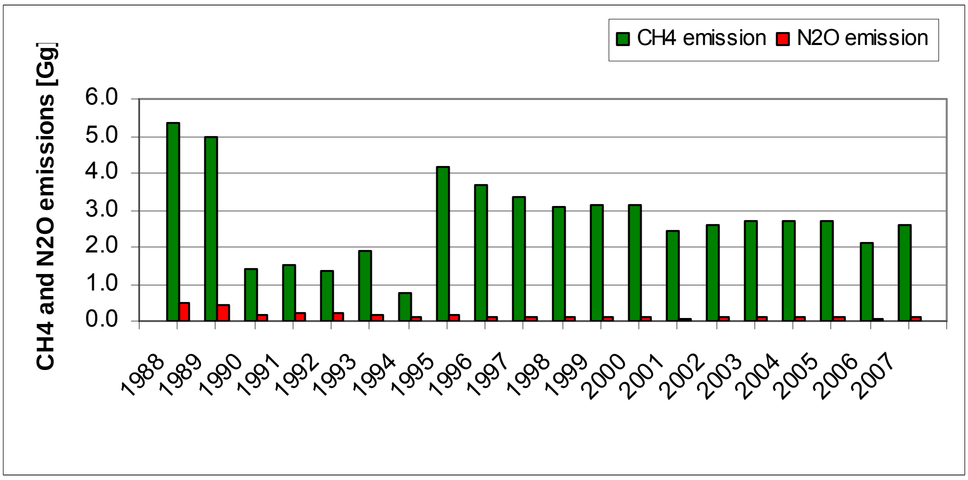

Figure 3.20. CH_4 and N_2O emissions for 1.A.4.a category in 1988-2007

1.A.4.b *Residential*

The data on fuel type use in stationary sources in the sub-category 1.A.4.b *Residential* over the 1988-2007 period are presented in table 3.11. Sources in that sub-category are not covered by the EU ETS.

Table 3.11. Fuel consumption in 1988-2007 in subcategory 1.A.4.b [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	6.024	6.662	1.702	1.012	1.840	6.072	8.970
Gaseous Fuels	102.610	107.414	122.204	133.674	141.212	141.590	151.671
Solid Fuels	682.841	583.880	285.135	355.892	373.615	439.866	367.015
Biomass	26.682	25.632	34.335	27.721	33.969	123.084	123.154
TOTAL	818.157	723.587	443.376	518.299	550.636	710.612	650.810
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	12.834	18.230	24.790	26.920	29.033	37.280	42.000
Gaseous Fuels	159.559	143.057	150.022	138.268	135.995	127.611	133.737
Solid Fuels	365.396	353.171	323.771	245.509	261.444	192.778	216.059
Biomass	105.000	101.000	100.000	100.700	95.000	95.000	104.500
TOTAL	642.789	615.458	598.583	511.397	521.472	452.669	496.296
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	44.181	48.091	48.730	44.470	33.480	40.330	-
Gaseous Fuels	127.093	127.629	126.376	135.111	138.686	132.622	-
Solid Fuels	196.036	181.505	176.814	208.626	242.147	218.472	-
Biomass	104.500	103.075	103.360	100.700	104.500	95.000	-
TOTAL	471.810	460.300	455.280	488.907	518.813	486.424	-

Figure 3.21 show emissions of CO_2 in 1.A.4.b in the 1988-2007 period while CH_4 and N_2O, emissions in the same sub-category are shown in figure 3.22.

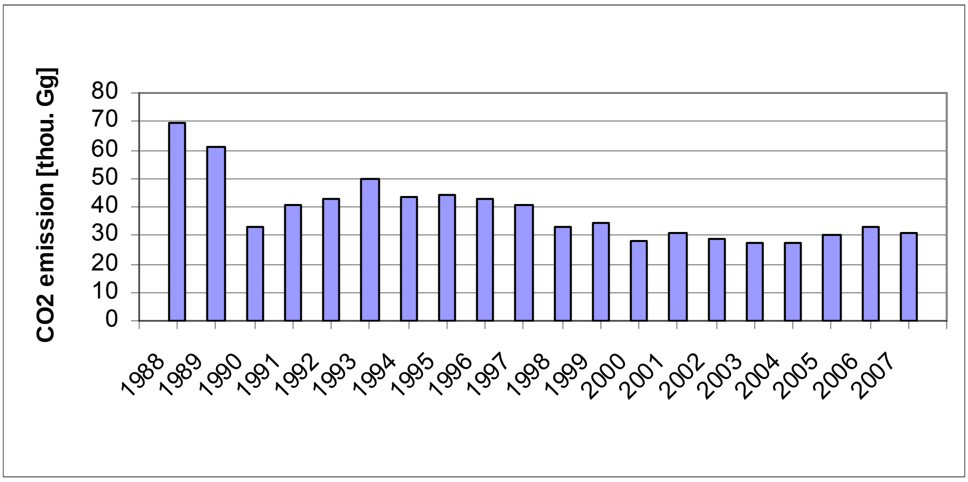

Figure 3.21. CO_2 emission for 1.A.4.b category in 1988-2007

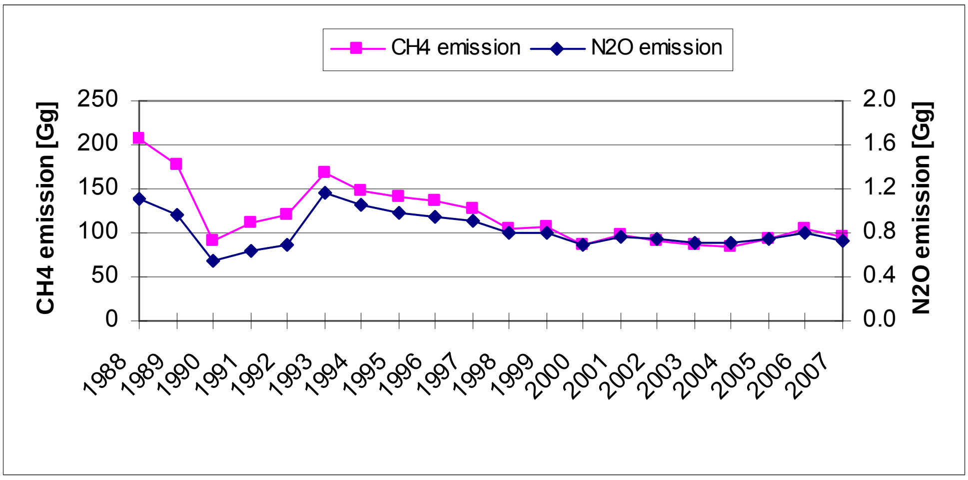

Figure 3.22. CH_4 and N_2O emissions for 1.A.4.b category in 1988-2007

1.A.4.c *Agriculture/Forestry/Fisheries* – stationary sources

The data on fuel type use in stationary sources in the sub-category 1.A.4.c Agriculture/Forestry/Fisheries over the 1988-2007 period are presented in table 3.12. For the year 2007, the share of EU ETS installations was estimated for each fuel type and for the sum of fuels (1.7%).

Table 3.12. Fuel consumption in 1988-2007 in subcategory 1.A.4.c [PJ]

	1988	1989	1990	1991	1992	1993	1994
Liquid Fuels	0.333	0.274	2.760	2.000	0.480	14.060	18.280
Gaseous Fuels	0.085	0.089	0.448	0.275	0.055	0.132	0.212
Solid Fuels	17.973	17.301	29.835	47.516	56.922	57.993	70.315
Biomass	0.043	0.034	0.039	0.278	0.583	12.737	11.647
TOTAL	18.434	17.698	33.082	50.069	58.040	84.922	100.454
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Liquid Fuels	10.510	6.250	9.128	8.160	8.410	8.804	8.464
Gaseous Fuels	0.243	0.428	0.571	0.869	0.476	0.536	0.777
Solid Fuels	69.299	67.002	61.955	55.247	59.368	40.330	45.464
Biomass	18.500	17.567	17.000	17.100	17.100	17.100	19.043
TOTAL	98.552	91.247	88.654	81.376	85.354	66.770	73.748
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**ETS share for 2007 [%]**
Liquid Fuels	6.904	9.528	8.560	10.804	4.088	3.720	22.5
Gaseous Fuels	0.914	1.197	1.182	1.084	1.493	1.841	5.7
Solid Fuels	37.594	35.305	34.452	38.978	45.996	40.708	0.4
Biomass	19.010	19.017	19.878	19.038	19.977	19.060	0.0
TOTAL	64.422	65.047	64.072	69.904	71.554	65.330	1.7

Figures 3.23 and 3.24 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.4.c in the period: 1988-2007. The calculations show that in 2007 app. 3% of CO_2 emissions in the sub-category 1.A.4.c came from installations covered by the EU ETS.

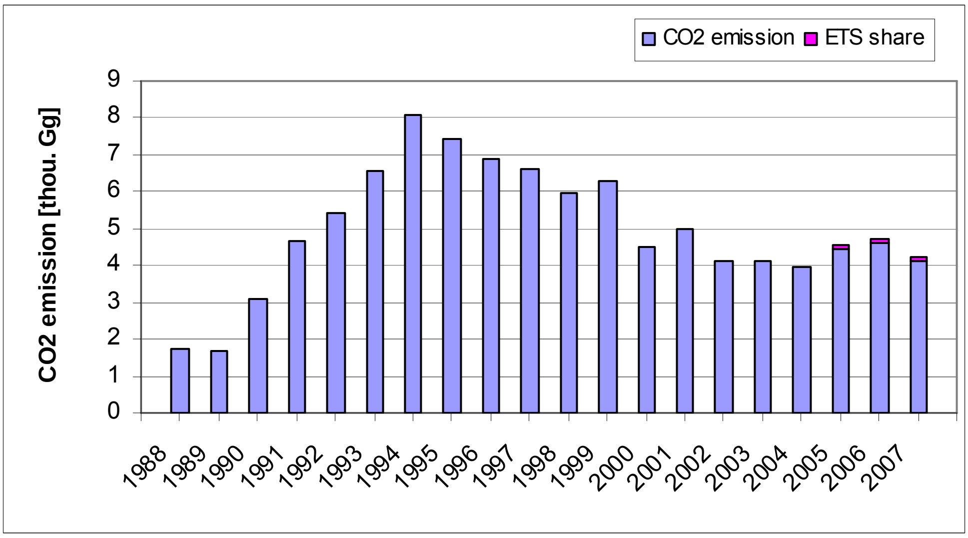

Figure 3.23. CO_2 emission for 1.A.4.c category in 1988-2007

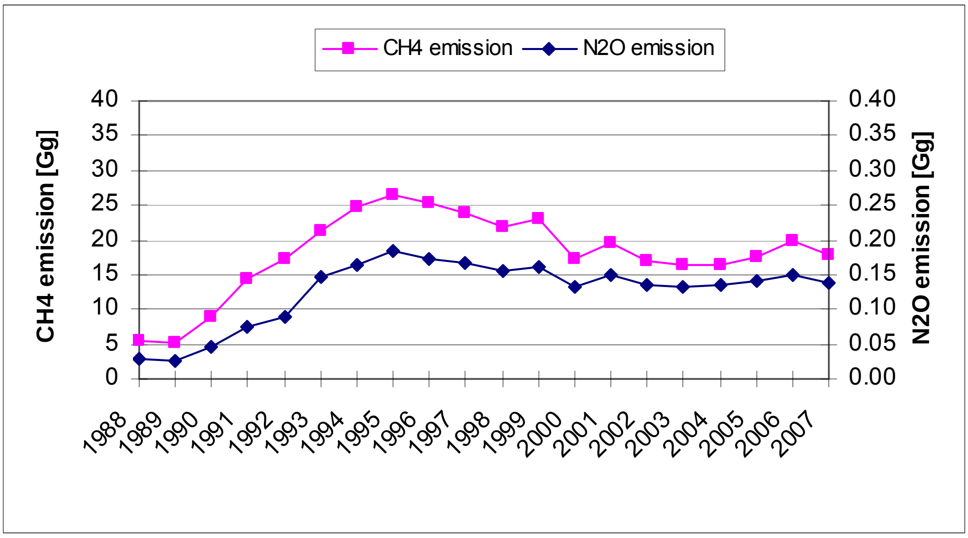

Figure 3.24. CH_4 and N_2O emissions for 1.A.4.c category in 1988-2007

The mobile source classified in the sub-category 1.A.2.c (i.e. machinery and off-road vehicles in agriculture) are described below.

Mobile sources

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 2008] – 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 2008e] – used for estimation of fuel use for part of the sub-category 1.A.3.d – *Navigation* - for maritime shipping
- „Fuel-Energy Economy" [GUS 2008a] – 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 2008] – 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

For calculation of CO_2 emissions in road transport (1.A.3.b) domestic emission factors estimated each year by ITS were used [ITS 2008]. For other means of transport (including mobile source outside the category 1.A.3) default emission factors were used for CO_2 [IPCC 1997, 2006].
Estimation of CH_4 and N_2O emissions for all mobile sources (source categories: 1.A.3 and mobile sources in 1.A.2.f and 1.A.4.c) were based on the default emission factors [IPCC 1997, 2006]. Table 3.13 shows the values of the emission factors for mobile sources used in the national inventory.

Table. 3.13. Emission factors [kg/GJ] for transport types (means) in 2007

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.a.BS	70.75	0.03	0.002
	2.i.a.LG	63.11	0.02	0.0002
	2.i.a.ON	73.16	0.002	0.004
	2.i.b.BS	70.75	0.02	0.001
1.A.3.b. Passenger Cars with catalysts	2.i.g.BS	70.31	0.007	0.003
	2.i.g.LG	63.11	0.02	0.0002
	2.i.g.ON	73.16	0.002	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t without catalysts	2.ii.a.BS	70.75	0.02	0.001
	2.ii.a.LG	63.11	0.03	0.0002
	2.ii.a.ON	73.16	0.001	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t with catalysts	2.ii.g.BS	70.31	0.02	0.001
	2.ii.g.LG	63.11	0.01	0.0002
	2.ii.g.ON	73.16	0.001	0.004
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. without catalysts	2.iii.a.ON	73.16	0.006	0.003
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. with catalysts	2.iii.g.ON	73.16	0.006	0.003
1.A.3.b.iii Buses	2.iii.a.ON	73.16	0.0039	0.0013
	2.iii.g.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

Type of transport	Category code	EF CO_2	EF CH_4	EF N_2O
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.

Trends of fuel use and methodology over the period: 1988-2007

The methodology used for estimation of GHG emissions in the national inventory for mobile sources for the entire time series: 1988-2007 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 1988-2007. The values of the EFs are those in table 3.13. 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 3.13 following the fluctuations of NCVs and subsequent unit conversions. This applies - inter alia - to CO_2 and CH_4 emission factors for jet fuel.

1.A.3.a *Civil Aviation*

Data on fuel use in domestic aviation are show in figure 3.25. 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 3.26 and 3.27 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.3.a in the period: 1988-2007.

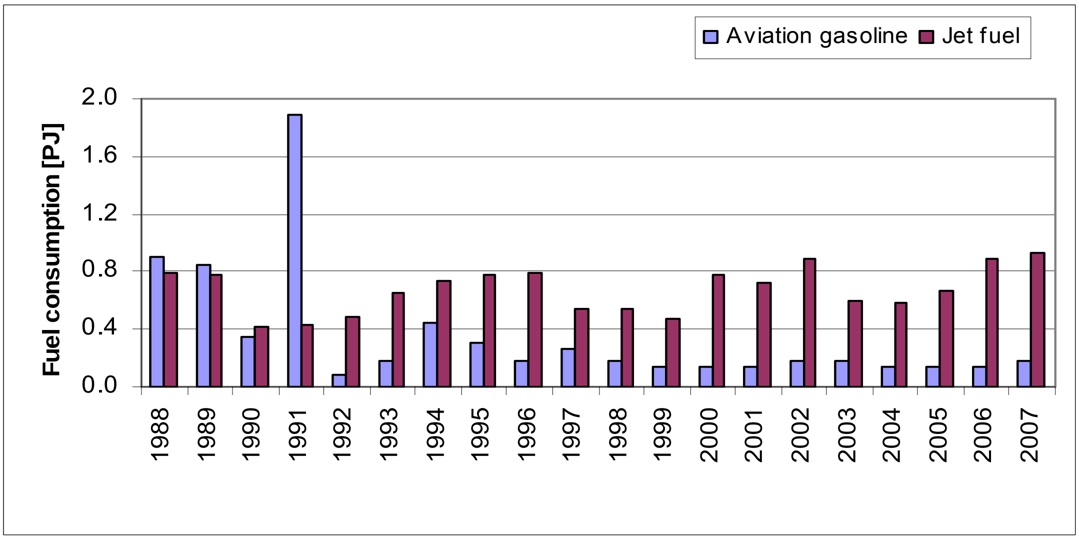

Figure 3.25. Fuel consumption in 1.A.3.a category for 1988-2007

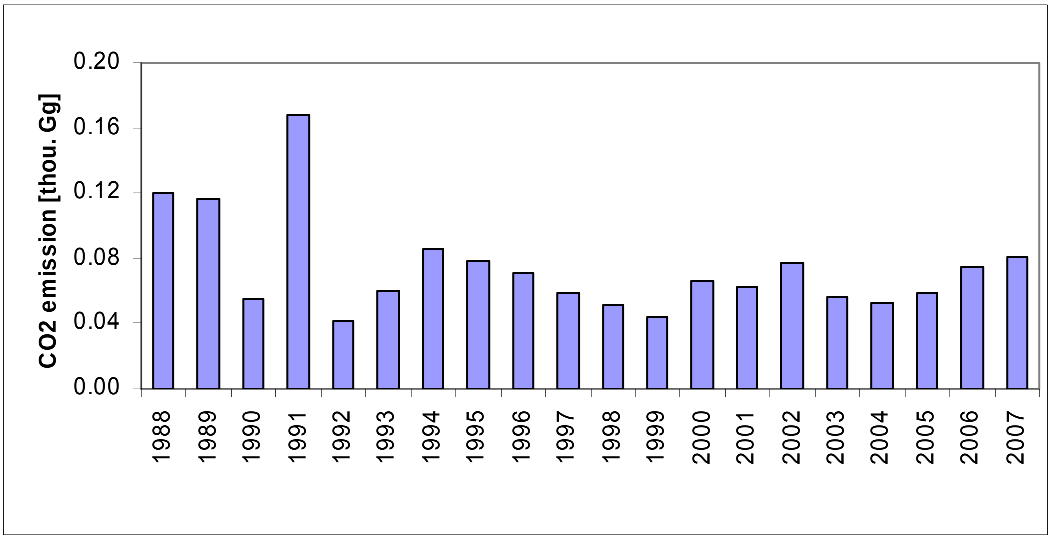

Figure 3.26. CO_2 emission for 1.A.3.a category in 1988-2007

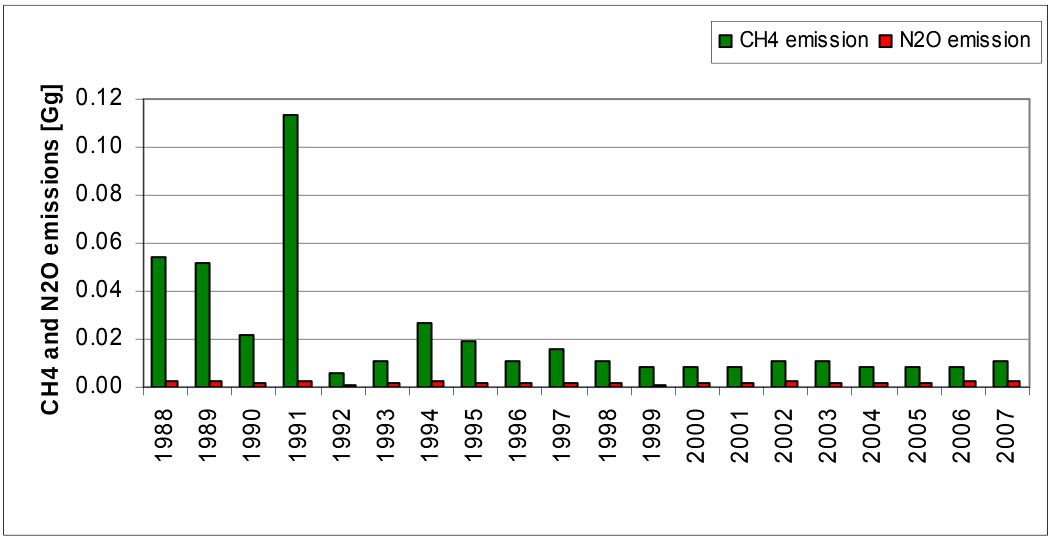

Figure 3.27. CH_4 and N_2O emissions for 1.A.3.a category in 1988-2007

1.A.3.b *Road Transportation*

The amount of vehicles according to categories in 2007 [ITS 2008] (data are partly approximated) is given below:

Category		Amount [thous. pcs]
2.i.	Passenger cars	14 589
2.i.α.BS		5 285
2.i.α.LG		697
2.i.α.ON		900
2.i.β.BS		300
2.i.γ.BS		5 177
2.i.γ.LG		1 230
2.i.γ.ON		1000
2.ii.	Light duty vehicles <3.5t	1 949
2.ii.α.BS		505
2.ii.α.LG		70
2.ii.α.ON		380
2.ii.β.BS		20
2.ii.γ.BS		360
2.ii.γ.LG		124
2.ii.γ.ON		490
2.iii.	Heavy duty vehicles > 3.5t	694
2.iii.α.BS		20
2.iii.α.ON		379
2.iii.γ.ON		295
2.iv.	Busses > 3.5t	75
2.iv.α.ON		41
2.iv.γ.ON		34
2.v.	Motorcycles	825
2.v.BS		825
2.vi.	Mopeds	525
2.vi.BS		525

Consumption of main fuels in road transport (gasoline, diesel oil and LPG) in the 1988-2007 period is shown in figure 3.28.

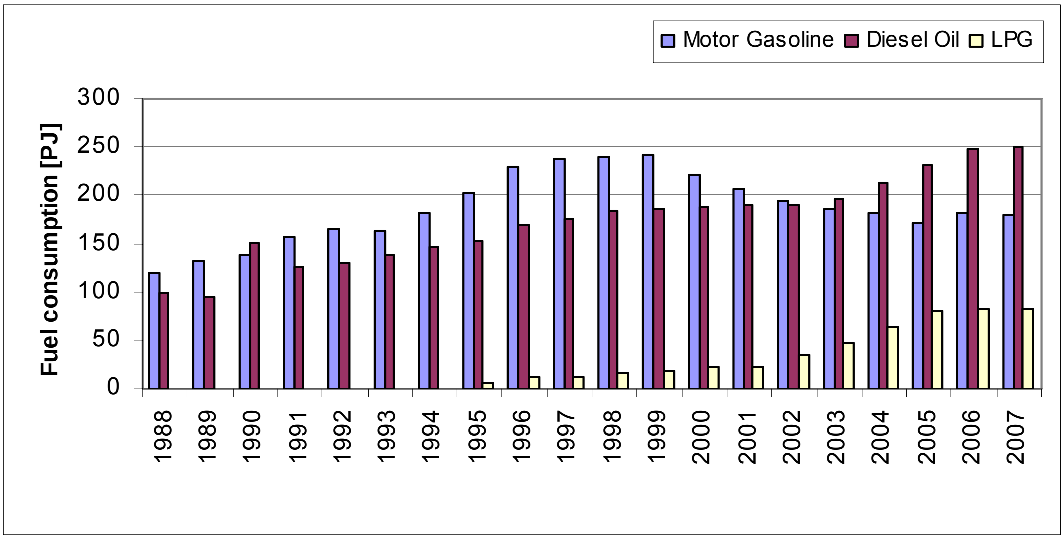

Figure 3.28. Fuel consumption in 1.A.3.b category for 1988-2007

There is a growing trend of consumption of biofuels in road transport. In 2005, 2006 and 2007 the following amounts of biofuel was used:

- biodiesel 0.510 PJ in 2005, 1.214PJ in 2006 and 1.072 PJ in 2007
- bioethanol 1.420 PJ in 2005, 2.305 PJ in 2006 and 3.356 PJ in 2007.

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.

Figure 3.29 shows CO_2 emissions in sub-category 1.A.3.b in the period: 1988-2007. Emissions of CH_4 and N_2O in the same sub-category are shown in figure 3.30.

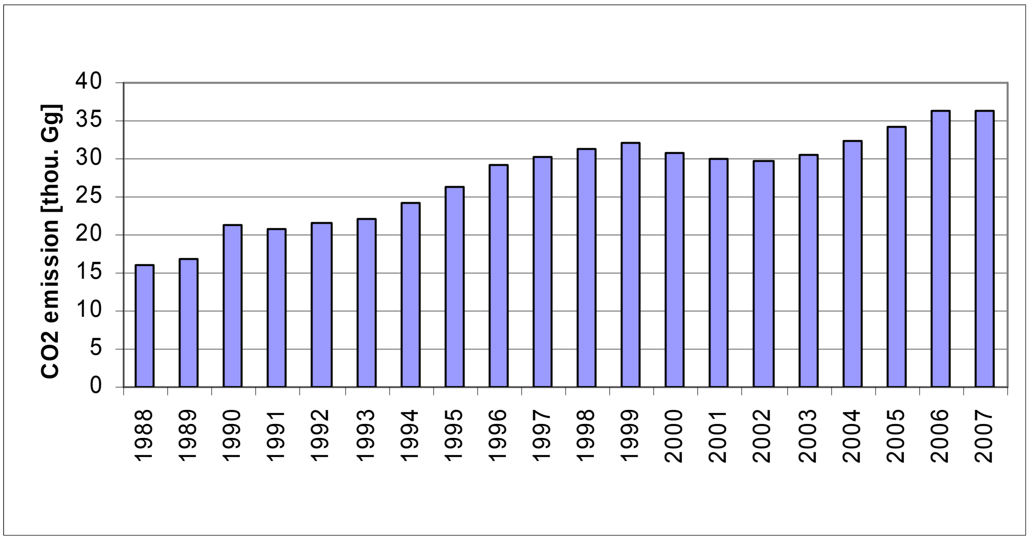

Figure 3.29. CO_2 emission for 1.A.3.b category in 1988-2007

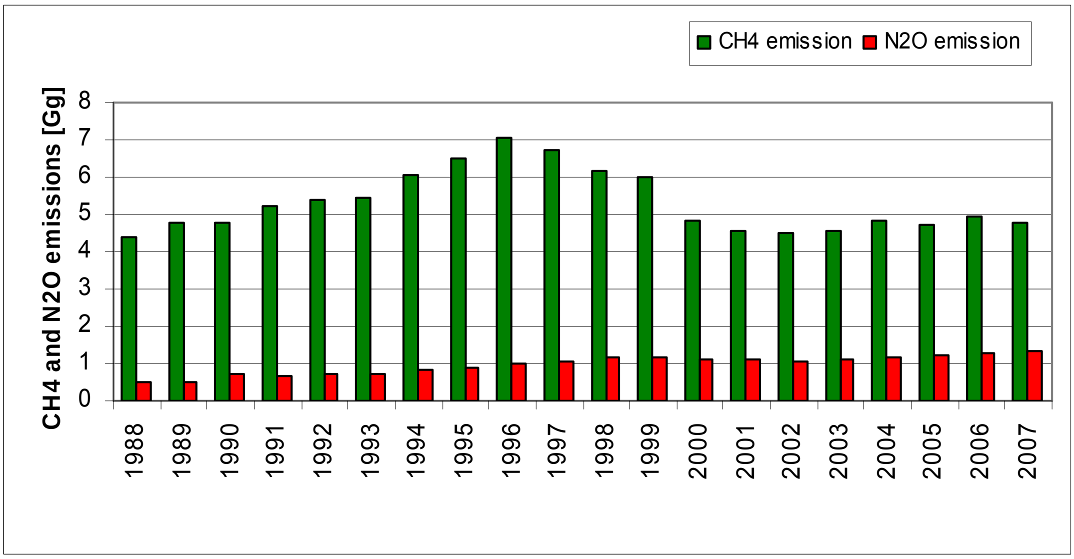

Figure 3.30. CH_4 and N_2O emissions for 1.A.3.b category in 1988-2007

1.A.3.c *Railways*

The amounts of fuels used in railway transport in the 1988-2007 period are shown in figure 3.31.

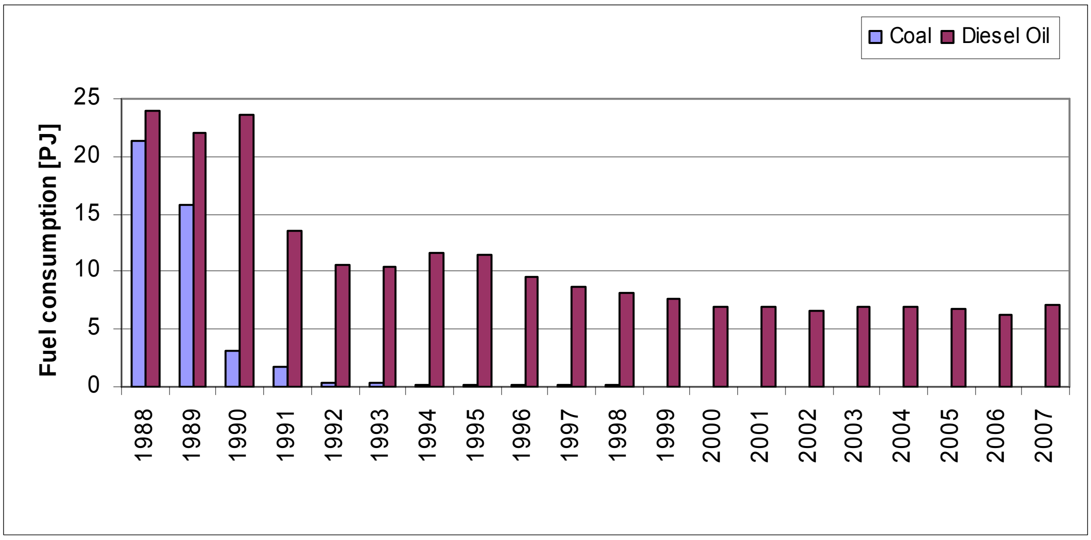

Figure 3.31. Fuel consumption in 1.A.3.c category for 1988-2007

Figures 3.32 and 3.33 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.3.c for the entire time series beginning in the base year.

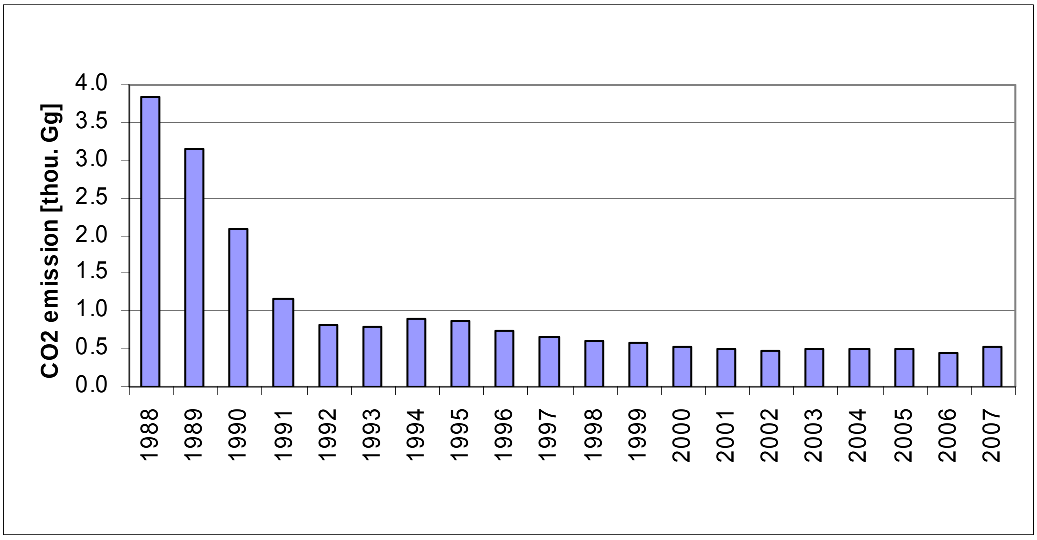

Figure 3.32. CO_2 emission for 1.A.3.c category in 1988-2007

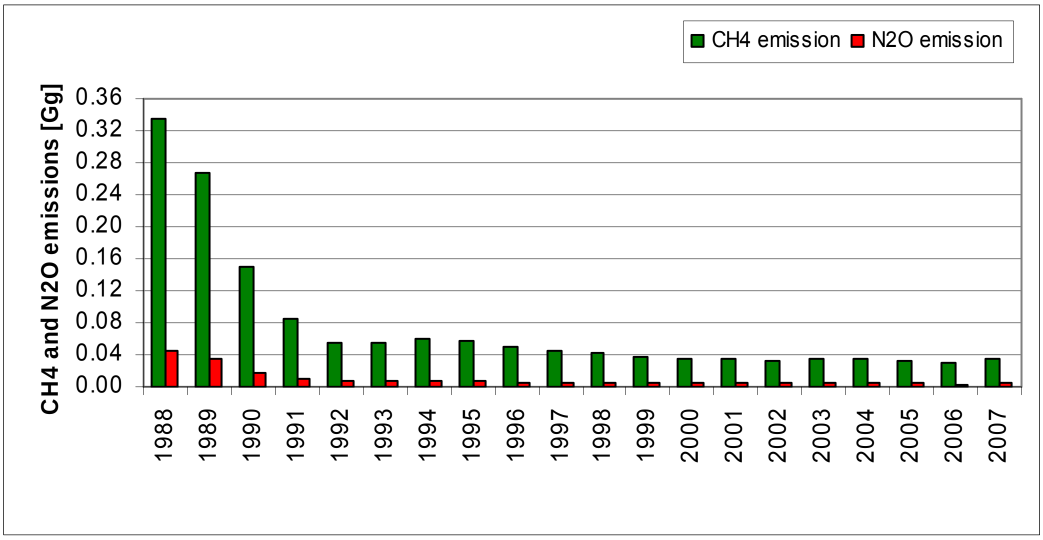

Figure 3.33. CH_4 and N_2O emissions for 1.A.3.c category in 1988-2007

1.A.3.d *Navigation*

The amounts of fuels (diesel and fuel oil) used in both inland water and maritime navigation in the 1988-2007 period are shown in figure 3.34.

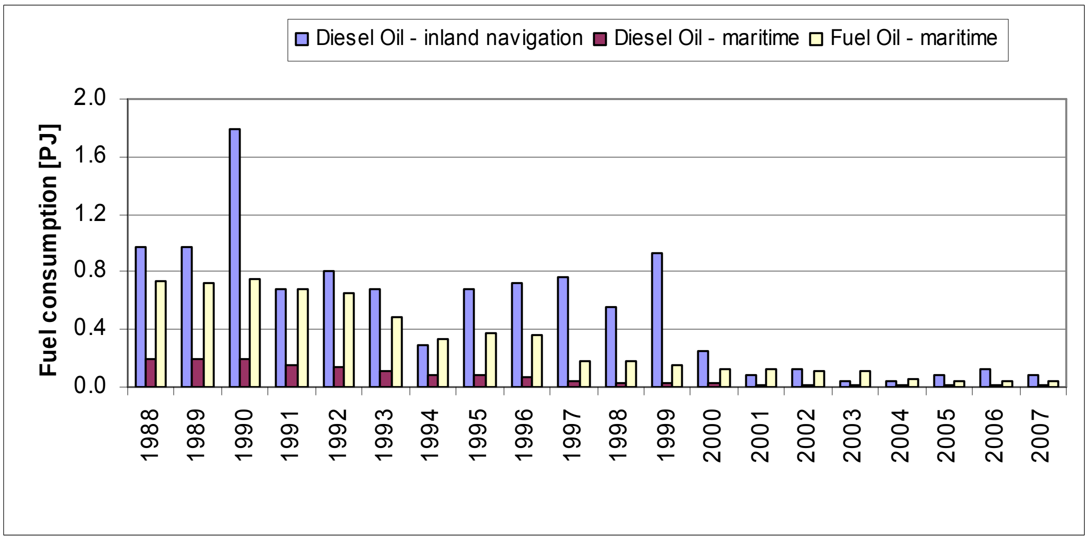

Figure 3.34. Fuel consumption in 1.A.3.d category for 1988-2007

Figures 3.35 and 3.36 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.3.d for the entire time series 1988-2007.

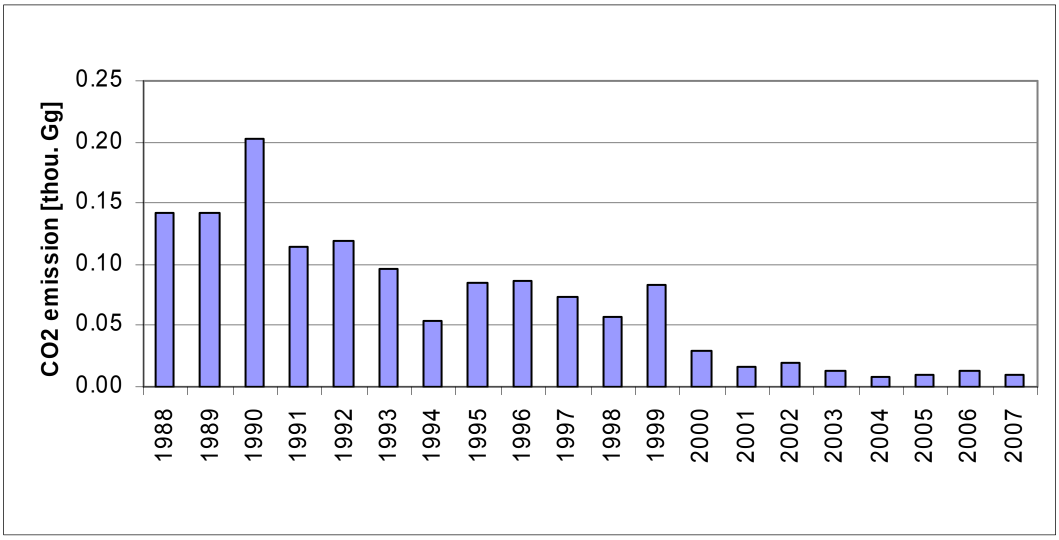

Figure 3.35. CO_2 emission for 1.A.3.d category in 1988-2007

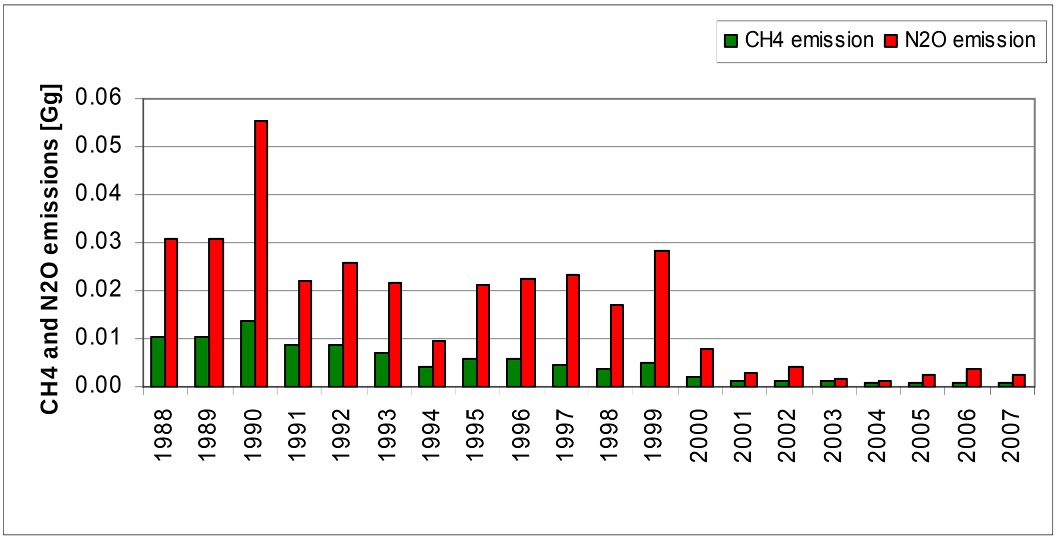

Figure 3.36. CH_4 and N_2O emissions for 1.A.3.d category in 1988-2007

1.A.3.e *Other Transportation*

The amounts of fuels (gasoline, diesel oil and LPG – without piplines) used in the sub-category 1.A.3.e in the 1988-2007 period are shown in figure 3.37

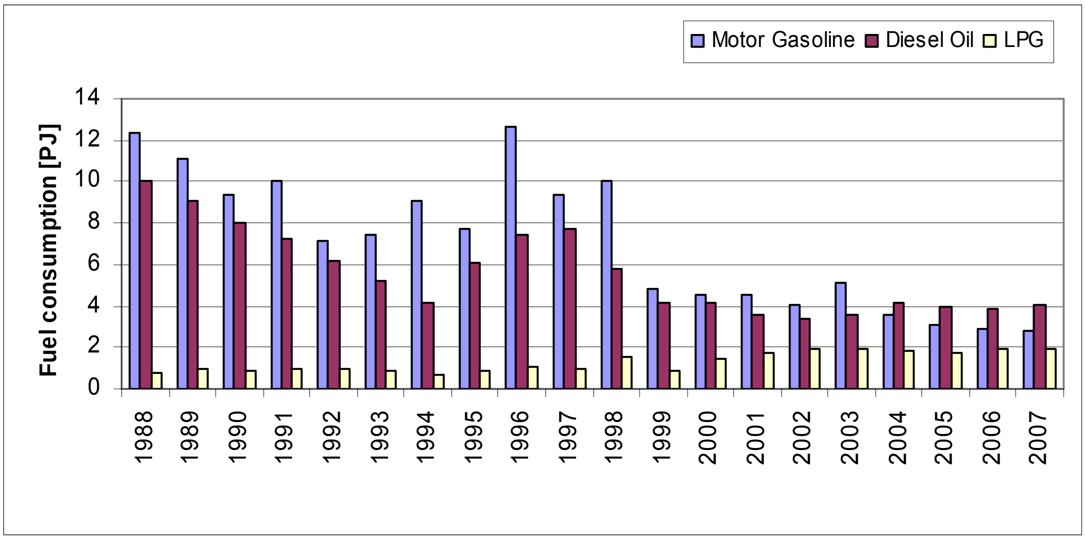

Figure 3.37. Fuel consumption in 1.A.3.e category for 1988-2007

Figures 3.38 and 3.39 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.3.e for the entire time series 1988-2007.

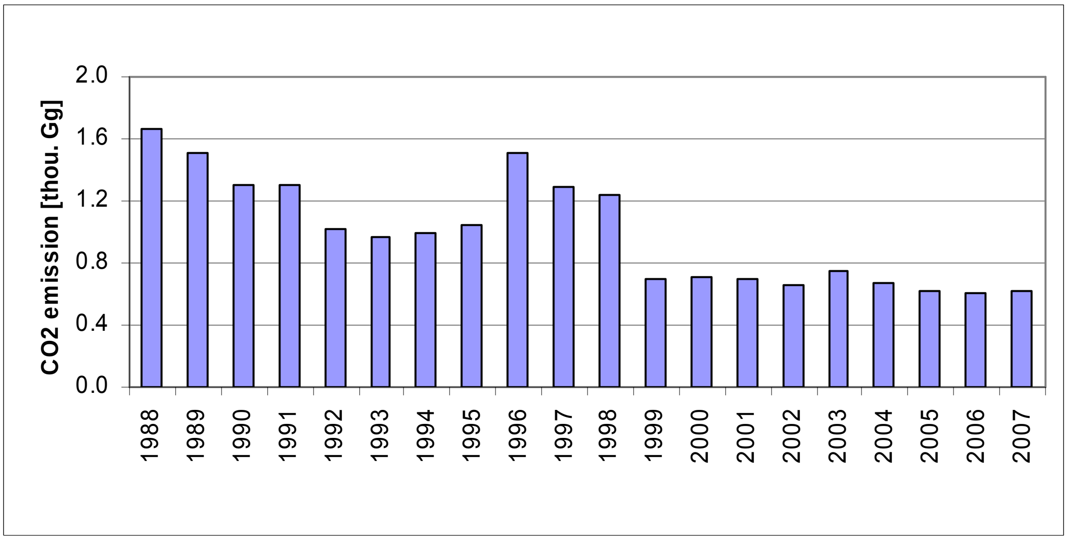

Figure 3.38. CO_2 emission for 1.A.3.e category in 1988-2007

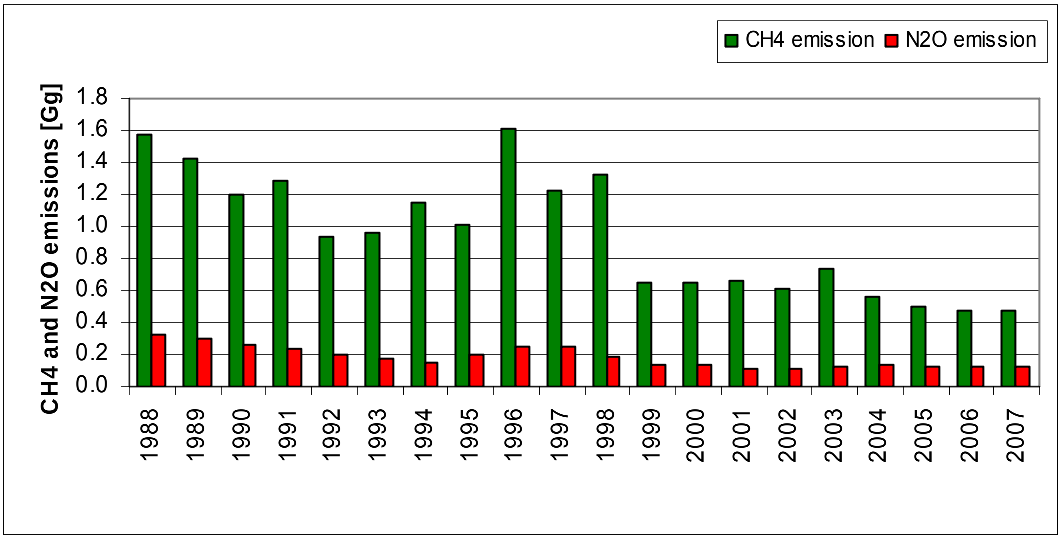

Figure 3.39. CH_4 and N_2O emissions for 1.A.3.e category in 1988-2007

Pipelines transport

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 pipline Jamal was compleated, the amount of this fuel increased sharply from 21 TJ in 1999 to 2498 TJ in 2000. Activity data for Motor gasoline and Diesel oil were available respectively from year 2001 and 2000.
The amounts of fuels (gasoline, diesel oil and natural gas) used in the sub-category 1.A.3.e in Piplines in the 1988-2007 period are shown in figure 3.37

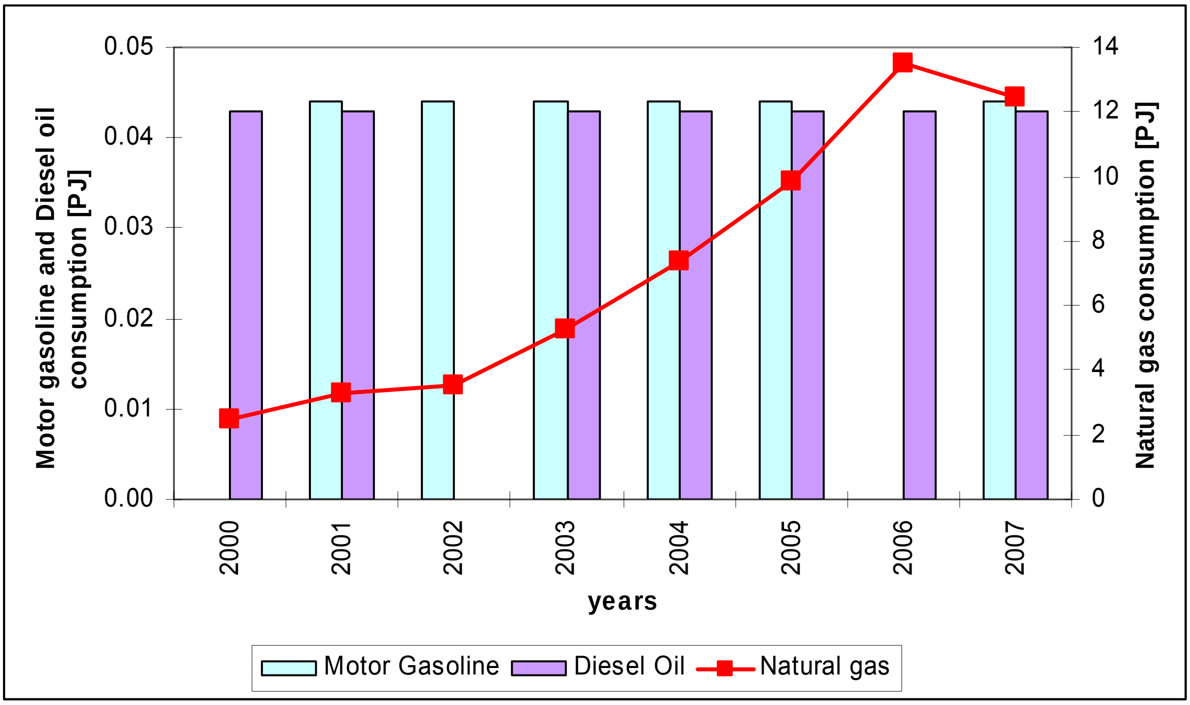

Figure 3.40. Fuel consumption in Pipelines category for 1988-2007

Figures 3.41 and 3.42 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.3.e from Pipelines for the entire time series 1988-2007.

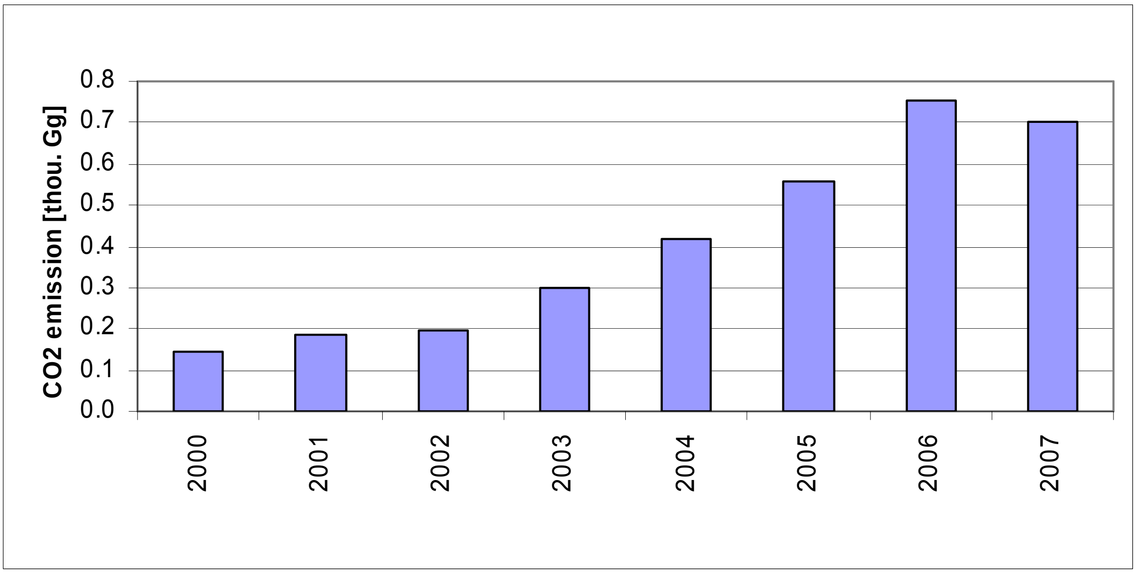

Figure 3.41. CO_2 emission from Pipelines category in 1988-2007

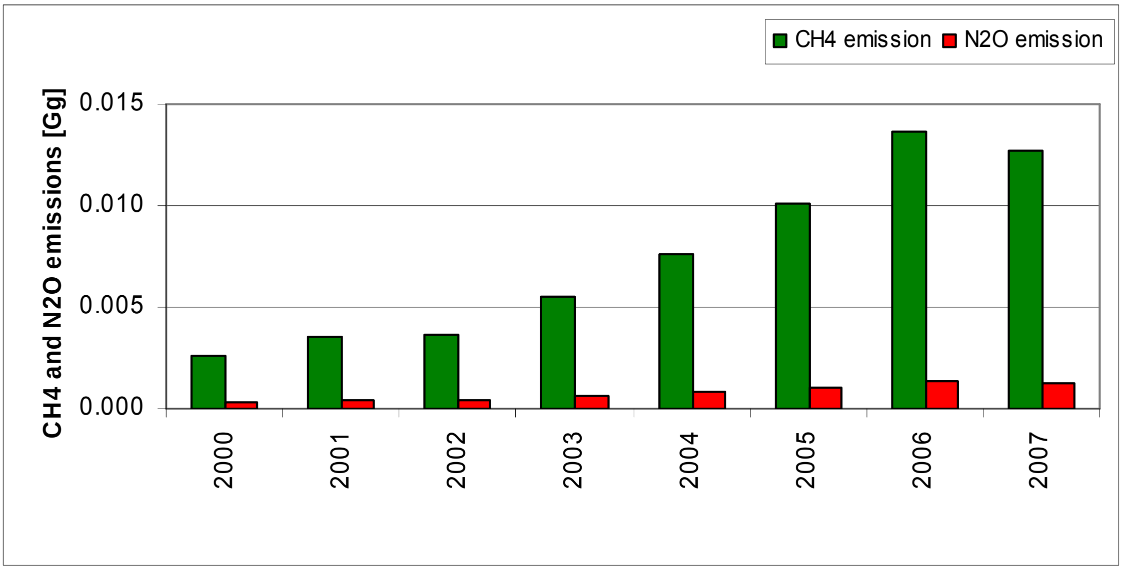

Figure 3.42. CH_4 and N_2O emissions from Pipelines category in 1988-2007

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 1988-2007 period are presented in table 3.14. The amounts of corresponding emissions of CO_2, CH_4 and N_2O are shown in tables 3.15–3.17.

Table 3.14. Fuel consumption [PJ] in 1988-2007 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
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	88.37	60.64
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
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
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

ON - diesel oil, OP - fuel oil

Table 3.15. CO_2 emission [thous. Gg] in 1988-2007 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
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	6.451	4.427
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
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

Table 3.16. CH_4 emission [Gg] in 1988-2007 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
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	0.353	0.243
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
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

Table 3.17. N_2O emission [Gg] in 1988-2007 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
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	0.575	0.395
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
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

3.2.1.2. *Fuel combustion – Reference Approach (CRF 1.A.b)*

The CO_2 emissions from fuel combustion category was estimated also by use of reference approach characterizing "top–down" approach to GHG emissions estimations. 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 is calculated as:

apparent consumption = production + imports – exports – stock change

Data about production, imports, exports and stock change based on Eurostat database (see table 3.18)

Table 3.18. Production, imports, exports, bunkers and stock change in 2007.

FUEL TYPES [TJ]			Production	Imports	Exports	International bunkers	Stock change	Apparent consumption
Liquid Fossil	Primary Fuels	Crude Oil	30 364	879 544	12 129	-	54 495	843 284
	Secondary Fuels	Gasoline	-	32 956	18 612	0	6 556	7 788
		Jet Kerosene	-	43	14 921	17 647	946	-33 471
		Gas / Diesel Oil	-	126 522	14 569	2 130	20 789	89 034
		Residual Fuel Oil	-	3 880	46 200	8 160	-2 160	-48 320
		LPG	-	102 166	1 150	-	368	100 648
		Ethane	-	0	0	-	0	0
		Naphtha	-	3 740	1 452	-	0	2 288
		Bitumen	-	6 825	17 238	-	78	-10 491
		Lubricants	-	5 334	7 854	0	378	-2 898
		Petroleum Coke	-	1 005	31	-	-565	1 539
		Refinery Feedstocks	-	57 758	0	-	0	57 758
		Other Oil	-	3 615	6 250	-	5 514	-8 150
Other Liquid Fossil			-	0	0	-	0	0
Liquid Fossil Totals			**30 364**	**1 223 387**	**140 406**	**27 937**	**86 399**	**999 009**
Solid Fossil	Primary Fuels	Anthracite	0	0	0	-	0	0
		Coking Coal*	IE	IE	IE	-	IE	IE
		Other Bituminous Coal	2 116 618	156 659	327 610	0	-69 539	2 015 207
		Lignite	499 660	69	0	-	148	499 581
	Secondary Fuels	BKB and Patent Fuel	-	70	0	-	19	51
		Coke Oven/Gas Coke	-	3 332	177 436	-	1 273	-175 377
Other Solid Fossil			-	0	0	-	0	0
Solid Fossil Totals			**2 616 278**	**160 130**	**505 046**	**0**	**-68 100**	**2 339 462**
Gaseous Fossil		Natural Gas (Dry)	163 147	346 884	1 509	-	-9 669	518 190
Other Gaseous Fossil			-	0	0	-	0	0
Gaseous Fossil Totals			**163 147**	**346 884**	**1 509**	**0**	**-9 669**	**518 190**
Total			***2 809 789***	***1 730 402***	***646 962***	***27 937***	***8 631***	***3 856 661***
Biomass total			**199 226**	**590**	**758**	**0**	**1 011**	**198 047**
		Solid Biomass	192 354	0	0	-	956	191 398
		Liquid Biomass	4 164	590	758	-	55	3 941
		Gas Biomass	2 708	0	0	-	0	2 708

*IE – included in other bituminous coal

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 non-energy consumption and feedstocks.
The differences between reference and sectoral approaches in CO_2 emissions are low and in 2007 was equal 1.23 %. Comparison of both methods is given in table 3.19.

Table 3.19. Differences between CO_2 emissions in sectoral and reference approach in period 1988 – 1989.

Year	Reference approach [Gg]	Sectoral approach [Gg]	Difference [%]
2007	306 352	302 640	1.23
2006	311 437	305 177	2.05
2005	303 429	296 078	2.48
2004	300 910	299 900	0.34
2003	301 760	300 123	0.55
2002	294 028	290 613	1.17
2001	297 510	301 038	-1.17
2000	297 723	301 922	-1.39
1999	313 733	312 997	0.23
1998	323 410	323 772	-0.11
1997	349 292	349 553	-0.07
1996	355 082	356 665	-0.44
1995	341 947	346 214	-1.23
1994	332 638	343 344	-3.12
1993	354 602	349 266	1.53
1992	350 902	342 297	2.51
1991	356 686	350 260	1.83
1990	357 683	347 419	2.95
1989	434 863	419 184	3.74
1988	458 223	440 389	4.05

3.2.1.3 *International bunker*

1990-2007 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 waken 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 1988-2007 period are presented in table 3.20.

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: 1990-2007 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 marine bunker for the 1988-2007 period are presented in table 3.20.

Table 3.20. Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2007

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
AVIATION BUNKER										
Fuel consumption – jet fuel [Gg]	351.15	352.45	181.45	192.85	216.6	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	43	43	43	43	43	43	43
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										
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 3.20. (cont.). Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
AVIATION BUNKER										
Fuel consumption – jet fuel [Gg]	237.5	209.95	341.05	321.1	391.4	265.05	260.3	295.45	394.25	410.4
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
Calorific value [MJ/kg]	43	43	43	43	43	43	43	43	43	43
CO_2 potential emission factor [g/kg]	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
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
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]	0.005	0.005	0.007	0.007	0.008	0.006	0.006	0.006	0.008	0.009
N_2O emission factor [g/kg]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
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
N_2O emission [Gg]	0.024	0.021	0.034	0.032	0.039	0.027	0.026	0.030	0.039	0.041
NAVIGATION BUNKER										
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
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
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
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
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
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
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
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
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
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
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

3.2.2 *Fugitive emissions from fuels* (CRF 1.B)

3.2.2.1 *Fugitive emissions from fuels* – coal mining (CRF 1.B1.a)

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

Based on two domestic studies [Gawlik et al., 1994, and Gawlik and Grzybek (G&G), 2001] domestic emission factors were estimated for the following emission sources in underground mines:

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

For the year 1999 annual emissions for one of closed mines were estimated what allowed to calculate emission factor from this source relating to coal mined.

The set of Polish emissions factors used in the national inventory for the above listed emission sources given are presented in table 3.21a below. This table includes results from the study: [Kwarciński et al. 2005] done in 2005 in which emission factors were estimated – once again – based on detailed data and measurements for the year 2003. Also a 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 are publicly available e.g. in publications of Polish Geological Institute [PIG, 2008].

Table 3.21. Methane emission factors analysis

Emissions sources	[Gawlik et al. 1994]		[Gawlik & Grzybek 2001]		[Kwarciński et al. 2005]	
	Nm^3 CH_4 /Mg Coal	Gg CH_4 /Mg Coal	Nm^3 CH_4 /Mg Coal	Gg CH_4 /Mg Coal	Nm^3 CH_4 /Mg Coal	Gg CH_4 /Mg Coal
Venting systems	6.0050	4.0234	6.4430	4.3168	5.8011	3.8868
De-methane systems			0.5962	0.3994	0.9927	0.6651
Post-mining processes	1.4810	0.9923	1.0200	0.6834	0.4288	0.2873
Production waste	0.0649	0.0435	0.0630	0.0422	0.0289	0.0194
Closed mines			0.0489	0.0328		0.0000

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: 1988-2007 based on the above listed references (table 3.22).

Table 3.22. Analysis of methane emission factors for sources and years

Year	venting systems	methane capture systems	post-mining processes	production waste	closed mines
1988	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1989	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1990	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1991	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE

Year	venting systems	methane capture systems	post-mining processes	production waste	closed mines
1992	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1993	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1994	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1995	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1996	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1997	Gawlik 1994	direct data	Kwarciński 2005	Kwarciński 2005	NE
1998	G&G 2001	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
1999	G&G 2001	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2000	G&G 2001	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2001	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2002	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2003	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2004	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2005	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2006	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001
2007	Kwarciński 2005	direct data	Kwarciński 2005	Kwarciński 2005	G&G 2001

Coal Mining and Handling – surface mines (CRF 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, 2008] 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.

3.2.2.2 *Fugitive emissions from fuels* – coke oven gas (CRF 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 3.23 have been taken from domestic case study [Steczko 1994]. Activity data for 1990-2007 come from [EUROSTAT]. For years: 1988-1989, the activity data come from national statistics [GUS 1989a-1990a].

Table. 3.23. Emission factors for CO_2 and CH_4 from coke oven gas system

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

3.2.2.3 *Fugitive emissions from fuels* – oil (CRF 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 national statistics [GUS 1989a-1990a].

Table 3.24. Activity data for emission from oil system

	Extraction	Extraction	Import	Transport	Input to oil refineries
	PJ	Gg	Gg	Gg	PJ
1988	6.58	159	14992	15151	618.69
1989	6.48	157	14725	14882	628.44
1990	6.73	160	13126	13286	540.57
1991	6.65	158	11454	11612	493.52
1992	8.45	200	13052	13252	555.44
1993	9.94	235	13674	13909	565.05
1994	11.94	284	12721	13005	565.32
1995	12.26	292	12957	13249	564.42
1996	13.36	317	14026	14343	615.35
1997	12.24	289	14713	15002	630.29
1998	15.27	360	15367	15727	679.46
1999	18.44	434	16022	16456	710.30
2000	27.69	653	18002	18655	774.75
2001	32.60	767	17558	18325	763.40
2002	30.86	728	17942	18670	753.98
2003	32.55	765	17448	18213	742.73
2004	37.73	886	17316	18202	771.55
2005	36.08	848	17912	18760	772.96
2006	33.83	796	19813	20609	851.96
2007	30.36	721	20885	21606	847.03

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. 3.25).

Table 3.25. Emission factors for CO_2 and CH_4 from oil production and transmission

CO_2 emission factors		
production	EF CO2 [Gg/PJ]	6.3150
transmission	EF CO2 [Gg/m^3]	0.00049
CH_4 emission factors		
production	EF CH4 [Gg/PJ]	0.0618
transmission	EF CH4 [Gg/m^3]	0.0054
refining	EF CO2 [Gg/PJ]	0.0007

3.2.2.4 *Fugitive emissions from fuels* – natural gas (CRF 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 1990-2007 come from [EUROSTAT]. For years 1988-1989 activity data come from national statistics [GUS 1989a-1990a]. Activity data are given in table 3.26

Table 3.26. Activities for natural gas system [TJ].

year	Extraction	Total consumption
1988	156 618	401 372
1989	145 022	392 287
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	181 274	575 767

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 3.27 and 3.28.

Table 3.27. Emission factors for CO_2 and CH_4 from high-methane gas system.

CO_2 emission factors	[Gg/PJ]
Gas extraction	0.000402
Gas processing	0.014368
Gas transmission	0.000558
Underground gas storage	0.000011
Gas distribution	0.001234

CH_4 emission factors	
Gas production	0.100848
Gas processing	0.000004
Gas transmission	0.055135
Underground gas storage	0.001433
Gas distribution	0.309945

Table 3.28. Emission factors for CO2 and CH4 from nitrified natural gas system.

CO2 emission factors	[Gg/PJ]
Gas production	0.000060
Gas processing	0.051321
Gas transmission	0.000192
Gas distribution	0.000558
CH4 emission factors	
Gas production	0.034307
Gas processing	0.101227
Gas transmission	0.035733
Gas distribution	0.317671

3.2.2.5. *Fugitive emissions from fuels* – Venting and Flaring (CRF 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.

3.3 Uncertainties

Uncertainty analysis for this IPCC sector was prepared with use of *Tier 1* methodology defined in the IPCC Good Practice Guidance. Summary results of the analysis are presented in the table 3.29., more detailed information for this and other sectors can be found in annex 5 of this report.

Table 3.29. Uncertainty analysis estimation for sector *Energy*

2007	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
1. Energy	**302,824.57**	**768.18**	**6.21**	2.1%	42.6%	30.8%
A. Fuel Combustion	**302,626.10**	**127.74**	**6.21**	2.1%	33.7%	30.8%
1. Energy Industries	181,992.63	2.93	2.68	3.4%	50.6%	47.7%
2. Manufacturing Industries and Construction	5,188.49	0.18	0.03	2.8%	75.0%	75.0%
3. Transport	171,540.83	1.89	2.53	3.6%	75.0%	50.0%
4. Other Sectors	5,263.31	0.10	0.01	1.4%	75.0%	50.0%
5. Other	2,924.58	0.77	0.10	20.0%	53.9%	151.3%
B. Fugitive Emissions from Fuels	**34664.17**	**3.70**	**0.68**	2.4%	46.0%	49.9%
1. Solid Fuels	4755.87	0.15	0.19	3.6%	75.1%	75.1%
2. Oil and Natural Gas	22861.26	2.08	0.30	3.4%	75.0%	50.0%

3.4 Recalculations

1.A. Fuel combustion

Fuel combustion in stationary sources

- for the year 2005, fuel consumption and the corresponding CO_2 emission data for the installations (plants) covered by the EU ETS were used; the data come from verification reports for the individual installations covered by the Emission Trading Scheme (concerns individual sub-categories in 1.A. excluding 1.A.3). (In previous GHG inventory, emissions for 1988-2005 were based on statistical data only).
- for the year 2006, the classification of individual EU ETS installations into particular IPCC categories was verified, for improvement of consistency with methodology used for preparation of national fuel balances as well as with classification applied for EU ETS installations in GHG inventory for 2005 and 2007.
- hard coal consumption was corrected for the year 2006, because in Eurostat database there was a mistake in the sum of coking coal and bituminous coal, which were used as the input in district heating plants. The value in Eurostat database was: 169 761 TJ instead of 125 671 TJ (123 219 TJ of bituminous coal and 2 452 TJ of coking coal). This mistake resulted with overestimation of GHG emissions in 1.A.1.a sub-category by app. 4 thou. Gg CO_2
- for the years 1990-2006, data on fuel consumption were updated based on Eurostat database corrected in mid-year 2008
- for the entire period 1990-2006, the activity data and emissions for liquid fuels were supplemented by the omitted fuel named in Eurostat database as *Other petrol_prod-3290.* In previous GHG inventory, only *Other petrol_prod-3280* was included. At

present the fuel classified as Other petroleum products is the sum of *Other petrol_prod-3280* and *Other petrol_prod-3290* .

- for the year 2005 coke non-energy consumption in 1.A.2.c was shifted partly into energy consumption, because the coke consumption estimated based on verified reports for EU ETS installations producing chemicals was higher than value in the statistics. It was due to mistake made by one of the enterprises, which gave its energy consumption of coke as non-energy use in G-03 report.
- fuel use data for the years: 1990-2006 in the sub-categories: 1.A.3.*a Civil Aviation*, 1.A.3.*c Railways*, 1.A.3.d *Navigation* (concerns inland navigation) and within the international marine bunker were estimated based on the actual Eurostat database. It caused increase of emission ranged from 0,01 to 0,05% in different years.

Recalculations introduced after In-country Review 7-12.09.2009

- pipeline transport was transferred from 1.A.1.c to 1.A.3 category since 1994, it means for the years where activity data were available (where fuel consumption in pipeline transport was separated in Energy Sector).
- for the year 1999, blast furnace gas consumption in 1.A.2.f sub-category was corrected; this correction concerns only activity data for solid fuels, while emission values were correct.
- activity data and emission values concerning the following sub-categories: 1.A.4.b, 1.A.4.c – mobile sources (1.A.4.c.ii and 1.A.4.c.iii) and 1.A.2.f.ii (machinery and off-road transport in industry and construction) were updated for the year 2007. These updating caused the following changes in the emission values: for 1.A.4.b and 1.A.4.c categories – drop of CO_2 emissions of 104.3 and 9.9 Gg respectively, while for 1.A.2.f – increase of CO_2 emission of 19.7 Gg.

<u>Reference Approach</u>

- Fraction of carbon stored was corrected for natural gas for period 1990-2007
- for the years 1990-2007, data were updated based on Eurostat database corrected in mid-year 2008

Recalculations introduced after In-country Review 7-12.09.2009

- for the years 1990-2006, data on crude oil consumption were updated based on Eurostat database corrected in mid-year 2008

<u>Fuel combustion in mobile sources</u>

- CO_2 emission for LPG in 1995 was corrected
- Fuel consumption in 1990-2006 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. The changes resulted in emission increase between 0.01 do 0.05 % in individual years.

Recalculations introduced after In-country Review 7-12.09.2009

- pipeline transport was transferred from 1.A.1.c to 1.A.3 category since 1994, it means for the years where activity data were available (where fuel consumption in pipeline transport was separated in Energy Sector).

- for the years 1988-2007, for Passenger car with catalysts, N_2O emission factor for gasoline was corrected based on COPERT IV emission factors, from 0,02 kg/GJ to 0,003 kg/Gg.

1.B Fugitive emissions

- Activity data for emission estimation of from the systems of: natural gas, coke-oven gas and oil were taken from [EUROSTAT] database. Earlier AD came from national statistics.
- Emissions from rafination of oil were estimated based on default emission factors [IPCC 2000].
- Emission factors were updated for the transmission system and underground storage of natural gas. Current EFs come from [Steczko K. 2003]. Earlier EFs came from an older publication [Steczko 1994].

3.5 Planned improvements

1.A. Fuel combustion

- wider application of data from verification reports on CO_2 emissions from installations covered by the EU ETS in GHG inventory and for improvement of consistency as regards aggregation methodology of these data with methodology used for preparation of national fuel balances.
- 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*).

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 Key categories

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 1.8%
- 2.B.1. *Ammonia Production* (CO2 emission), share in total GHG emission 1.1%
- 2.B.2. *Nitric Acid Production* (N2O emission), share in total GHG emission 1.1%
- 2.C.1. *Iron and Steel Production* (CO2 emission), share in total GHG emission 2.1%

Share of these categories in total Poland's GHG emissions is 6.1%.

4.2 Sector overview and methodological issues

For the 2007, in sector 2. *Industrial Processes,* there were used data concerning CO_2 process emissions from installations which take part in the EU ETS. Emission 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* (partly) 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 or CO_2 from fire equipments which is given in reports)

4.2.1. *Mineral Products* (CRF 2.A)

4.2.1.1. *Clinker Production* (CRF 2.A.1)
CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2007 for installation of clinker production, which participate in the Community Emission Trading Scheme [KASHUE 2009]. This emission was estimated as 7050.4 Gg CO_2. Data on clinker production was taken from [GUS 2008b].
The clinker production in period 1988-2007 is shown on figure 4.1. Data on clinker production for entire inventoried period was taken from [GUS 1989b-2008b].

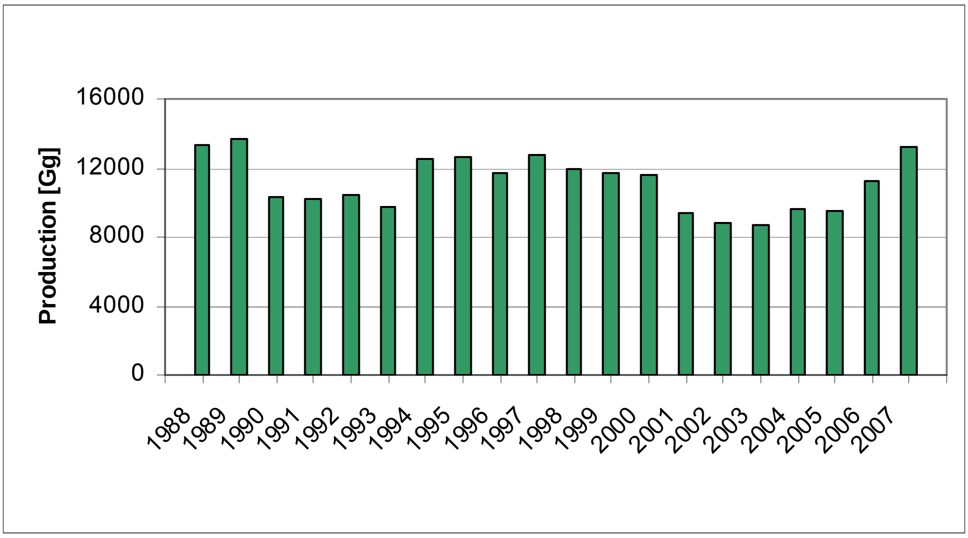

Figure 4.1. Clinker production in 1988-2007

CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2007 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: 1988-1989 – default emission factor from IPCC – 525 kg/t of clinker
- for years: 1990-2000 – emission factor equal 529 kg CO_2/ t of clinker – average from country specific factors for years: 2001-2004 (2001 – 531 kg CO/t, 2002 – 530 kg CO2/t, 2003 – 528 kg CO2/t, 2004 – 527 kg CO2/t)
- for years: 2001-2004 - country specific factors (given above) from [IMMB 2006].

CO_2 emissions from clinker production in period 1988-2007 are shown on figure 4.2.

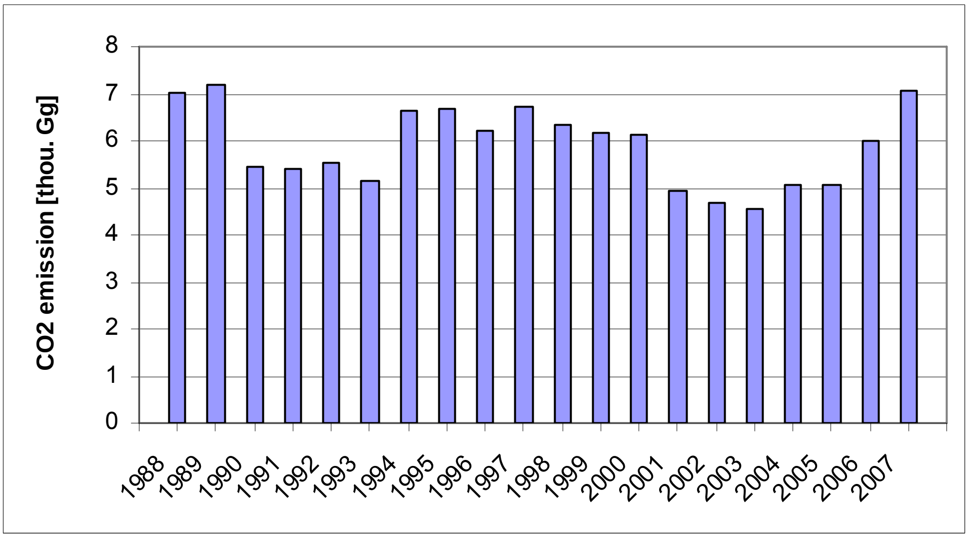

Figure 4.2. CO_2 process emission for clinker production in 1988-2007

4.2.1.2. *Lime Production* (CRF 2.A.2)

Emission of CO_2 from lime production was calculated based on data on lime production from [GUS 2008b]. The applied emission factor is equal 785 kg / Mg lime. This is default value given for this subcategory in [IPCC 1997].

Emission for period 1988-2007 was estimated based on emission factors. Data about production was taken from statistical yearbooks [GUS 1989b-2008b] (figure 4.3). Default emission factor was used for all years – 785 kg CO_2/t of lime). CO_2 emissions in period 1988-2007 are shown on figure 4.4.

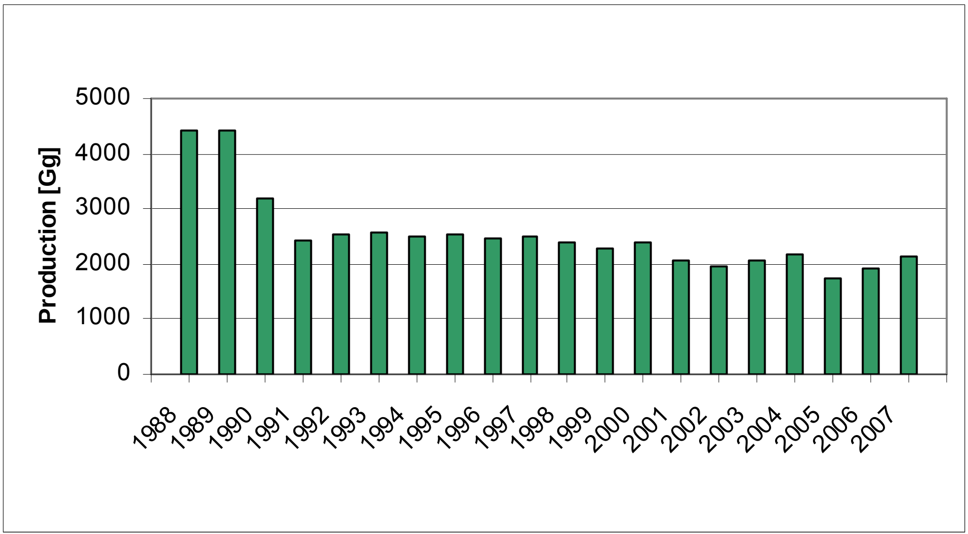

Figure 4.3. Lime production in 1988-2007

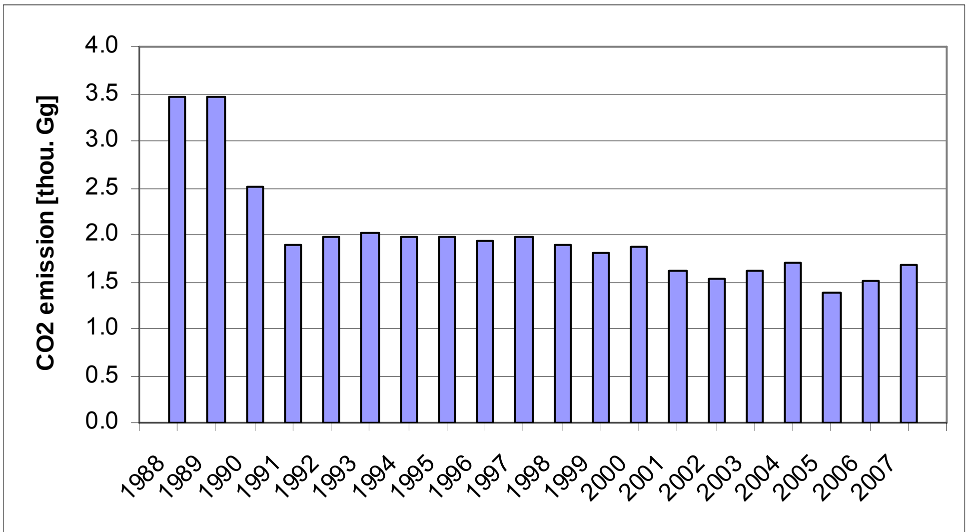

Figure 4.4. CO_2 process emission for lime production in 1988-2007

4.2.1.3. *Limestone and Dolomite Use* (CRF 2.A.3)

In this subcategory there were used only emissions from limestone and dolomite use in sulphur removal installations in power industry, which participate in EU ETS. It was assumed that CO_2 process emission given in reports for installations producing energy and heat (type E1) comes from limestone and dolomite use in sulphur removal process. Emissions for this subcategory in GHG inventory correspond to emissions from the EU ETS verified reports. For 2007 the emission value was 594.2 Gg CO_2, for 2006: 617.8 Gg CO_2, and for 2005: it was 568.5 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).

4.2.1.4. *Soda Ash Production and Use* (CRF 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 2008e]. 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: 1988-2007 were used data about soda ash production from G-03 reports and default emission factor 415 kg CO2/t soda ash for CO_2 emission estimations (figure 4.5).

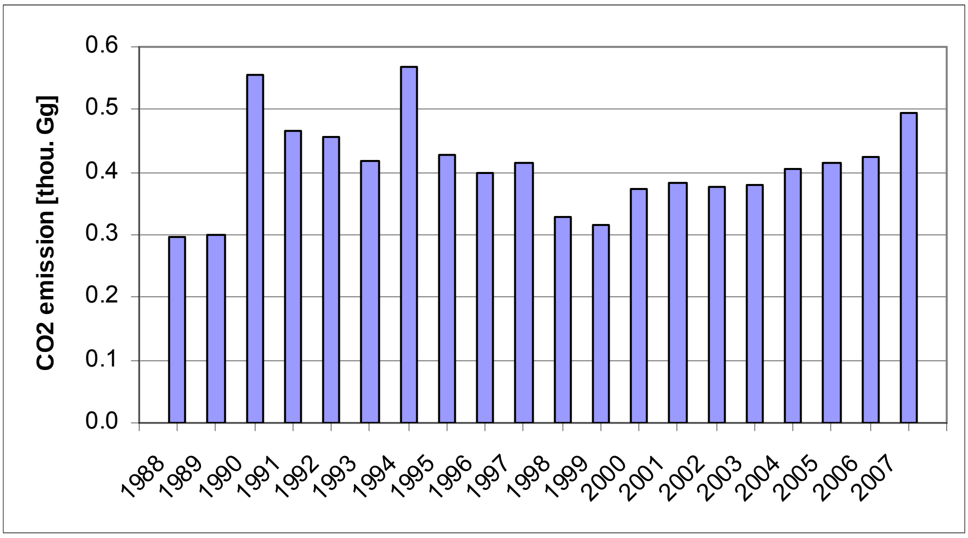

Figure 4.5. CO_2 emission from soda ash use and production in 1988-2007

4.2.1.5. *Other* (CRF 2.A.7)

- *Glass production*

CO_2 emission from glass production was taken from the verified reports for 2007 for installation of glass and glass wool production, which participate in the emission trading scheme [KASHUE 2009]. In 2007 this emission amounted to 350.1 Gg CO_2. In 2006 emission taken from the verified reports for 2006 for installations participating in the emission trading scheme was 339.2 Gg while in 2005 343.5 Gg CO_2. 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 2007 for installation of ceramics production, which participate in EU ETS [KASHUE 2009]. This emission value was equal to 228.5 Gg CO_2. In 2006 and 2005, the emissions were also taken from the verified reports for installation participating in EU ETS: 260.9 Gg CO_2, and 284.7 Gg CO_2, respectively. For years: 1988-2004 the emissions in this subcategory were not estimated.

4.2.2. *Chemical Industry* (CRF 2.B)

4.2.2.1. *Ammonia Production* (CRF 2.B.1)

CO_2 emissions for ammonia production are estimated based on the data on natural gas use in this process. The amount of natural gas used in volume units was taken from [GUS 2008e]. To estimate carbon content in natural gas was used factor 0.525 kg C/m^3 from IPCC [IPCC 1997]. 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: 1988-2007. In years 1989-1990, also coke-oven gas was used for ammonia production and this fact was reflected in the inventory calculations. 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: 1988-2007 are shown in figure 4.6

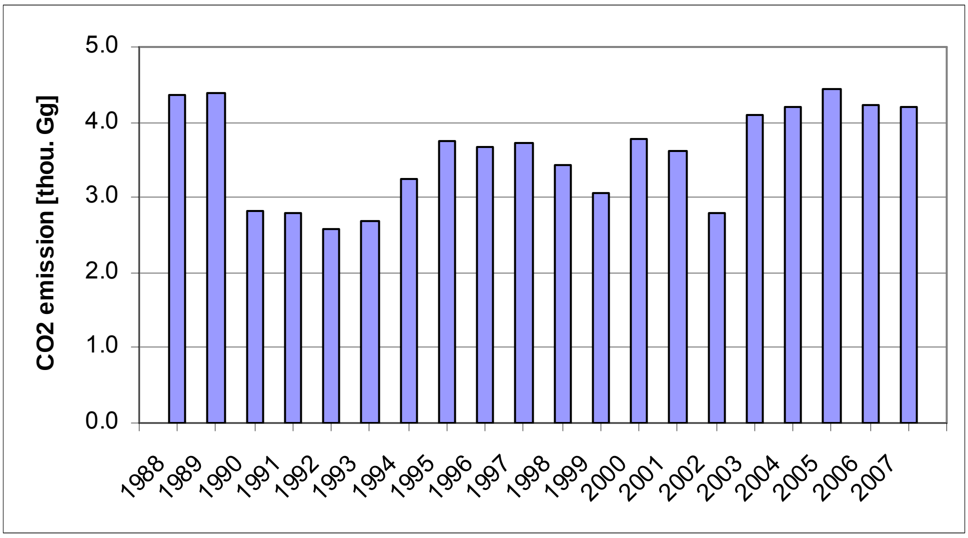

Figure 4.6. CO_2 process emission for ammonia production in 1988-2007

CH_4 process emissions for ammonia production were estimated for all years based on data on ammonia production from G-03 reports (figure 4.7) and emission factor 4.9 kg CH_4/Mg NH_3 [CITEPA 1992].

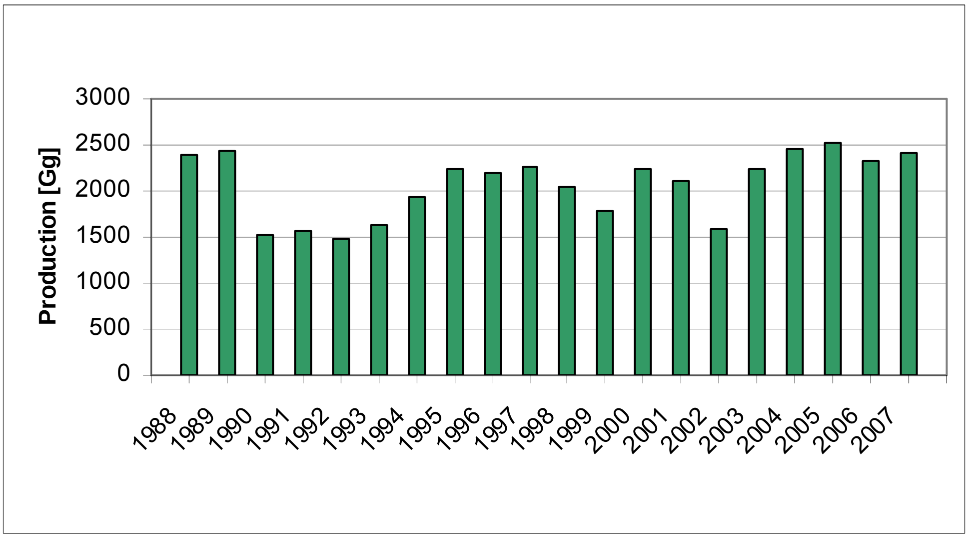

Figure 4.7. Production of ammonia in 1988-2007

Process of ammonia production is not a source of N_2O emission [Kozłowski 2001].

4.2.2.2. *Nitric Acid Producti*on (CRF 2.B.2)

Estimation of N_2O emission from nitric acid production was based on the annual HNO_3 production data from [GUS 2008b]. The applied country specific emission factor: 6.47 kg/Mg nitric acid is taken from[Kozłowski 2001].
Nitrous oxide emissions for the entire period was calculated based on the same emissions factor and data on production from [GUS 1989b-2008b]. The amount of production and N_2O emissions from nitric acid production are shown in figures 4.8 and 4.9.

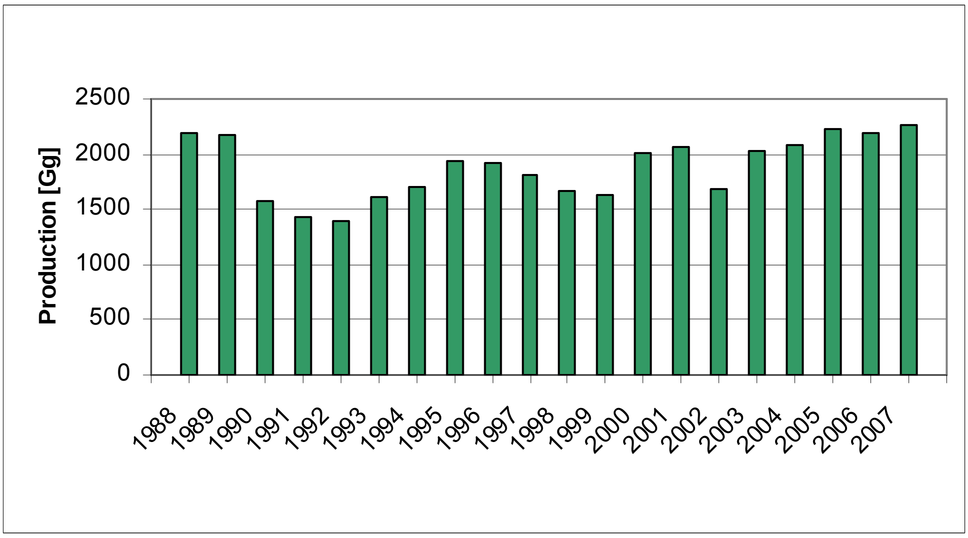

Figure 4.8. Production of nitric acid in 1988-2007

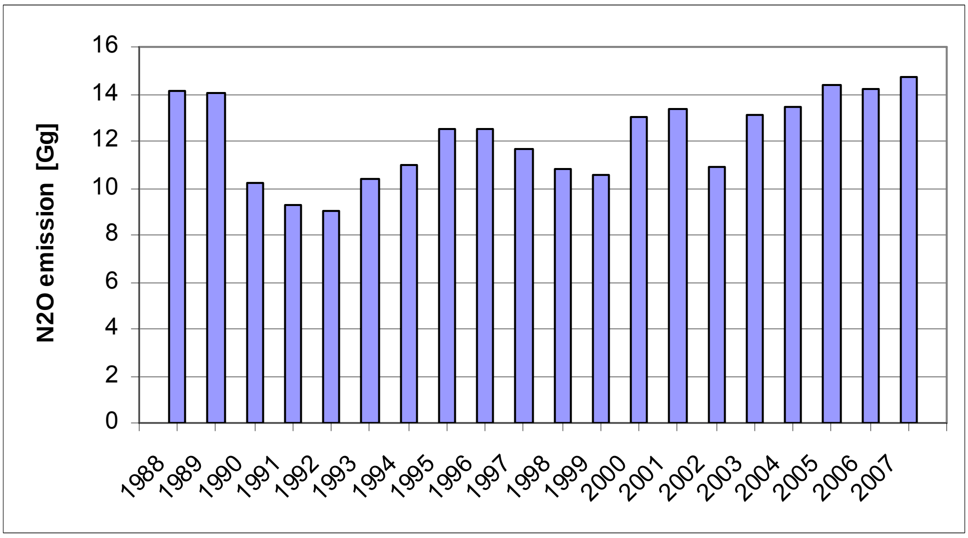

Figure 4.9. N_2O process emission for nitric acid production in 1988-2007

4.2.2.3. *Carbide Production* (CRF 2.B.4)

Activity data concerning calcium carbide production from [GUS 2008b] was applied. CO_2 emission factor for this category, which is equal 2190 kg CO_2/ Mg carbide (1090 kg CO_2/ Mg carbide from production + 1100 kg CO_2/ Mg carbide from use), was taken from [IPCC 1997]. For all inventoried years, starting from the base year, the same source of data relating to production volume was used [GUS 1989b-2008b]. In the current inventory, emissions for years 1988 and 1989 were recalculated. Previously, the emission factor (equal to 1100 kg CO_2/Mg), which corresponds to emissions only from carbide use was applied. At present, for the entire period since 1988 the same emission factor was applied to assess CO_2 process emissions from 2.B.4 category: 2190 kg CO_2/Mg carbide [IPCC 1997].

4.2.2.4. *Other* (CRF 2.B.5)

- *Carbon Black Production*

CH_4 emission from production of carbon black was estimated based on annual carbon black production from [GUS 2008e]. 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-2008e].

In current inventory, the emission factor of 11 kg CH_4/Mg was applied for calculation of CH_4 emission for the entire period 1988-2007. Emissions for 1988-1989 were recalculated to ensure consistency. Previously, for 1988 and 1989, the lower EF was used: 10 kg CH_4/Mg [CITEPA 1992].

- *Ethylene Production*

Emission of CO_2 from ethylene production was calculated based on ethylene annual production from [GUS 2008b]. Emission factor was taken from [CITEPA 1992]. Its value is 0.3 kg CO_2 / Mg ethylene produced.

For the entire time series 1988–2007 the same activity data source – GUS publications [GUS 1989b-2008b] 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 1988-2007. Emissions of CH_4 from ethylene production for 1988-1989 were added in the current inventory.

- *Caprolactam Production*

Data on annual caprolactam production for inventory calculation purpose was taken from [GUS 2008b]. 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-2008b] 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 2008b] and CH_4 EF equal 2 kg CH_4/ Mg [IPCC 1997]. Estimation of CH_4 emissions for 1988-1989 were added in the current inventory. For all years the same emission factor of 2 kg CH_4/ Mg methanol was used [IPCC 1997] as well as data on methanol production taken from national statistics [GUS 1989b-2008b].

- *Styrene Production*

For 1988-2007 methane emissions from styrene production were estimated for the first time. For all years the same emission factor was used of 4 kg CH_4/ Mg styrene [IPCC 1997]. Data on styrene production applied for emission estimation for 1995-2007 was taken from G-03 questionnaires [GUS 1996e-2008e], while for previous years (1988-1994) the activity data were obtained directly from the only styrene producer (personal communication).

4.2.3. *Metal Production* (CRF 2.C)

4.2.3.1. *Iron and Steel Production* (CRF 2.C.1)

4.2.3.1.1. *Iron Ore Sinter Production* (CRF 2.C.1.a)

Carbon dioxide process emissions from iron ore sinter production for 2007 come from the verified reports on annual emissions of CO_2 from iron ore sinter installations in the EU ETS

[KASHUE 2009]. 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 2005-2006 were estimated. In comparison with previous inventory, the CO_2 emission values in *2.C.1.a.* subcategory for 2005 and 2006 were changed.
It is due to the fact that currently for years 2005-2007 the total CO_2 emission from sintering process were reported in 2.C sub-category without excluding emission from fuel consumption for heating of the sinter belts. In the previous inventory, the emission from fuels used in sintering plants was not included in sector 2 IPPC, because fuel consumption from sintering plants was included in activity data of 1.A.2.a *Iron and steel production*, so emission from this fuel combustion was included in 1.A.2.a as well.

In the current GHG inventory for 2.C.1.a sub-category for 2005-2007, CO_2 emission values, consistent with total CO_2 emissions from the verified reports for sintering plants were taken. 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) subtracted from activity data in 1.A.2.a are as follows:

	2005	**2006**	**2007**
coke	8.499	8.957	8.638
anthracite	0.587	0.856	0.962
blast furnace gas	0.133	0.107	0.115
coke oven gas	0.369	0.294	0.285

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 respective subcategories of 2.C.1 These emissions were estimated according to methodology applied for emission calculation in 2.A.2.a sub-sector.
Above mentioned emissions [Gg] are as follows:

	2005	**2006**	**2007**
CH_4	0.091	0.099	0.096
N_2O	0.014	0.015	0.014

Emissions of CO2 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.
Activity data applied for calculations (amount of iron ore sinter production) are presented in table 4.1.

For the entire period 1988-2007 emissions of CH_4 were also estimated from iron ore sinter production. The default emission factor for CH_4 (0.07 kg/t), was taken from [IPCC 2006]. For the years 2005-2007, 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 4.1. Iron ore sinter production [Gg] and CO_2 emissions from sinter production in years 1988-2007 [Gg]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production	14107.3	12992.5	11779.4	8612.7	8621.7	7628.2	8787.4	8646.6	8318.6	8980.8
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	6882.1	6475.9	8078.7	7352.8	7616.9	7732.2	8590.6	6168.4	6907.8	6954.0
CO_2 emissions	492.4	522.0	619.8	516.5	545.5	636.6	645.5	1269.2	1386.4	1386.1

4.2.3.1.2. *Steel Cast Production* (CRF 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 1988-2006 equals 41.7-46.1% (cast steel production was calculated based on the yield value and steel cast production published every year in [*Modern Casting*])
- in electric arc furnaces 97% steel for cast steel is melted and 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 1988-2007 were presented in table 4.2.

Table 4.2. Activity data for estimation of CO2 process emission from steel casting in 1988-2007

Year	Liquid steel Mg	Liquid steel melted in electric arc furnace, Mg	Liquid steel melted in induction furnace, Mg	Electrode consumption, Mg	CO2 emission from burning out of electrodes, Mg	Amount of carbon burn out, Mg	CO2 emission from burn out of carbon, Mg	Total CO2 emission from melting of steel, Gg
1988	641892	622635	19257	4981	18264	3113	11415	29.679
1989	538289	522140	16149	4177	15316	2611	9573	24.889
1990	434685	421644	13041	3373	12368	2108	7730	20.098
1991	225968	219189	6779	1754	6430	1096	4018	10.448
1992	165766	160793	4973	1286	4717	804	2948	7.664
1993	150473	145959	4514	1168	4281	730	2676	6.957
1994	159910	155113	4797	1241	4550	776	2844	7.394
1995	175901	170624	5277	1365	5005	853	3128	8.133
1996	193919	188101	5818	1505	5518	941	3449	8.966
1997	178378	173027	5351	1384	5075	865	3172	8.248
1998	140090	135887	4203	1087	3986	679	2491	6.477
1999	123874	120158	3716	961	3525	601	2203	5.728

2000	124775	121032	3743	968	3550	605	2219	5.769
2001	122748	119066	3682	953	3493	595	2183	5.675
2002	109009	105739	3270	846	3102	529	1939	5.040
2003	111511	108166	3345	865	3173	541	1983	5.156
2004	117354	113833	3521	911	3339	569	2087	5.426
2005	133187	129191	3996	1034	3790	646	2369	6.158
2006	132747	128765	3982	1030	3777	644	2361	6.138
2007	142198	137932	4266	1103	4046	690	2529	6.575

4.2.3.1.3. *Iron Cast Production* (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 1988-2007 were as follow: 67-72% for gray iron, 47.9-50.7% for ductile cast iron, 32.3-34.5% for malleable cast iron (total amount of melted cast iron for particular year was calculated based on iron cast production [*Modern Casting*] and metal yield value);
- part of coke in charge is 15% (150 kg / Mg metal charge).
- part of $CaCO_3$ in charge is 25% of coke addition (3.75% of metal charge).
- yield of liquid metal from cupola is 95% (melting loss 5%).
- part of cast iron melted in cupola was assumed 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 37.7% in 2007
- 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 1988-2007 were presented in the table 4.3.

Table 4.3. CO2 process emission from cast iron production in years 1988-2007

Year	Liquid cast iron Mg	Liquid cast iron melted in cupola, Mg	Metal charge into cupola Mg	Coke consumption Mg	$CaCO_3$ consumption Mg	CO2 emission from $CaCO_3$ break down 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

CH_4 emission for entire period 1988-2007 was estimation based on EF = 0.20 kg CH_4/Mg. This EF was taken from [Radwański 1995].

4.2.3.1.4. *Pig Iron Production in Blast Furnaces* (CRF 2.C.1.e)
CO_2 emission for 2007 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.
Emission values for 2005 and 2006 were recalculated according to methodology applied for 2007. CO_2 emission from pig iron production for 2007 was estimated at 3879.2 Gg. For 2005 and 2006 the values were: 2952.7 Gg and 3700.3 Gg CO_2, respectively.
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, are as follows:

	2005	**2006**	**2007**
hard coal (including anthracite)	0.482	3.647	3.036
natural gas	2.829	0.109	0.742
coke	38.798	44.496	43.010
coke oven gas	3.264	3.884	5.569

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 not should 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 2.A.2.a sub-sector.
Above mentioned emissions [Gg] are as follows:

	2005	**2006**	**2007**
CH_4	0.399	0.485	0.467
N_2O	0.060	0.073	0.070

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 entire period from [GUS 1989e-2005e], BF gas production for 1888-1989 from [GUS 1989a-1990a] 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-2008e]. This value for 2007 is 5804.4 Gg, for 2005 and 2006: 4481.2 Gg and 5543.4 Gg, respectively. CO_2 emission values and data concerning BF process applied in C balance for period 1988-2004 were presented in table 4.4.

Table 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]	74 535	71 785	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	4 919.3	4 737.8	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	5 329.8	5 117.3	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]	461.6	449.0	389.9	257.9	242.8	223.4	261.1	267.0	227.8
CO2 EMISSION[Gg]	**1 693**	**1 646**	**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. (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**

4.2.3.1.5. *Basic Oxygen Furnace Steel Production* (CRF 2.C.1.f)
Amount of CO_2 process emission from basic oxygen furnace steel production in 2007 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 2007 was 766.9 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 2005-2006 were recalculated and for these years emission values from the verified reports were assumed like for 2007 - without excluding fuels used for energy purposes. The values of CO_2 emissions for 2005 and 2006 are as follow: 547.5 Gg and 843.4 Gg.
Basic oxygen steel production in 2005-2007 amounted to: 4892.7 Gg, 5766.4 Gg and 6187.9 Gg, respectively [GUS 2008b].
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**
hard coal (including anthracite)	0.000	0.000	0.000
natural gas	0.540	0.598	0.701
coke	0.216	0.254	0.236
coke oven gas	0.609	0.654	0.607
blast furnace gas	0.105	0.101	0.115

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 2.A.2.a sub-sector.
Above mentioned emissions [Gg] are as follows:

	2005	**2006**	**2007**
CH_4	0.003	0.004	0.004
N_2O	0.0004	0.0005	0.0005

For years 1988-2004, CO_2 process emission from basic oxygen furnace steel production was estimated on the basis of carbon balances (table 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 taken 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.

4.2.3.1.6. *Electric Furnace Steel Production* (2.C.1.g)

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

	2005	**2006**	**2007**
hard coal (including anthracite)	0.261	0.336	0.511
coke	0.036	0.032	0.032

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 2.A.2.g subcategory.
Above mentioned emissions [Gg] are as follows:

	2005	**2006**	**2007**
CH_4	0.003	0.004	0.005
N_2O	0.0004	0.0006	0.0008

Annual electric furnace steel production in 2005-2007 amounted to: 3443.2 Gg for 2005, 4225.3 Gg for 2006 and 4432.8 Gg for 2007 [GUS 2008b].

Activity data on steel production in electric furnaces and on CO_2 emissions related to this process in 1988-2004 are presented in table 4.6 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 4.6) 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 1988-2007 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 2005-2007, 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 4.5. 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 4.5. (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	1366064.9	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 4.6 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 4.6. (continued.) 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**

4.2.3.1.7. *Coke production* (CRF 2.C.1.j)

Processing emission of CO_2 from coking plants in the period 1990-2007 was estimated based on elementary carbon budgets in the coking plants (tab. 4.7). Data concerning input and output are based on [Eurostat] and [GUS 1991a-2008a]. Coke productions for 1990-2007 were applied according to data in [Eurostat].

For the years 1988 and 1989 analogous C budgets (tab. 4.7) were used only for estimation of CO_2 emission factors. All data concerning input and output in C balance was taken from [GUS 1989a-1990a] and for that reason the values of CO_2 emissions in 1988 and 1989 differ in CRF and table 4.7. Production of coke for CO_2 emission estimation for 1988-1989 was taken from [GUS 1989b-1990b].

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].

CH_4 emission in the period 1990-2007 was estimated based on coke production volume from [Eurostat], while for 1988 and 1989 from [GUS 1989b-1990b]. For the entire period emission factor equal 0.5 kg CH_4/Mg coke produced [IPCC 1997; Workbook table 2-9] was applied. CH_4 emission values for years 1988-1989 were recalculated, because in the previous inventory emission factor: 0.1 g CH_4 / Mg was used, according to [IPCC 2006; table 4.2].

Table 4.7. Carbon balance for coke production in years 1988-2007

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
INPUT [TJ]										
Coking coal	658115	639140	534118	448516	438558	405168	436596	451761	403902	420825
High Methane Natural Gas		1239	1012	1668	2092	2526	1335	1076	1842	1364
Coke	1077	1486	947	534	1746	1543	2354	2283	1784	1669
Blast furnace gas		152	0	0	0	0	0	0	0	0
Tar	390	306	619	330	157	115	82	194		
Industrial waste		2								
NCV [MJ/kg]										
Coking coal	29.48	29.47	29.33	29.44	29.47	29.41	28.49	29.36	29.36	29.45
INPUT - Material-specific carbon content [kg C/GJ]										
Coking coal	25.98	25.98	25.99	25.98	25.98	25.98	26.02	25.99	25.99	25.98
High Methane Natural Gas	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
Blast furnace gas	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Tar	22	22	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Industrial waste	39	39	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
INPUT - Carbon contents in charge components [Gg]										
Coking coal	17099.2	16606.2	13880.4	11654.0	11394.7	10528.1	11360.6	11739.7	10495.9	10934.3
High Methane Natural Gas	0.0	18.9	15.5	25.5	32.0	38.6	20.4	16.5	28.2	20.9
Coke	31.8	43.8	27.9	15.8	51.5	45.5	69.4	67.3	52.6	49.2
Blast furnace gas	0.0	10.0	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
Industrial waste	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carbon contents in charge – SUM [Gg]	17139.5	16685.8	13937.5	11702.6	11481.7	10614.8	11452.3	11827.8	10576.7	11004.4
OUTPUT [TJ]										
Coke	466962	452889	380655	320752	312418	288431	321009	322383	288300	298053
Coke-Oven Gas	115366	114320	100628	89478	85741	77314	84100	84769	76036	79286
Tar	27580	27429	22885	20268	20648	19071	21147	21265	19832	19600
Benzol	7702	7231	6167	5151	5646	5159	6011	6057	5447	5429
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
Coke-Oven Gas	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
Benzol	23	23	23	23	23	23	23	23	23	23
OUTPUT - Carbon content in products [Gg]										
Coke	13775.4	13360.2	11229.3	9462.2	9216.3	8508.7	9469.8	9510.3	8504.9	8792.6
Coke-Oven Gas	1499.8	1486.2	1308.2	1163.2	1114.6	1005.1	1093.3	1102.0	988.5	1030.7
Tar	606.8	603.4	503.5	445.9	454.3	419.6	465.2	467.8	436.3	431.2
Benzol	177.5	163.4	141.8	118.5	129.9	118.7	138.2	139.3	125.3	124.9
Carbon content in products - SUM [Gg]	16059.4	15613.2	13182.8	11189.8	10915.1	10052.0	11166.5	11219.4	10054.9	10379.3
C process emission[Gg]	1080.1	1072.6	754.7	512.8	566.6	562.8	285.8	608.4	521.8	625.0
CO2 process emission[Gg]	**3960.4**	**3932.8**	**2767.1**	**1880.3**	**2077.6**	**2063.6**	**1047.8**	**2230.6**	**1913.4**	**2291.8**
Coke output [Gg]	**16795**	**16323**	**13671**	**11411**	**11094**	**10282**	**11456**	**11579**	**10340**	**10536**
EF [kg CO2/Mg of coke]	**236**	**241**	**202**	**165**	**187**	**201**	**91**	**193**	**185**	**218**

Table 4.7. (continued.) Carbon balance for coke production in years 1988-2007

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
INPUT [TJ]										
Coking coal	373917	334582	363260	359331	351567	406805	401491	331593	378744	13534.0
High Methane Natural Gas	874	741	542	1067	811	190	274	469	505	
Coke	1975	1429	1896	982	1642	1435	1505	1926	2076	399294
Blast furnace gas	0	0	0	0	0	0	0	0	0	420
Tar	15									2278
Industrial waste										0
NCV [MJ/kg]										
Coking coal	29.54	29.48	29.62	29.53	29.53	29.56	29.55	29.51	29.59	29.50
INPUT - Material-specific carbon content [kg C/GJ]										
Coking coal	25.98	25.98	25.98	25.98	25.98	25.98	25.98	25.98	25.98	25.98
High Methane Natural Gas	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
Blast furnace gas	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Tar	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Industrial waste	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
INPUT - Carbon contents in charge components [Gg]										
Coking coal	9714.2	8693.1	9436.2	9335.5	9133.7	10568.3	10430.4	8615.0	9838.8	10374.0
High Methane Natural Gas	13.4	11.3	8.3	16.3	12.4	2.9	4.2	7.2	7.7	6.4
Coke	58.3	42.2	55.9	29.0	48.4	42.3	44.4	56.8	61.3	67.2
Blast furnace gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tar	0.3	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
Carbon contents in charge – SUM [Gg]	9786.2	8746.6	9500.5	9380.8	9194.5	10613.6	10479.0	8679.0	9907.8	10447.7
OUTPUT [TJ]										
Coke	266064	237065	254374	252286	246207	285907	285927	237152	270125	287632.4
Coke-Oven Gas	73457	62989	68849	69008	65570	75091	72947	61947	71712	76950.0
Tar	17950	16265	17003	17233	16463	18188	17421	14603	16219	16218.5
Benzol	4857	4525	2499	4789	4475	5253	5358	4403	3804	3803.7
OUTPUT - Material-specific carbon content [kg C/GJ]										
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Coke-Oven Gas	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
Benzol	23	23	23	23	23	23	23	23	23	23
OUTPUT - Carbon content in products [Gg]										
Coke	7848.9	6993.4	7504.0	7442.4	7263.1	8434.3	8434.8	6996.0	7968.7	8485.2
Coke-Oven Gas	954.9	818.9	895.0	897.1	852.4	976.2	948.3	805.3	932.3	1000.3
Tar	394.9	357.8	374.1	379.1	362.2	400.1	383.3	321.3	356.8	356.8
Benzol	111.7	104.1	57.5	110.1	102.9	120.8	123.2	101.3	87.5	87.5
Carbon content in products - SUM [Gg]	9310.4	8274.2	8830.6	8828.8	8580.6	9931.4	9889.7	8223.8	9345.2	9929.8
C process emission[Gg]	475.8	472.4	669.9	552.0	613.9	682.2	589.3	455.2	562.6	517.9
CO2 process emission[Gg]	**1744.4**	**1732.3**	**2456.2**	**2023.9**	**2251.0**	**2501.2**	**2160.7**	**1669.1**	**2062.8**	**1898.9**
Coke output [Gg]	**9747**	**8368**	**8972**	**8946**	**8723**	**10112**	**10097**	**8404**	**9613**	**10168**
EF [kg CO2/Mg of coke]	**179**	**207**	**274**	**226**	**258**	**247**	**214**	**199**	**215**	**187**

4.2.3.2. *Ferroalloys production* (CRF 2.C.2)

Emission of CO_2 concerning ferroalloys production was estimated based on annual ferrosilicon production taken from [GUS 2008b]. Applied emission factor of 3900 kg CO_2 / Mg ferrosilicon, was taken from [IPCC 1997] for ferrosilicon – 75% Si.

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

In the period 1988-2006 CO_2 and CH_4 process emission from ferroalloys production was estimated also based on annual ferrosilicon production taken from [GUS 1989b-2007b] (figure 4.10) and emission factors as in year 2007.

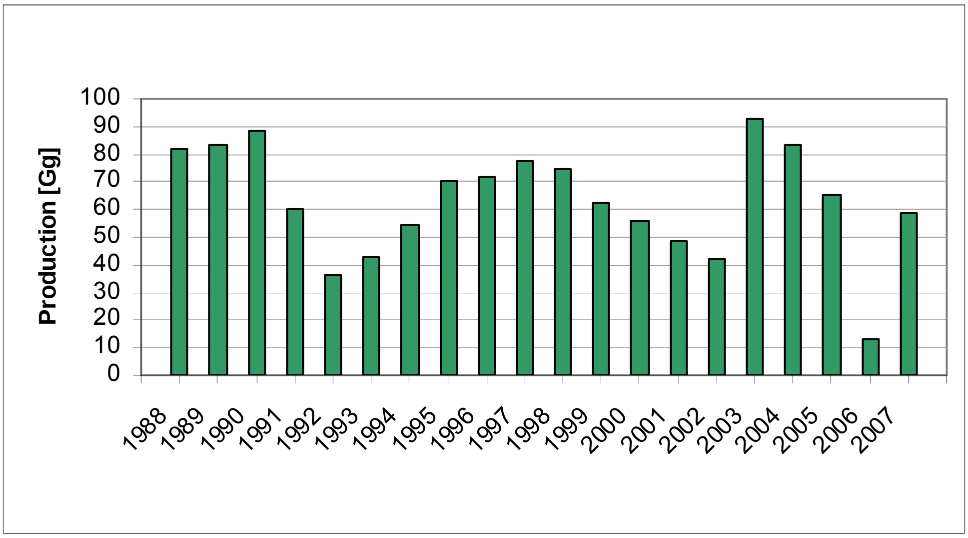

Figure 4.10. Production of ferrosilicon in 1988-2007

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4.2.3.3. *Aluminium Production* (CRF 2.C.3)

Calculation of CO_2 emission from primary aluminium production for 2007 is based on the data on aluminium production published in [GUS 2008b]. 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 1988-2007 was estimated based on according to the above mentioned description. The amount of emissions for the entire trend is shown in figure 4.11.

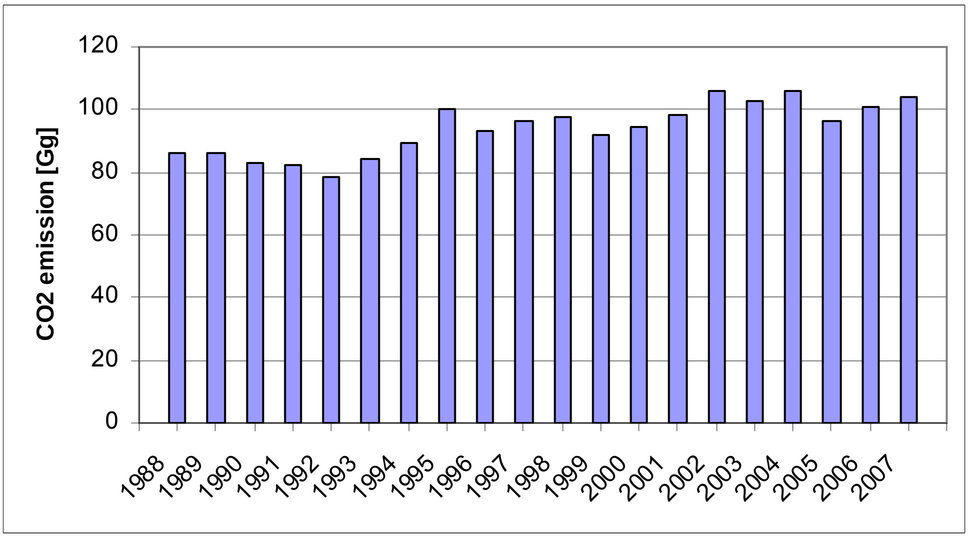


Figure 4.11. CO_2 process emission for aluminium production in 1988-2007

4.2.3.4. *Zinc production*

Process emission of CO_2 from zinc production was estimated based on annual zinc production taken from GUS [GUS 2008b]. The emission factor comes from [IPCC 2006] – table 4.24 and is 1.72 Mg CO_2/Mg zinc.

For the entire period 1988-2007 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 4.12.

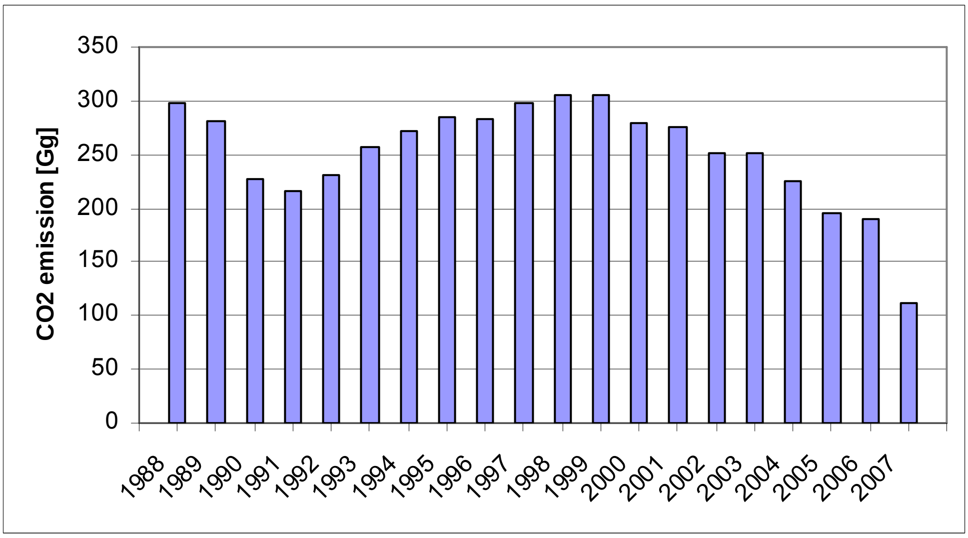


Figure 4.12. CO_2 process emission for zinc production in 1988-2007

4.2.3.5. *Lead production*

Process emission of CO_2 from lead production was estimated based on annual lead production taken from GUS [GUS 2008b]. The default emission factor of 0.52 Mg CO_2/ Mg lead from [IPCC 2006] – table 4.21 was applied.

For the entire period 1988-2007 the same emission factor was used. Data on lead production come from [GUS 1989b-2008b]. The trend of process emissions from lead production is given in figure 4.13.

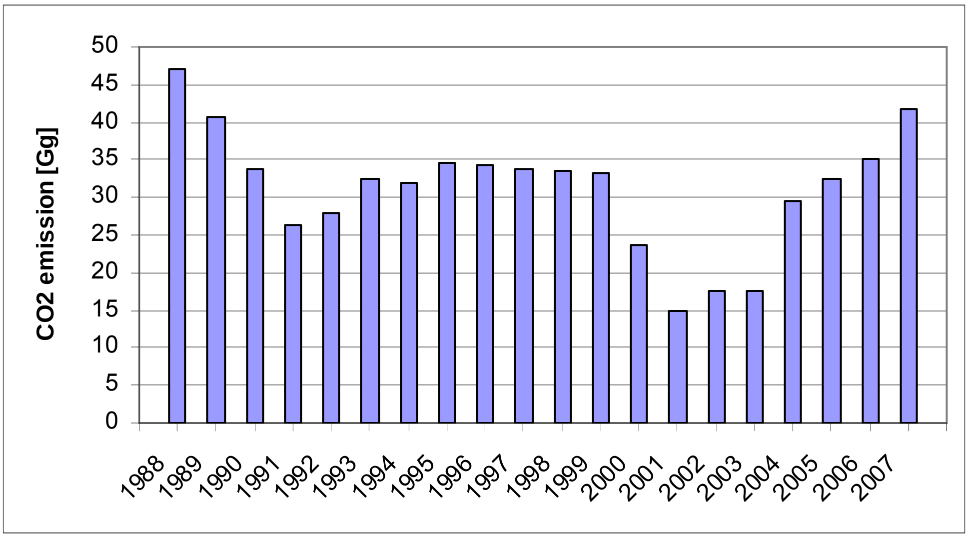


Figure 4.13. CO_2 process emission for lead production in 1988-2007

4.2.4. *Other production* (CRF 2.D)

4.2.4.1. *Pulp and paper production* (CRF 2.D.1)
CO_2 process emissions from pulp and paper production for 2007 and for 2005-2006 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS [KASHUE 2009]. These emissions were: 77 Mg CO_2 for 2007, 48 Mg CO_2 for 2006 and 77 Mg CO_2 for 2005, respectively.

4.2.5. *Other* (CRF 2.G)

4.2.5.1. *Refinery processes*
CO_2 emission value estimated as process emission of CO_2 from the verified reports for refineries, which participate in EU ETS was included in this sub-category [KASHUE 2009]. Values of process emissions amounted to: 956.5 Gg for 2007, 1144.1 Gg CO_2 in 2006 and 1094.0 Gg CO_2 in 2005, respectively. This part of refinery emission mainly resulted from the following processes: hydrogen production, regeneration of catalysts, after-burning gases from asphalt production and hydrocarbon flaring in refineries.

4.2.6 *Consumption of Halocarbons and SF_6* (CRF 2.F)

Emissions of HFC, PFCs and SF_6 are based on activity data available at public statistics data 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. The main emission factors for HFC-134a [IPCC 2000] are given in table 4.8.

Table 4.8. 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 %

The main source of emission of PFC gases in Poland is aluminium production Activities on aluminium production were taken from [GUS 2008b]. *Tier 1* method and the following emission factors as in [IPCC 2000] were used for estimation of PFC emissions:
for CF_4 EF = 0.61 kg/Mg aluminium produced
for C_2F_6 EF = 0.061 kg/Mg aluminium produced

As concerns SF_6 – the only sources estimated in Poland are electrical equipment and sound-proof windows. The following emission factors [IPCC 2000] were used for calculation of SF_6 emission:
Equipment manufacturing – EF = 0.06 Mg/Mg of SF_6 used
Equipment use – EF = 0.05 Mg/Mg SF6 in use (1995), EF = 0.02 Mg/Mg (since 1996)

Table 4.9 includes the activity data used for estimation of PFC and SF6 emissions over the period: 1995-2007.

Table 4.9. Activity data used for estimation of PFC and SF_6 emissions

Activity characteristic for the source sector	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
2.C. Metal production													
3. Aluminium Production [Gg]	55.278	51.924	53.614	54.168	50.974	52.335	54.600	58.800	57.240	58.931	53.582	55.939	57.647
2.F Consumption of HFC, PFC and SF_6													
2.F.8. Electrical equipment – amount of SF_6 in use [Mg]	11.000	14.024	17.048	20.072	23.096	26.120	28.702	32.039	33.748	36.446	40.567	44.606	44.606
2.F.8 Electrical equipment – amount of imported SF_6 [Mg]	0.000	0.600	0.600	2.000	2.330	2.660	3.303	4.160	2.500	3.588	5.160	5.160	5.160

4.3 Uncertainties

Uncertainty analysis for this IPCC sector was prepared with use of *Tier 1* methodology defined in the IPCC Good Practice Guidance. Summary results of the analysis are presented in the table 4.10., more detailed information for this and other sectors can be found in annex 5 of this report.

Table 4.10. Uncertainties analysis elaborated for sector *Industrial Processes*

2007	**CO_2 [Gg]**	**CH_4 [Gg]**	**N_2O [Gg]**	**CO_2 Emission uncertainty [%]**	**CH_4 Emission uncertainty [%]**	**N_2O Emission uncertainty [%]**
2. Industrial Processes	**24,426.94**	**20.29**	**15.52**	5.3%	13.6%	29.9%
A. Mineral Products	10,399.77			11.0%		
B. Chemical Industry	4,244.16	13.35	15.43	7.0%	19.0%	30.1%
C. Metal Production	8,826.39	6.94	0.0854515	5.9%	15.4%	
D. Other Production	0.08			5.0%		
G. Other	956.54			5.0%		

4.4 Recalculations

- in subcategory 2.B.1 *Ammonia* p*roduction* for 1988 and 1989 factor of carbon content for coke oven gas used as input in ammonia production process were changed. In the current inventory C content factor 13 kg C/GJ [IPCC 1997] was applied instead of 12.10 kg C/GJ recommended in [IPCC 2006]. This correction results in increase of CO_2 emission by over 10 Gg in 1988 and 6 Gg in 1989.
- In subcategory 2.B.4 *Carbide* p*roduction*, for 1988 and 1989, CO_2 emission factor was verified. Earlier EF was related only to carbide use, not carbide production
- for the entire period 1988-2007 CH_4 process emissions from styrene production were estimated for the first time. Emission factor of 4 kg CH_4/ Mg styrene was used [IPCC 1997].
- for years 1988-1989 CH_4 emission factor for carbon black production was changed for trend consistency. EF equal 11 kg C/GJ [IPCC 1997] was applied instead of 10 kg C/GJ, which was used earlier.
- for 1988 and 1989 CH_4 process emission from ethylene production was estimated based on EF equal 1 kg CH_4/ Mg [IPCC 1997].
- for 1988 and 1989 CH_4 process emission from methanol production was calculated based on EF equal 2 kg CH_4/ Mg [IPCC 1997].
- CO_2 emission values for production of casts made of iron alloys were corrected. CO_2 emission values for steel cast production for 1990, 1996-1997, 2000-2002, 2005 and 2006 were verified.
- CH_4 EF for coke production for 1988 and 1989 was changed. Methane EF equal 0,5 kg/ Mg from [IPCC 1997] was applied (value of EF used previously was 0,0001 kg/Mg [IPCC 2006])
- For 2005-2006 CO_2 emission values were verified for 2.C.1 sub-categories as follows: *Iron Ore Sintering, Blast Furnaces Process, Basic Oxygen Furnace Steel* and *Electric Furnace Steel*. For the sub-categories listed above, CO_2 emission values were taken from verified reports. For the reason, that these emissions include also emissions from fuel consumption in the mentioned processes, this fuel consumption was subtracted from 1.A.2.a. CH_4 and N_2O emissions from those shifted fuels were also included in respective sub-sectors of 2.C.1.
- For 2005 and 2006 CO_2 emissions in 2.G. *Other* were supplemented with emissions from hydrocarbon flaring in refineries from verified reports for refineries and emissions from CO_2 use in fire-extinguisher given also in the verified reports.

4.5 Planned improvements

- verification and updating of emission factors for process emissions of N_2O from nitric acid production (sub-category 2.B.2)
- to distinguish CO_2 emissions from limestone and dolomite use among various sub-categories in source sector 2 and estimation of total CO_2 emission in the sub-category 2.A.3 Limestone and Dolomite Use
- wider application of data from verification reports on CO_2 emissions from installations covered by the EU ETS in GHG inventory and actions for improvement methodology of aggregation, disaggregation and supplementation this data with additional information from plants for obtaining full agreement with statistical data.

5. Solvent and Other Product Use (CRF sector 3)

5.1 Key categories

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

5.2 Sector overview and 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 [IETU 2009, IOŚ EMEP 2009]. 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*

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.

Additionally, N_2O emissions form anesthesiology were estimated in sub-sector 3.D.

5.3 Uncertainties

Uncertainty analysis for this IPCC sector was prepared with use of *Tier 1* methodology defined in the IPCC Good Practice Guidance. Summary results of the analysis are presented in the table 5.1. more detailed information for this and other sectors can be found in annex 5 of this report.

Table 5.1. Uncertainty analysis for the sector *Solvent and Other Product Use*

2007	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
3. Solvent and Other Product Use	**609.04**		**0.40**	15.0%		50.0%

5.4 Recalculations

- No recalculations of GHG emissions were carried our in this category.

5.5 Planned improvements

- Experts study is planned on N_2O use in anesthesiology.

6. Agriculture (CRF sector 4)

6.1 Key categories

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

- 4.A. Enteric Fermentation (CH4 emission), share in total GHG emission	2.3%
- 4.B. Manure Management (CH4 emission), share in total GHG emission	0.9%
- 4.B. Manure Management (N2O emission), share in total GHG emission	1.5%
- 4.D.1. Direct Soil Emissions (N2O emission), share in total GHG emission	2.8%
- 4.D.3. Indirect Soil Emissions (N2O emission), share in total GHG emission	1.1%

Share of these categories in total Poland's GHG emissions is 8.7%.

6.2 Sector overview and methodological issues

6.2.1 *Methane emissions from Enteric Fermentation* (CRF 4.A)

In order to calculate CH_4 emission factors from enteric fermentation and manure management the Gross Energy Intake (GE) was calculated [IPCC 2000, equation 4.11] for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other matured cattle (over 2 years). Country specific parameters like pregnancy [GUS R1 2008], milk production (table 6.1), percent of fat in milk [GUS R 2008] come from national statistics. Digestible energy (DE – expressed as a percent of gross energy) was estimated by [Walczak 2006] and change from 58.6% in 1988 through 60% in 1995 up to 62.8% in 2004 and after for dairy cattle what was caused by diet improving. As concerns non-dairy cattle, DE values 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%.

Above mentioned parameters were used for calculation GE factor (and further emission factor), for dairy cattle for entire trend 1988–2007 (table 6.1) which fluctuates following changes in milk production and other parameters. So methane emission factor for dairy cattle vary from 88.8 up to 95.9 kg CH_4/animal/year, following GE changes, and is slightly higher then IPCC default one (81 kg CH_4/animal/year) because of using country specific parameters for calculations. 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 are presented in table 6.2. The values of EFs vary from 39.1 up to 48.5 kg CH_4/animal/year. 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 1 year and mature sheep above 1 year Parameters for sheep are presented in table 6.3. Weighted mean emission factors for sheep for 1988–2006 oscillate around IPCC default value of 8 kg CH_4/animal/year (7.8–8.3 kg CH_4/animal/year). 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 2008].

Methane emissions from enteric fermentation of cattle and sheep were based on *Tier 2* method [IPCC 2000, equations 4.1–4.14]. In case of goats, horses and swine the *Tier 1* method and default Emission Factors for CH_4 was applied [IPCC 1997]. Activity data comes from national statistics [GUS R2 2007].

Table 6.1. Dairy cattle population, milk production, daily Gross Energy Intake (GE), CH_4 emissions factors and CH_4 emissions in 1988–2007

Years	Population [thousands]	Milk production [kg/day/cow]	GE Gross Energy Intake [MJ/cow/day]	EF Emission Factor [kg CH_4 / animal / year]	CH4 Emission [Gg CH4]
1988	4806	8.9	235.237	92.573	444.91
1989	4994	9.2	236.590	93.105	464.97
1990	4919	8.9	232.836	91.628	450.72
1991	4577	8.7	229.198	90.196	412.83
1992	4257	8.5	225.947	88.917	378.52
1993	3983	8.7	225.881	88.891	354.05
1994	3863	8.8	226.560	89.158	344.42
1995	3579	8.9	225.712	88.825	317.90
1996	3461	9.2	227.696	89.605	310.12
1997	3490	9.5	229.767	90.420	315.57
1998	3542	9.9	229.602	90.355	320.04
1999	3418	9.9	228.373	89.872	307.18
2000	3098	10.4	230.791	90.824	281.37
2001	3005	10.8	234.447	92.262	277.25
2002	2873	11.0	234.819	92.409	265.49
2003	2897	11.2	235.931	92.846	268.98
2004	2796	11.5	237.233	93.359	261.03
2005	2795	11.7	238.822	93.984	262.69
2006	2824	11.9	239.649	94.309	266.33
2007	2787	12.1	243.636	95.878	267.21

Table 6.2. Non–dairy cattle population, weighted mean mass, daily Gross Energy Intake (GE), CH_4 emissions factors and CH_4 emissions in 1988–2007

Years	Population [thousands]	Weighted mean mass [kg]	GE Gross Energy Intake (Weighted mean) [MJ/animal/day]	EF Emission Factor (Weighted mean) [kg CH_4 / animal / year]	CH4 Emission (Weighted mean) [Gg CH4]
1988	5516	248	101.074	39.776	219.40
1989	5739	257	104.437	41.099	235.87
1990	5130	259	104.856	41.264	211.68
1991	4267	254	102.646	40.395	172.36
1992	3964	245	99.320	39.085	154.93
1993	3660	245	99.369	39.105	143.12
1994	3833	242	98.205	38.647	148.13
1995	3727	246	99.805	39.276	146.38
1996	3675	244	99.279	39.070	143.58
1997	3817	256	103.591	40.766	155.60
1998	3413	309	120.919	47.591	162.41
1999	3137	311	120.480	47.413	148.73
2000	2985	308	121.123	47.666	142.28
2001	2729	305	119.830	47.157	128.69
2002	2660	303	123.221	48.491	128.99
2003	2592	311	120.655	47.463	123.02
2004	2557	315	120.878	47.569	121.63
2005	2688	307	120.384	47.375	127.34
2006	2782	312	121.738	47.943	133.28
2007	2909	316	121.767	47.919	139.40

Table 6.3. Sheep population, daily Gross Energy Intake (GE), CH_4 emissions factors and CH_4 emissions in 1988–2007

Years	Population [thousands]	GE Gross Energy Intake (Weighted mean) [MJ/animal/day]	EF Emission Factor (Weighted mean) [kg CH_4 / animal / year]	CH4 Emission [Gg CH4]
1988	4377	17.933	7.863	34.41
1989	4409	18.128	7.972	35.15
1990	4159	18.192	8.011	33.32
1991	3234	18.035	7.927	25.64

Years	Population [thousands]	GE Gross Energy Intake (Weighted mean) [MJ/animal/day]	EF Emission Factor (Weighted mean) [kg CH_4 / animal / year]	CH4 Emission [Gg CH4]
1992	1870	18.479	8.175	15.29
1993	1268	18.384	8.124	10.30
1994	870	18.552	8.216	7.15
1995	713	18.527	8.205	5.85
1996	552	18.578	8.231	4.54
1997	491	18.668	8.279	4.06
1998	453	18.466	8.173	3.70
1999	392	18.544	8.212	3.22
2000	362	18.474	8.167	2.96
2001	343	18.873	8.383	2.88
2002	345	17.901	7.838	2.70
2003	338	17.858	7.823	2.64
2004	318	18.458	8.174	2.60
2005	316	18.651	8.280	2.62
2006	301	18.402	8.145	2.45
2007	332	18.131	7.992	2.65

6.2.2 *Methane emissions from Manure Management* (CRF 4.B)

The IPCC *Tier 2* methodology was used to establish domestic CH_4 emission factors for cattle, sheep and swine. The *Tier 1* methodology was used for estimation of default emission factors for goats, horses and poultry [IPCC 1997]. The factors recommended for cool climate were used. Animal population was taken from [GUS R2 2007].

The country specific CH_4 emission factors for manure management for dairy and non-dairy cattle (for specific subcategories), sheep and swine were calculated for 2007 based on:

- country specific data on the fraction of manure managed in given AWMS from [Walczak 2007] for which weighted mean value was calculated for the following cattle subcategories: calves under 1 year, young cattle 1-2 years, dairy cows, and other matured cattle over 2 years (table 6.6),
- B_o (methane-producing potential) factors were taken from [IPCC 1997, tables B–3,4,6,7],
- Vs (average daily volatile excreted solids) for dairy, non-dairy cattle and sheep were estimated based on country specific GE; VS for swine was the default value from [IPCC 1997, tables B–6],
- MCFs (methane conversion factors) for individual manure management systems concerning cool climate are from [IPCC 2000, table 4.10].

Examples of above mentioned indicators and emission factors for livestock for 2007 are shown in table 6.4. Entire trend of CH_4 emission factors for cattle, swine and sheep are presented in table 6.5

Table 6.4. Methane-producing potential (B_o), volatile solids excreted (Vs) and CH_4 emission factors for manure management in 2007

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	4.52	10.40
Non-dairy cattle	0.17	2.10	4.81
Sheep	0.19	0.36	0.17
Goats	0.17	0.28	0.12
Horses	0.33	1.72	1.39
Swine	0.45	0.50	6.54
Poultry	0.32	0.10	0.08

Table 6.5. Methane emission factors [kg CH_4/head/year] and emissions [Gg CH_4] trends for 1988–2007 for manure management of cattle, swine and sheep

Years	Dairy cattle		Non–dairy cattle		Swine		Sheep	
	EF	Emission	EF	Emission	EF	Emission	EF	Emission
1988	5.86	28.17	2.00	11.05	5.21	102.21	0.17	0.73
1989	5.91	29.51	2.60	14.91	5.21	98.20	0.17	0.74
1990	5.63	27.69	1.61	8.28	5.40	105.16	0.17	0.70
1991	5.51	25.24	2.09	8.90	5.59	122.28	0.17	0.54
1992	5.27	22.42	1.98	7.84	5.78	127.67	0.17	0.32
1993	5.00	19.93	1.83	6.69	5.97	112.59	0.17	0.22
1994	5.02	19.37	1.75	6.72	6.16	119.88	0.17	0.15
1995	4.99	17.87	1.68	6.25	6.35	129.60	0.17	0.12
1996	4.78	16.53	2.13	7.84	6.54	117.42	0.17	0.10
1997	5.06	17.67	1.55	5.90	6.54	118.54	0.17	0.08
1998	4.73	16.76	1.96	6.71	6.54	125.29	0.17	0.08
1999	5.85	20.00	3.93	12.33	6.54	121.17	0.17	0.07
2000	6.22	19.27	3.91	11.66	6.54	111.92	0.17	0.06
2001	6.28	18.87	3.87	10.57	6.54	111.81	0.17	0.06
2002	9.32	26.79	6.03	16.03	6.54	121.77	0.17	0.06
2003	9.29	26.92	5.91	15.31	6.54	121.61	0.17	0.06
2004	9.27	25.91	5.93	15.16	6.54	111.04	0.17	0.05
2005	9.33	26.07	5.88	15.81	6.54	118.39	0.17	0.05
2006	9.36	26.44	5.97	16.62	6.54	123.42	0.16	0.05
2007	10.40	29.00	4.81	14.01	6.54	118.50	0.17	0.06

6.2.3 *Nitrous oxide emissions from Manure Management* (CRF 4.B)

Livestock population for N_2O emission calculation from manure management was taken from [GUS R2 2007]. The fractions of manure managed in given AWMS for each type of animals, taken from [Walczak 2009], are presented in the table 6.6.

Table 6.6. Fractions of manure managed in given AWMS for each type of animals in 2007

Livestock	Type of AWSM		
	Liquid System	Solid Storage and Dry lot	Pasture Range and Paddock
Dairy cattle	0.0768	0.8068	0.12
Non-dairy cattle	0.1189	0.7862	0.09
Sheep	---	0.5000	0.50
Goats	---	0.9000	0.10
Horses	---	0.9000	0.10
Swine	0.2863	0.7137	---
Poultry	0.2000	0.8000	---

The default values of nitrogen excretion per head of animal for each type of animals (values for Eastern Europe) from [IPCC 1997, table 4–20] (table 6.7) were used for emission calculation. Default values of N_2O emission factors for management systems from [IPCC 2000, table 4.12] were applied (tables 6.8 and 6.9).

Table 6.7. Emissions of nitrogen excreted in livestock manure in 2007 in liquid system and solid storage and dry lot

Livestock	Nitrogen excreted in manure Nex [kg/animal/year]
Dairy cattle	70.0
Non-dairy cattle	50.0
Sheep	16.0
Goats	25.0
Horses	25.0
Swine	20.0
Poultry	0.6

Table 6.8. Factors of N_2O–N emission for various manure management systems [IPCC 2000]

Animal Waste Management Systems	Emission Factor [kg N2O-N/ kg N]
Liquid systems	0.001
Solid storage and dry lot	0.020

Methane emissions from enteric fermentation (443.1 Gg CH_4 in 2006) as well as methane and nitrous oxide emissions from manure management (173.8 Gg CH_4 and 19.6 Gg N_2O in 2006) are closely related to livestock population. So in 2007 CH_4 emissions were slightly higher than in 2006 and much lower than in 1988. There is a general trend of decreasing livestock population since late 1980-ties in Poland, stabilizing in 2000–2007.

6.2.4 *Nitrous Oxide Emissions from Agricultural Soils* (CRF 4.D)

Nitrous oxide emissions from agricultural soils dramatically decreased after 1989 and then stabilized. Since 2004 N_2O emissions slightly go up (figure 6.1). 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.

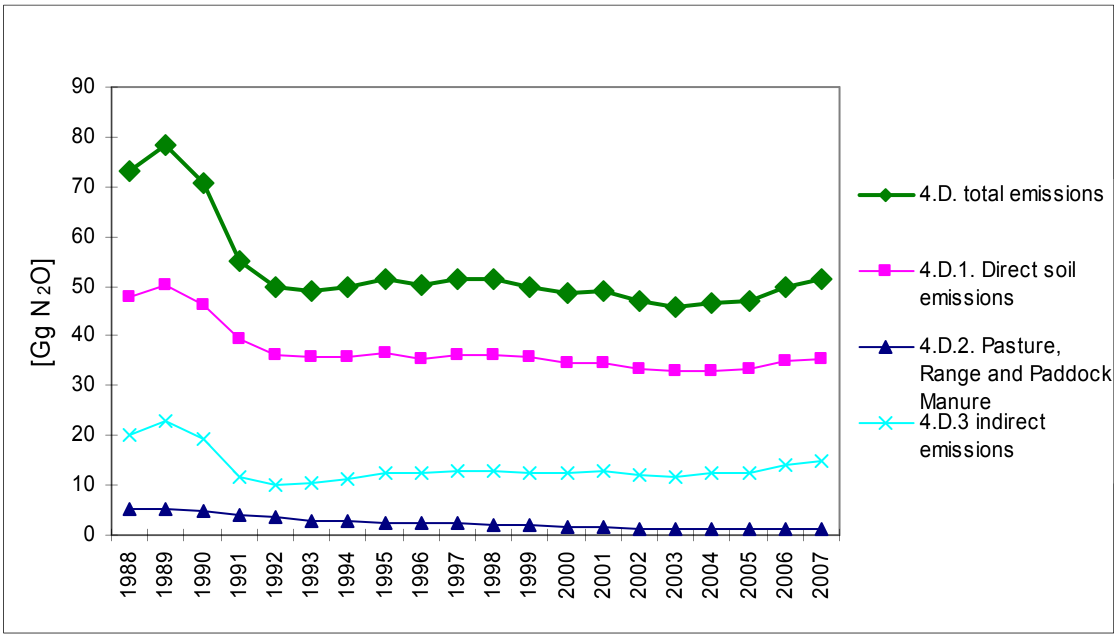


Figure 6.1. N_2O emissions from agricultural soils for 1988–2007

6.2.4.1 *Direct Soil Emissions of Nitrous Oxide* (CRF 4.D.1)

6.2.4.1.1 *N_2O emissions from synthetic fertilizers* (CRF 4.D.1.1)

N_2O emission from synthetic fertilizers was estimated based on the amount of synthetic fertilizer nitrogen applied to agricultural fields published in [GUS R 2008]. The nitrogen fraction converted to N_2O was estimated as 0.9 (1–0.1 $Frac_{gasf}$ – see 4.D.3) and this is default value from [IPCC 1997]. The country specific emission factor (0.008 kg N_2O-N / kg N applied) taken from [Mercik 2001] was corrected for 0.009 kg N_2O-N / kg N as the previous one included the fraction of nitrogen that is emitted as NO_x + NH_3. Activity data concerning consumption of nitrogen fertilizers in terms of pure ingredient amounted for 1056 Gg in 2007 (table 6.9).

Table 6.9. Nitrogen fertilizers use in 1988–2007 in Poland

Years	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Nitrogen fertilizers use [Gg]	1335	1520	1274	735	619	683	758	836	852	890
Years	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Nitrogen fertilizers use [Gg]	891	862	861	895	862	832	895	895	996	1056

Nitrous oxide emissions regarding synthetic fertilizers use in 2007 was about 13.3 Gg N_2O and comparing to 2006 emissions was higher because of increased use of nitrogen fertilizers by about 60 Gg. General trend in N_2O emissions follows nitrogen fertilizers use which decreases from 1335 Gg N in 1988 to 832 Gg N in 2003 and then slightly increases up to 1056 Gg N in 2007 (table 6.9).

6.2.4.1.2 *N_2O emissions from animal manure applied to soils* (CRF 4.D.1.2.)

Manure nitrogen use as fertiliser was estimated according to IPCC guidelines. The total amount of nitrogen in animal excreta was calculated based on animal population taken from [GUS R2 2007] and the default values of nitrogen excretion per head of animal for each type of animals (values for Eastern Europe) from [IPCC 1997]. The data on fraction of manure managed in each AWMS applied in Poland are the country specific data taken from Polish studies [Walczak 2009]. The fractions of manure managed in given AWMS for each type of animals are given in table 6.6.

N_2O emission factors for all listed AWMS were taken from [IPCC 1997, table 4-22]. The fraction of nitrogen excreted during grazing was calculated based on data estimated for 4.D.2 *Pasture, range and paddock manure*. The value of the total nitrogen excretion fraction that is emitted as NO_x and NH_3 (0.2 kg NH_3-N + NO_x-N / kg of nitrogen excreted by livestock) was taken from [IPCC 1997, table 4-19]. The fraction of livestock nitrogen excretion contained in excrements burned was assumed as 0 in calculations.

Nitrous oxide emissions from animal manure applied to soils in 2007 was about 9.7 Gg N_2O and was comparable to those in 2006, but much lower than in base year 1988. This is caused by general decreasing trend of livestock population, mainly cattle and sheep after 1989 (see table 6.1).

6.2.4.1.3 *N_2O emissions from N-fixing crops* (CRF 4.D.1.3)

N_2O emission from N-fixing crops was calculated based on equation 4.26 [IPCC 2000] and the data on sown area of N-fixing crops, published in [GUS R3 2008]. Factors like: residue/crop ratio ($Res_{BF}/Crop_{BF}$), dry matter fraction ($Frac_{Dm}$) and fraction of crop biomass that is N ($Frac_{NCRBF}$) 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 6.2.5). Residue/Crop ratio ($Res_{BF}/Crop_{BF}$) for crops cultivated for forage is taken as 0 according to [IPCC 2000] as the entire plants are harvested as product for forage. Emission Factor for N_2O was taken from Polish case study [Mercik 2001] amounting of 0.01 N_2O– N/1 kg N (assumed that 1% of nitrogen fixed by N-fixing plants is denitrificated to N_2O).

Emissions from N-fixing crops in 2007 amounted for 0.7 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.

6.2.4.1.4 *N_2O emissions from crop residue* (CRF 4.D.1.4)

N_2O emissions from N-fixing plants residues were estimated based on data on sown area of N-fixing crops published in [GUS R3 2008]. There was assumed that 1% of nitrogen fixed by N-fixing plants is denitrificated to N_2O so the emission factor for N-fixing plants is 0,010 N_2O–N/kg N [Mercik 2001]. Additionally there was assumed that nitrogen amount in N-fixing plant residues is 90 kg N/ha [Mercik 2001].

As concerns residues from non N-fixing crops there was assumed that quantity of dry residue from 1 ha of non-N-fixing crop harvested area is 2 Mg d.m. / ha and content of nitrogen in plant residues is 0.76%. The emission factor is 0.010 kg N_2O-N/ kg N contained in residues [Mercik 2001]. The activity data is area sown with other than N-fixing crops which is published in [GUS R3 2008].

Emission from crop residues in 2007 was about 3 Gg N_2O and has stabilized for the last 6 years. But comparing to 1988 the sown area of N–fixing crops has decreased six-fold following general trend of decreasing area of agricultural land in Poland as well as decreasing livestock population (significant part of N-fixing plants are used as forage).

6.2.4.1.5 *N_2O emissions from cultivation of histosols* (CRF 4.D.1.5)

The area of cultivated histosols in Poland was estimated as a case study for the purposes if 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. Estimation of cultivated histosols area for entire time series was made using an interpolation for the 1975–1995 and extrapolation after 1995. N_2O emission from cultivation of histosols was estimated based on default emission factor for Mid-Latitude Organic Soils from [IPCC 2000, table 4.17]: 8 kg N_2O-N /ha.

Nitrous oxide emissions from cultivated histosols in Poland in 2007 was about 8.8 Gg N_2O and is falling since 1988 because of continuous progress of mineralization of organic matter as well as increasing area of histosols occupied by forest and scrub communities following cultivation termination of these areas.

6.2.4.2 *N_2O emissions from pasture, range and paddock manure* (CRF 4.D.2)

Animal population for calculation of N_2O emission from pasture range and paddock was taken from [GUS R2 2007]. Total amount of nitrogen in animal excreta was estimated based on the data presented in table 6.7. The default values of nitrogen excretion per head of animal for each type of animals (values for Eastern Europe) from [IPCC 1997, table 4-20] were used. The data on fraction of manure related with grazing animal are the country specific data taken from Polish case study [Walczak 2009]. N_2O emission factor for pasture range and paddock is 0,02 kg N_2O-N/kg N and was taken from [IPCC 1997, table 4-19].

Table 6.10. Fraction of manure related with grazing animal, nitrogen excreted in AWMS systems in 2007

Livestock	Nitrogen excreted in AWMS [kg N / year / 1000]
Dairy cattle	22709.278
Non-dairy cattle	13815.664
Sheep	2656.000
Goats	360.000
Horses	822.500
Total	40363.442

Emissions in 2007 from pasture, range and paddock manure were 1.3 Gg N_2O and has stabilized since 2002, but this value is much lower than in 1988 by about 75% what was caused by decreasing livestock population as well as decreasing percentage of livestock grazed.

6.2.4.3 *Indirect N_2O emissions* (CRF 4.D.3)

The *Tier 1a* method was used for assessing indirect emissions of N_2O in Poland. The basic equation for estimating a country's indirect N_2O emissions:

$$N_2O_{indirect} \rightarrow N = N_2O_{(G)} \rightarrow N + N_2O_{(L)} \rightarrow N,$$

where:

$N_2O_{indirect} \rightarrow N$ – emissions of N_2O in units of nitrogen,

$N_2O_{(G)} \rightarrow N$ – N_2O produced from volatilisation of applied synthetic fertiliser and animal manure N, and its subsequent atmospheric deposition as nitrogen compounds (kg N/year),

$N_2O_{(L)} \rightarrow N$ –N_2O produced form leaching and runoff of applied fertiliser and animal manure N (kg N/year).

6.2.4.3.1 *Atmospheric deposition* (CRF 4.D.3.1)

Atmospheric deposition of nitrogen compounds fertilises soils and surface waters. It results in enhanced biogenic N_2O formation. According to this methodology the amount of N applied to soils is equal to the total amount of synthetic fertiliser nitrogen applied to soils plus the total amount of animal manure nitrogen excreted in country. Those values have to be multiplied by appropriate volatilisation factors. This sum is then multiplied by an emission factor (table 6.11). Calculations were made according to the following equation:

$$N_2O_{(G)} \rightarrow N = [(N_{FERT} * Frac_{GASF}) + (Nex/1000 * Frac_{GASM})] * EF_4,$$

where:

$N_2O_{(G)} \rightarrow N$ – N_2O produced from volatilisation of applied synthetic fertiliser and animal manure N, and its subsequent atmospheric deposition as nitrogen compounds,

N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soils, this value is taken from [GUS R 2008],

Nex – total amount of animal manure nitrogen excreted in AWMS system (table 6.7),

$Frac_{GASF}$ – fraction of synthetic N fertiliser that volatilises to nitrogen compounds, default value [IPCC 1997, table 4-19],

$Frac_{GASM}$ – fraction of animal manure N that volatilises to nitrogen compounds, default value [IPCC 1997, table 4-19],

EF_4– emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, default value [IPCC 2000, table 4.18].

Table 6.12. Estimation of indirect emissions of N_20–N from atmospheric deposition in 2007

N_{FERT} [Gg/year]	$Frac_{GASF}$ [kg N/kgN]	Nex [kgN/year/1000]	$Frac_{GASM}$ [kg N/kg N]	EF [kgN_2O-N/kg N]	$N_2O_{(G)} \rightarrow N$ [GgN_2O-N]
1 056	0.1	40 363.44	0.2	0.01	1.14

6.2.4.3.2 *Nitrogen leaching and run-off* (CRF 4.D.3.2)

Part of the nitrogen is lost from agricultural soils through leaching and runoff, an d gets to the groundwater, rivers and wetlands. It results in biogenic production of N_2O. To estimate the amount of applied N that leaches or runs off, the total amount of synthetic fertiliser nitrogen and the total amount of animal N excretion must be summed and then multiplied by a fraction of N input, that is lost through leaching and runoff. Then it must be multiplied by an appropriate emission factor (table 6.12). Calculations were made according to the following equation:

$$N_2O_{(L)} \rightarrow N = (N_{FERT} + Nex/1000) * Frac_{LEACH} * EF_5,$$

where:

$N_2O_{(L)} \rightarrow N$ – N_2O produced form leaching and runoff of applied fertiliser and animal manure N,

N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soils, this value is taken from [GUS R 2008],

Nex – total amount of animal manure nitrogen excreted in AWMS system (table 6.7),

$Frac_{LEACH}$ – fraction nitrogen input to soil that is lost through leaching and runoff, default value [IPCC 1997, tab. 4-24],

EF_5 – emission factor for N_2O emissions for leaching/runoff, default value [IPCC 2000, tab. 4.18].

Table 6.13. Estimation of indirect emissions of N_20–N from nitrogen leaching and run-off in 2007

N_{FERT} [Gg/year]	Nex [kgN/year /1000]	$Frac_{LEACH}$ [kg N/kg N]	EF [kgN_2O-N/kg N]	$N_2O_{(L)}$ [GgN_2O-N]
1 056	40 363.44	0.3	0.025	8.223

The following equation is a conversion of $N_2O \rightarrow N$ emissions to N_2O emissions:

$$N_2O = N_2O \rightarrow N * 44/28$$

Indirect emission in 2007 was about 14.7 Gg N_2O and was higher than in 2006 and lower than in 1988. The main reason for this was change in nitrogen fertilizers use in particular years (see table 6.9).

6.2.5 *Field Burning of Agricultural Residues* (CRF 4.F)

CH_4 and N_2O emissions from burning of agricultural residues in fields in 2006 were estimated 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 containing cereals, pulses, tuber and root, oil-bearing plants, vegetables and fruits which residues could be burned on fields. Activity data concerning crop production was taken from [GUS R3 2008]. 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 6.13.

Greenhouse gas emissions in 2007 from field burning of agricultural residues amounted for 1.19 Gg CH_4 and 0.05 Gg N_2O and was higher than in 2006 because of increased crop production. The main reason for low crop production in 2006 was drought that occurred in spring and summer months of 2006 in many regions of Poland.

Table 6.13. 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 oxidised	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

6.3 Uncertainties

Uncertainty analysis for this IPCC sector was prepared with use of *Tier 1* methodology defined in the IPCC Good Practice Guidance. Summary results of the analysis are presented in the table 6.14., more detailed information for this and other sectors can be found in annex 5 of this report.

Table 6.14. Uncertainty analysis estimation for sector *Agriculture*

2007	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
4. Agriculture		**618.10**	**71.16**		27.4%	65.1%
A. Enteric Fermentation		443.13			34.3%	
B. Manure Management		173.78	19.61		42.8%	148.2%
D. Agricultural Soils			51.51			70.1%
F. Field Burning of Agricultural Residues		1.19	0.05		21.5%	93.0%

6.4 Recalculations

Following recommendations Expert Review Team reviewing Polish inventory in 2008 the recalculations in some agriculture subcategories were made:

- Emissions of N_2O from cultivated histosols (CRF 4.D.1.5) for 1988–1989 have been recalculated based on an updated area of histosols following case study [Oświecimska–Piasko, 2008] to keep series consistency. This change resulted in decrease of N_2O emissions by 11.6% in 1988 (1.3 Gg) and 11.4% in 1989 (1.3 Gg).
- N_2O emissions from N–fixing crops (CRF 4.D.1.3) was calculated using equation 4.26 [IPCC 2000]. N_2O emissions from crop residues (CRF 4.D.1.4) were earlier estimated separately as subcategories 4.D.1.3 and 4.D.1.4. Those recalculations resulted in increase in N_2O emissions in both subcategories by 50% in 1988 (from 4.9 up to 7.3 Gg) and by 23% in 2006 (from 3.0 to 3.7 Gg).

Additionally some minor corrections were made in CH_4 emissions for subcategory 4.A Enteric fermentation and 4.B Animal manure related to correction of herd population as well as Gross Energy factors for non-dairy cattle what caused slight increase in emissions (0.01–0.09 Gg CH_4) for years: 1998, 2003, 2005 and 2006.

6.5 Planned improvements

Following recommendations Expert Review Team reviewing Polish inventory in 2007 some further improvements are scheduled in the agriculture sector:

- Due to change in non–dairy cattle livestock age characterization since 1998 the test was taken for consistency for entire inventoried series Analysis indicated lack of consistency in reporting of population of calves aging of 0–6 months and 6–12 months before and after 1998 in official statistics (GUS), what needs further analysis.
- More specific AWMS division for subcategories for non–dairy cattle is scheduled for 2009 to apply fully the *Tier 2* methodology in estimating CH_4 emissions for this category of livestock for 1988–2006.

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

7.1 Key categories

Following categories from sector 5 have been identified as appendix 1.

7.2 Sector overview and methodological issues

The inventory for 2007 for land use, land use change and forestry sector were estimated according to new [IPCC 2003] methodology and results are presented in table 7.1.

Table 7.1. Total CO_2 emissions and removals from LULUCF sector in 2007

Greenhouse gas source and sink categories	2007		
	Net CO_2 emissions/ removals	CH_4	N_2O
	(Gg)		
5. Total Land-Use Categories	-42884.77	113.581	0.008
5A. Forest Land	-54132.18	0.146	0.001
1. Forest Land remaining Forest Land	-50555.19	0.146	0.001
2. Land converted to Forest Land	-3576.99	IE	IE
5B. Cropland	8419.64	IE	IE
1. Cropland remaining Cropland	8419.64	IE	IE
2. Land converted to Cropland	0.00	IE	IE
5C. Grassland	-201.00	0.180	0.000
1. Grassland remaining Grassland	134.91	0.180	0.000
2. Land converted to Grassland	-335.91	IE	IE
5D. Wetlands	3102.14	113.255	0.007
1. Wetlands remaining Wetlands	3102.14	113.255	0.007
2. Land converted to Wetlands	0.05	NO	NO
5E. Settlements	-73.42	NO	NO
1. Settlements remaining Settlements	-73.42	NO	NO
2. Land converted to Settlements	0.00	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 2007

Year	2007
Greenhouse gas source and sink categories	Area [ha]
5. Total Land-use categories	
5A. Forest Land	9 255 000.00
total organic soils area at forest area	240 560.00
total mineral soils area at forest area	9 014 440.00
5.A.1. Forest Land remaining Forest Land	8 858 000.00
organic soils	231 381.25
mineral soils	8 626 618.75
5.A. 2. Land converted to Forest Land	397 000.00
organic soils	9 178.75
mineral soils	387 821.25
5B. Cropland	12 206 000.00
5B1. Cropland remaining Cropland	12 206 000.00
drained organic soils	553 663.60
mineral soils	12 741 000.00
5.B.1A Other Cropland remaining Cropland (temporarily not in use)	0.00
5.B.2. Land converted to Cropland	0.00
5C. Grassland	3 271 000.00
5C1. Grassland remaining Grassland	3 216 000.00
drained organic soils	147 176.40
mineral soils	3 068 823.60
5.C.2. Land converted to Grassland	0.00
5D. Wetlands	880 200.00
5D1. Wetlands remaining Wetlands	
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	872 000.00
5.D.2. Land converted to Wetlands	879 000.00
Area of land converted annually to flooded land	7 000.00
Area of land converted annually to peat extraction	0.00
Area of nutrient poor organic soils converted to peat extraction	0.00
5E. Settlements	2 041 000.00
5E1. Settlements remaining Settlements	2 024 000.00
5E2. Land converted to Settlements	17 000.00
5F. Other Land	3 615 800.00
5G. 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 2007 was a net CO_2 sink. Detail results of inventory made according to subcategories are given below.

7.2.1. Forest Land (CRF 5.A)

GHG balance in this category is a net sink. In 2007 net CO_2 sink was about 54 132 Gg CO_2 .

Area of Forest lands in Poland in year 2007

According to data on December 31, 2007 forest land in Poland equals 9,048,000 ha. This is equivalent to 28.9% of the forest cover [Raport 2007]. The highest level of forest cover appears in Lubuskie Province (48.87%), the lowest – in Łódzkie Province (20.9%), The forest cover in Poland is presented in figure 7.1 bellow:

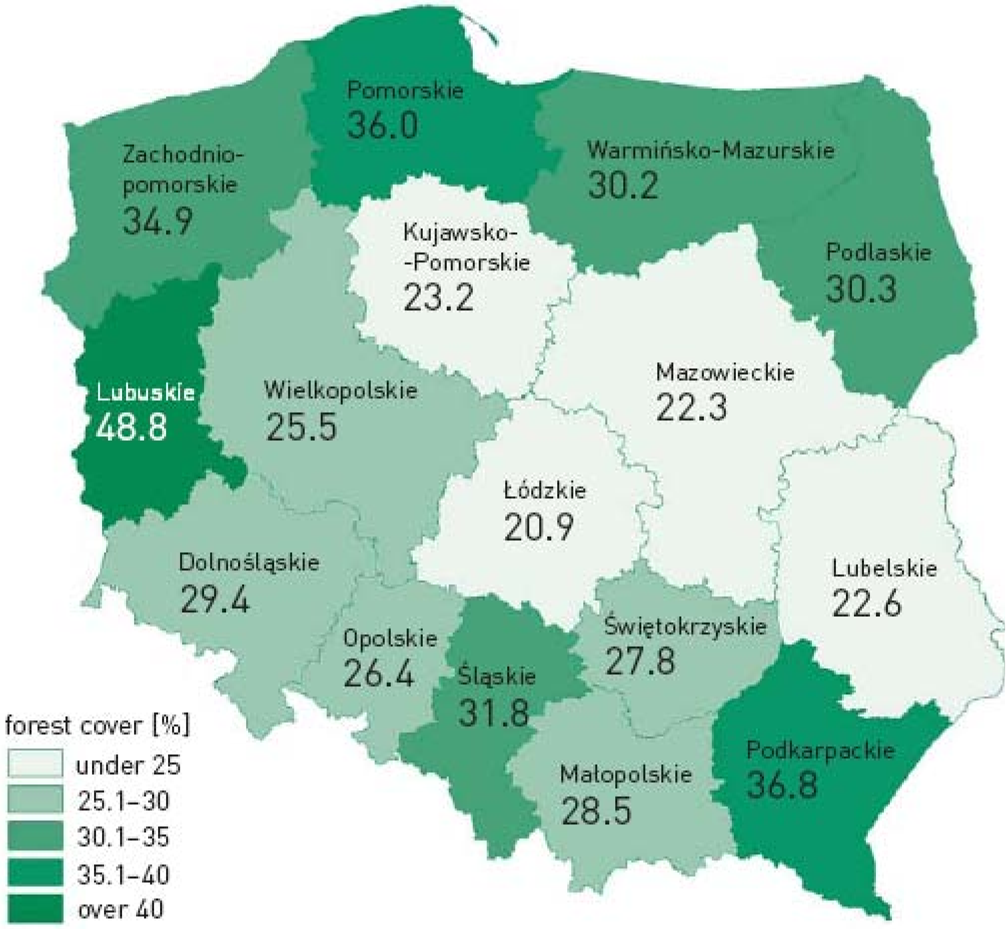


Figure 7.1. Forest cover by provinces
Source: Forests in Poland 2008. Centrum Informacyjne Lasów Państwowych. Lasy Państwowe.

In 2007, comparing with 2006, forest cover increased by 22,000 ha. Since 1990 forest cover in Poland has expanded to 354,000 ha. [Raport 2007].

Ownership structure

The structure of ownership in Poland is predominated by public owned forests – 82.1% of the area, including the forests under the State Forests NFH management – 78.1%. The area of the forests in private hands equals 17.8% of the total area.

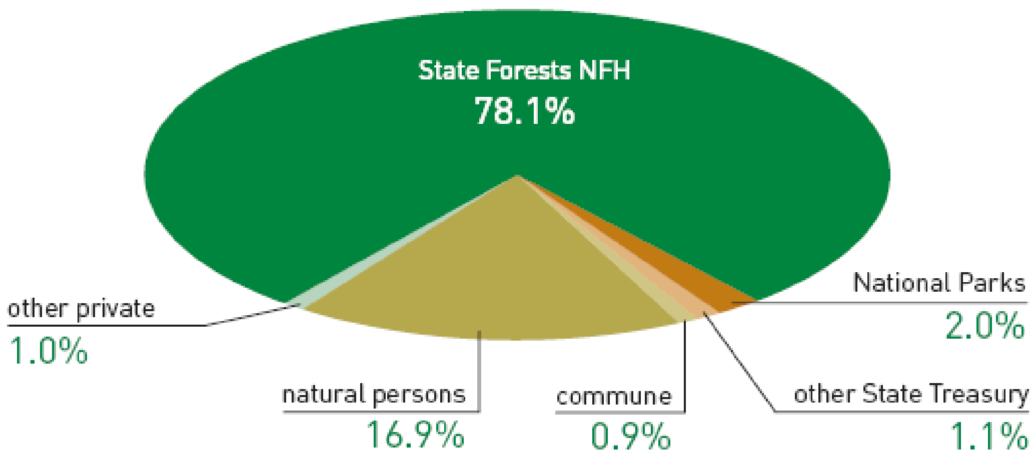


Figure 7.2. Structure of forest ownership in Poland
Source: Forests in Poland 2008. Centrum Informacyjne Lasów Państwowych. Lasy Państwowe.

In the whole post-war period the ownership structure remained almost unchanged. The year 1990 saw an increase by 0.9% of the forests in private hands and the share of public-owned forests has decreased by the same value. There has been a notable rise in the share of forests from the second group within the national parks area – from 1.3% in 1990 up to 2.0% in 2007. [Raport 2007].

Wood reserves

According to the last "Forest Area and Wood Reserves Revision", updated on January 1, 2008 by the Forest Management and Geodesy Bureau and the State Forests NFH, the wood reserves in forests managed by the State Forests NFH gained 1,676,180.1 thou. m^3 of gross merchantable timber. On the other hand, Forest Management and Geodesy Bureau's data (status on January 1, 1999), concerning reserves in the private and commune-owned forests, note 188.6 million m3 of gross merchantable timber. Last information regarding the whole country wood reserves (by Central Statistical Office) refers to 1997. The comparison of the resources managed by the State Forests NFH and of forests in other forms of ownership (experts' estimation updated on January 1, 2008) reveals that their total value was approximately 1,914 million m^3 of gross merchantable timber at that time. [Raport 2007].

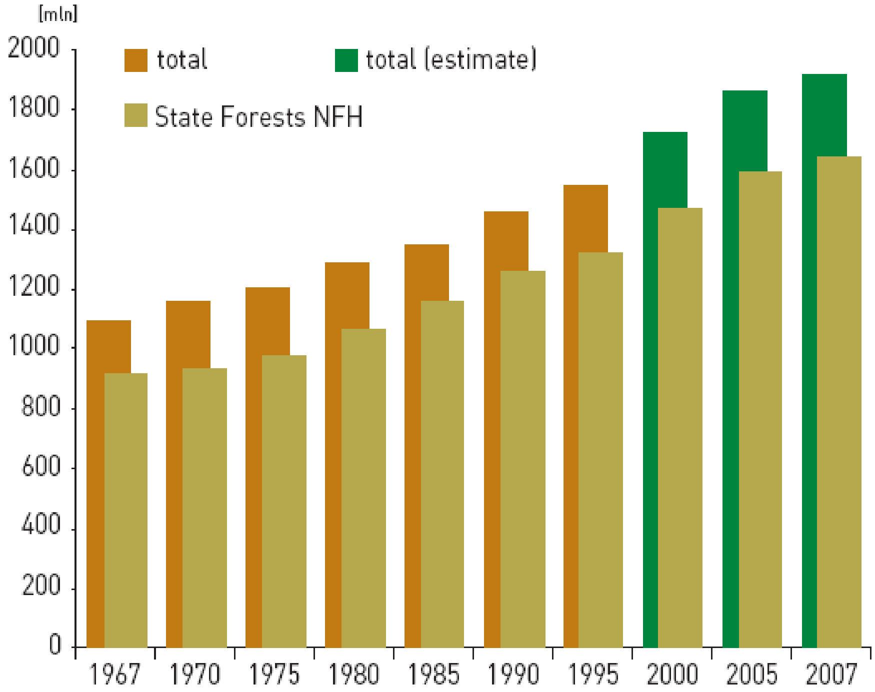


Figure 7.3. Wood resources in forests of Poland in 1967–2007, calculated in mln m^3 of gross merchantable timber

Source: Forests in Poland 2008. Centrum Informacyjne Lasów Państwowych. Lasy Państwowe.

Species structure

Species structure in forests in Poland is presented bellow:

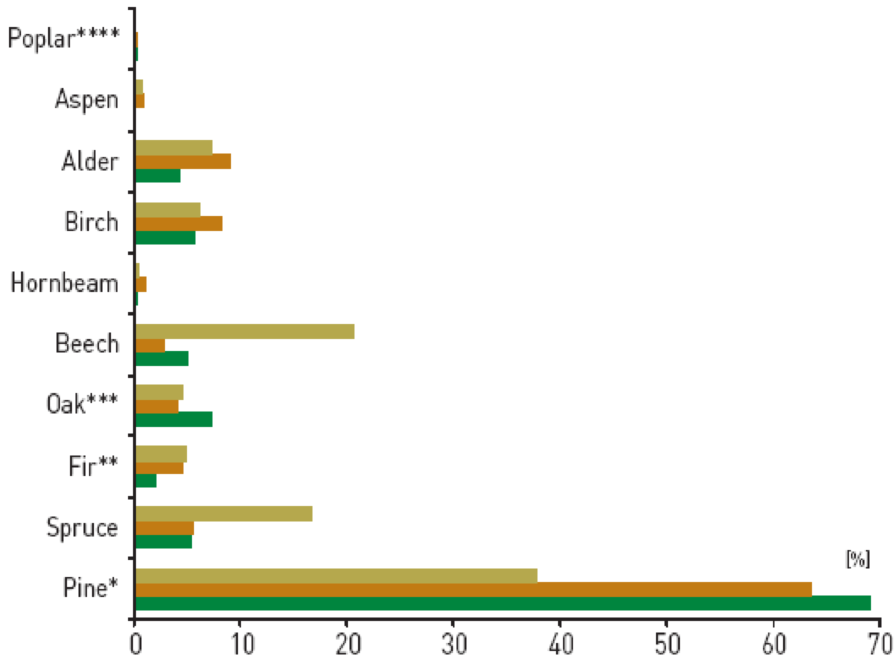


Figure 7.4. Total share of dominant species in the area of the State Forest NFH, National Parks, private and commune – owned stands

Source: Forests in Poland 2008. Centrum Informacyjne Lasów Państwowych. Lasy Państwowe.

Coniferous species dominate in Polish forests, covering nearly one third of the total forest area. Pine (accounting for 69% of stands in the State Forests NFH and 63% in private and commune-owned forests) finds the optimal climatic and site conditions within its Euro-Asiatic natural range, thus being capable of developing a number of important ecotypes. In the period 1945–2007, the species structure of Poland's forests underwent substantial changes expressed, among other things, in an increase in the share of stands with the prevalence of broadleaved species. In the State Forests NFH, where these changes could be observed, the increase was from 13% to 24%. Nonetheless, the proportion of broadleaved stands is still lower than could be expected, which results from the geographical distribution of forest habitats.

Age structure

Stands aged 41-80, representing age classes III and IV prevail in the age structure of Poland's forests, covering 25 % and 19% of the area, respectively. As of 1999, stands aged 21-40 occupied 35% of forest area and stands in age class III – 25%. Stands older than 100 years, including stands in the restocking class (KO), stands in the class for restocking (KDO) and stands with selection structure (SP) under the management of the State Forests NFH accounted for 14% of the area, while those in private and commune-owned forests – merely 2%. The share of unforested land in private and commune-owned forests accounted for slightly over 5%, while in the State Forests NFH, it is 5%.

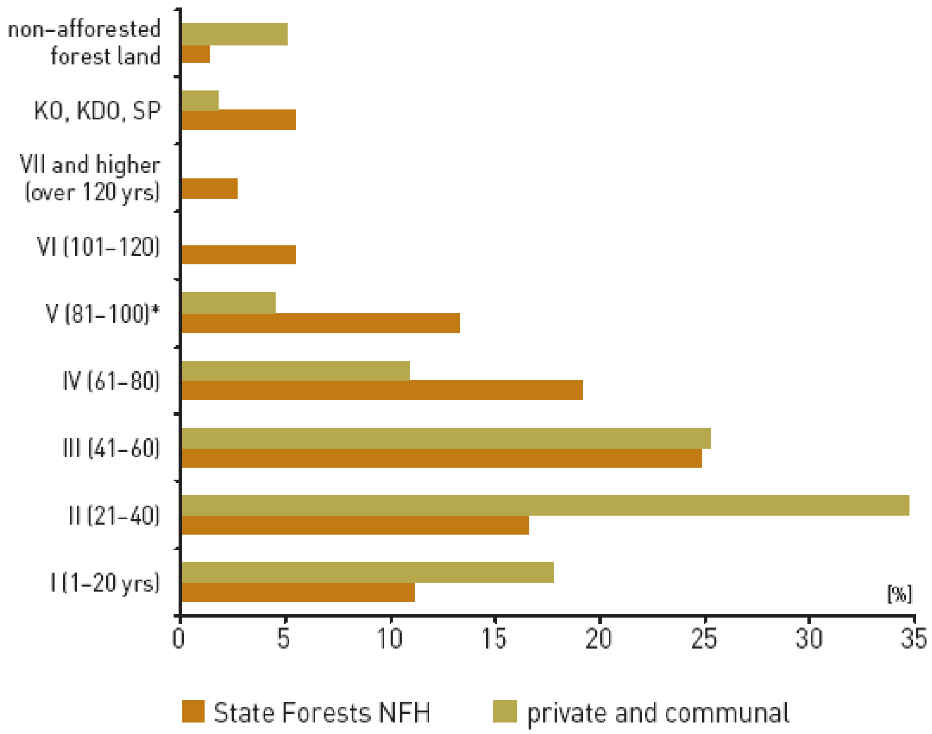


Figure 7.5. Area share of stands by age class in the States Forests NFH, private and commune forests

Source: Forests in Poland 2008. Centrum Informacyjne Lasów Państwowych. Lasy Państwowe.

As regards the change in the age structure of stands over time, the proportion of stands older than 80 years continues to increase, from c. 0.9 million hectares in 1945, to c. 1.6 million hectares (excluding the KO and KDO classes) in 2007. The average age of stands within the State Forests NFH did not change and was 60 years in 2006, and 40 years in private forests in 1999.

Structure of stand volume

According to the statistics on January 1, 2008, with regard to the forest area (except for land associated with forestry), the average stands volume in forests managed by the State Forests NFH was at the level of 240 m3/ha. In private and commune-owned forests – 119 m3/ha according to the data provided on January 1, 1999.

Annual increment of the timber resources

The gross merchantable timber increment is estimated on the basis of the difference in volume by the end and beginning of the year, considering harvest in a given year. The values of the current net growth (increasing standing timber resources) and gross growth (after taking into account harvest and so-called loses in bucking) in the recent 20 years in the State Forests NFH are presented bellow:

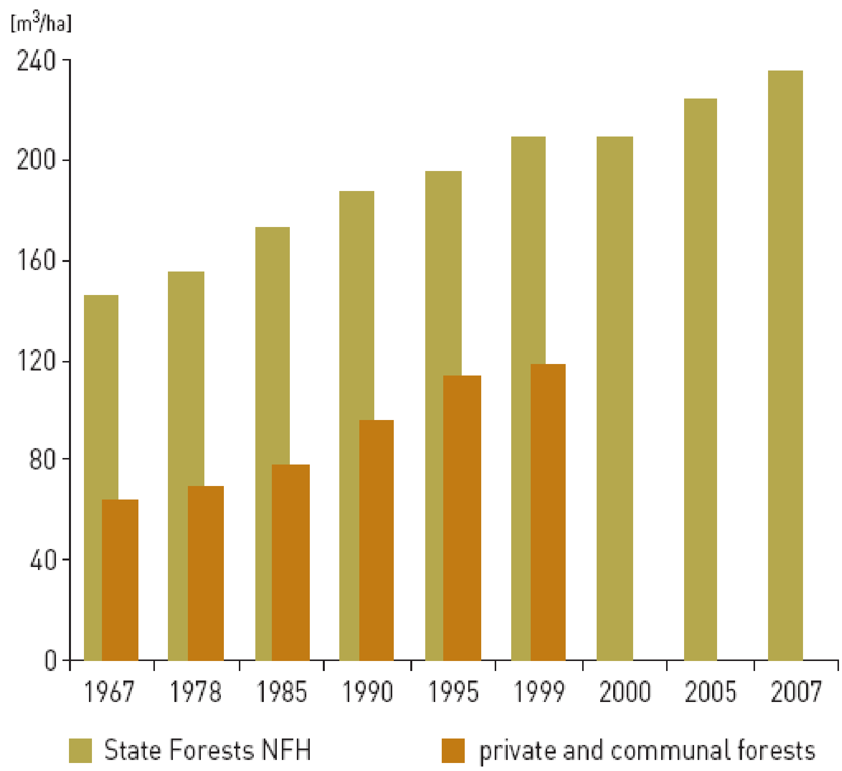


Figure 7.6. Current net growth of timber resources and the value of gross merchantable timber (plus the loses in production) in forests managed by the State Forests NFH in the period 1986–2007 calculated in mln m^3 (Central Statistical Office, Forest Management and Geodesy Bureau).
Source: Forests in Poland 2008. Centrum Informacyjne Lasów Państwowych. Lasy Państwowe.

The lack of current and reliable data concerning timber resources in privately owned, communal, and State Treasury owned forests, except for those of the State Forests NFH, makes it impossible to trace changes in the volume of forest resources throughout the country.

However, it is possible to define the increment of timber resources in the State Forests NFH on the basis of the information on the volume of resources at the end and at the beginning of the year, taking into consideration a given year's harvest.

From January 1987 to January 2007, gross merchantable timber increment in the forests managed by the State Forests National Forest Holding amounted to about 993 million m^3. During that period, 545 million m^3 of merchantable timber was harvested which means that 448 million m^3 of gross merchantable timber representing about 45% of total increment augmented the standing volume.

The average annual increment in gross merchantable timber calculated, for the last 20 years (1987–2006), from the difference in volume by the end (January 2007) and beginning (January 1987) of the period including harvest and per hectare of forest land administered by the State Forests NFH is 7.2 m^3/ha. In turn, the mean annual increment in gross merchantable timber calculated in the State Forests NFH over the last five years is 9.1 m^3/ha.

Accompanying infrastructure

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.

Soil area related to the forestry in Poland, according to the state on 31.12.2007, reached 206.000 ha, including 200.000 ha in the State Forests. [Central Statistical Office – Forestry 2008]

7.2.1.1. Forest Land remaining Forest Land (CRF 5.A.1)

GHG balance in this category is a net sink. In 2007 net CO_2 sink was about 50 555 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.

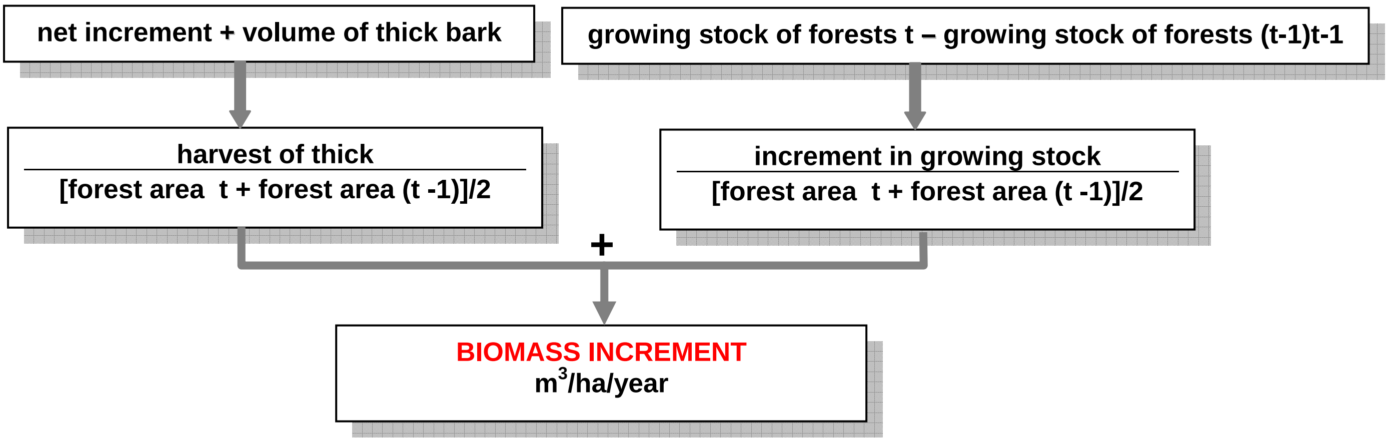
Live organic matter

Increase in forest

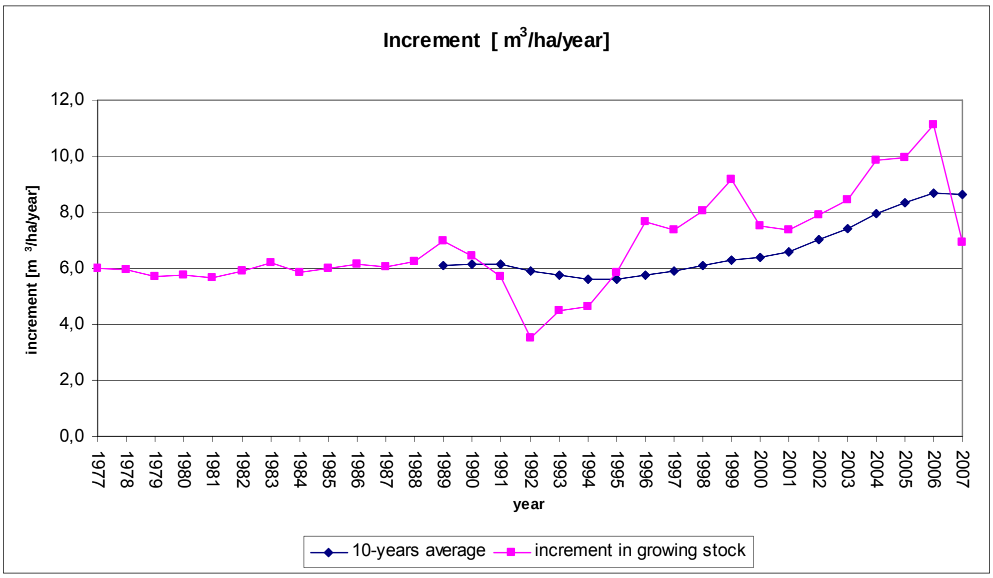
Increase of woody biomass in forest of all owners forms was estimated based on data published in Statistical Year Book for Forestry [Central Statistical Office 2007c]. Source data contains also area–volume tables with age classes prepared by Forest Management and Geodesy Bureau in order of Directorate General of State Forests published in annual reports "Results of updated estimates of forestry areas and resources in state owned forests" [BULiGL 2007 and 2008].

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 (m3/ha/year) for all forests is based on data of increment in growing stock and harvest of thick. Data of harvest of thick are given as net volume of thick wood (without bark). For calculation of harvest of thick it is necessary to add estimated volume of thick bark to net harvest of thick (assume that thick bark is about 25% of thick wood without bark [Czuraj, 1991]). Share of roots in harvest of thick was also estimated. Default ratio from guidelines AFOLU [IPCC 2006] was used – 0.17 (page 4.49, table 4.4).
Increase is determined by forest type, age class and quality of forest habitats.

Scheme for calculation of increase in biomass in forests is presented bellow (Figure 7.7):



Calculations of annual increment are based on forest area and growing stock of forests [Central Statistical Office 2008]. 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. The results are presented at the graph bellow (Figure 7.8):



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 from Forest Management and Geodesy Bureau (2008.01.01)

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	0.46	1168376.1	0.318172
Spruce	0.41	102570.4	0.025361
Fir	0.40	45572.2	0.010825
Beech	0.60	98483.9	0.035415
Oak	0.60	111356.7	0.040147
Hornbeam	0.67	4516.1	0.001799
Birch	0.56	70837.4	0.023618
Alder	0.46	65212.0	0.018059
Poplar	0.39	1896.3	0.000437
Aspen	0.39	3918.0	0.000917
Sum	-	1672742.1	-
Weighted mean wood density			0.48131

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 by data from Forest Management and Geodesy Bureau. (2008.01.01)

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]	[t/m^3]
Pine	360339.5	0.89	320702.2	451548.6	-
Spruce	40755.8	0.68	27713.94	39021.23	-
Fir	20702.4	0.75	15526.8	21861.73	-
Beech	48390.5	0.91	44035.36	62001.78	-
Oak	59255.9	0.96	56885.66	80095.01	-
Hornbeam	1241.3	0.86	1067.518	1503.065	-
Birch	5031.6	0.83	4176.228	5880.129	-
Alder	13880.2	0.64	8883.328	12507.73	-
Poplar	47.4	0.56	26.544	37.37395	-
Aspen	1092.6	0.44	480.744	676.8876	-
Sum	550737.2			675133.6	1.225872

* 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 is equal 0.307. It was calculated by use of volume of thick for conifers and broadleaves and multiplying it by adequate factors (conifers – 0.23, broadleaves – 0.32 [IPCC 2003]).

Dead organic matter

Assumed that carbon stock change in dead organic matter (dead wood and litter) is equal zero.

Forests soils

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	2007 (t)	1987 (t-20)
High Activity Soils	39.6	31.4
Low Activity Soils	19.0	19.8
Sandy	37.3	45.1
Wetland	4.2	3.7
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	50 or 95	110.0
	Low Activity Soils	33 or 85	70.0
	Sandy	34 or 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 if 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. Estimation of cultivated histosols area for entire time series was made using an interpolation for the 1975–1995 and extrapolation after 1995.

Total organic soils area in 2007 was estimated for 240 560 ha, with the following split for subcategories: forest land remaining forest land – 231 381,25 ha, land converted to forest land – 9 178,75 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.

<u>CH_4, N_2O, CO and NOx emissions from forest fires</u>

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 0.03 [IPCC],
D – emission factor [g/kg d.m.] – see table 7.8

Table 7.8. Emissions ratios for calculation CH4, N2O, 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 CO2 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.

7.2.1.2. Land converted to Forest Land (CRF 5.A.2)

GHG balance in this category is a net sink. In 2007 net CO_2 sink was about 3 576 Gg CO_2. Calculations for this subcategory are analogical to calculations for subcategory 5.A.1.

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

7.2.2. Cropland (CRF 5.B.)

This category includes arable and tillage land, and agro-forestry systems (orchards) where vegetation character is not consistent with the selected of national definitions for forest land category.
In 2007 this category was a net CO_2 emissions and accounted for about 8 419 Gg CO_2.

7.2.2. Cropland remaining Cropland (CRF 5.B.1.)

Living organic matter

Annual carbon stock change in living biomass was calculated based on cropland area covered by perennial woody biomass (orchards). Annual growth rate for perennial woody biomass was calculated as 0.18 [t C/ha*year].

GHG balance in this category is a net sink. In 2007 net CO_2 sink was about 93 Gg CO_2.

Agriculture soils

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	50 or 95	51.5
	Low Activity Soils	33 or 85	44.1
	Sandy	34 or 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 - $F_{LU}(0\text{-}T) = 0.80$, [IPCC 2003 tab. 3.3.4. page 3.77],
- stock change factor for management regime in the beginning of inventory year - $F_{MG}(0\text{-}T)=1.00$ [IPCC 2003 tab. 3.3.4. page 3.77],
- Stock change factor for input of organic matter in the beginning of inventory year - $F_I(0\text{-}T)=1.1$ [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 if 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–1970–ties and mid–1990–ties. The area from which CO_2 and N_2O emissions were calculated covers 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. Estimation of cultivated histosols area for entire time series was made using an interpolation for the 1975–1995 and extrapolation after 1995. 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 2007 from agricultural lime application was 386,1 Gg CO_2. Emission from lime application is decreasing. Emission from agricultural lime application is reported together with lime application in Grassland.

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

7.2.2.2. Land converted to Cropland (CRF 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.

7.2.3. Grassland (CRF 5.C1)

This category includes rangelands and pasture land that are not considered as croplands. In Poland there is no perennial woody biomass on area of grassland.

GHG balance in this category is a net sink. In 2007 net CO_2 sink was over 201 Gg CO_2.

7.2.3.1. Grassland remaining Grassland (CRF 5.C.1)

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

Soils

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 [kg d.m./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.

7.2.3.2. Land converted to Grassland (CRF 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.

Soils

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	50 or 95	99.0
	Low Activity Soils	33 or 85	66.0
	Sandy	34 or 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

CO2 emission from cultivated organic soils converted to grassland is reported in subcategory 5.C.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.

7.2.4. Wetlands (CRF 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.

7.2.4.1 Wetlands remaining wetlands (CRF 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 2007 was 1 200 ha and area of flooded land was 880 200 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		
low peat deposit	67 120		
nutrient poor organic soils, in it:	11 220		
transition peat deposit	2 116		
high peat deposit	5 136		
mix-typical peat deposit	3 055		
other peat deposit	913		
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 2000-2006 value from year 1999 was taken.

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 2007d]. 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.

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	

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	

CH_4 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.]

7.2.4.1 Land converted to Wetlands (CRF 5.D.2.)

In 2007 annual carbon stock change in living biomass was estimated on 0.05 Gg CO_2.
Calculations are based on equation 3.5.6, page 3. 140, IPCC 2003.
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.

7.2.5. Settlements (CRF 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

7.2.5.1. Settlements remaining Settlements (CRF 5.E.1.)

GHG balance in this category is a net sink. In 2007 net CO_2 sink was about 73 Gg CO_2.

Living organic matter

Calculations for carbon stock changes in living biomass were based on crown cower area method (urban green area - GUS 2007 Environmental Protection table 50(268), page 318).
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=1.8t C/ha crown cover*year [IPCC 2003, page 3.297]

7.2.5.2. Land converted to Settlements (CRF 5.E.2.)

Emissions/ removals from this subcategory was not estimated. Forest lands in Poland are not converted to any other lands. Forest land after deforestation remain forest land, because in future these lands are reforested.

7.2.6. Other land (CRF 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.

7.3 Uncertainties

Uncertainty analysis for this IPCC sector was prepared with use of *Tier 1* methodology defined in the IPCC Good Practice Guidance. Summary results of the analysis are presented in the table 7.13., more detailed information for this and other sectors can be found in annex 5 of this report.

Table 7.13. Uncertainty analysis estimation for sector *Land Use, land use Change and Forestry*

2007	**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	**-42884.81**	**113.59**	**0.01**	19.3%	99.7%	88.0%
A. Forest Land	-54132.18	0.146	0.001	15.0%	100.0%	100.0%
B. Cropland	8419.60			15.0%		
C. Grassland	-201.00	0.17984	6.415E-06	15.0%	100.0%	100.0%
D. Wetlands	3102.19	113.26	0.0068	15.0%	100.0%	100.0%
E. Settlements	-73.42			15.0%		
F. Other Land						

7.4 Recalculations

No recalculations were made.

7.5 Planned improvements

A large area inventory of the national forests of all the ownership categories started in 2005 and covered a five-year cycle (2005-2009). The aim of this study is to identify and then to monitor the forest status as well as the rate and trend of the change taking place in forests. The inventory results will be used for statistical purposes; in addition to the provision of data on Polish forests for national and international reporting purposes, they will also serve for the formulation, implementation and assessment of the National Forest Policy. It is planned to analyze and use large inventory results for emissions end removal estimations in sector 5 LULUCF including activities under article 3.3 and 3.4 of Kyoto Protocol.

8. Waste (CRF sector 6)

8.1 Key categories

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 1.6%

8.2 Methodological issues

The methane emissions from solid waste disposals in 2004 were calculated using the IPCC Waste Model 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 oxidised 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 2008].

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	0.16-0.19	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
Sewage sludge	0.04-0.05	0.05	0.05
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
Sewage sludge	0.1–0.2	0.185	0.185
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 2008]
- Municipal Solid Wastes (MSW) – 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 t/m^3.

Table 8.4. Data sources for amount of municipal waste

1970	4113.98	[GUS 1987]
1971	4624.65	interpolation
1972	5135.31	interpolation
1973	5645.98	interpolation
1974	6156.64	[GUS 1974d]
1975	6788.96	[GUS 1986d]
1976	7397.99	interpolation
1977	8007.03	[GUS 1981d]
1978	8702.83	[GUS 1981d]
1979	9052.63	[GUS 1981d]
1980	9868.72	[GUS 1986d]
1981	10014.42	[GUS 1986d]
1982	10329.07	[GUS 1986d]
1983	10541.91	[GUS 1986d]
1984	10864.54	[GUS 1986d]
1985	11086.95	[GUS 1986d]
1986	11546.86	[GUS 1987]
1987	11877.45	[GUS 1989d]
1988	12084.18	[GUS 1989d]
1989	12000.95	[GUS 1990d]
1990	11098.28	[GUS 1996]
1991	10637.98	[GUS 1996]
1992	10621.00	[GUS 1996]
1993	10644.66	[GUS 1996]
1994	11014.64	[GUS 1996]
1995	10985.00	[GUS 2005d]
1996	11621.22	[GUS 1997d]
1997	12183.44	[GUS 1998d]
1998	12275.77	[GUS 1999d]
1999	12316.90	[GUS 2000d]
2000	12226.00	[GUS 2005d]

2001	11109.00	[GUS 2005d]
2002	10508.70	[GUS 2005d]
2003	9925.00	[GUS 2005d]
2004	9759.00	[GUS 2005d]
2005	9354.30	[GUS 2006d]
2006	9473.00	[GUS 2007d]
2007	9570.00	[GUS 2008d]

The percentage of waste generated, which goes to solid waste disposal sites – according to the GUS Statistical Yearbook, Environment 1990, in 1982-1990 there was no combustion of waste and the composting was on level of 0.1% (the same in 1981 – GUS 1987). Because of the lack of data, for other years this value was assumed on level of 0.1%. The percentage of waste going to SWDS for the years 1970-1976 was assumed as in 1977 – 96%. Distribution of solid waste disposal sites for managed and unmanaged ones was made in accordance to elaboration [Gworek 2003].

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 and on data from [KPGO 2003] for 2001 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%

Year	Food	Garden	Paper	Wood	Textile	Plastics, and other inert
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	18%	2%	16%	3%	3%	57%
2005	18%	2%	16%	3%	3%	57%
2006	18%	2%	16%	3%	3%	57%
2007	18%	2%	16%	3%	3%	57%

Recovery of methane was assumed on the basis of [GUS OZE 2008] and for 2007 it was 26.37 Gg of methane.

8.2.1.2 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.

Activity data

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 1975-2007. Before year 1975 there were no data on industrial waste.

Table 8.6. 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]

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 sewage sludge 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 sewage sludge the composition of waste was made.

Table 8.7. 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%

Emission factors

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

Table 8.8. DOC and DOC_f indicators

DOC (Degradable Organic Carbon)	Range	Default	Adopted Value
Food waste	0.08-0.20	0.15	0.15
Garden	0.36-0.45	0.4	0.4
Paper	0.39-0.46	0.43	0.43
Wood and straw	0.20-0.40	0.24	0.24
Textiles	0.39	0.39	0.39
Rubber	0.08-0.20	0.15	0.15
DOCf		0.5	0.5

Table 8.9. 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 8.10. 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	0.05–0.07	0.06	0.06
Paper	0.02–0.04	0.03	0.03
Wood and straw	0.20-0.40	0.24	0.24
Textiles	0.02–0.04	0.03	0.03
Rubber	0.1–0.2	0.185	0.185
Delay time (months)		6	6
Fraction of methane (F) in developed gas		0.5	0.5
Oxidation factor (OX)		0	0

8.2.2 *Waste Water Handling* (CRF 6.B)

8.2.2.1. *Industrial wastewater* (CRF 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 2008d]. Data on employment and production from some branches were taken from [GUS 2008].

Table 8.11. Amount of industrial wastewater in [million m^3]

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Mining and quarrying	548	426.5	519	470	453	392	382	378	362	340
Iron and steel	94.2	119.6	99.8	73.1	51.4	47	45.8	44.4	43	43.9
Non-iron metals	48.7	86.1	39.7	67.8	66.2	59.7	128	134	142	172
Synthetic fertilizers	123	118.3	92.5	58.4	53.5	48.5	51.3	41.5	48.5	51.9
Food products: Meat & Poultry	3.3	3	2.7	3.2	5.4	4.6	3.9	4	4.2	4.2
Food products: Fish Processing	1.6	1.5	1.3	1.2	1.1	0.9	0.8	0.3	0.4	0.2
Food products: Vegetables & Fruits	14.2	12	10	8.5	7.4	8	7.4	8.3	7.8	7.7
Food products: Vegetable Oils	3.7	2.5	1.5	1	0.5	2.1	1.2	1	3.6	4.8
Food products: Dairy Products	19.5	20.6	19.7	17.7	16.2	15.3	14.2	13.2	12.5	12.2
Food products: Sugar	23.7	21	20.4	13.9	10	11	7.9	7.7	6.5	5.7
Food products: Soft Drinks	4.1	4.2	4.3	5	5.8	2.3	2.6	2.4	2.6	2.9
Food products: Beer & Malt	4	4	4.3	4	4	3.6	2.7	2.1	1.7	1.7
Food products: Other	2.7	5.72	3.7	2.6	0.6	1.5	1.6	1.5	0.9	1.1
Textiles	14.2	13.86	11.1	8.2	9	7.8	7.3	6.4	5.7	5.2
Leathers	6.3	5.666	4.7	4.2	3	2.6	1.7	1.6	1.3	1.1
Wood and Paper	195	199.1	184	168	146	132	129	121	117	114
Petroleum Refineries	43.2	43.38	38.7	40	36.6	33.6	32.6	33.2	28.1	25.1
Organic Chemicals	126	224.1	107	120	108	97.7	101	98.6	94.3	81.5
Plastics & Resins	17.4		17.6	15.8	15.7	15.1	14.6	12.6	6.7	9.2
Other non-metallic	58.2	59.6	53.3	43.9	31	28	29.6	29.3	28.8	32.9
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
Other	90.9	91.32	95.2	89.8	79.8	82.7	104	94.5	115	110
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Mining and quarrying	336	362.3	350	332	293	272	261	267	272	271
Iron and steel	25.3	13.2	14.2	14.8	13.3	9.6	8.2	6.5	7.4	10.8
Non-iron metals	188	184.8	184	187	184	155	135	132	132	133
Synthetic fertilizers	52.3	52.6	51.7	49.7	50.3	46	49.4	48.6	50.7	52.6
Food products: Meat & Poultry	3.9	4	3.6	3.4	3.4	3.5	4.1	4.3	4.6	4.8
Food products: Fish Processing	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0	0
Food products: Vegetables & Fruits	9.4	7.5	7.5	7.2	6.4	7.8	6.8	6.6	7	6.8
Food products: Vegetable Oils	2.5	3.2	2.4	0.7	0.3	0.2	0.3	0.3	0.4	0.4
Food products: Dairy Products	12.3	11.4	11.3	11.7	11.3	11.5	13	13.5	13.8	14.4
Food products: Sugar	6.1	4.9	4	2.9	2.7	2.7	2.2	1.8	1.4	1.9
Food products: Soft Drinks	2.7	2.6	2.5	2.1	2.2	3.1	2	2.1	2.1	1.9
Food products: Beer & Malt	1.6	1.4	1.3	1.3	1.4	1.2	1.2	1.3	1.7	1.4
Food products: Other	2.5	0.5	0.8	0.7	0.7	0.8	3.3	2.8	2.3	2.4
Textiles	4.7	3.1	2.6	2.1	1.7	1.6	1.5	1.6	1.3	0.7
Leathers	0.7	0.7	1.1	1.2	0.9	0.8	0.6	0.7	0.6	0.6
Wood and Paper	106	90.3	81.7	76.9	77.1	71.5	70.9	68.9	69.7	67.6
Petroleum Refineries	24.3	20.3	17.8	18.1	16.8	17.4	19.6	19.3	20.7	23
Organic Chemicals	63.1	55.9	47.7	42.4	42	38.3	36	38.4	38.6	39.1
Plastics & Resins	10.3	8.4	7.8	4.7	2.7	2.5	2.5	2.4	2.2	2.3
Other non-metallic	27.9	29.8	32.3	34.2	38	31.9	37.4	36.3	43.2	39.4
Manufacturing of Machinery and Transport Equipment	25.1	22	12	10.4	9.1	8.1	6.8	7	4.4	4.2
Other	161	116.7	121	130	126	120	129	128	128	148

Table 8.12. 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].
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* (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 2008d] Activity data for year 1988-2006 are presented in table.. 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] and its value was 0.953 (for this estimation the country specific value of BOD = 369 g O_2/m^3 was used). The emission factors calculated on the basis of the study mentioned above and applied in inventory report are:

- for wastewater: 0.030 kg CH_4 / kg BOD
- for sewage sludge: 0.488 kg CH_4 / kg BOD.

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 anareobically treated with and without methane recovery are estimated according to [Bernacka 2005]. These value are as follows: percentage of wastewater anareobically treated – 5%, fractions of sludge anareobically degraded – 81.3% of which with methane recovery – 83.5%.

Table 8.13. Activity data for domestic and commercial wastewater.

Year	Municipal waste discharged into collection system	% treated wastewater
	mln m^3	%
1988	2478.1	52.75
1989	2443.5	54.79
1990	2313.9	60.11
1991	2166.1	62.91
1992	2075.3	64.08
1993	1981.4	64.68
1994	1999.2	63.81
1995	1852.4	67.89
1996	1751.8	71.04
1997	1691.9	75.32
1998	1655.5	79.21
1999	1589.9	81.31
2000	1494.0	83.23
2001	1425.3	86.12
2002	1353.1	88.01
2003	1323.7	87.56
2004	1293.6	89.07
2005	1273.6	89.51
2006	1265.2	91.33
2007	1265.5	92.78

N_2O emission from humane sewage was calculated according to default method [IPCC 1997]. Country population was taken from [GUS 2008] and value of protein consumption per capita per year was taken from FAO database. For years 2004-2007 protein consumption was assumed on the level of 2003 data (lack of data in FAO database after 2003). Default values were used for fraction of nitrogen in protein and for N_2O emission factor [IPCC 2000].

8.2.3 *Waste Incineration* (CRF 6.C)

Waste incineration was estimated based on IPCC methodology [IPCC 2000] and domestic case study [Wielgosiński 2003]. Emission factors for CO2 from incineration of municipal waste were taken from [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. 2009].

Table 8.14. Activity data in [Gg]

municipal waste incinerated	43.8
industrial waste incinerated	158.2
medical waste incinerated	25.3
sewage sludge incinerated	73.2

Table 8.15. Biogenic and non-biogenic content of waste

non-biogenic content of waste	
municipal waste incinerated	0.7
industrial waste incinerated	0.9
medical waste incinerated	0.4
biogenic content of waste (1-non-biogenic)	
municipal waste incinerated	0.3
industrial waste incinerated	0.1
medical waste incinerated	0.6
sewage sludge incinerated	1

Table 8.16. 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

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 Energy sector methodology description part (chapter 3.2.1.1).

8.3 Uncertainties

Uncertainty analysis for this IPCC sector was prepared with use of *Tier 1* methodology defined in the IPCC Good Practice Guidance. Summary results of the analysis are presented in the table 8.17., more detailed information for this and other sectors can be found in annex 5 of this report.

Table 8.17. Uncertainty analysis estimation for sector *Waste*

2007	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
6. Waste	**311.55**	**318.14**	**3.59**	51.0%	79.4%	50.9%
A. Solid Waste Disposal on Land		267.83			92.8%	
B. Wastewater Handling		50.30	3.49		86.9%	52.2%
C. Waste Incineration	311.55		0.09	51.0%		22.4%

8.4 Recalculations

Solid Waste Disposal Sites

- On the basis of [GUS OZE 2008] the recovery of methane in SWDS was recalculated for years 2004-2005, which didn't influenced significantly in emission, and was added for years 2001-2003, which caused with drop of emission on about 20 Gg
- Composition of waste going to SWDS for the years 1988-1989 was recalculated. This caused with growth of emission from Waste sector by 12% for base year.

Domestic Wastewater

- Protein consumption for years 2004-2007 was replaced by FAO database. Because of lack of data for these years value for 2003 was used.

8.5 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.

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
ETS	Emission Trading Scheme
GHG	Greenhouse Gases
IE	Included elsewhere
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
POPs	Persistent Organic Pollutants
SWDS	Solid waste disposal site

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ANNEXES

Annex 1. Key categories in 2007

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 70.6% 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 66.28% of the total GHG emissions. Combustion of solid fuels in stationary sources alone, made up 55.6% 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 70.55%.

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 2007	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	221 721.91	0.5558	0.56
2	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	36 274.54	0.0909	0.65
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	23 435.44	0.0587	0.71
4	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	19 256.02	0.0483	0.75
5	4.D.1	4.D.1. Direct Soil Emissions	N2O	11 015.12	0.0276	0.78
6	4.A	4.A. Enteric Fermentation	CH4	9 305.67	0.0233	0.80
7	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	8 518.41	0.0214	0.83
8	2.C1	2.C.1. Iron and Steel Production	CO2	8 341.75	0.0209	0.85
9	2.A.1	2.A.1 Cement Production	CO2	7 050.41	0.0177	0.86
10	6.A	6.A. Solid Waste Disposal on Land	CH4	6 471.52	0.0162	0.88
11	4.B	4.B. Manure Management	N2O	6 077.80	0.0152	0.90
12	1.B.2.b.	1.B.2.b. Natural Gas	CH4	4 782.73	0.0120	0.91
13	4.D.3	4.D.3. Indirect Soil Emissions	N2O	4 559.39	0.0114	0.92
14	2.B.2	2.B.2. Nitric Acid Production	N2O	4 552.69	0.0114	0.93
15	2.B.1.	2.B.1. Ammonia Production	CO2	4 208.63	0.0106	0.94
16	4.B	4.B. Manure Management	CH4	3 649.41	0.0091	0.95

Level Assessment with category 5

		IPCC Source Categories	Direct GHG	Emission in 2007	Absolut Value of Current Year Estimate	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	221 721.91	221 721.91	0.4743	0.47
2	5.A.1	5.A.1 Forest Land remaining Forest Land	CO2	-50 555.19	50 555.19	0.1081	0.58
3	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	36 274.54	36 274.54	0.0776	0.66
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	23 435.44	23 435.44	0.0501	0.71
5	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	19 256.02	19 256.02	0.0412	0.75
6	4.D.1	4.D.1. Direct Soil Emissions	N2O	11 015.12	11 015.12	0.0236	0.77
7	4.A	4.A. Enteric Fermentation	CH4	9 305.67	9 305.67	0.0199	0.79
8	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	8 518.41	8 518.41	0.0182	0.81
9	5.B.1	5.B.1 Cropland remaining Cropland	CO2	8 419.60	8 419.60	0.0180	0.83
10	2.C1	2.C.1. Iron and Steel Production	CO2	8 341.75	8 341.75	0.0178	0.85
11	2.A.1	2.A.1 Cement Production	CO2	7 050.41	7 050.41	0.0151	0.86
12	6.A	6.A. Solid Waste Disposal on Land	CH4	6 471.52	6 471.52	0.0138	0.88
13	4.B	4.B. Manure Management	N2O	6 077.80	6 077.80	0.0130	0.89
14	1.B.2.b.	1.B.2.b. Natural Gas	CH4	4 782.73	4 782.73	0.0102	0.90
15	4.D.3	4.D.3. Indirect Soil Emissions	N2O	4 559.39	4 559.39	0.0098	0.91
16	2.B.2	2.B.2. Nitric Acid Production	N2O	4 552.69	4 552.69	0.0097	0.92
17	2.B.1.	2.B.1. Ammonia Production	CO2	4 208.63	4 208.63	0.0090	0.93
18	4.B	4.B. Manure Management	CH4	3 649.41	3 649.41	0.0078	0.94
19	5.A.2	5.A.2 Land converted to Forest Land	CO2	-3 576.99	3 576.99	0.0077	0.94
20	5.D.1	5.D.1 Wetlands remaining Wetlands	CO2	3 102.14	3 102.14	0.0066	0.95

Trend Assessment without category 5

		IPCC Source Categories	Direct GHG	Base Year Estimate	Emission in 2007	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	384 148.28	221 721.91	0.5558	0.1766	39.18645	0.39
2	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	16 068.28	36 274.54	0.0909	0.0884	19.61393	0.59
3	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	15 813.67	23 435.44	0.0587	0.0435	9.64939	0.68
4	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	18 580.41	19 256.02	0.0483	0.0217	4.82038	0.73
5	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	18 455.82	8 518.41	0.0214	0.0161	3.56232	0.77
6	2.F.1	2.F.1. Refrigeration and Air Conditioning Equipment	HFC	0.00	2 676.06	0.0067	0.0095	2.10644	0.79
7	1.B.2.b.	1.B.2.b. Natural Gas	CH4	3 396.76	4 782.73	0.0120	0.0084	1.87497	0.81
8	6.A	6.A. Solid Waste Disposal on Land	CH4	5 914.40	6 471.52	0.0162	0.0081	1.80365	0.83
9	1.A.3.c	1.A.3.c Transport Railways	CO2	3 853.56	536.76	0.0013	0.0078	1.72134	0.84
10	2.A.1	2.A.1 Cement Production	CO2	7 028.18	7 050.41	0.0177	0.0074	1.63969	0.86
11	4.A	4.A. Enteric Fermentation	CH4	15 706.86	9 305.67	0.0233	0.0064	1.41330	0.87
12	2.B.2	2.B.2. Nitric Acid Production	N2O	4 386.47	4 552.69	0.0114	0.0052	1.14329	0.89
13	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 460.68	1 722.02	0.0043	0.0051	1.12614	0.90
14	4.B	4.B. Manure Management	CH4	3 419.72	3 649.41	0.0091	0.0044	0.97011	0.91
15	2.B.1.	2.B.1. Ammonia Production	CO2	4 357.99	4 208.63	0.0106	0.0040	0.88831	0.92
16	2.G	2.G. Other	CO2	0.00	956.54	0.0024	0.0034	0.75293	0.92
17	2.A.2	2.A.2. Lime Production	CO2	3 477.55	1 682.10	0.0042	0.0028	0.61061	0.93
18	4.D.2	4.D.2. Animal Production	N2O	1 575.89	393.26	0.0010	0.0026	0.56717	0.93
19	1.A.1, 2, 4	Stationary combustion Biomass	CH4	213.46	800.02	0.0020	0.0023	0.51097	0.94
20	2.C1	2.C.1. Iron and Steel Production	CO2	10 888.61	8 341.75	0.0209	0.0023	0.50848	0.94
21	2.B.4	2.B.4. Carbide Production (calcium carbide)	CO2	904.25	35.35	0.0001	0.0021	0.47524	0.95

Trend Assessment with category 5

		IPCC Source Categories	Direct GHG	Base Year Estimate	Absolut Value of Base Year Estimate	Emission in 2007	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	221 721.91	221 721.91	0.4743	0.1899	37.4878	0.37
2	1.A.3.b	1.A.3.b Transport Road Transportation	CO2	16 068.28	16 068.28	36 274.54	36 274.54	0.0776	0.0690	13.6165	0.51
3	5.A.1	5.A.1 Forest Land remaining Forest Land	CO2	-42 705.20	42 705.20	-50 555.19	50 555.19	0.1081	0.0527	10.4021	0.62
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	15 813.67	15 813.67	23 435.44	23 435.44	0.0501	0.0330	6.5035	0.68
5	1.B.1.a.	1.B.1.a. Coal Mining and Handling	CH4	18 455.82	18 455.82	8 518.41	8 518.41	0.0182	0.0152	3.0011	0.71
6	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	18 580.41	18 580.41	19 256.02	19 256.02	0.0412	0.0151	2.9850	0.74
7	5.A.2	5.A.2 Land converted to Forest Land	CO2	0.00	0.00	-3 576.99	3 576.99	0.0077	0.0102	2.0116	0.76
8	5.C.1	5.C.1 Grassland remaining Grassland	CO2	4 530.69	4 530.69	134.91	134.91	0.0003	0.0093	1.8369	0.78
9	5.D.1	5.D.1 Wetlands remaining Wetlands	CO2	0.00	0.00	3 102.14	3 102.14	0.0066	0.0088	1.7446	0.80
10	2.F.1	2.F.1. Refrigeration and Air Conditioning Eq	HFC	0.00	0.00	2 676.06	2 676.06	0.0057	0.0076	1.5050	0.81
11	4.A	4.A. Enteric Fermentation	CH4	15 706.86	15 706.86	9 305.67	9 305.67	0.0199	0.0071	1.3978	0.82
12	5.D.2	5.D.2 Land converted to Wetlands	CH4	0.00	0.00	2 378.46	2 378.46	0.0051	0.0068	1.3376	0.84
13	1.A.3.c	1.A.3.c Transport Railways	CO2	3 853.56	3 853.56	536.76	536.76	0.0011	0.0067	1.3250	0.85
14	5.B.1	5.B.1 Cropland remaining Cropland	CO2	8 165.26	8 165.26	8 419.60	8 419.60	0.0180	0.0065	1.2878	0.86
15	1.B.2.b.	1.B.2.b. Natural Gas	CH4	3 396.76	3 396.76	4 782.73	4 782.73	0.0102	0.0064	1.2557	0.88
16	5.E.1	5.E.1 Settlements remaining Settlements	CO2	-2 925.46	2 925.46	-73.42	73.42	0.0002	0.0060	1.1938	0.89
17	6.A	6.A. Solid Waste Disposal on Land	CH4	5 914.40	5 914.40	6 471.52	6 471.52	0.0138	0.0058	1.1425	0.90
18	2.A.1	2.A.1 Cement Production	CO2	7 028.18	7 028.18	7 050.41	7 050.41	0.0151	0.0051	0.9979	0.91
19	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 460.68	4 460.68	1 722.02	1 722.02	0.0037	0.0046	0.9148	0.92
20	2.B.2	2.B.2. Nitric Acid Production	N2O	4 386.47	4 386.47	4 552.69	4 552.69	0.0097	0.0036	0.7085	0.93
21	4.B	4.B. Manure Management	CH4	3 419.72	3 419.72	3 649.41	3 649.41	0.0078	0.0031	0.6086	0.93
22	2.G	2.G. Other	CO2	0.00	0.00	956.54	956.54	0.0020	0.0027	0.5379	0.94
23	2.B.1.	2.B.1. Ammonia Production	CO2	4 357.99	4 357.99	4 208.63	4 208.63	0.0090	0.0027	0.5270	0.94
24	4.B	4.B. Manure Management	N2O	9 335.10	9 335.10	6 077.80	6 077.80	0.0130	0.0027	0.5231	0.95
25	2.A.2	2.A.2. Lime Production	CO2	3 477.55	3 477.55	1 682.10	1 682.10	0.0036	0.0026	0.5222	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	CO_2		
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	T
2.A.2	2.A.2. Lime Production	CO_2		T
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 production)	CO_2		
2.B.1.	2.B.1. Ammonia Production	CO_2	L	T
2.B.1.	2.B.1. Ammonia Production	CH_4		
2.B.2	2.B.2. Nitric Acid Production	N_2O	L	T
2.C1	2.C.1. Iron and Steel 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	
2.C1	2.C.1. Iron and Steel Production	CH_4		
2.C2	2.C.2. Ferroalloys Production	CO_2		
2.C2	2.C.2. Ferroalloys Production	CH_4		

	IPCC Source Categories	Direct GHG	Level Assessement - L, Trend Assessment - T	
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		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	T
4.B	4.B. Manure Management	N_2O	L	T
4.D.1	4.D.1. Direct Soil Emissions	N_2O	L	
4.D.2	4.D.2. Animal Production	N_2O		
4.D.3	4.D.3. Indirect Soil 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.C.2	5.C.2. Land converted to Grassland	CO_2		
5.D.1	5.D.1 Wetlands remaining Wetlands	CO_2	L	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	CH4		
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		
6.C	6.C. Waste Incineration	N_2O		

Annex 2. Energy balance data for main fuels in 2007

Energy balances in 2007 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

Evaluation of fuel consumption in national combustion processes	Lignite - Eurostat	
	10^3 Mg	TJ
In	57 546	499 729
From national sources	57 538	499 660
1) Indigenous production	57 538	499 660
2) Transformation output or return	0	0
3) Stock decrease	0	0
Import	8	69
Out	57 546	499 729
National consumption	57 529	506 617
1) Transformation input	56 896	501 140
a) input for secondary fuel production	0	0
b) fuel combustion	56 896	501 140
2) Direct consumption	633	5 477
Non-energy use	0	0
Combusted directly	633	5 477
Combusted in Poland	57 529	506 617
Stock increase	17	148
Export	0	0
Losses and statistical differences	0	-7 036
Net calorific value	MJ/kg lub MJ/m3	8.81

Natural gas consumption

Evaluation of fuel consumption in national combustion processes	Natural gas - Eurostat
	TJ
In	510 031
From national sources	163 147
1) Indigenous production	163 147
2) Transformation output or return	0
3) Stock decrease	0
Import	346 884
Out	510 031
National consumption	516 769
1) Transformation input	50 073
a) input for secondary fuel production	420
b) fuel combustion	49 653
2) Direct consumption	466 696
Non-energy use	80 247
Combusted directly	386 449
Combusted in Poland	436 102
Stock increase	-9 669
Export	1 509
Losses and statistical differences	1 421

Coke oven gas consumption

Evaluation of fuel consumption in national combustion processes	Coke oven gas - Eurostat
	TJ
In	76 950
From national sources	76 950
1) Indigenous production	0
2) Transformation output or return	76 950
3) Stock decrease	0
Import	0
Out	76 950
National consumption	75 962
1) Transformation input	19 907
a) input for secondary fuel production	0
b) fuel combustion	19 907
2) Direct consumption	56 055
Non-energy use	0
Combusted directly	56 055
Combusted in Poland	75 962
Stock increase	0
Export	0
Losses and statistical differences	988

Blast furnace gas consumption

Evaluation of fuel consumption in national combustion processes	Blast furnace gas - Eurostat
	TJ
In	34 626
From national sources	34 626
1) Indigenous production	0
2) Transformation output or return	34 626
3) Stock decrease	0
Import	0
Out	34 626
National consumption	34 589
1) Transformation input	5 965
a) input for secondary fuel production	0
b) fuel combustion	5 965
2) Direct consumption	28 624
Non-energy use	0
Combusted directly	28 624
Combusted in Poland	34 589
Stock increase	0
Export	0
Losses and statistical differences	37

Annex 3. National energy balance 2007 – EUROSTAT

Solid Fuels and Gases	Hard coal	Anthracite	Coking coal	Bitumenus coal	Sub-bitum. coal	Patent fuels	Coke	Total lignite	Lignite ancien	Lignite recent	Peat	Brown coal briquettes	Tar, benzol	Coke-oven gas	Blast-furn. gas	Gasworks gas	Derived Gases	Natural Gas
.200700.87.							1000 t								TJ(GCV)			TJ(GCV)
Primary production	**87 406**	-	**13 636**	**73 770**	-	-	-	**57 538**	-	**57 538**	-	-	-	-	-	-	-	**181 274**
Redovered products	906	-	-	906	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Imports	5 924	-	2 268	3 656	-	-	119	8	-	8	-	4	-	-	-	-	-	385 427
Stock change	3 000	-	101	2 899	-	-	-45	-17	-	-17	-	-1	-	-	-	-	-	10 743
Exports	11 900	-	2 363	9 537	-	-	6 337	-	-	-	-	-	-	-	-	-	-	1 677
Bunkers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption	**85 336**	-	**13 642**	**71 694**	-	-	**-6 263**	**57 529**	-	**57 529**	-	**3**	-	-	-	-	-	**575 767**
Transformation input	**66 486**	-	**13 658**	**52 828**	-	-	**1 313**	**56 896**	-	**56 896**	-	-	-	**22 119**	**5 965**	-	**28 084**	**55 637**
Classic thermal Power Stations	47 539	-	-	47 539	-	-	-	56 865	-	56 865	-	-	-	21 346	5 965	-	27 311	43 709
Public thermal power stations	45 348	-	-	45 348	-	-	-	56 865	-	56 865	-	-	-	11 831	-	-	11 831	40 882
Autoprod. thermal power stations	2 191	-	-	2 191	-	-	-	-	-	-	-	-	-	9 515	5 965	-	15 480	2 827
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	13 534	-	13 534	-	-	-	93	-	-	-	-	-	-	-	-	-	-	467
Blast-furnace plants	-	-	-	-	-	-	1 215	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	5 413	-	124	5 289	-	-	5	31	-	31	-	-	-	773	-	-	773	11 461
Transformation output	-	-	-	-	-	-	**10 168**	-	-	-	-	-	-	**85 500**	**34 626**	**115**	**120 241**	-
Classic thermal Power Stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Autoprod. thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	10 168	-	-	-	-	-	-	85 500	-	-	85 500	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34 626	-	34 626	-
Gas works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	115	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interproduct transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Products transferred	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Returns from petrochem. industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the energy branch	**1 143**	-	**216**	**927**	-	-	**1**	**151**	-	**151**	-	-	-	**44 936**	**5 229**	**6**	**50 171**	**64 657**
Production and distribution of eledtricity	624	-	-	624	-	-	-	-	-	-	-	-	-	677	5 229	-	5 906	-
Pumping stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Extraction and agglo. of solid fuels	302	-	-	302	-	-	-	22	-	22	-	-	-	147	-	-	147	504
Coke-oven and gas works plants	217	-	216	1	-	-	1	-	-	-	-	-	-	44 112	-	6	44 118	4 139
Oil and Nat. Gat extraction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12 539
Oleducs and Gazeducs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13 852
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33 497
Nuclear fuel fabrication plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	**1 798**	-	-	**1 798**	**2 983**
Available for final consumption	**17 707**	-	**-232**	**17 939**	-	-	**2 591**	**482**	-	**482**	-	**3**	-	**16 647**	**23 432**	**109**	**40 188**	**452 490**
Final non-energy consumption	**93**	-	-	**93**	-	-	**6**	-	-	-	-	-	-	-	-	-	-	**89 163**
Chemical industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89 163
Other sedtors	93	-	-	93	-	-	6	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	**16 976**	-	-	**16 976**	-	-	**2 648**	**482**	-	**482**	-	**3**	-	**17 347**	**23 395**	**105**	**40 847**	**364 731**
Industry	5 776	-	-	5 776	-	-	2 527	-	-	-	-	3	-	17 347	23 395	-	40 742	143 272
Iron & steel industry	321	-	-	321	-	-	2 013	-	-	-	-	-	-	14 757	23 395	-	38 152	24 782
Non-ferrous metal industry	-	-	-	-	-	-	226	-	-	-	-	-	-	-	-	-	-	7 492
Chemical industry	1 226	-	-	1 226	-	-	68	-	-	-	-	-	-	731	-	-	731	9 746
Glass, pottery & building mat. industry	1 838	-	-	1 838	-	-	158	-	-	-	-	2	-	1 793	-	-	1 793	47 192
Ore-extraction industry	24	-	-	24	-	-	1	-	-	-	-	-	-	-	-	-	-	1 192
Food, drink & tobacco industry	1 302	-	-	1 302	-	-	32	-	-	-	-	-	-	-	-	-	-	22 904
Textile, leather & clothing industry	76	-	-	76	-	-	1	-	-	-	-	-	-	-	-	-	-	2 693
Paper and printing	396	-	-	396	-	-	1	-	-	-	-	-	-	-	-	-	-	4 541
Engineering & other metal industry	187	-	-	187	-	-	14	-	-	-	-	-	-	66	-	-	66	14 456
Other industries	406	-	-	406	-	-	13	-	-	-	-	1	-	-	-	-	-	8 274
Ajustment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Railways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Road transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Air transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-
Inland navigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Households, commerce, pub. auth., etc.	11 200	-	-	11 200	-	-	121	482	-	482	-	-	-	-	-	105	105	221 459
Households	8 600	-	-	8 600	-	-	-	232	-	232	-	-	-	-	-	90	90	147 358
Agriculture	1 500	-	-	1 500	-	-	30	250	-	250	-	-	-	-	-	-	-	2 046
Fisheries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Services	1 100	-	-	1 100	-	-	91	-	-	-	-	-	-	-	-	15	15	72 055
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical difference	**638**	-	**-232**	**870**	-	-	**-63**	-	-	-	-	-	-	**-700**	**37**	**4**	**-659**	**-1 404**

Oil	Crude oil	Feedstocks	Total pet. products	Refinery gas	LPG	Motor spirit	Kerosenes, jet fuels	Naphtha	Gas / diesel oil	Residual fuel oil	Other pet. products	White spirit	Lubricants	Bitumen	Petroleum coke
.200700.87.	1000 t														
Primary production	**721**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redovered products	-	724	42	-	-	-	-	-	-	-	-	-	42	-	-
Imports	20 885	1 359	6 558	-	2 221	749	1	85	2 970	97	58	43	127	175	32
Stock change	-1 294	-	-788	-	-8	-149	-22	-	-488	54	-178	-4	-9	-2	18
Exports	288	-	3 118	-	25	423	347	33	342	1 155	63	100	187	442	1
Bunkers	-	-	254	-	-	-	-	-	50	204	-	-	-	-	-
Gross inland consumption	**20 024**	**2 083**	**2 440**	-	**2 188**	**177**	**-368**	**52**	**2 090**	**-1 208**	**-183**	**-61**	**-27**	**-269**	**49**
Transformation input	**20 113**	**2 832**	**202**	-	**3**	-	-	-	**17**	**182**	-	-	-	-	-
Classic thermal Power Stations	-	-	167	-	-	-	-	-	3	164	-	-	-	-	-
Public thermal power stations	-	-	144	-	-	-	-	-	3	141	-	-	-	-	-
Autoprod. thermal power stations	-	-	23	-	-	-	-	-	-	23	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-
Refineries	20 113	2 832	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	-	32	-	-	-	-	-	14	18	-	-	-	-	-
Transformation output	-	-	**21 570**	**962**	**243**	**3 876**	**802**	**1 398**	**8 787**	**2 831**	**631**	**115**	**258**	**1 667**	-
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	-	-	21 570	962	243	3 876	802	1 398	8 787	2 831	631	115	258	1 667	-
District heating plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	**749**	**-749**	**-173**	**-32**	-	-	**-373**	**-28**	**-32**	**-69**	-	**-42**	-	-
Interproduct transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Products transferred	-	74	-74	-	-	-	-	-	-	-32	-	-	-42	-	-
Returns from petrochem. industry	-	675	-675	-173	-32	-	-	-373	-28	-	-69	-	-	-	-
Consumption of the energy branch	-	-	**1 501**	**335**	**1**	**1**	-	-	**34**	**1 106**	**10**	-	-	**14**	-
Production and distribution of electricity	-	-	10	-	-	-	-	-	6	4	-	-	-	-	-
Pumping stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Extraction and agglo. of solid fuels	-	-	19	-	-	-	-	-	19	-	-	-	-	-	-
Coke-oven and gas works plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oil and Nat. Gat extraction plants	-	-	4	-	-	-	-	-	4	-	-	-	-	-	-
Oleducs and Gazeducs	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-
Oil refineries	-	-	1 464	335	-	-	-	-	4	1 102	9	-	-	14	-
Nuclear fuel fabrication plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Available for final consumption	**-89**	-	**21 558**	**454**	**2 395**	**4 052**	**434**	**1 077**	**10 798**	**303**	**369**	**54**	**189**	**1 384**	**49**
Final non-energy consumption	-	-	**2 994**	-	-	-	-	**979**	-	-	**329**	**54**	**250**	**1 382**	-
Chemical industry	-	-	1 247	-	-	-	-	979	-	-	242	20	6	-	-
Other sectors	-	-	1 747	-	-	-	-	-	-	-	87	34	244	1 382	-
Final energy consumption	-	-	**18 603**	**454**	**2 512**	**4 052**	**434**	-	**10 774**	**326**	**2**	-	-	-	**49**
Industry	-	-	1 425	454	145	4	2	-	473	296	2	-	-	-	49
Iron & steel industry	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-
Non-ferrous metal industry	-	-	9	-	1	-	-	-	4	4	-	-	-	-	-
Chemical industry	-	-	719	454	88	-	-	-	87	90	-	-	-	-	-
Glass, pottery & building mat. industry	-	-	152	-	7	-	-	-	43	53	-	-	-	-	49
Ore-extraction industry	-	-	68	-	2	-	-	-	66	-	-	-	-	-	-
Food, drink & tobacco industry	-	-	185	-	20	1	-	-	95	69	-	-	-	-	-
Textile, leather & clothing industry	-	-	12	-	2	-	-	-	9	1	-	-	-	-	-
Paper and printing	-	-	57	-	4	-	-	-	10	43	-	-	-	-	-
Engineering & other metal industry	-	-	62	-	11	1	2	-	44	3	1	-	-	-	-
Other industries	-	-	158	-	10	2	-	-	113	33	-	-	-	-	-
Ajustment	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
Transport	-	-	13 901	-	1 750	4 043	432	-	7 676	-	-	-	-	-	-
Railways	-	-	168	-	-	-	-	-	168	-	-	-	-	-	-
Road transport	-	-	13 295	-	1 750	4 039	-	-	7 506	-	-	-	-	-	-
Air transport	-	-	436	-	-	4	432	-	-	-	-	-	-	-	-
Inland navigation	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-
Households, commerce, pub. auth., etc.	-	-	3 277	-	617	5	-	-	2 625	30	-	-	-	-	-
Households	-	-	910	-	460	-	-	-	450	-	-	-	-	-	-
Agriculture	-	-	1 835	-	50	5	-	-	1 750	30	-	-	-	-	-
Fisheries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Services	-	-	532	-	107	-	-	-	425	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical difference	**-89**	-	**-39**	-	**-117**	-	-	**98**	**24**	**-23**	**38**	-	**-61**	**2**	-

Electricity and Renewables	Nuclear heat	Solar heat	Solal PV	Geothermal heat	Biomass	Wood	MSW	Biogas	Liquid Biofuels	Biogasoline	Biodiesel	Other liq. Biofuels	Other fuels	Derived heat	Wind power	Hydro power	Electrical energy
.200700.87.		TJ(GCV)							1000 t				TJ(GCV)		GWh		
Primary production	-	**15**	-	**439**	**199 210**	**190 510**	**1 844**	**2 708**	**138**	**93**	**45**	-	-	-	**522**	**2 352**	-
Redovered products	-	-	-	-	-	-	-	-	-	-	-	-	21 021	-	-	-	-
Imports	-	-	-	-	590	-	-	-	22	22	-	-	-	-	-	-	7 761
Stock change	-	-	-	-	-1 010	-924	-32	-	-2	-2	-	-	-2	-	-	-	-
Exports	-	-	-	-	753	-	-	-	21	2	19	-	-	-	-	-	13 109
Bunkers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption	-	**15**	-	**439**	**198 038**	**189 586**	**1 812**	**2 708**	**137**	**111**	**26**	-	**21 019**	-	**522**	**2 352**	**-5 348**
Transformation input	-	-	-	-	**27 739**	**25 434**	-	**2 305**	-	-	-	-	**4 783**	-	-	-	-
Classic thermal Power Stations	-	-	-	-	26 038	23 737	-	2 301	-	-	-	-	4 748	-	-	-	-
Public thermal power stations	-	-	-	-	17 486	17 471	-	15	-	-	-	-	-	-	-	-	-
Autoprod. thermal power stations	-	-	-	-	8 552	6 266	-	2 286	-	-	-	-	4 748	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	-	-	-	1 701	1 697	-	4	-	-	-	-	35	-	-	-	-
Transformation output	-	-	-	-	-	-	-	-	-	-	-	-	-	**321 014**	-	-	**155 887**
Classic thermal Power Stations	-	-	-	-	-	-	-	-	-	-	-	-	-	209 273	-	-	155 887
Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	179 214	-	-	148 024
Autoprod. thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	30 059	-	-	7 863
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	-	-	-	-	-	-	-	-	-	-	-	-	111 741	-	-	-
Exchanges and transfers, returns	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**-522**	**-2 352**	**2 874**
Interproduct transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-522	-2 352	2 874
Products transferred	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Returns from petrochem. industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the energy branch	-	-	-	-	**85**	**57**	-	**28**	-	-	-	-	**68**	**48 797**	-	-	**24 880**
Production and distribution of electricity	-	-	-	-	28	-	-	28	-	-	-	-	-	5 696	-	-	13 965
Pumping stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	301
Extraction and agglo. of solid fuels	-	-	-	-	-	-	-	-	-	-	-	-	-	5 013	-	-	6 011
Coke-oven and gas works plants	-	-	-	-	-	-	-	-	-	-	-	-	-	6 767	-	-	805
Oil and Nat. Gat extraction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-	51
Oleducs and Gazeducs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	413
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	10 891	-	-	661
Nuclear fuel fabrication plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**14 416**
Available for final consumption	-	**15**	-	**439**	**170 214**	**164 095**	**1 812**	**375**	**137**	**111**	**26**	-	**16 168**	**272 217**	-	-	**114 117**
Final non-energy consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chemical industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other sectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	-	**15**	-	**439**	**170 204**	**164 095**	**1 812**	**375**	**137**	**112**	**25**	-	**16 168**	**290 717**	-	-	**114 117**
Industry	-	-	-	-	46 060	44 193	1 783	84	-	-	-	-	16 168	83 636	-	-	45 787
Iron & steel industry	-	-	-	-	1	1	-	-	-	-	-	-	1 287	8 440	-	-	7 019
Non-ferrous metal industry	-	-	-	-	-	-	-	-	-	-	-	-	982	2 786	-	-	3 526
Chemical industry	-	-	-	-	121	121	-	-	-	-	-	-	6 875	49 976	-	-	8 873
Glass, pottery & building mat. industry	-	-	-	-	1 893	116	1 777	-	-	-	-	-	5 961	1 510	-	-	4 195
Ore-extraction industry	-	-	-	-	-	-	-	-	-	-	-	-	-	3 457	-	-	1 439
Food, drink & tobacco industry	-	-	-	-	248	164	-	84	-	-	-	-	-	2 835	-	-	5 073
Textile, leather & clothing industry	-	-	-	-	1	1	-	-	-	-	-	-	-	650	-	-	918
Paper and printing	-	-	-	-	30 877	30 877	-	-	-	-	-	-	118	3 651	-	-	3 271
Engineering & other metal industry	-	-	-	-	31	30	1	-	-	-	-	-	8	7 467	-	-	6 306
Other industries	-	-	-	-	12 883	12 883	-	-	-	-	-	-	937	2 864	-	-	5 167
Ajustment	-	-	-	-	5	-	5	-	-	-	-	-	-	-	-	-	-
Transport	-	-	-	-	3 922	-	-	-	137	112	25	-	-	-	-	-	3 276
Railways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3 276
Road transport	-	-	-	-	3 922	-	-	-	137	112	25	-	-	-	-	-	-
Air transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inland navigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Households, commerce, pub. auth., etc.	-	15	-	439	120 222	119 902	29	291	-	-	-	-	-	207 081	-	-	65 054
Households	-	-	-	357	95 000	95 000	-	-	-	-	-	-	-	180 000	-	-	26 369
Agriculture	-	-	-	-	19 060	19 060	-	-	-	-	-	-	-	928	-	-	1 500
Fisheries	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-	6
Services	-	15	-	82	6 162	5 842	29	291	-	-	-	-	-	26 136	-	-	37 179
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical difference	-	-	-	-	**10**	-	-	-	-	**-1**	**1**	-	-	**-18 500**	-	-	-

Solid Fuels and Gases	Total all fuels	All fuels ex.biomass	Hard coal	Anthracite	Coking coal	Bitumenus coal	Sub-bitum. coal	Patent fuels	Coke	Total lignite	Lignite ancien	Lignite redent	Peat	Brown coal briquett	Tar, benzol	Coke-oven gas	Blast-furn. gas	Gasworks gas	Derived Gas	Natural gas
.200700.87.										ktoe										
Primary production	**71 630**	**66 872**	**50 058**	-	**9 603**	**40 455**	-	-	-	**11 934**	-	**11 934**	-	-	-	-	-	-	-	**3 897**
Redovered products	1 776	1 776	497	-	-	497	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Imports	42 011	41 997	3 742	-	1 602	2 139	-	-	80	2	-	2	-	2	-	-	-	-	-	8 285
Stock change	-230	-206	1 661	-	71	1 590	-	-	-30	-4	-	-4	-	0	-	-	-	-	-	231
Exports	16 597	16 580	7 825	-	1 672	6 153	-	-	4 238	-	-	-	-	-	-	-	-	-	-	36
Bunkers	246	246	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption	**98 344**	**93 614**	**48 133**	-	**9 604**	**38 528**	-	-	**-4 189**	**11 932**	-	**11 932**	-	**1**	-	-	-	-	-	**12 377**
Transformation input	**75 501**	**74 839**	**36 761**	-	**9 619**	**27 142**	-	-	**879**	**11 970**	-	**11 970**	-	-	-	**475**	**142**	-	**618**	**1 196**
Classic thermal Power Stations	38 824	38 202	24 425	-	-	24 425	-	-	-	11 963	-	11 963	-	-	-	459	142	-	601	940
Public thermal power stations	36 950	36 533	23 299	-	-	23 299	-	-	-	11 963	-	11 963	-	-	-	254	-	-	254	879
Autoprod. thermal power stations	1 873	1 669	1 126	-	-	1 126	-	-	-	-	-	-	-	-	-	205	142	-	347	61
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	9 601	9 601	9 537	-	9 537	-	-	-	54	-	-	-	-	-	-	-	-	-	-	10
Blast-furnace plants	822	822	-	-	-	-	-	-	822	-	-	-	-	-	-	-	-	-	-	-
Gas works	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	23 106	23 106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	3 145	3 105	2 800	-	82	2 717	-	-	3	7	-	7	-	-	-	17	-	-	17	246
Transformation output	**52 408**	**52 408**	-	-	-	-	-	-	**6 870**	-	-	-	-	-	-	**1 838**	**827**	**2**	**2 667**	-
Classic thermal Power Stations	18 402	18 402	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Public thermal power stations	17 008	17 008	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Autoprod. thermal power stations	1 394	1 394	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	8 708	8 708	-	-	-	-	-	-	6 870	-	-	-	-	-	-	1 838	-	-	1 838	-
Blast-furnace plants	827	827	-	-	-	-	-	-	-	-	-	-	-	-	-	-	827	-	827	-
Gas works	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-
Refineries	21 799	21 799	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	2 669	2 669	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	**-22**	**-22**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Interproduct transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Products transferred	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Returns from petrochem. industry	-24	-24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the energy branch	**8 013**	**8 011**	**681**	-	**152**	**528**	-	-	**1**	**33**	-	**33**	-	-	-	**966**	**125**	**0**	**1 091**	**1 390**
Production and distribution of electricity	1 838	1 837	351	-	-	356	-	-	-	-	-	-	-	-	-	15	125	-	139	-
Pumping stations	26	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Extraction and agglo. of solid fuels	855	855	180	-	-	172	-	-	-	5	-	5	-	-	-	3	-	-	3	11
Coke-oven and gas works plants	1 398	1 398	129	-	152	1	-	-	1	-	-	-	-	-	-	948	-	0	948	89
Oil and Nat. Gat extraction plants	278	278	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	270
Oleducs and Gazeducs	335	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	298
Oil refineries	2 509	2 509	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	720
Nuclear fuel fabrication plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	**1 342**	**1 342**	-	-	-	-	-	-	-	-	-	-	-	-	-	**39**	-	-	**39**	**64**
Available for final consumption	**65 873**	**61 807**	**10 691**	-	**-167**	**10 858**	-	-	**1 801**	**-70**	-	**-70**	-	**1**	-	**358**	**560**	**2**	**920**	**9 727**
Final non-energy consumption	**4 833**	**4 833**	**53**	-	-	**53**	-	-	**4**	-	-	-	-	-	-	-	-	-	-	**1 917**
Chemical industry	3 146	3 146	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1 917
Other sectors	1 687	1 687	53	-	-	53	-	-	4	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	**61 221**	**57 156**	**10 025**	-	-	**10 025**	-	-	**1 792**	**98**	-	**98**	-	**1**	-	**373**	**559**	**2**	**934**	**7 840**
Industry	17 943	16 842	3 293	-	-	3 293	-	-	1 712	-	-	-	-	1	-	373	559	-	932	3 080
Iron & steel industry	3 793	3 793	183	-	-	183	-	-	1 363	-	-	-	-	-	-	317	559	-	876	533
Non-ferrous metal industry	716	716	-	-	-	-	-	-	153	-	-	-	-	-	-	-	-	-	-	161
Chemical industry	3 902	3 899	699	-	-	699	-	-	46	-	-	-	-	-	-	16	-	-	16	210
Glass, pottery & building mat. industry	2 932	2 887	1 048	-	-	1 048	-	-	107	-	-	-	-	1	-	39	-	-	39	1 014
Ore-extraction industry	316	316	14	-	-	14	-	-	1	-	-	-	-	-	-	-	-	-	-	26
Food, drink & tobacco industry	1 952	1 946	742	-	-	742	-	-	22	-	-	-	-	-	-	-	-	-	-	492
Textile, leather & clothing industry	209	209	43	-	-	43	-	-	1	-	-	-	-	-	-	-	-	-	-	58
Paper and printing	1 488	751	226	-	-	226	-	-	1	-	-	-	-	-	-	-	-	-	-	98
Engineering & other metal industry	1 213	1 213	107	-	-	107	-	-	9	-	-	-	-	-	-	1	-	-	1	311
Other industries	1 421	1 113	231	-	-	231	-	-	9	-	-	-	-	0	-	-	-	-	-	178
Ajustment	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transport	14 801	14 707	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Railways	453	453	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Road transport	13 898	13 805	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Air transport	448	448	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inland navigation	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Households, commerce, pub. auth., etc.	28 478	25 606	6 732	-	-	6 732	-	-	80	98	-	98	-	-	-	-	-	2	2	4 761
Households	18 193	15 924	5 169	-	-	5 169	-	-	-	47	-	47	-	-	-	-	-	2	2	3 168
Agriculture	3 492	3 037	902	-	-	902	-	-	20	51	-	51	-	-	-	-	-	-	-	44
Fisheries	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Services	6 791	6 644	661	-	-	661	-	-	61	-	-	-	-	-	-	-	-	0	0	1 549
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical difference	**-181**	**-181**	**613**	-	**-167**	**780**	-	-	**5**	**-168**	-	**-168**	-	**0**	-	**-15**	**1**	**0**	**-14**	**-30**

Oil	Crude oil	Feedstocks	Total pet. products	Refinery gas	LPG	Motor spirit	Kerosenes, jet fuels	Naphtha	Gas / diesel oil	Residual fuel oil	Other pet. products	White spirit	Lubricants	Bitumen	Petroleum coke
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Primary production	**725**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redovered products	-	735	42	-	-	-	-	-	-	-	-	-	42	-	-
Imports	21 008	1 380	6 833	-	2 440	787	1	89	3 022	93	42	45	127	163	24
Stock change	-1 302	-	-762	-	-9	-157	-23	-	-497	52	-128	-4	-9	-2	13
Exports	290	-	3 064	-	27	445	356	35	348	1 103	45	104	188	412	1
Bunkers	-	-	246	-	-	-	-	-	51	195	-	-	-	-	-
Gross inland consumption	**20 142**	**2 114**	**2 804**	-	**2 404**	**186**	**-378**	**55**	**2 127**	**-1 154**	**-131**	**-64**	**-27**	**-251**	**37**
Transformation input	**20 231**	**2 875**	**194**	-	**3**	-	-	-	**17**	**174**	-	-	-	-	-
Classic thermal Power Stations	-	-	160	-	-	-	-	-	3	157	-	-	-	-	-
Public thermal power stations	-	-	138	-	-	-	-	-	3	135	-	-	-	-	-
Autoprod. thermal power stations	-	-	22	-	-	-	-	-	-	22	-	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	3	-	3	-	-	-	-	-	-	-	-	-	-
Refineries	20 231	2 875	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	-	31	-	-	-	-	-	14	17	-	-	-	-	-
Transformation output	-	-	**21 799**	**1 137**	**267**	**4 073**	**824**	**1 469**	**8 941**	**2 705**	**452**	**120**	**259**	**1 553**	-
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	-	-	21 799	1 137	267	4 073	824	1 469	8 941	2 705	452	120	259	1 553	-
District heating plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exchanges and transfers, returns	-	**760**	**-782**	**-205**	**-35**	-	-	**-392**	**-28**	**-31**	**-49**	-	**-42**	-	-
Interproduct transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Products transferred	-	75	-73	-	-	-	-	-	-	-31	-	-	-42	-	-
Returns from petrochem. industry	-	685	-710	-205	-35	-	-	-392	-28	-	-49	-	-	-	-
Consumption of the energy branch	-	-	**1 510**	**396**	**1**	**1**	-	-	**35**	**1 057**	**7**	-	-	**13**	-
Production and distribution of electricity	-	-	10	-	-	-	-	-	6	4	-	-	-	-	-
Pumping stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Extraction and agglo. of solid fuels	-	-	19	-	-	-	-	-	19	-	-	-	-	-	-
Coke-oven and gas works plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oil and Nat. Gat extraction plants	-	-	4	-	-	-	-	-	4	-	-	-	-	-	-
Oleducs and Gazeducs	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-
Oil refineries	-	-	1 472	396	-	-	-	-	4	1 053	6	-	-	13	-
Nuclear fuel fabrication plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Available for final consumption	**-90**	-	**22 116**	**537**	**2 631**	**4 258**	**446**	**1 132**	**10 987**	**289**	**264**	**56**	**190**	**1 289**	**37**
Final non-energy consumption	-	-	**2 859**	-	-	-	-	**1 029**	-	-	**236**	**56**	**251**	**1 287**	-
Chemical industry	-	-	1 229	-	-	-	-	1 029	-	-	173	21	6	-	-
Other sedtors	-	-	1 630	-	-	-	-	-	-	-	62	35	245	1 287	-
Final energy consumption	-	-	**19 313**	**537**	**2 760**	**4 258**	**446**	-	**10 962**	**311**	**1**	-	-	-	**37**
Industry	-	-	1 505	537	159	4	2	-	481	283	1	-	-	-	37
Iron & steel industry	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-
Non-ferrous metal industry	-	-	9	-	1	-	-	-	4	4	-	-	-	-	-
Chemical industry	-	-	808	537	97	-	-	-	89	86	-	-	-	-	-
Glass, pottery & building mat. industry	-	-	139	-	8	-	-	-	44	51	-	-	-	-	37
Ore-extraction industry	-	-	69	-	2	-	-	-	67	-	-	-	-	-	-
Food, drink & tobacco industry	-	-	186	-	22	1	-	-	97	66	-	-	-	-	-
Textile, leather & clothing industry	-	-	12	-	2	-	-	-	9	1	-	-	-	-	-
Paper and printing	-	-	56	-	4	-	-	-	10	41	-	-	-	-	-
Engineering & other metal industry	-	-	64	-	12	1	2	-	45	3	1	-	-	-	-
Other industries	-	-	160	-	11	2	-	-	115	32	-	-	-	-	-
Ajustment	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
Transport	-	-	14 425	-	1 923	4 249	444	-	7 810	-	-	-	-	-	-
Railways	-	-	171	-	-	-	-	-	171	-	-	-	-	-	-
Road transport	-	-	13 805	-	1 923	4 245	-	-	7 637	-	-	-	-	-	-
Air transport	-	-	448	-	-	4	444	-	-	-	-	-	-	-	-
Inland navigation	-	-	2	-	-	-	-	-	2	-	-	-	-	-	-
Households, commerce, pub. auth., etc.	-	-	3 383	-	678	5	-	-	2 671	29	-	-	-	-	-
Households	-	-	963	-	505	-	-	-	458	-	-	-	-	-	-
Agriculture	-	-	1 869	-	55	5	-	-	1 781	29	-	-	-	-	-
Fisheries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Services	-	-	550	-	118	-	-	-	432	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical difference	**-90**	-	**-55**	-	**-129**	-	-	**103**	**24**	**-22**	**27**	-	**-61**	**2**	-

Electricity and Renewables	Nuclear heat	Total Renewables	Solal PV	Solar heat	Geothermal heat	Biomass	Wood	MSW	Biogas	Liquid Biofuels	Biogasoline	Biodiesel	Other liq. Biofuels	Other fuels	Derived heat	Wind power	Hydro power	Electrical energy
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Primary production	**-**	**5 016**	**-**	**0**	**10**	**4 758**	**4 550**	**44**	**65**	**99**	**60**	**40**	**-**	**-**	**-**	**45**	**202**	**-**
Redovered products	-	-	-	-	-	-	-	-	-	-	-	-	-	502	-	-	-	-
Imports	-	14	-	-	-	14	-	-	-	14	14	-	-	-	-	-	-	667
Stock change	-	-24	-	-	-	-24	-22	-1	-	-1	-1	-	-	0	-	-	-	-
Exports	-	18	-	-	-	18	-	-	-	18	1	17	-	-	-	-	-	1 127
Bunkers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gross inland consumption	**-**	**4 988**	**-**	**0**	**10**	**4 730**	**4 528**	**43**	**65**	**94**	**71**	**23**	**-**	**502**	**-**	**45**	**202**	**-460**
Transformation input	**-**	**663**	**-**	**-**	**-**	**663**	**607**	**-**	**55**	**-**	**-**	**-**	**-**	**114**	**-**	**-**	**-**	**-**
Classic thermal Power Stations	-	622	-	-	-	622	567	-	55	-	-	-	-	113	-	-	-	-
Public thermal power stations	-	418	-	-	-	418	417	-	0	-	-	-	-	-	-	-	-	-
Autoprod. thermal power stations	-	204	-	-	-	204	150	-	55	-	-	-	-	113	-	-	-	-
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gas works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	41	-	-	-	41	41	-	0	-	-	-	-	1	-	-	-	-
Transformation output	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**7 667**	**-**	**-**	**13 404**
Classic thermal Power Stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4 998	-	-	13 404
Public thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4 280	-	-	12 728
Autoprod. thermal power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	718	-	-	676
Nuclear power stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Patent fuel and briquetting plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Coke-oven plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Blast-furnace plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Gas works	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
District heating plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2 669	-	-	-
Exchanges and transfers, returns	**-**	**-247**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**		**-45**	**-202**	**247**
Interproduct transfers	-	-247	-	-	-	-	-	-	-	-	-	-	-	-		-45	-202	247
Products transferred	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Returns from petrochem. industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Consumption of the energy branch	**-**	**2**	**-**	**-**	**-**	**2**	**1**	**-**	**1**	**-**	**-**	**-**	**-**	**2**	**1 165**	**-**	**-**	**2 139**
Production and distribution of electricity	-	1	-	-	-	1	-	-	1	-	-	-	-	-	136	-	-	1 201
Pumping stations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26
Extraction and agglo. of solid fuels	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120	-	-	517
Coke-oven and gas works plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	-	-	69
Oil and Nat. Gat extraction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	4
Oleducs and Gazeducs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	36
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	260	-	-	57
Nuclear fuel fabrication plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Distribution losses	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1 240**
Available for final consumption	**-**	**4 076**	**-**	**0**	**10**	**4 065**	**3 919**	**43**	**9**	**94**	**71**	**23**	**-**	**386**	**6 502**	**-**	**-**	**9 812**
Final non-energy consumption	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Chemical industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Other sectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Final energy consumption	**-**	**4 076**	**-**	**0**	**10**	**4 065**	**3 919**	**43**	**9**	**94**	**72**	**22**	**-**	**386**	**6 944**	**-**	**-**	**9 812**
Industry	-	1 100	-	-	-	1 100	1 056	43	2	-	-	-	-	386	1 998	-	-	3 937
Iron & steel industry	-	0	-	-	-	0	0	-	-	-	-	-	-	31	202	-	-	604
Non-ferrous metal industry	-	-	-	-	-	-	-	-	-	-	-	-	-	23	67	-	-	303
Chemical industry	-	3	-	-	-	3	3	-	-	-	-	-	-	164	1 194	-	-	763
Glass, pottery & building mat. industry	-	45	-	-	-	45	3	42	-	-	-	-	-	142	36	-	-	361
Ore-extraction industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	83	-	-	124
Food, drink & tobacco industry	-	6	-	-	-	6	4	-	2	-	-	-	-	-	68	-	-	436
Textile, leather & clothing industry	-	0	-	-	-	0	0	-	-	-	-	-	-	-	16	-	-	79
Paper and printing	-	737	-	-	-	737	737	-	-	-	-	-	-	3	87	-	-	281
Engineering & other metal industry	-	1	-	-	-	1	1	0	-	-	-	-	-	0	178	-	-	542
Other industries	-	308	-	-	-	308	308	-	-	-	-	-	-	22	68	-	-	444
Ajustment	-	0	-	-	-	0	-	0	-	-	-	-	-	-	-	-	-	-
Transport	-	94	-	-	-	94	-	-	-	94	72	22	-	-	-	-	-	282
Railways	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	282
Road transport	-	94	-	-	-	94	-	-	-	94	72	22	-	-		-	-	-
Air transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-
Inland navigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Households, commerce, pub. auth., etc.	-	2 882	-	0	10	2 871	2 864	1	7	-	-	-	-	-	4 946	-	-	5 594
Households	-	2 278	-	-	9	2 269	2 269	-	-	-	-	-	-	-	4 299	-	-	2 267
Agriculture	-	455	-	-	-	455	455	-	-	-	-	-	-	-	22	-	-	129
Fisheries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	1
Services	-	149	-	0	2	147	140	1	7	-	-	-	-	-	624	-	-	3 197
Other	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical difference	**-**	**0**	**-**	**-**	**-**	**0**	**-**	**-**	**-**	**0**	**-1**	**1**	**-**	**-**	**-442**	**-**	**-**	**-**

Annex 4

Report of Polish National Registry

1. Introduction

In accordance with Decision 13/CMP.1 elaborated on the basis of the Kyoto Protocol requirements in October of year 2008 all Parties took part in Go-live process aiming in establishing connection with the International Transaction Log (ITL). Therefore, moment of switch-over of Polish National Registry to the ITL is assumed to be a beginning of the reporting period.

2. Accounting of the Kyoto Protocol Units

Annual Submission Item	Reporting
a. 15/CMP.1 annex I.E paragraph 11: Standard Electronic Format (SEF)	Reference to: SEF 2008-PL v1.0.xls
b. 15/CMP.1 annex I.E paragraph 12: List of discrepant transactions	Reference to: SIAR Reports 2008-PL v1.0.xls; Report R-2 No discrepant transactions occurred during the reporting period.
c. 15/CMP.1 annex I.E paragraph 13 & 14: List of CDM notifications	Reference to: SIAR Reports 2008-PL v1.0.xls; Report R-3 No CDM notifications were received by the National Registry of Poland during the reporting period (year 2008).
d. 15/CMP.1 annex I.E paragraph 15: List of non-replacements	Reference to: SIAR Reports 2008-PL v1.0.xls; Report R-4 No non-replacements occurred during the reporting period
e. 15/CMP.1 annex I.E paragraph 16: List of invalid units	Reference to: SIAR Reports 2008-PL v1.0.xls; Report R-5 There were no invalid units to list for the reporting period.
f. 15/CMP.1 annex I.E paragraph 17: Actions and changes to address discrepancies	No actions and changes were conducted during the reporting period.
g. 15/CMP.1 annex I.E	Currently the revised Commitment Period Reserve for

paragraph 18: CPR calculation	Poland equals 1 942 410 776 tCO2eq. It was calculated as emission in year 2004 multiplied by 5. Based on recalculation of the GHG inventory emissions and removals for 2007 made according to ERT recommendations in September 2009 the following value of revised Commitment Period Reserve was calculated: (5 * emission in 2007) 5 * 398 905 454 tCO2 eq = 1 994 527 271 tCO2eq The given value of CPR will be updated in Polish Registry as soon as UNFCCC Secretariat approves it.

3. Changes to the National Registry

Reporting Item	Reporting
15/CMP.1 annex II.E paragraph 32. (a): Change of name or contact	Contact name regarding registry issues: Mr Przemyslaw Jedrysiak Institute of Environmental Protection 4 Kolektorska Street, 01-692 Warsaw przemyslaw.jedrysiak@kashue.pl
15/CMP.1 annex II.E paragraph 32. (b): Change of cooperation arrangement	Polish National Registry is maintained as a separate registry. It is not consolidated with any other Parties.
15/CMP.1 annex II.E paragraph 32. (c): Change to database or the capacity of National Registry	At the end of reporting year a capacity of the data bases of PL Registry equals 94,6MB. in total. The main data base occupies 72,5MB, transaction data base - 16,3MB, security data base 2,9MB and reconciliation data base - 2,9MB.
15/CMP.1 annex II.E paragraph 32. (d): Change of conformance to technical standards	In reported year registry began to work on production environment with new software version fully conformed with Data Exchange Standard. Conformity was checked and proved by reliable tests (a.o. tests according to Annex H of DES). In October 2008, during the Go-live process, Polish registry system was connected to the Independent Transaction Log.
15/CMP.1 annex II.E paragraph 32. (e): Change of discrepancies procedures	No change of discrepancies procedures occurred in the reporting period.
15/CMP.1 annex II.E paragraph 32. (f): Change of Security	No significant changes of security occurred in the reporting year However, in relation to applying new security rules for submitting calls to ITL ServiceDesk with given personal identification number relevant provisions containing demand of informing ITL administrator about registry administrator dismissal were introduced into registry

	administrator dismissal procedure.
15/CMP.1 annex II.E paragraph 32. (g): Change of list of publicly available information	No change of list of publicly available information occurred in the reporting period.
15/CMP.1 annex II.E paragraph 32. (h): Change of Internet address	Internet address for access to user interface of national registry has not been changed during reporting year.
15/CMP.1 annex II.E paragraph 32. (i): Change of data integrity measure	No change of data integrity measure occurred in the reporting period .
15/CMP.1 annex II.E paragraph 32. (j): Change of test results	No change occurred in the reporting period. Before beginning of Go-live process Polish Registry took part in following preparatory tests: Rehearsal 2 (testing the complete Go-live process), Registry Coordinated Testing (testing carrying out various transactions and Rehearsal 3 (testing connectivity between production environments of national registries and the ITL)

4. The previous Annual Review recommendations

Recommendations	Recommendation was addressed (yes/no)
n/a	n/a

Annex 5. Uncertainty assessment of the 2007 inventory

Uncertainty analysis for the year 2007 was estimated with use of Approach 1 methodology described in IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories and 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Approach 1 is simplified methodology 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 in-depth review of the Polish GHG emission inventory were taken into account and additional analyses were made in *Agriculture* sector.
Following the recommendations of Emission Review Team from September 2009 uncertainties of N2O emission factors in sector 1.A. Fuel Combustion were revised. Additional analysis was done for CH4 factors in sector 1.A and for fugitive emission in sector 1.B. In general CH4 and N2O uncertainty estimates were considered as too low and not reflecting real problem.

For sector 5. *LUCF* and *Industrial gases* (HFC, PFC, SF6) due to lack of appropriate information, uncertainty estimates were made directly to emission values.

First step of the Approach 1 analysis was to assign uncertainty to each activity and emission factor. Next step was to estimate error propagation and its influence of total results. 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 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.

To estimate uncertainty of input data, the results of research made in 2000 for the 1998 GHG emission inventory were used. These data were assigned for emission factors for CH_4 and N_2O in sector *4. Agriculture* and partly in *6. Waste*. Another source of data was literature describing details of uncertainty analysis of Scandinavian countries for 2002 GHG inventory. After investigation of socio-economic parameters literature data was applied to activities in sector *1. Energy* and for activities and emission factors in sector *2. Industrial processes.* Other uncertainties for activities and factors were estimated with help expert's opinion in National Emission Centre in Warsaw (activities and factors in 6.C Waste/Waste Incineration).

Results of analysis of error propagation of uncertainty of national totals is shown below:

CO_2 – 3.7%	CH_4 – 24.2%	N_2O - 48.2%
HFC - 44.7%	PFC - 20.0%	SF6 - 100.0%

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* (solid and liquid fuels 2%, gaseous 1%). 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 (3.7%) 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. 24.2% 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%).* First time were used new uncertainty estimates were for N_2O emissions in *2.C. Metal Production (sinter, electric furnaces, pig iron and basic oxygen furnaces)* with relatively low uncertainty at 20% level. Data available from polish part of EU Emission Trading Scheme reporting were taken into account during this analysis.

Highest value of uncertainty of national total occurred in N_2O (48.2%) 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 estimates were applied directly to emission values of each pollutant. Results are HFC – 44.7%, PFC – 20.0%, SF6 – 100.0%. Due to lack of information, additional analysis need to be done for these gases.

The uncertainty assessment of GHG Inventory for 2007 was made on the basis of calculations and experts opinions made in previous years (during compiling inventories for years 1988-2005) and recommendations of the UNFCCC expert review team in 2005, 2008 and 2009. The calculations cover simplified approach for LULUCF sector and industrial gases.

Planned improvements

Inventory team is planning to improve uncertainty estimates in few parallel process. In Polish 2009 submission new data from EU ETS were included into analysis and in next submissions will be followed by TIER 2 analysis based on Monte Carlo simulations.

Technical preparations as purchasing modelling software, preparing new inventory uncertainty model are already done. At the moment of submitting this report calculating environment is tested.

In separate process inventory experts are preparing set of analysis which will be followed by application of probability distribution functions to each of the input values.

Description of assumptions made and whole procedure of uncertainty analysis will be extended to cover more details than in previous reports.

GHG inventory 2007 – Uncertainty analysis, part 1, sectors 1-2

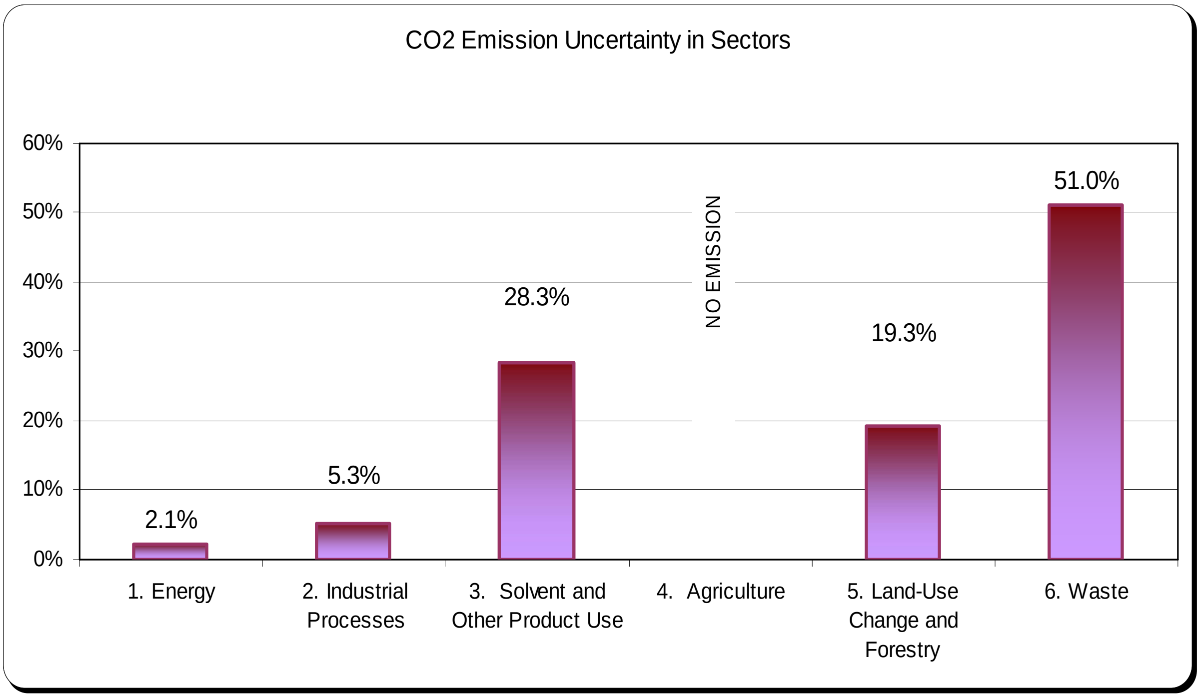
2007	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
TOTAL									**285,287.30**	**1,878.62**	**96.89**	**3.7%**	**24.2%**	**48.2%**	10,562.98	454.23	46.66
1. Energy									**302,824.57**	**768.18**	**6.21**	2.1%	42.6%	30.8%	**6440.17**	**327.52**	**1.91**
A. Fuel Combustion									**302,626.10**	**127.74**	**6.21**	2.1%	33.7%	30.8%	6440.15	43.11	1.91
1. Energy Industries									181,992.63	2.93	2.68	3.4%	50.6%	47.7%	6187.18	1.48	1.28
Liquid Fuels	70,578	2.0%	73.51	2.53	0.48	2.0%	75.0%	75.0%	5,188.49	0.18	0.03	2.8%	75.0%	75.0%	146.75	0.13	0.03
Solid Fuels	1,747,407	2.0%	98.17	1.08	1.45	3.0%	75.0%	50.0%	171,540.83	1.89	2.53	3.6%	75.0%	50.0%	6184.99	1.42	1.27
Gaseous Fuels	95,378	1.0%	55.18	1.00	0.10	1.0%	75.0%	50.0%	5,263.31	0.10	0.01	1.4%	75.0%	50.0%	74.43	0.07	0.00
Biomass	27,824	20.0%	105.11	27.57	3.67	0.0%	50.0%	150.0%	2,924.58	0.77	0.10	20.0%	53.9%	151.3%		0.41	0.15
2. Manufacturing Industries and Construction									34,664.17	3.70	0.68	2.4%	46.0%	49.9%	837.73	1.70	0.34
Liquid Fuels	68,478.33	3.0%	69.45	2.15	2.77	2.0%	75.0%	75.0%	4,755.87	0.15	0.19	3.6%	75.1%	75.1%	171.48	0.11	0.14
Solid Fuels	202,757.80	1.5%	112.75	10.24	1.49	3.0%	75.0%	50.0%	22,861.26	2.08	0.30	3.4%	75.0%	50.0%	766.79	1.56	0.15
Gaseous Fuels	127,502.27	4.0%	55.27	1.00	0.10	1.0%	75.0%	50.0%	7,047.05	0.13	0.01	4.1%	75.1%	50.2%	290.56	0.10	0.01
Biomass	45,168.50	4.0%	109.42	29.95	3.99	0.0%	50.0%	150.0%	4,942.34	1.35	0.18	4.0%	50.2%	150.1%		0.68	0.27
3. Transport									38,212.74	5.30	1.49	2.5%	10.3%	49.9%	955.32	0.54	0.74
Liquid Fuels	531,409.27	1.5%	70.60	9.93	2.79	2.0%	10.2%	50.0%	37,516.85	5.28	1.48	2.5%	10.3%	50.0%	937.92	0.54	0.74
Solid Fuels	IE,NA,NO	3.0%	NA	NA	NA	3.0%	13.5%	50.0%				4.2%	13.8%	50.1%	0.00	0.00	0.00
Biomass	12.47	4.0%	NA	NA	NA	1.0%	24.0%	50.0%	695.89	0.01	0.00	4.1%	24.3%	50.2%	28.69	0.00	0.00
Other Fuels	4,428.00	4.0%	70.80	3.00	0.60	0.0%	50.0%	50.0%	313.50	0.01	0.00	4.0%	50.2%	50.2%	12.54	0.01	0.00
4. Other Sectors									47,756.56	115.81	1.36	2.6%	37.2%	85.5%	1256.96	43.05	1.16
Liquid Fuels	131,258.10	3.0%	70.94	6.07	3.26	2.0%	50.0%	150.0%	9,311.66	0.80	0.43	3.6%	50.1%	150.0%	335.74	0.40	0.64
Solid Fuels	289,424.69	3.0%	94.39	269.63	1.50	3.0%	50.0%	150.0%	27,319.82	78.04	0.43	4.2%	50.1%	150.0%	1159.08	39.09	0.65
Gaseous Fuels	199,313.10	3.0%	55.82	5.00	0.10	1.0%	50.0%	150.0%	11,125.08	1.00	0.02	3.2%	50.1%	150.0%	351.81	0.50	0.03
Biomass	120,207.50	3.0%	109.62	299.29	3.99	0.0%	50.0%	150.0%	13,177.67	35.98	0.48	3.0%	50.1%	150.0%		18.02	0.72
5. Other									0.00	0.00	0.00	0.0%	0.0%		0.00	0.00	0.00
Liquid Fuels	IE	4.0%	NA	NA	NA	2.0%	100.0%	150.0%	IE	IE	IE	4.5%	100.1%	150.1%	0.00	0.00	0.00
Solid Fuels	IE	4.0%	NA	NA	NA	3.0%	80.0%	150.0%	IE	IE	IE	5.0%	80.1%	150.1%	0.00	0.00	0.00
Gaseous Fuels	IE	4.0%	NA	NA	NA	1.0%	90.0%	150.0%	IE	IE	IE	4.1%	90.1%	150.1%	0.00	0.00	0.00
Biomass	IE	4.0%	NA	NA	NA	0.0%	95.0%	150.0%	IE	IE	IE	4.0%	95.1%	150.1%	0.00	0.00	0.00
B. Fugitive Emissions from Fuels									**198.463**	**640.44**	**0.00**	8.0%	50.7%	100.1%	15.88	324.67	0.00
1. Solid Fuels									1.57	410.05	0.00	6.6%	74.1%		0.10	303.79	0.00
1. B. 1. a. Coal Mining and Handling															0.00	0.00	0.00
i. Underground Mines [Activity in Mt, EF in kg/t]	82.78	2.0%		4.89139			75.0%			404.90			75.0%		0.00	303.79	0.00
ii. Surface Mines [Activity in Mt, EF in kg/t]	57.70	2.0%		0.01273			75.0%			0.73			75.0%		0.00	0.55	0.00
1. B. 1. c. Other [CO2 Emisson from Coking Gas Subsystem]	0.76	2.0%	2,060,765	5,791,695.00			75.0%		1.57	4.41		6.6%	15.0%		0.10	0.66	
2. Oil and Natural Gas									196.895	230.39	0.00	8.1%	49.7%	100.1%	15.88	114.56	0.00
1. B. 2. a. Oil															0.00	0.00	0.00
ii. Production [Activity in PJ, EFs in kg/PJ]	30.36	5.0%	6,315,000	61,800.00		6.6%	75.0%		191.748	1.88		8.3%	75.2%		15.88	1.41	0.00
iii. Transport [Activity in Gg]	21,606.00	5.0%	NE	NE		6.6%	75.0%		0.012	0.14		8.3%	75.2%		0.00	0.10	0.00
iv. Refining/storage [Gg]	847.03	5.0%		745.00		6.6%	75.0%		NA	0.63			75.2%			0.47	
1. B. 2. b. Natural Gas															0.00	0.00	0.00
i. Production / Processing [Activity in PJ, EFs in kg/PJ]	181.27	5.0%	22,886.28	96,378.68		6.6%	75.0%		4.149	17.47		8.3%	75.2%		0.34	13.13	0.00
ii. Transmission [Activity in PJ, EFs in kg/PJ]	575.77	5.0%	521.75	53,213.10		6.6%	75.0%		0.300	30.64		8.3%	75.2%		0.02	23.03	0.00
iv. Distribution [Activity in PJ, EF in kg/PJ]	575.77	5.0%	1,167.05	310,710.18		6.6%	75.0%		0.672	178.90		8.3%	75.2%		0.06	134.47	0.00
v. Other Leakage [Activity in PJ, EFs in kg/PJ]	575.77	5.0%	9.91	1,290.91		6.6%	75.0%		0.006	0.74		8.3%	75.2%		0.00	0.56	
1. B. 2. c. Venting and Flaring	605.88	5.0%	12.00			6.6%		100.0%	0.007		0.000783	8.3%		100.1%			
2. Industrial Processes									**24,426.94**	**20.29**	**15.52**	5.3%	13.6%	29.9%	1289.60	2.75	4.64
A. Mineral Products									10,399.77		0	11.0%			1142.50	0.00	0.00
1. Cement Production [Activity in kt, EF in t/t]	13,168.00	5.0%	0.53541973			15.0%			7,050.41			15.8%			1114.77	0.00	0.00
2. Lime Production [Activity in kt, EF in t/t]	2,142.80	10.0%				10.0%			1,682.10			14.1%			237.88	0.00	0.00
3. Limestone and dolomite Use [activitz in kt, EFs in t/t]	NA		NA	NA	NA				594.16			10.0%					
4. Soda Ash (production) [Activity in kt, EF in t/t]	1,191.67	10.0%	0.415			0.0%			494.54			10.0%			49.45	0.00	0.00
7. Other (ETS Data; Bricks, Tiles, Ceramic Materials and Glass production) [emission data only]									578.57			1.0%			5.79	0.00	0.00
B. Chemical Industry									4,244.16	13.35	15.43	7.0%	19.0%	30.1%	297.61	2.53	4.64
1. Ammonia Production [Activity in kt, EF in t/t]	2,417.54	5.0%	1.74086928	0.0049		5.0%	20.0%		4,208.63	11.85		7.1%	20.6%		297.59	2.44	0.00
2. Nitric Acid Production [Activity in kt, EF in t/t]	2,269.88	2.0%			0.01			30.0%			14.69			30.1%	0.00	0.00	4.42
3. Adipic Acid Production [Activity in kt, EF in t/t]	NO	5.0%			0.00			10.0%	NO					11.2%			
4. Carbide Production (calcium carbide) [Activity in kt, EF in t/t]	16.14	5.0%	2.19			5.0%			35.35			7.1%			2.50	0.00	0.00
5. Other (Carbon Black) [Activity in kt, EF in t/t]	38.16	5.0%		0.01			20.0%			0.42			20.6%		0.00	0.09	0.00
5. Other (Ethylene) [Activity in kt, EF in t/t]	623.70	5.0%	0.0003	0.00100		5.0%	20.0%		0.19	0.62		7.1%	20.6%		0.01	0.13	0.00
5. Other (N2O for Medical Use) [Activity in kt, EF in t/t]	114.61	5.0%			IE	10.0%		20.0%		0.46	IE				0.00	0.00	IE
5. Other (Methanol) [Activity in kt, EF in t/t]	0.22	5.0%		0.00200			20.0%			0.00			20.6%		0.00	0.00	0.00
5. Other (Caprolactam) [Activity in kt, EF in t/t]	157.60	5.0%			0.0047			20.0%			0.75				0.00	0.00	
C. Metal Production									8,826.39	6.94	0.09	5.9%	15.4%	17.2%	516.63	1.07	0.01
1. Iron and Steel Production															0.00	0.00	0.00
Sinter [Activity in kt, EF in t/t]	6,953.95	5.0%	0.20	0.000084	0.0000021	10.0%	20.0%	20.0%	1,386.10	0.58	0.01	11.2%	20.6%	20.6%	154.97	0.12	0.00
Coke [Activity in kt, EF in t/t]	10,168.00	5.0%	0.19	0.000500		10.0%	20.0%		1,898.89	5.08		11.2%	20.6%		212.30	1.05	0.00
Open-heart Steel [Activity in kt, EF in t/t]	NO	5.0%															
Electric Furnace Steel [Activity in kt, EF in t/t]	4,432.81	5.0%	0.08965	0.000121	0.0000002	10.0%	20.0%	20.0%	397.38	0.54	0.00	11.2%	20.6%	20.6%	44.43	0.11	0.00
Pig Iron [Activity in kt, EF in t/t]	5,804.42	5.0%	0.66832	0.000080	0.0000120	10.0%	20.0%	20.0%	3,879.21	0.47	0.07	11.2%	20.6%	20.6%	433.71	0.10	0.01
Iron Cast [Activity in kt, EF in t/t]	1,019.09	5.0%	0.007	0.000200		10.0%	20.0%		6.67	0.20		11.2%	20.6%		0.75	0.04	0.00
Steel Cast [Activity in kt, EF in t/t]	142.20	5.0%	0.046			10.0%			6.57			11.2%			0.74	0.00	0.00
Basic Oxygen Furnace Steel [Activity in kt, EF in t/t]	6,187.91	5.0%	0.12394	0.000001	0.0000001	10.0%	20.0%	20.0%	766.93	0.00	0.00	11.2%	20.6%	20.6%	85.75	0.00	0.00
2. Ferroalloys Production [Activity in kt, EF in t/t]	58.54	5.0%	3.9	0.001000		5.0%	20.0%		228.30	0.06		7.1%	20.6%		16.14	0.01	0.00
3. Aluminium Production [Activity in kt, EF in t/t]	57.65	5.0%	1.8			5.0%			103.76			7.1%			7.34	0.00	0.00
5. Other (Zinc Production) [Activity in kt, EF w t/t]	64.50	5.0%	1.7			5.0%			110.94			7.1%			7.84		
5. Other (Lead Production) [Activity in kt, EF w t/t]	80.06	5.0%	0.5			5.0%			41.63			7.1%			2.94		
D. Other Production									0.077			5.0%			0.00	0.00	0.00
G. Other									956.543			5.0%			47.83	0.00	0.00

GHG inventory 2007 – Uncertainty analysis, part 2, sector 3-6

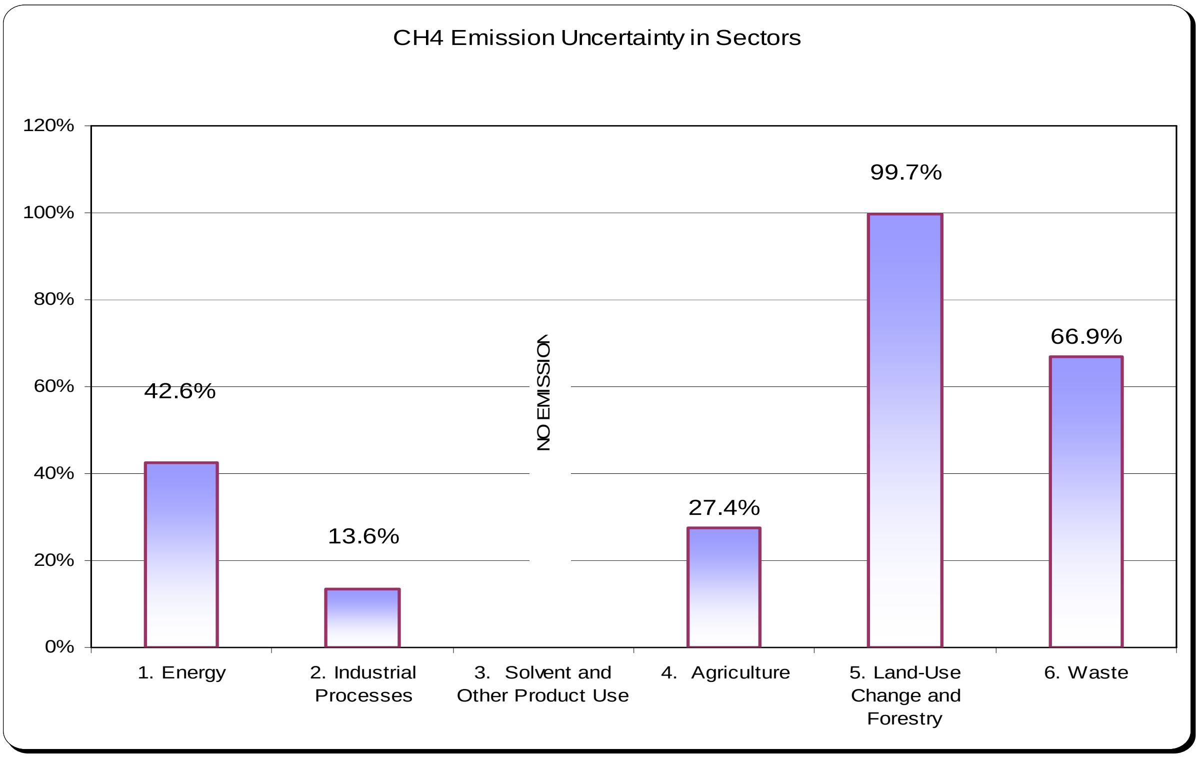
2007	Aktywność [TJ]	Niepewność aktywności [%]	WE CO_2 [t/TJ]	WE CH_4 [kg/TJ]	WE N_2O [kg/TJ]	Niepewność WE CO_2 [%]	Niepewność WE CH_4 [%]	Niepewność WE N_2O [%]	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	Niepewność emisji CO_2 [%]	Niepewność emisji CH_4 [%]	Niepewność emisji N_2O [%]	Niepewność bezwzględna emisji CO_2 [Gg]	Niepewność bezwzględna emisji CH_4 [Gg]	Niepewność bezwzględna emisji N_2O [Gg]
3. Solvent and Other Product Use	**173.85**	**20.0%**	**3.50329472**		**0.00230086**	**20.0%**		**50.0%**	**609.04**		**0.40**	28.3%		53.9%	172.26	0.00	0.22
4. Agriculture										**618.10**	**71.16**		27.4%	65.1%	0.00	169.32	46.35
A. Enteric Fermentation										443.13			34.3%		0.00	152.10	0.00
1. Cattle															0.00	0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2,787.0	5.0%		95.88			50.0%			267.21			50.2%		0.00	134.27	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2,909.0	5.0%		47.92			50.0%			139.40			50.2%		0.00	70.05	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	332.0	5.0%		8.08			50.0%			2.68			50.2%		0.00	1.35	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	144.0	5.0%		5.00			50.0%			0.72			50.2%		0.00	0.36	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	329.0	5.0%		18.00			50.0%			5.92			50.2%		0.00	2.98	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	18,129.0	5.0%		1.50			50.0%			27.19			50.2%		0.00	13.66	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	150,620.0	5.0%		0.00			50.0%			0.00			50.2%		0.00	0.00	0.00
B. Manure Management										173.78	19.61		42.8%	148.2%	0.00	74.40	29.06
1. Cattle															0.00	0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2,787	5.0%		10.40			50.0%			29.00			50.2%		0.00	14.57	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	2,909	5.0%		4.81			50.0%			14.01			50.2%		0.00	7.04	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	332	5.0%		0.17			50.0%			0.06			50.2%		0.00	0.03	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	144	5.0%		0.12			50.0%			0.02			50.2%		0.00	0.01	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	329	5.0%		1.39			50.0%			0.46			50.2%		0.00	0.23	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	18,129	5.0%		6.54			50.0%			118.50			50.2%		0.00	59.55	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	150,620	5.0%		0.08			50.0%			11.75			50.2%		0.00	5.90	0.00
11. Liquid Systems [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%			0.001000			150.0%			0.24			150.1%	0.00	0.00	0.36
12. Solid Storage and Dry Lot [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%			0.020000			150.0%			19.36			150.1%	0.00	0.00	29.06
D. Agricultural Soils											51.51			70.1%	0.00	0.00	36.11
1. Direct Soil Emissions															0.00	0.00	0.00
Synthetic Fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	950,400,000	5.0%			0.01			150.0%			13.28			150.1%	0.00	0.00	19.92
Animal Wastes Applied to Soils [Activity in kg N, EF in kg N2O-N/kg N]	616,212,446	5.0%			0.01			150.0%			9.68			150.1%	0.00	0.00	14.53
N-fixing Crops [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	46,577,850	5.0%			0.01			150.0%			0.73			150.1%	0.00	0.00	1.10
Crop Residue [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	192,906,000	5.0%			0.01			150.0%			3.03			150.1%	0.00	0.00	4.55
Cultivation of Histosols [Activity in ha, EF in kg N2O-N/ha]	700,840	5.0%			8.00			150.0%			8.81			150.1%	0.00	0.00	13.22
2. Animal Production [Activity in kg N, EF in kg N2O-N/kg N]	40,363,442	5.0%			0.02			150.0%			1.27			150.1%	0.00	0.00	1.90
3. Indirect Emissions [Activity in kg N/yr, EF in kg N2O/kg N]	113,672,688	20.0%			1.29386501			150.0%			14.71			151.3%			22.26
F. Field Burning of Agricultural Residues										1.19	0.05		21.5%	93.0%	0.00	0.25	0.04
1. Cereals															0.00	0.00	0.00
Wheat [Activity in t of crop production, EF in kg/t dm]	8,317,000	30.0%		0.1816	0.0004		20.0%	150.0%		0.15	0.00		36.1%	153.0%	0.00	0.05	0.01
Barley [Activity in t of crop production, EF in kg/t dm]	4,008,000	30.0%		0.1473	0.0004		20.0%	150.0%		0.06	0.00		36.1%	153.0%	0.00	0.02	0.00
Maize [Activity in t of crop production, EF in kg/t dm]	1,722,000	30.0%		0.0367	0.0001		20.0%	150.0%		0.01	0.00		36.1%	153.0%	0.00	0.00	0.00
Oats [Activity in t of crop production, EF in kg/t dm]	1,462,000	30.0%		0.1506	0.0004		20.0%	150.0%		0.02	0.00		36.1%	153.0%	0.00	0.01	0.00
Rye [Activity in t of crop production, EF in kg/t dm]	3,126,000	30.0%		0.2004	0.0004		20.0%	150.0%		0.06	0.00		36.1%	153.0%	0.00	0.02	0.00
Other Cereals [Activity in t of crop production, EF in kg/t dm]	8,500,000	30.0%		0.1618	0.0004		20.0%	150.0%		0.14	0.00		36.1%	153.0%	0.00	0.05	0.00
2 Pulses (Other non-specified)	285,000	30.0%		0.0432	0.0003		20.0%	150.0%		0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
3 Tuber and Root															0.00	0.00	0.00
Potatoes [Activity in t of crop production, EF in kg/t dm]	11,791,000	30.0%		0.1796	0.0014		20.0%	150.0%		0.21	0.02		36.1%	153.0%	0.00	0.08	0.03
Other Tuber and Root [Activity in t of crop production, EF in kg/t dm]	0	30.0%		0.0000	0.0000		20.0%	150.0%		0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
5 Other															0.00	0.00	0.00
Fruits, Veget., Rape, Tabacco, Hop, Hey [Activity in t of crop prod., EF in kg/ t of crop]	23,802,000	30.0%		0.0225	0.0008		20.0%	150.0%		0.54	0.02		36.1%	153.0%	0.00	0.19	0.03
													0.0%	0.0%	0.00	0.00	0.00
5. Land-Use Change and Forestry									**-42,884.81**	**113.59**	**0.01**	19.3%	99.7%	88.0%	-8269.39	113.26	0.007
A. Forest Land									-54,132.18	0.146	0.001	15.0%	100.0%	100.0%	-8119.83	0.15	0.001
B. Cropland									8,419.60			15.0%			1262.94	0.00	0.000
C. Grassland									-201.00	0.18	0.00	15.0%	100.0%	100.0%	0.00	0.18	0.000
D. Wetlands									3,102.19	113.26	0.01	15.0%	100.0%	100.0%	465.33	113.26	0.007
E. Settlements									-73.42			15.0%			-11.01	0.00	0.000
F. Other Land									0.00			15.0%			0.00	0.00	0.000
6. Waste									**311.55**	**358.47**	**3.59**	51.0%	66.9%	50.9%	158.86	239.89	1.82
A. Solid Waste Disposal on Land										308.17			76.5%		0.00	235.87	0.00
1 Managed Waste Disposal on Land [Activity in Gg, EF in t/t MSW]	1,273.72	23.0%		0.031667996			100.0%			40.34			102.6%		0.00	41.39	0.00
2 Unmanaged Waste Disposal Sites - deep (>5 m) [Activity in Gg, EF in t/t MSW]	7,824.28	23.0%		0.031667996			100.0%			247.7793			102.6%		0.00	254.25	0.00
3 Other - Total Waste Disposal on Land (Draft Guidlines 2006) [Activity in Gg, EF in t/t MSW]	71.25	23.0%		0.281448804			100.0%			20.05			102.6%		0.00	20.58	0.00
B. Wastewater Handling										50.30	3.49		86.9%	52.2%	0.00	43.72	1.82
Industrial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	338.91			0.02			100.0%			9.41			100.0%		0.00	9.41	0.00
Domestic and Commercial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	519.22	30.0%		0.078770624			100.0%			40.90			104.4%		0.00	42.70	0.00
N2O from human sewage [Activity in 1000s of population, EF in kg N2O-N/kg sewage N produced]	38,125.00	15.0%			0.0000917			50.0%			3.49			52.2%	0.00	0.00	1.82
C. Waste Incineration									311.55		0.09	51.0%		22.4%	158.86	0.00	0.02
biogenic [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			150.19		0.06	51.0%		30.0%	76.58	0.00	0.02
plastics and other non-biogenic waste [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			311.55		0.03	51.0%		30.0%	158.86	0.00	0.01

Industrial gases inventory 2007 – Uncertainty analysis for HFC, PFC and SF_6.

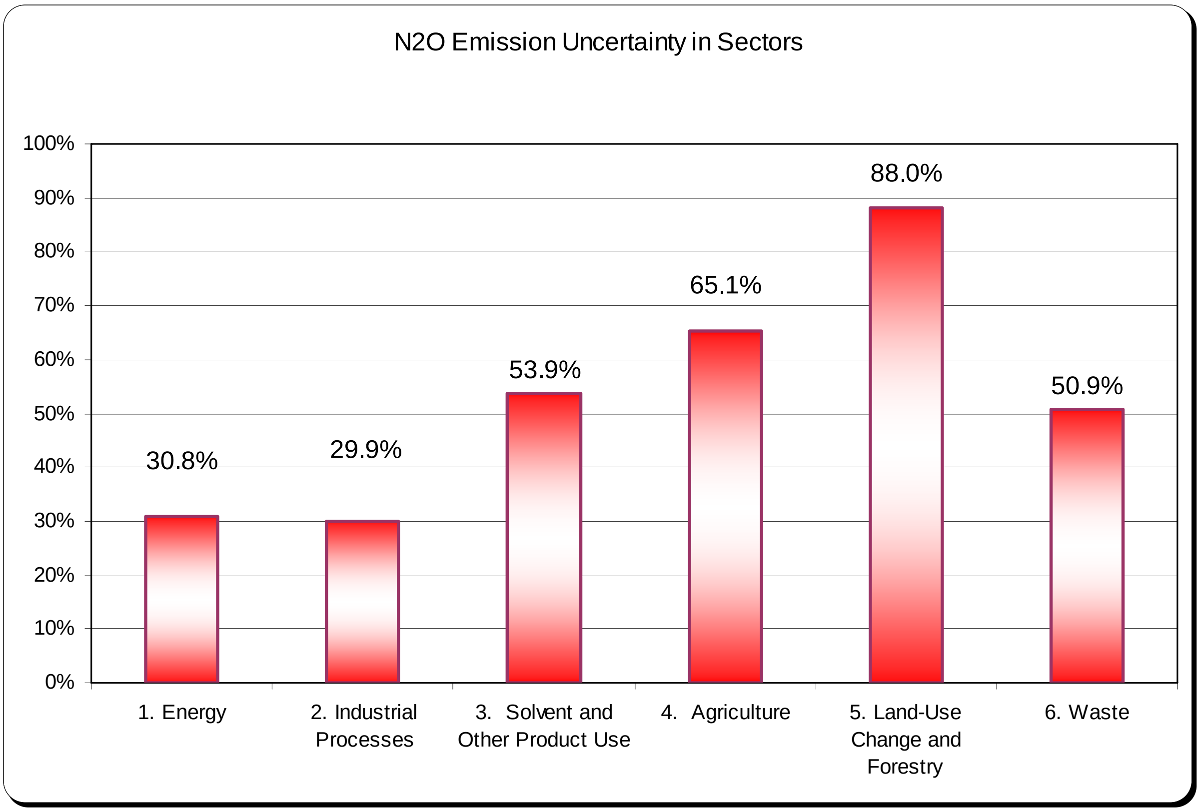
	HFC Emission [Gg of CO_2 eq.]	PFC Emission [Gg of CO_2 eq.]	SF_6 Emission [Gg of CO_2 eq.]	HFC Emission uncertainty [%]	PFC Emission uncertainty [%]	SF_6 Emission uncertainty [%]	HFC Emission absolute uncertainty [Gg of CO_2 eq.]	PFC Emission absolute uncertainty [Gg of CO_2 eq.]	SF_6 Emission absolute uncertainty [Gg of CO_2 eq.]
TOTAL	**3,327.01**	**276.65**	**31.92**	**44.7%**	**20.0%**	**100.0%**	**1,485.52**	**55.33**	**31.92**
2. Industrial Processes	**3,327.01**	**276.65**	**31.92**	**44.7%**	**20.0%**	**100.0%**	**1,485.52**	**52.18**	**31.92**
C. Metal Production		260.92			20.0%			52.18	
3. Aluminium Production		260.92			20.0%			52.18	
F. Consumption of Halocarbons and SF6	3,327.01	15.73	31.92	44.7%		100.0%	1485.52	0.00	31.92
1. Refrigeration and Air Conditioning Equipment	2,676.06			50.0%			1338.03		
2. Foam Blowing	292.16			50.0%				0.00	
3. Fire Extinguishers	13.28	15.73		50.0%	20.0%				
4. Aerosols/ Metered Dose Inhalers	345.51			50.0%			172.76		
8. Electrical Equipment			31.92			100.0%			31.92



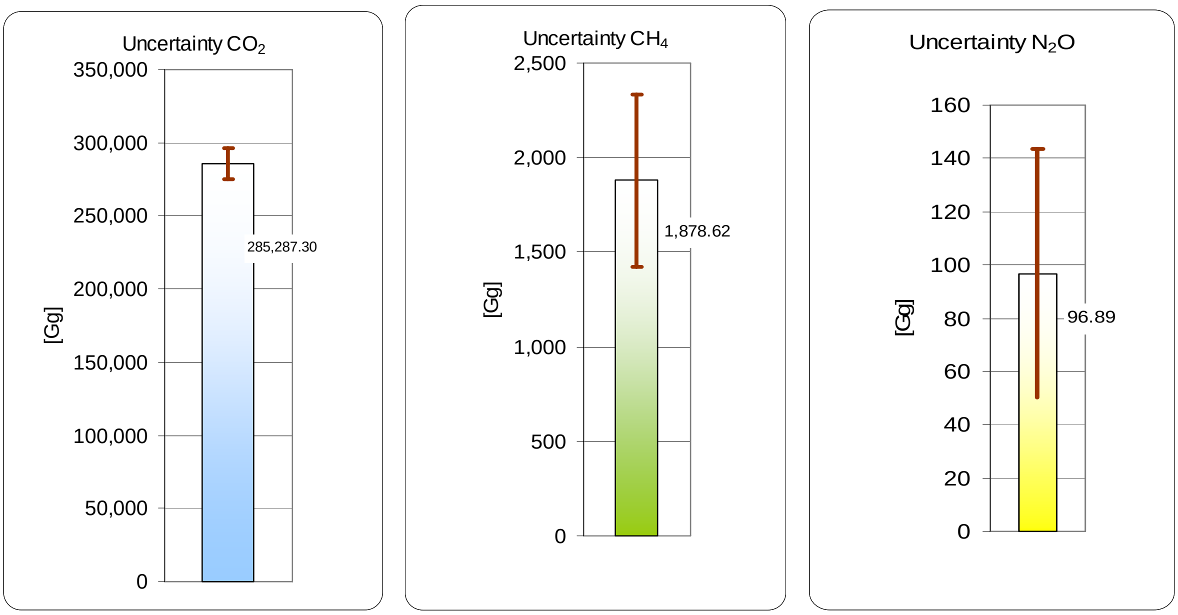
Results of uncertainty analysis in percents for CO_2 with sectoral split.



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.