Krajowy Ośrodek Bilansowania i Zarządzania Emisjami

POLAND'S
NATIONAL INVENTORY REPORT
2014

Greenhouse Gas Inventory
for 1988-2012

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

Warszawa, May 2014

IOŚ-PIB
INSTYTUT OCHRONY ŚRODOWISKA – PAŃSTWOWY INSTYTUT BADAWCZY
INSTITUTE OF ENVIRONMENTAL PROTECTION – NATIONAL RESEARCH INSTITUTE
00-548 Warszawa, ul. Krucza 5/11d

www.ios.edu.pl
NIP 525-000-73-07
REGON 001240700

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

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

Reporting entity:

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

Warszawa
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The Authors Team:

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

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EXECUTIVE SUMMARY

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

ES.1.1. Background information on climate change

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

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

The Polish greenhouse gas inventory is compiled on an annual basis and submitted in the required by the UNFCCC deadline. The underlying National Inventory Report (NIR), submitted in 2013, presents the results of the greenhouse gases (GHGs) inventory in Poland for 2012 as well as for the whole preceding period since 1988.

The Polish inventory covers the following GHGs:

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

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

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

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

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

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

Poland's assigned amount units (AAU) for 2008–2012 have been calculated based on GHG emissions for 1988 estimated in 2006 and revised in course of the review of Initial report of Poland under the Kyoto Protocol performed in 2007 [IRR 2007]. The fixed GHG inventory in 1988 amounted to 563 442 774 tCO_2 eq., so the Poland's AAU is:

563 442 774 tCO_2 eq. * 94% * 5 = **2 648 181 038 tCO_2 eq.**

The national commitment period reserve (CPR) for Poland was calculated according to decision 11/CMP.1. It is calculated as 100 per cent of five times the most recently reviewed inventory, as this amount is lower than 90 per cent of Poland's assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol. For the year 2012 (the most recent inventory), the aggregated anthropogenic emissions of GHG from sources listed in Annex A of the Kyoto Protocol are estimated at 399 267 970 tCO_2 equivalent. The CPR is calculated as 5 times the Annex A emissions for 2012 and amounts to 1 996 339 848 tCO_2 equivalent:

399 267 970 tCO_2 eq. * 5 = **1 996 339 848 tCO_2 eq.**

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

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

ES.2.1. GHG inventory

The GHG emissions in the base year 1988 and the year 2012, expressed as CO_2 equivalents, are presented in table ES.1. In 2012 the total national emission of GHG was 399.27 million tonnes of CO_2 eq., excluding GHG emissions and removals from category 5 (*Land use, land use change and forestry* – LULUCF). Compared to the base year (1988), the 2012 emissions have decreased by 29.1%.

Table ES.1. National emissions of greenhouse gases for the base year 1988 and 2012 [Gg CO_2 eq.]

Pollutant	Base year	2012	(2012-base)/base [%]
	Emission in CO_2 eq. [Gg]	Emission in CO_2 eq. [Gg]	
CO_2 (with LULUCF)	436 209.10	286 189.28	-34.4
CO_2 (without LULUCF)	469 143.82	320 861.67	-31.6
CH_4 (with LULUCF)	53 672.51	43 305.05	-19.3
CH_4 (without LULUCF)	53 665.03	41 032.63	-23.5
N_2O (with LULUCF)	40 334.29	30 134.92	-25.3
N_2O (without LULUCF)	40 333.53	29 589.58	-26.6
HFCs	26.44	7 700.22	29021.9
PFCs	250.18	41.81	-83.3
SF_6	23.77	42.06	77.0
TOTAL net emission (with LULUCF)	530 466.09	367 413.33	-30.7
TOTAL without LULUCF	563 442.77	399 267.97	-29.1

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

Trend of aggregated greenhouse gases emissions follows the trend of emissions CO_2 alone which is the primary greenhouse gas emitted in Poland. The GHGs trend for period between 1988 and 1990 indicates dramatic decrease triggered by significant economical changes, especially in heavy industry, related to political transformation from centralized to market economy. This drop in emissions continued up to 1993 and then emissions started to rise with a peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. The succeeding years characterize slow decline in emissions up to 2002, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. Since 2008 stabilisation in emissions has been noted with distinct decrease in 2009 related to world economic slow-down (tables ES.2, ES.3 and figure ES.1). Since 2010 GHG emissions in Poland gradually decreases.

Table ES.2. National emissions of greenhouse gases for 1988–2012 according to gases

GHG	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
CO_2 (with LULUCF)	453 897.85	427 097.54	346 780.27	350 796.51	367 298.38	358 106.55	354 402.33	344 155.42	338 227.29	329 848.87	296 343.05	279 235.19
CO_2 (without LULUCF)	469 413.91	449 307.24	374 812.04	372 751.84	363 232.78	363 798.15	359 432.55	360 975.63	374 430.77	365 459.54	338 295.80	328 870.88
CH_4 (with LULUCF)	58 065.28	57 145.96	51 847.50	50 351.90	48 290.68	47 759.25	48 013.67	47 956.25	47 891.34	48 144.62	46 194.23	46 073.80
CH_4 (without LULUCF)	55 875.20	54 951.49	49 651.04	48 176.24	45 906.91	45 549.80	45 802.00	45 753.23	45 650.92	45 938.54	44 002.43	43 859.16
N_2O (with LULUCF)	44 816.05	46 901.69	42 114.84	35 476.95	33 124.20	32 928.87	33 353.32	34 324.74	33 887.13	34 096.10	34 135.35	33 082.23
N_2O (without LULUCF)	44 487.31	46 572.90	41 786.00	35 153.29	32 753.79	32 599.16	33 022.99	33 997.36	33 552.49	33 769.08	33 811.89	32 747.68
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	10.40	197.03	307.83	467.51	591.18	848.88
PFCs	127.55	127.77	122.88	122.40	116.61	125.47	132.33	148.96	139.45	149.56	150.87	145.27
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	13.91	30.53	24.95	24.02	25.09	24.64
TOTAL (with LULUCF)	**556 906.72**	**531 272.95**	**440 865.48**	**436 747.76**	**448 829.88**	**438 920.14**	**435 925.95**	**426 812.92**	**420 478.00**	**412 730.68**	**377 439.78**	**359 410.00**
TOTAL (without LULUCF)	**569 903.97**	**550 959.40**	**466 371.96**	**456 203.77**	**442 010.09**	**442 072.58**	**438 414.17**	**441 102.72**	**454 106.41**	**445 808.23**	**416 877.25**	**406 496.50**

* emissions for 1988 estimated for entire series up to 2012 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table ES.2. (cont.) National emissions of greenhouse gases for 1988–2012 according to gases

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
285 608.63	290 438.03	268 995.76	279 692.74	271 267.85	270 738.04	266 553.58	297 935.27	290 500.12	277 865.71	297 695.90	289 326.42	286 189.28
318 749.13	314 937.70	303 506.41	315 455.19	319 291.94	318 387.03	331 306.03	331 556.56	324 146.03	310 278.97	329 622.49	327 722.76	320 861.67
45 696.37	45 434.70	44 504.47	44 982.59	44 648.29	45 067.47	45 506.73	44 877.25	44 060.23	42 945.14	43 521.26	42 741.72	43 305.05
43 489.56	43 249.96	42 305.10	42 694.81	42 441.35	42 845.43	43 275.92	42 657.01	41 832.92	40 714.64	41 287.30	40 502.62	41 032.63
32 670.35	32 748.10	31 938.72	32 246.41	32 396.79	32 848.33	34 166.21	35 060.14	34 447.00	30 679.63	30 254.52	30 570.51	30 134.92
32 336.66	32 421.50	31 605.75	31 687.44	31 855.34	32 305.37	33 624.55	34 522.43	33 908.27	30 139.77	29 715.86	30 030.81	29 589.58
1 352.23	2 084.35	2 734.23	3 375.58	4 256.05	5 100.46	5 741.02	6 522.37	6 019.53	6 468.37	6 755.80	7 394.47	7 700.22
151.88	168.74	177.61	172.31	175.86	160.65	166.08	158.41	139.85	59.24	56.13	49.88	41.81
24.18	23.96	24.41	21.72	23.44	28.09	34.80	32.66	34.46	39.42	37.07	40.90	42.06
365 503.64	**370 897.88**	**348 375.21**	**360 491.34**	**352 768.29**	**353 943.04**	**352 168.41**	**384 586.10**	**375 201.19**	**358 057.51**	**378 320.68**	**370 123.91**	**367 413.33**
396 103.65	**392 886.22**	**380 353.50**	**393 407.05**	**398 043.98**	**398 827.04**	**414 148.40**	**415 449.44**	**406 081.06**	**387 700.41**	**407 474.65**	**405 741.44**	**399 267.97**

Table ES.3. National emissions of greenhouse gases for 1988–2012 according to IPCC categories

IPCC sector	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
1. Energy	467 445.46	446 817.81	374 281.29	374 801.99	365 251.96	367 287.29	360 963.55	362 121.61	377 260.64	367 108.60	339 284.77	331 282.02
2. Industrial Processes	32 945.25	31 839.04	24 448.63	21 197.10	20 232.35	20 448.92	22 834.72	24 388.49	23 373.41	24 164.22	22 483.91	21 476.04
3. Solvent and Other Product Use	1 006.46	946.14	629.23	608.22	558.57	519.36	521.05	562.59	567.38	562.86	563.45	554.54
4. Agriculture	55 740.10	58 484.60	54 327.99	46 594.76	42 952.68	40 746.10	41 127.57	41 085.94	39 904.08	40 675.49	40 886.75	39 342.20
5. Land-Use, Land-Use Change and Forestry	-12 997.25	-19 686.45	-25 506.48	-19 456.01	6 819.79	-3 152.44	-2 488.22	-14 289.80	-33 628.41	-33 077.55	-39 437.48	-47 086.50
6. Waste	12 766.70	12 871.81	12 684.82	13 001.69	13 014.53	13 070.90	12 967.28	12 944.09	13 000.90	13 297.06	13 658.38	13 841.69
TOTAL net emission (with LULUCF)	**556 906.72**	**531 272.95**	**440 865.48**	**436 747.76**	**448 829.88**	**438 920.14**	**435 925.95**	**426 812.92**	**420 478.00**	**412 730.68**	**377 439.78**	**359 410.00**

* emissions for 1988 estimated for entire series up to 2012 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table ES.3. (cont.) National emissions of greenhouse gases for 1988–2012 according to IPCC categories

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
318 226.15	316 759.83	305 505.95	316 386.93	319 560.60	319 271.23	330 964.75	328 672.00	321 668.53	310 193.64	329 242.00	324 731.47	319 657.56
24 515.59	23 051.12	21 633.63	24 712.86	26 644.79	27 015.45	28 886.92	31 577.45	29 570.42	23 683.73	25 092.04	27 783.33	26 958.32
627.89	631.77	661.01	645.02	677.09	687.75	761.46	721.65	797.18	751.41	779.40	786.71	759.67
37 355.29	36 994.73	37 002.95	36 343.45	36 023.42	36 604.69	38 265.87	39 048.88	38 859.60	37 741.80	37 078.80	37 328.84	36 653.86
-30 600.01	-21 988.33	-31 978.30	-32 915.71	-45 275.69	-44 884.00	-61 979.98	-30 863.34	-30 879.88	-29 642.90	-29 153.97	-35 617.53	-31 854.64
15 378.73	15 448.76	15 549.97	15 318.78	15 138.08	15 247.93	15 269.40	15 429.46	15 185.33	15 329.84	15 282.41	15 111.08	15 238.55
365 503.64	**370 897.88**	**348 375.21**	**360 491.34**	**352 768.29**	**353 943.04**	**352 168.41**	**384 586.10**	**375 201.19**	**358 057.51**	**378 320.68**	**370 123.91**	**367 413.33**

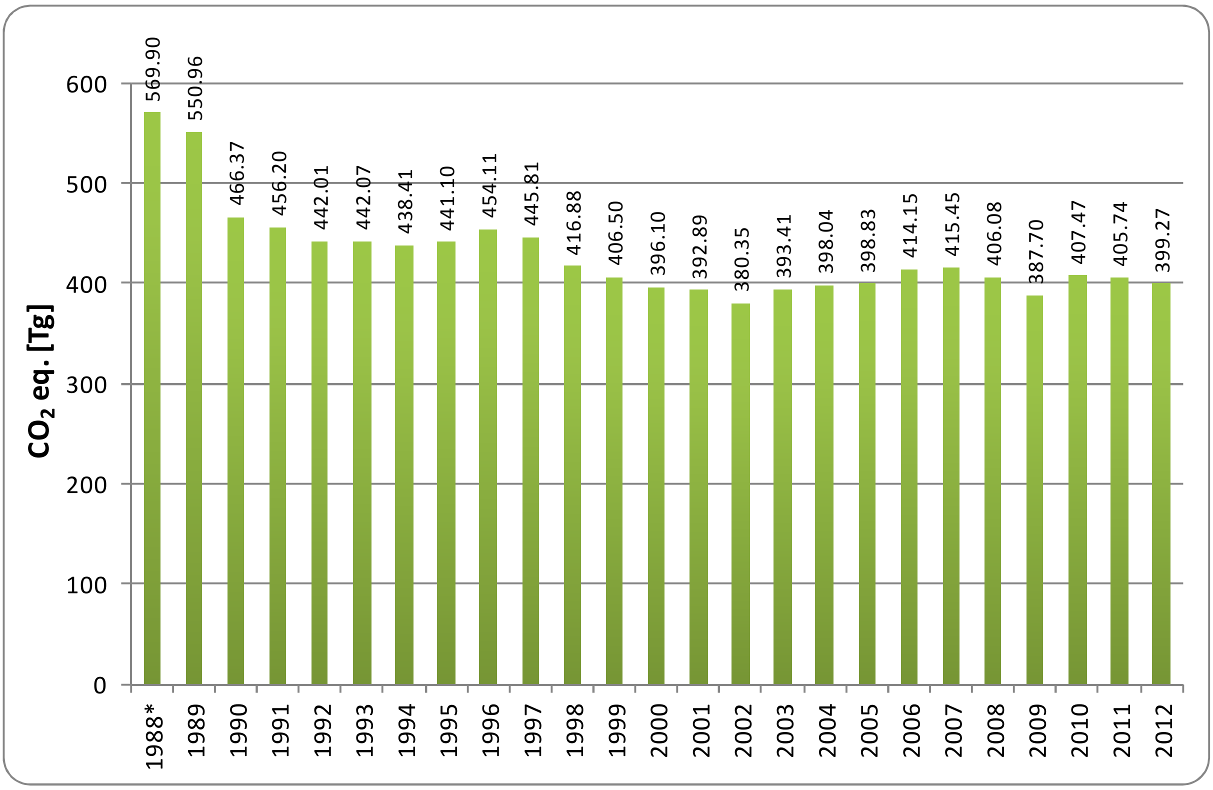

Figure ES.1. Trend of aggregated GHGs emissions excluding category 5 for 1988–2012

* emissions for 1988 estimated for entire series up to 2012 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

ES.2.2. KP-LULUCF activities

The emissions and removals balance of greenhouse gases for the period 2008-2012, to related activities of land use, land use change and forestry (LULUCF) under Article 3.3 and 3.4 of the Kyoto Protocol is presented in Table ES.4. For activities related to afforestation/reforestation and forest management estimated balance is negative, what means the activity is considered as a net CO_2 sink.

Table ES.4. The emissions and removals balance of greenhouse gases for the period 2008-2012, to related activities of land use, land use change and forestry (LULUCF) [Gg CO_2 eq.]

KP	Activity	2008	2009	2010	2011	2012
art. 3.3	Afforestation/ reforestation	-2 339.17	-2 420.36	-2 554.16	-2 641.66	-2 777.73
	Deforestation	350.62	375.80	322.76	353.44	289.64
art. 3.4	Forest management	-36 191.85	-34 806.89	-34 113.55	-40 403.57	-36 450.47
	Cropland management	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*
	Grazing land management	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*
	Revegetation	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*

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

ES.3.1. GHG inventory

Carbon dioxide emissions

The CO_2 emissions (excluding category 5) in 2012 were estimated as 320.86 million tonnes. This is 31.6% lower than in the base year. CO_2 emission (excluding category 5) accounted for 80.4% of total GHG emissions in Poland in 2012. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission by 93.0% in 2012. The shares of the main subcategories were as follows: *Energy industries* – 52.6%, *Manufacture Industries and Construction* – 9.5%, *Transport* – 14.4% and *Other Sectors* – 16.5%. *Industrial Processes* contributed to the total CO_2 emission by 5.6% in 2012. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 removal in LULUCF sector in 2012, was calculated to be approximately 34.7 million tonnes. 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 1 953.93 Gg in 2012 i.e. 41.03 million tonnes of CO_2 equivalents. Compared to the base year, the emission in 2012 was lower by 23.5%. The contribution of CH_4 to the national total GHG emission was 10.3% in 2012. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed 30.0%, 27.9% and 33.7% to the national methane emission in 2012, respectively. The emission from the first mentioned sector was covered by emission from Underground Mines (18.4% of total CH_4 emission) and Oil and Natural Gas system (11.6% of total CH_4 emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 21.9% of total CH_4 emission in 2012. Waste disposal sites contributed to 20.9% of the methane emission from total CH_4 emission and Wastewater Handling contributed to 12.9% of total CH_4 emission.

Nitrous oxide emissions

The nitrous oxide emissions (excluding category 5) in 2012 were 95.45 Gg i.e. 29.59 million tonnes of CO_2 equivalents. The emission was app. 26.6% lower than the respective figure for the base year. The contribution of N_2O to the national total GHG emission was 7.4% in 2012. The main N_2O emission sources and its shares in total N_2O emission in 2012 are as follow: *Agricultural Soils* – 68.6%, *Manure Management* – 16.5%, *Chemical Industry* – 3.6% and *Fuel Combustion* – 7.1%.

Emissions of industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2012 was 7 784.09 Gg CO_2 eq. what accounts for 1.9% of total GHG emissions share in 2012. Industrial gases emissions were about 2491.3% higher comparing to the base year (table ES.2). This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. Share of HFCs, PFCs and SF_6 in total 2012 emissions was respectively as follows: 1.93%, 0.010% and 0.011%.

ES.3.2. KP-LULUCF activities

Estimated emissions and removals of greenhouse gases for the period 2008-2012, associated with the LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol are presented in Table ES.4. in Section E.S.2.2.

Estimated sink associated with the afforestation activity, increased by 18.2% as compared to 2008. The emissions associated with deforestation as compared to 2008, decreased by 17.4%. Relatively high drop was caused by the smaller forest land exclusions for non-forestry and non agricultural purposes. The size of net absorption for forest management activity for the year 2012 is approximately 0.8% higher than in 2008.

ES.4. Trends of indirect greenhouse gases and SO_2

Emissions of all GHG precursors have significantly diminished since 1990. In case of SO_2 emissions, which amounted to 853.3 Gg in 2012, the decrease was noted by about 70% between 1990 and 2012 what was caused by the decline of the heavy industry in the late 1980s and early 1990s. In late 1990s the emissions declined because of the diminished share of coal and lignite among fuels used for power and heat generation. Wider application of flue gases desulphurisation installations had the essential impact for ongoing SO_2 emissions decrease.

Emissions of NO_X in 2012 amounted 817.3 Gg and significantly decreased between 1990 and 2012. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s as well as the lower share of hard coal and lignite in fuel used in 1990s. Increasing emissions from road transport cause comparatively lower (36%) total emission reductions than in case of SO_2 (*ca.* 70%).

CO emissions in 2012 amounted to 2818.4 Gg and dropped by more than 60% between 1990 - 2012 triggered by the decrease of fuel used in non-industrial combustion sector (services households and agricultural combustion sources), also road transport.

Emissions of NMVOC were about 630.3 Gg in 2012 and dropped by approximately 24% between 1990 and 2012 due to decreases in: road transport (*ca* 48%), non-industrial combustion and industrial combustion.

PART I:
ANNUAL INVENTORY SUBMISSION

1. INTRODUCTION

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

1.1.1. Background information on climate change

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

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

Underlying report has been elaborated for fulfilling Poland's obligations under United Nations Framework Convention on Climate Change (UNFCCC) signed in New York on 9 May 1992 and its Kyoto Protocol signed in Kyoto on 11 December 1997 of which Poland is the Party, as well as for the needs of Regulation (EU) No 525 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

1.1.2. Background information on greenhouse gas inventories

The Polish greenhouse gas inventory is compiled on an annual basis and submitted in the required by the UNFCCC deadline. The underlying National Inventory Report (NIR), submitted in 2014, presents the results of the greenhouse gases (GHGs) inventory in Poland for 2012 as well as for the whole preceding period since 1988.

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

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

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

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

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

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

Poland's assigned amount units (AAU) for 2008–2012 have been calculated based on GHG emissions for 1988 estimated in 2006 and revised in course of the review of Initial report of Poland under the Kyoto Protocol performed in 2007 [IRR 2007]. The fixed GHG inventory in 1988 amounted to 563 442 774 tCO_2 eq., so the Poland's AAU is:

563 442 774 tCO_2 eq. * 94% * 5 = **2 648 181 038 tCO_2 eq.**

The national commitment period reserve (CPR) for Poland was calculated according to decision 11/CMP.1. It is calculated as 100 per cent of five times the most recently reviewed inventory, as this amount is lower than 90 per cent of Poland's assigned amount calculated pursuant to Article 3, paragraphs 7 and 8, of the Kyoto Protocol. For the year 2012 (the most recent inventory), the aggregated anthropogenic emissions of GHG from sources listed in Annex A of the Kyoto Protocol are estimated at 399 267 970 tCO_2 equivalent. The CPR is calculated as 5 times the Annex A emissions for 2012 and amounts to 1 996 339 848 tCO_2 equivalent:

399 267 970 tCO_2 eq. * 5 = **1 996 339 848 tCO_2 eq.**

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

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

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

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

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

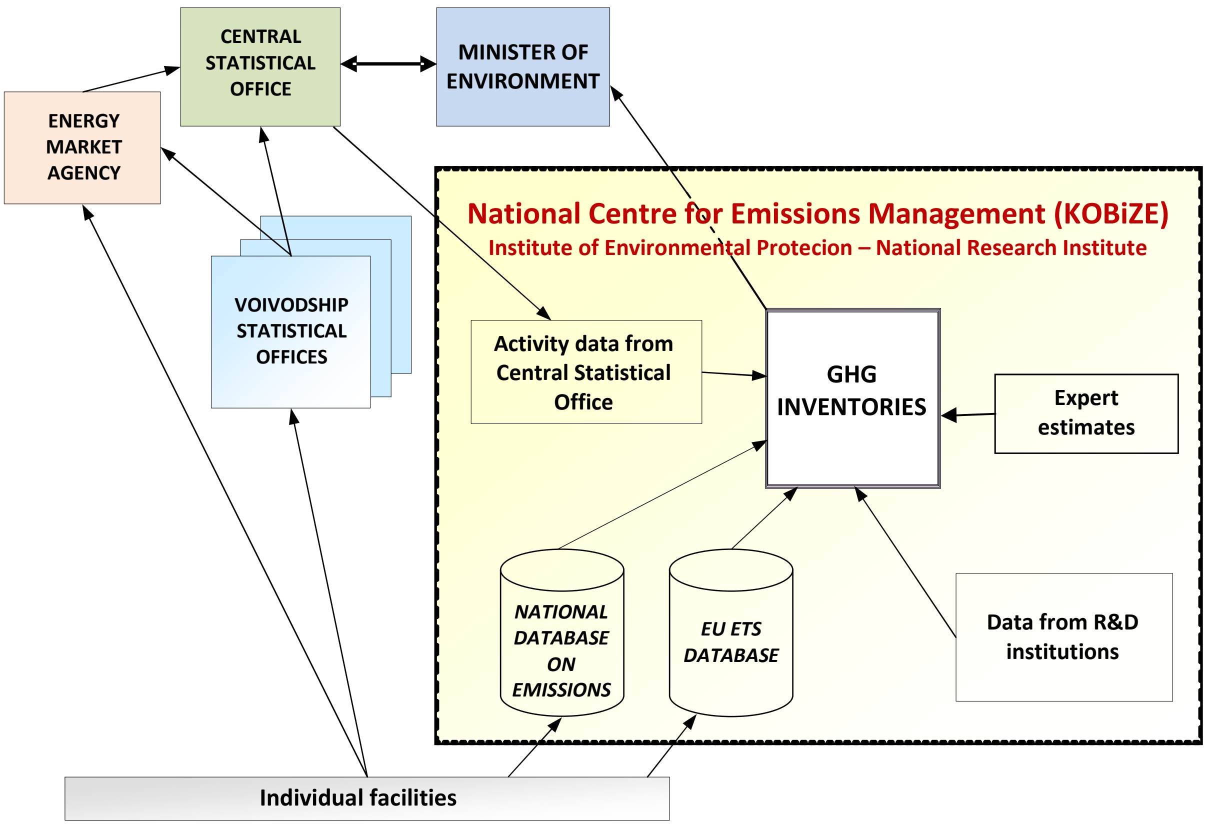

Figure 1.1. National GHG emissions inventory system scheme

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

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

1.3. Inventory preparation

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

- activity data are mostly taken from official public statistics (GUS, EUROSTAT) or, when required data are not directly available, (commissioned) research reports or expert estimates are used instead,
- emission factors for the main emission categories are mostly taken from reports on domestic research; IPCC default data are used in cases where the emission factors are highly uncertain (e.g. CH_4 and N_2O emission from stationary combustion), or when particular source category contribution to national total is insignificant,
- All activity data, emission factors and resulting emission data are stored at ZBIRE’s database in the KOBIZE, which is constantly updated and extended to meet the ever changing requirements for emission reporting, with respect to UNFCCC and LTRAP as well as their protocols.

1.4. Brief general description of methodologies and data sources used

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

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

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

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

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

Table 1.1. Hard coal consumption in 2012

National fuel balance	Hard coal - Eurostat	
	10^3 Mg	TJ
In	89 571	2 128 346
From national sources	79 813	1 887 647
1) Indigenous production	79 234	1 874 557
2) Transformation output or return	579	13 090
3) Stock decrease	0	0
Import	9 758	240 699
Out	89 571	2 128 344
National consumption	75 514	1 791 753
1) Transformation input	57 928	1 345 225
a) input for secondary fuel production	11 910	352 548
b) fuel combustion	46 018	992 677
2) Direct consumption	17 586	446 528
Non-energy use	98	2 229
Combusted directly	17 488	444 299
Combusted in Poland	63 506	1 436 976
Stock increase	6 838	155 458
Export	7 029	196 249
Losses and statistical differences	190	-15 116
Net calorific value	MJ/kg	22.63

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

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

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

1.5. Brief description of key categories

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

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

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

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

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

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

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

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

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

The estimate of emission uncertainty for the year 2012 was made using *Tier 1* approach. The uncertainty ranges varied significantly among various source categories and are presented within sectoral chapters 3-8. More details, including sectoral information on uncertainty ranges, are given in Annex 6.

1.8. General assessment of the completeness

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

2. Trends in greenhouse gas emissions

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

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

For non-CO_2 gases, the inventory results can also be presented (table 2.1) in units of CO_2 equivalents by applying values of the so called Global Warming Potentials - GWP. GWP for methane is 21, and for nitrous oxide 310. Carbon dioxide is the main GHG in Poland with the 80.4% (excluding category 5) share in 2012, while the methane contributes with 10.3% (excluding category 5) to the national total. Nitrous oxide contribution is 7.4% (excluding category 5) and all industrial GHG together contribute 1.9%. Percentage share of GHG in national total emissions in 2012 is presented at figure 2.1.

Table 2.1. Greenhouse gas emissions in 2012 in CO_2 eq.

Pollutant	2012	
	Emission in CO_2 eq. [Gg]	Share [%]
CO_2 (with LULUCF)	286 189.28	77.89
CO_2 (without LULUCF)	320 861.67	80.36
CH_4 (with LULUCF)	43 305.05	11.79
CH_4 (without LULUCF)	41 032.63	10.28
N_2O (with LULUCF)	30 134.92	8.20
N_2O (without LULUCF)	29 589.58	7.41
HFCs	7 700.22	1.93
PFCs	41.81	0.01
SF_6	42.06	0.01
TOTAL net emission (with LULUCF)	367 413.33	100.00
TOTAL without LULUCF	399 267.97	100.00

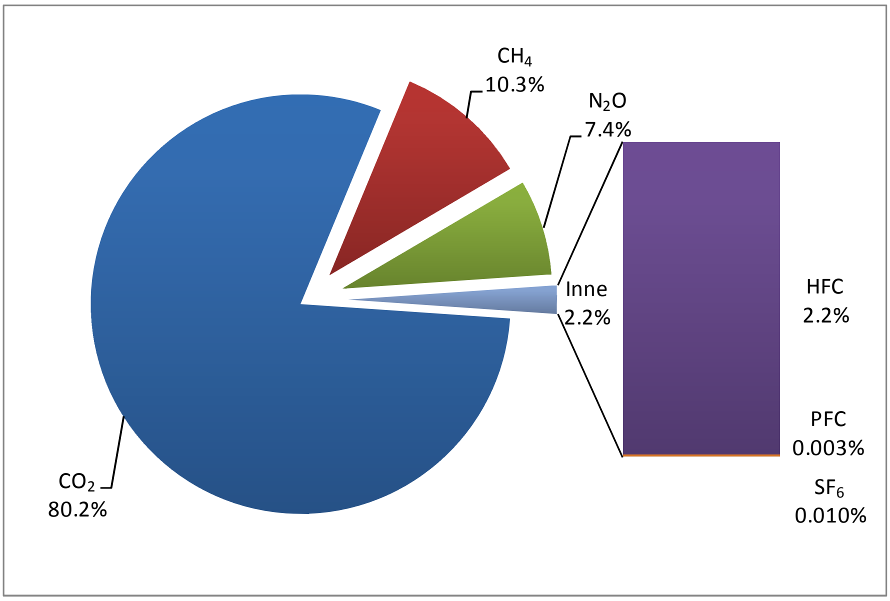

Figure 2.1. Percentage share of greenhouse gases in national total emission in 2012 (excluding category 5)

Emissions of main GHGs in 2012, 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 2012 [Gg]

[Gg]	CO_2	CH_4	N_2O
TOTAL without LULUCF	320 861.67	1 953.93	95.45
TOTAL with LULUCF	286 189.28	2 062.15	97.21
1. Energy	302 127.65	734.85	6.77
A. Fuel Combustion	298 403.80	149.46	6.77
1. Energy Industries	168 641.71	5.07	2.76
2. Manufacturing Industries and Construction	30 635.46	4.49	0.56
3. Transport	46 148.22	4.89	1.85
4. Other Sectors	52 978.41	135.01	1.60
5. Other	IE, NO	IE, NO	IE, NO
B. Fugitive Emissions from Fuels	3 723.85	585.38	0.00
1. Solid Fuels	1 869.44	359.33	NA
2. Oil and Natural Gas	1 854.41	226.06	0.00
2. Industrial Processes	17 819.61	14.47	3.39
A. Mineral Products	10 064.05	NA	NA
B. Chemical Industry	4 316.53	13.21	3.39
C. Metal Production	2 297.08	1.25	0.00
D. Other Production	9.54	NE	NE
G. Other	1 132.41	NO	NO
3. Solvent and Other Product Use	635.67	NE	0.40
4. Agriculture	NE	545.79	81.27
A. Enteric Fermentation	NE	427.48	NE
B. Manure Management	NE	117.43	15.71
D. Agricultural Soils	NE	NA	65.52
F. Field Burning of Agricultural Residues	NE	0.88	0.04
5. Land Use, Land-Use Change and Forestry	-34 672.39	108.21	1.7591
A. Forest Land	-39 573.27	1.49	1.0648
B. Cropland	1 307.56	IE, NO	0.6745
C. Grassland	377.82	0.07	0.00101
D. Wetlands	3 102.17	106.65	0.0189
E. Settlements	113.34	NA, NO	NA, NO
F. Other Land	NA, NO	NA, NO	NA, NO
6. Waste	278.74	658.83	3.63
A. Solid Waste Disposal on Land	NA, NO	407.64	NE
B. Wastewater Handling	NE	251.20	3.58
C. Waste Incineration	278.74	NO	0.05

Table 2.3. Emissions of industrial gases: HFCs, PFCs and SF_6 in 2012 [Gg eq. Gg]

2012	HFCs	PFCs	SF_6	Total in eq. CO_2
Total Industrial gases [Gg eq. CO_2]	7 700.22	41.81	42.06	7 784.09
C. Metal Production	NE	29.63	4.35	33.98
3. Aluminium Production	NE	29.63	4.35	33.98
F. Consumption of Halocarbons and SF_6	7 700.22	12.17	37.72	7 750.11
1. Refrigeration and Air Conditioning Equipment	7 437.48	NO	NO	7 437.48
2. Foam Blowing	105.33	NO	NO	105.33
3. Fire Extinguishers	44.24	12.17	NA	56.41
4. Aerosols	111.89	NA	NA	111.89
8. Electrical Equipment	NA,NO	NA	37.72	37.72

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 2012 for CO_2, CH_4 and N_2O.

Trend of aggregated greenhouse gases emissions follows the trend of emissions CO_2 alone which is the primary greenhouse gas emitted in Poland. The GHGs trend for period between 1988 and 1990 indicate dramatic decrease triggered by significant economic changes, especially in heavy industry, related to political transformation from centralized to market economy. This drop in emissions continued up to 1993 and then emissions started to rise with peak in 1996 as a result of development in heavy industry and other sectors and dynamic economic growth. The succeeding years characterize slow decline in emissions up to 2002, when still energy efficiency policies and measures were implemented, and then slight increase up to 2007 caused by animated economic development. Since 2008 stabilisation in emissions has been noted with distinct decrease in 2009 related to world economic slow-down (figure 2.2 and tables 2.5 and 2.6). Since 2010 GHG emissions in Poland gradually decreases.

Table 2.4. Percentage shares of individual source sectors in 2012 emissions

Percentage share of emissions of source sectors in current year without LULUCF	Share [%]		
	CO_2	CH_4	N_2O
TOTAL	100.00	100.00	100.00
1. Energy	94.16	37.61	7.09
A. Fuel Combustion	93.00	7.65	7.09
1. Energy Industries	52.56	0.26	2.89
2. Manufacturing Industries and Construction	9.55	0.23	0.58
3. Transport	14.38	0.25	1.94
4. Other Sectors	16.51	6.91	1.68
5. Other	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1.16	29.96	0.00
1. Solid Fuels	0.58	18.39	0.00
2. Oil and Natural Gas	0.58	11.57	0.00
2. Industrial Processes	5.55	0.74	3.55
A. Mineral Products	3.14	0.00	0.00
B. Chemical Industry	1.35	0.68	3.55
C. Metal Production	0.72	0.06	0.00
D. Other Production	0.00	0.00	0.00
G. Other	0.35	0.00	0.00
3. Solvent and Other Product Use	0.20	0.00	0.42
4. Agriculture	0.00	27.93	85.14
A. Enteric Fermentation	0.00	21.88	0.00
B. Manure Management	0.00	6.01	16.46
D. Agricultural Soils	0.00	0.00	68.64
F. Field Burning of Agricultural Residues	0.00	0.05	0.04
5. Land Use, Land-Use Change and Forestry	-	-	-
A. Forest Land	-	-	-
B. Cropland	-	-	-
C. Grassland	-	-	-
D. Wetlands	-	-	-
E. Settlements	-	-	-
F. Other Land	-	-	-
6. Waste	0.09	33.72	3.80
A. Solid Waste Disposal on Land	0.00	20.86	0.00
B. Wastewater Handling	0.00	12.86	3.75
C. Waste Incineration	0.09	0.00	0.05

Table 2.5. National emissions of greenhouse gases for 1988–2012 according to gases [Gg CO_2 eq.]

GHG	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
CO_2 (with LULUCF)	453 897.85	427 097.54	346 780.27	350 796.51	367 298.38	358 106.55	354 402.33	344 155.42	338 227.29	329 848.87	296 343.05	279 235.19
CO_2 (without LULUCF)	469 413.91	449 307.24	374 812.04	372 751.84	363 232.78	363 798.15	359 432.55	360 975.63	374 430.77	365 459.54	338 295.80	328 870.88
CH_4 (with LULUCF)	58 065.28	57 145.96	51 847.50	50 351.90	48 290.68	47 759.25	48 013.67	47 956.25	47 891.34	48 144.62	46 194.23	46 073.80
CH_4 (without LULUCF)	55 875.20	54 951.49	49 651.04	48 176.24	45 906.91	45 549.80	45 802.00	45 753.23	45 650.92	45 938.54	44 002.43	43 859.16
N_2O (with LULUCF)	44 816.05	46 901.69	42 114.84	35 476.95	33 124.20	32 928.87	33 353.32	34 324.74	33 887.13	34 096.10	34 135.35	33 082.23
N_2O (without LULUCF)	44 487.31	46 572.90	41 786.00	35 153.29	32 753.79	32 599.16	33 022.99	33 997.36	33 552.49	33 769.08	33 811.89	32 747.68
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	10.40	197.03	307.83	467.51	591.18	848.88
PFCs	127.55	127.77	122.88	122.40	116.61	125.47	132.33	148.96	139.45	149.56	150.87	145.27
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	13.91	30.53	24.95	24.02	25.09	24.64
TOTAL (with LULUCF)	**556 906.72**	**531 272.95**	**440 865.48**	**436 747.76**	**448 829.88**	**438 920.14**	**435 925.95**	**426 812.92**	**420 478.00**	**412 730.68**	**377 439.78**	**359 410.00**
TOTAL (without LULUCF)	**569 903.97**	**550 959.40**	**466 371.96**	**456 203.77**	**442 010.09**	**442 072.58**	**438 414.17**	**441 102.72**	**454 106.41**	**445 808.23**	**416 877.25**	**406 496.50**

* emissions for 1988 estimated for entire series up to 2012 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table 2.5. (cont.) National emissions of greenhouse gases for 1988–2012 according to gases [Gg CO_2 eq.]

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
285 608.63	290 438.03	268 995.76	279 692.74	271 267.85	270 738.04	266 553.58	297 935.27	290 500.12	277 865.71	297 695.90	289 326.42	286 189.28
318 749.13	314 937.70	303 506.41	315 455.19	319 291.94	318 387.03	331 306.03	331 556.56	324 146.03	310 278.97	329 622.49	327 722.76	320 861.67
45 696.37	45 434.70	44 504.47	44 982.59	44 648.29	45 067.47	45 506.73	44 877.25	44 060.23	42 945.14	43 521.26	42 741.72	43 305.05
43 489.56	43 249.96	42 305.10	42 694.81	42 441.35	42 845.43	43 275.92	42 657.01	41 832.92	40 714.64	41 287.30	40 502.62	41 032.63
32 670.35	32 748.10	31 938.72	32 246.41	32 396.79	32 848.33	34 166.21	35 060.14	34 447.00	30 679.63	30 254.52	30 570.51	30 134.92
32 336.66	32 421.50	31 605.75	31 687.44	31 855.34	32 305.37	33 624.55	34 522.43	33 908.27	30 139.77	29 715.86	30 030.81	29 589.58
1 352.23	2 084.35	2 734.23	3 375.58	4 256.05	5 100.46	5 741.02	6 522.37	6 019.53	6 468.37	6 755.80	7 394.47	7 700.22
151.88	168.74	177.61	172.31	175.86	160.65	166.08	158.41	139.85	59.24	56.13	49.88	41.81
24.18	23.96	24.41	21.72	23.44	28.09	34.80	32.66	34.46	39.42	37.07	40.90	42.06
365 503.64	**370 897.88**	**348 375.21**	**360 491.34**	**352 768.29**	**353 943.04**	**352 168.41**	**384 586.10**	**375 201.19**	**358 057.51**	**378 320.68**	**370 123.91**	**367 413.33**
396 103.65	**392 886.22**	**380 353.50**	**393 407.05**	**398 043.98**	**398 827.04**	**414 148.40**	**415 449.44**	**406 081.06**	**387 700.41**	**407 474.65**	**405 741.44**	**399 267.97**

Table 2.6. National emissions of greenhouse gases for 1988–2012 according to IPCC categories [Gg CO_2 eq.]

IPCC sector	1988*	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
1. Energy	467 445.46	446 817.81	374 281.29	374 801.99	365 251.96	367 287.29	360 963.55	362 121.61	377 260.64	367 108.60	339 284.77	331 282.02
2. Industrial Processes	32 945.25	31 839.04	24 448.63	21 197.10	20 232.35	20 448.92	22 834.72	24 388.49	23 373.41	24 164.22	22 483.91	21 476.04
3. Solvent and Other Product Use	1 006.46	946.14	629.23	608.22	558.57	519.36	521.05	562.59	567.38	562.86	563.45	554.54
4. Agriculture	55 740.10	58 484.60	54 327.99	46 594.76	42 952.68	40 746.10	41 127.57	41 085.94	39 904.08	40 675.49	40 886.75	39 342.20
5. Land-Use, Land-Use Change and Forestry	-12 997.25	-19 686.45	-25 506.48	-19 456.01	6 819.79	-3 152.44	-2 488.22	-14 289.80	-33 628.41	-33 077.55	-39 437.48	-47 086.50
6. Waste	12 766.70	12 871.81	12 684.82	13 001.69	13 014.53	13 070.90	12 967.28	12 944.09	13 000.90	13 297.06	13 658.38	13 841.69
TOTAL net emission (with LULUCF)	**556 906.72**	**531 272.95**	**440 865.48**	**436 747.76**	**448 829.88**	**438 920.14**	**435 925.95**	**426 812.92**	**420 478.00**	**412 730.68**	**377 439.78**	**359 410.00**

* emissions for 1988 estimated for entire series up to 2012 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

Table 2.6. (cont.) National emissions of greenhouse gases for 1988–2012 according to IPCC categories

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]	CO_2 eq. [Gg]
318 226.15	316 759.83	305 505.95	316 386.93	319 560.60	319 271.23	330 964.75	328 672.00	321 668.53	310 193.64	329 242.00	324 731.47	319 657.56
24 515.59	23 051.12	21 633.63	24 712.86	26 644.79	27 015.45	28 886.92	31 577.45	29 570.42	23 683.73	25 092.04	27 783.33	26 958.32
627.89	631.77	661.01	645.02	677.09	687.75	761.46	721.65	797.18	751.41	779.40	786.71	759.67
37 355.29	36 994.73	37 002.95	36 343.45	36 023.42	36 604.69	38 265.87	39 048.88	38 859.60	37 741.80	37 078.80	37 328.84	36 653.86
-30 600.01	-21 988.33	-31 978.30	-32 915.71	-45 275.69	-44 884.00	-61 979.98	-30 863.34	-30 879.88	-29 642.90	-29 153.97	-35 617.53	-31 854.64
15 378.73	15 448.76	15 549.97	15 318.78	15 138.08	15 247.93	15 269.40	15 429.46	15 185.33	15 329.84	15 282.41	15 111.08	15 238.55
365 503.64	**370 897.88**	**348 375.21**	**360 491.34**	**352 768.29**	**353 943.04**	**352 168.41**	**384 586.10**	**375 201.19**	**358 057.51**	**378 320.68**	**370 123.91**	**367 413.33**

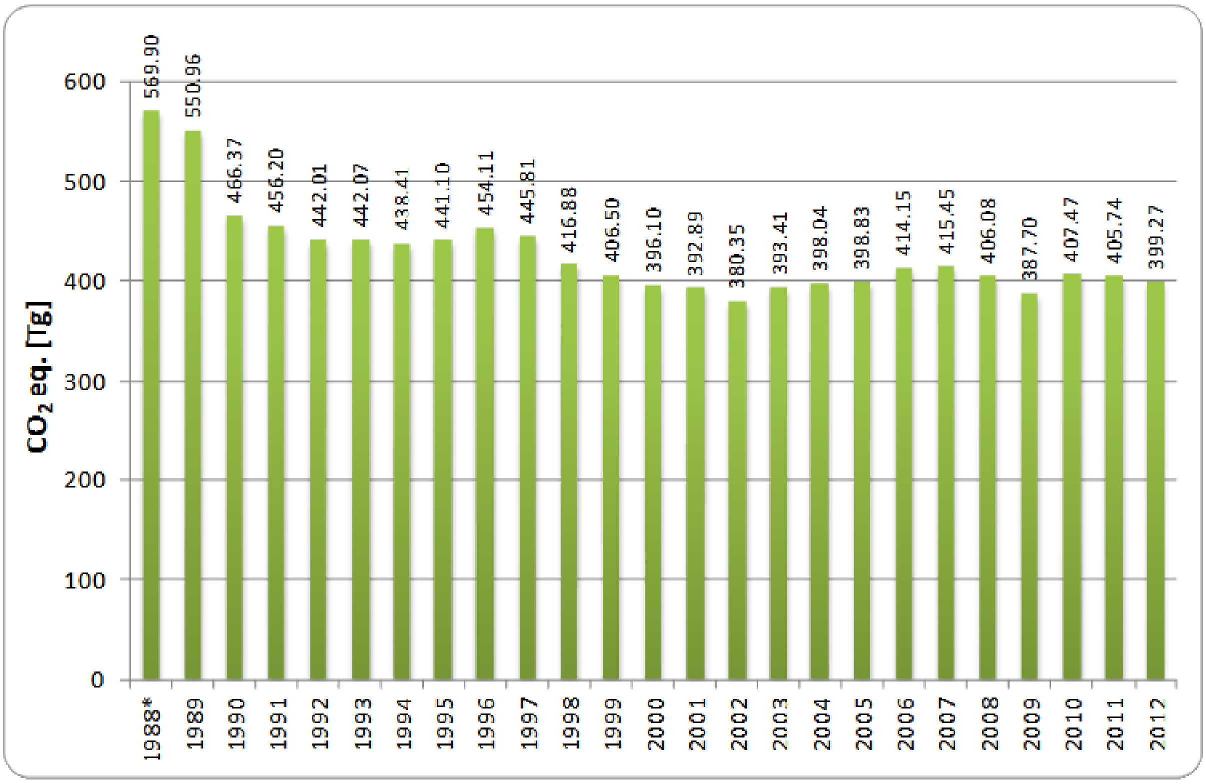

Figure 2.2. Trend of aggregated GHGs emissions (excluding category 5) for 1988–2012

* emissions for 1988 estimated for entire series up to 20122 for consistency of data and methodologies applied; emissions differ from those fixed for accounting the Kyoto Protocol reduction target

2.2. Description and interpretation of emission trends by gas

Carbon dioxide (CO_2)

In 2012, the CO_2 emissions (without LULUCF) were estimated as 320.86 million tonnes, while when sector 5. LULUCF is included the figure reaches 286.19 million tonnes (table 2.1). CO_2 share in total GHG emissions in 2012 amounted to 80.4%. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission (without LULUCF) by 93.0% in 2012 (fig. 2.3). The shares of the main subcategories in 1.A were as follows: *Energy industries* - 52.6%, *Manufacture Industries and Construction* – 9.5%, *Transport* – 14.4% and *Other Sectors* – 16.5%. Sector 2. *Industrial Processes* contributed to the total CO_2 emission by 5.6% in 2012. *Mineral Products* (especially *Cement Production*) is the main emission source in this sector. The CO_2 emission/removal in LULUCF sector in 2012, was calculated to be approximately 34.7 million tonnes. It means that app. 10.8% of the total CO_2 emissions are offset by CO_2 uptake by forests.

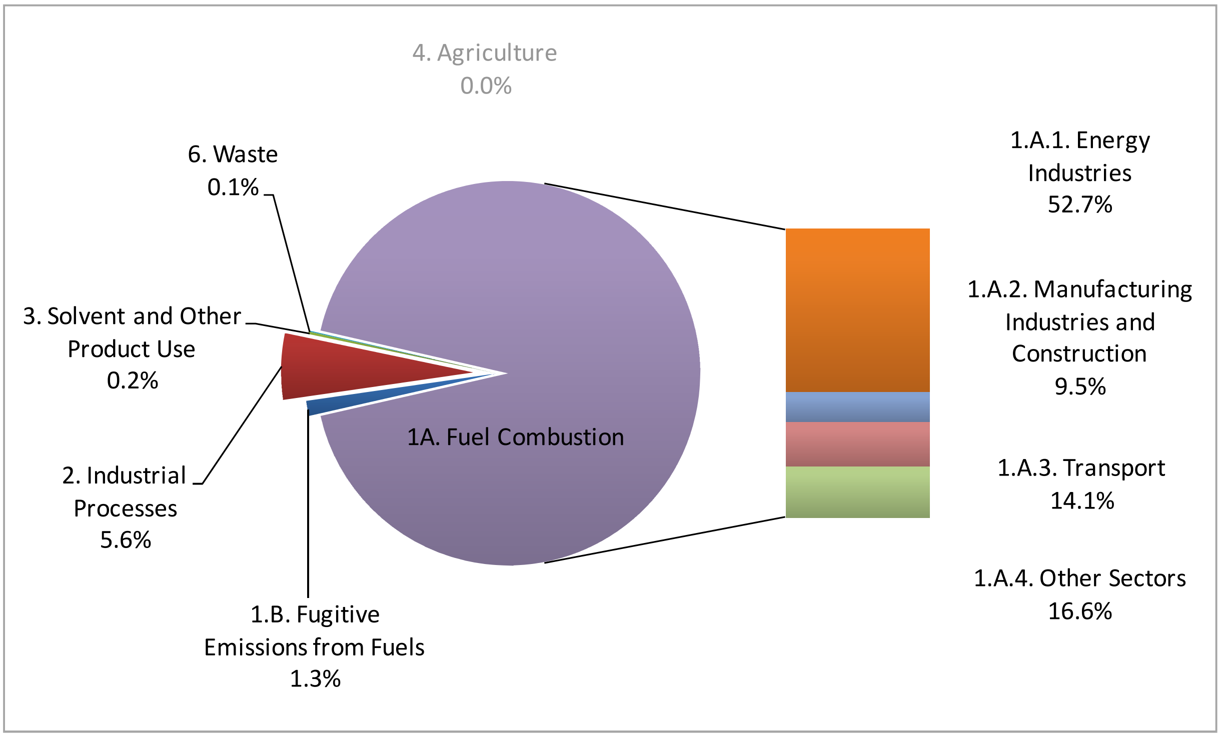

Figure 2.3. Carbon dioxide emission (excluding category 5) in 2012 by sector

Methane (CH_4)

The CH_4 emission (excluding category 5) amounted to 1 953.93 Gg in 2012 i.e. 41.03 million tonnes of CO_2 equivalents (table 2.1). CH_4 share in total GHG emissions in 2012 amounted to 10.3%. Three of main CH_4 emission sources include the following categories: *Fugitive Emissions from Fuels, Agriculture* and *Waste*. They contributed to 30.0%, 27.9% and 33.7% of the national methane emission in 2012, respectively (fig. 2.4). The emission from the first mentioned sector was covered by emission from *Underground Mines* (app. 18.4% of total CH_4 emission) and *Oil and Natural Gas* system (about 11.6% of total emission). The emission from *Enteric Fermentation* dominated in *Agriculture* and amounted to app. 21.9% of total methane emission in 2012. *Disposal sites* contributed to 20.9% of the methane emission and *Wastewater Handling* contributed to 12.9%.

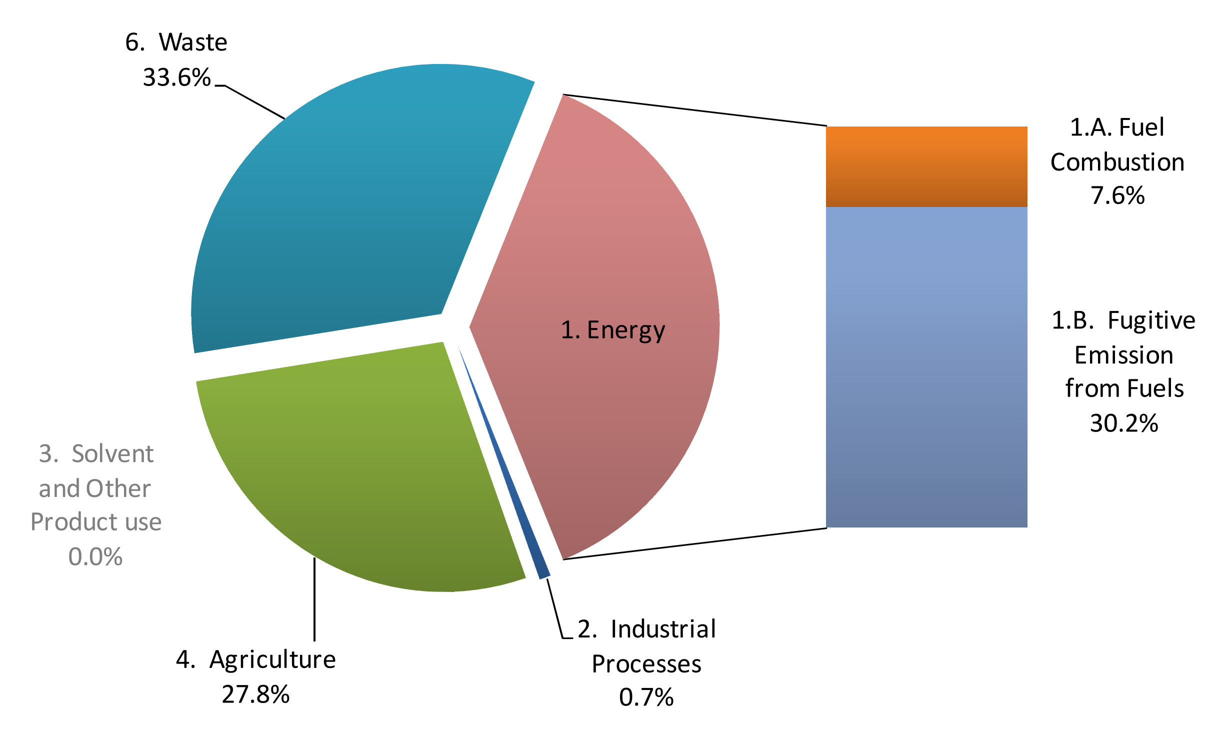

Figure 2.4. Methane emission (excluding category 5) in 2012 by sector

Nitrous oxide (N_2O)

The nitrous oxide emissions (excluding category 5) in 2012 were 95.45 Gg i.e. 29.59 million tonnes of CO_2 equivalents (table 2.2). N_2O share in total GHG emissions in 2012 amounted to 7.4%. The main N_2O emission sources and its shares in total N_2O emission in 2012 are: *Agricultural Soils* – 68.6%, *Manure Management* – 16.5%, *Chemical Industry* – 3.6% and *Fuel Combustion* – 7.1% (fig. 2.5).

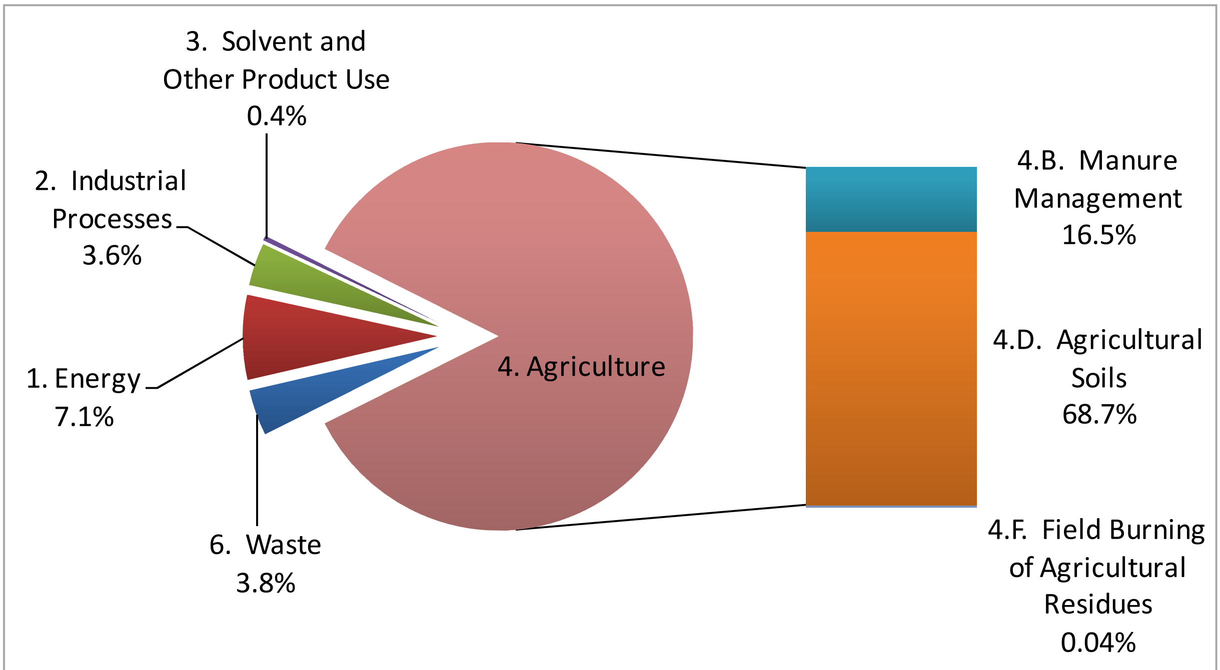

Figure 2.5. Nitrous oxide emission (excluding category 5) in 2012 by sector

Industrial gases

The total emission of industrial gases (HFCs, PFCs and SF_6) in 2012 was 7 784.09 Gg CO_2 eq. what accounts for 1.9% of total GHG emissions share in 2012. This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. Shares of HFCs, PFCs and SF_6 in total 2012 GHG emissions was respectively as follows: 1.93%, 0.010% and 0.011%.

The total emissions in 2012 according to groups of industrial gases are as follows: HFCs –7.70 million tonnes of CO_2 equivalents, PFCs – 0.04 million tonnes of CO_2 equivalents and SF_6 – 0.04 million tonnes of CO_2 equivalents.

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

Percentage share of individual GHGs to national total in the base year (1988) are presented in Table 2.7 and figure 2.6. The emissions given here for base year are those accepted for the purpose of estimation of Assigned Amount under Kyoto Protocol obligations for 2008–2012 [IRR 2007], which accounted for 563 442.77 Gg CO_2 eq. Compared to 1988, the percentage share of CO_2 (excluding category 5) in 2012 decreased from 83.3% to 80.4%.

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

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

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

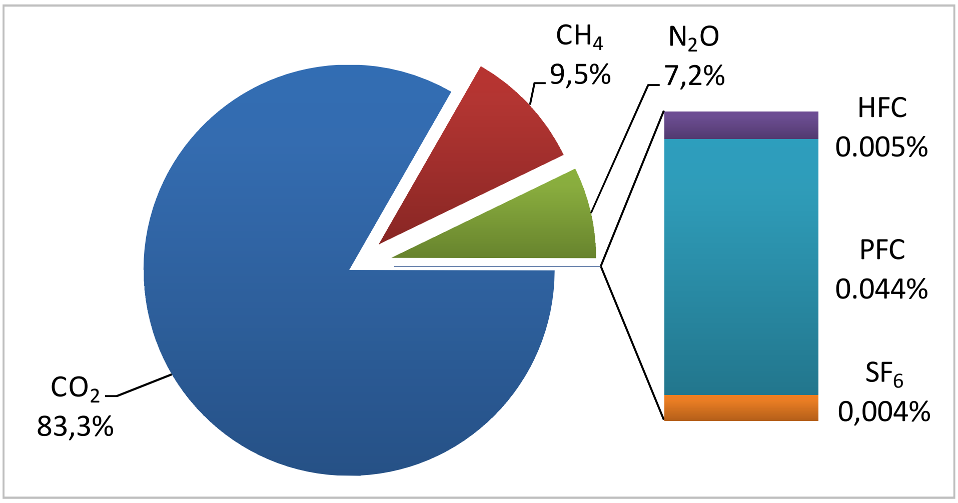

Figure 2.6. Percentage share of national greenhouse gas emissions in base year (1988) excluding emission from sector 5

The data for the GHGs and for the national total GHG emission for 2012 in comparison to the base year are given in table 2.8 and illustrated on figure 2.7 also in relation to the Poland's reduction target under the Kyoto Protocol.

Table 2.8. Greenhouse gas emissions in 2012 with respect to base year 1988/1995*

Pollutant	Base year Emission in CO_2 eq. [Gg]	2012 Emission in CO_2 eq. [Gg]	2012/base year [%]
CO_2 (with LULUCF)	436 209.10	286 189.28	65.61
CO_2 (without LULUCF)	469 143.82	320 861.67	68.39
CH_4 (with LULUCF)	53 672.51	43 305.05	80.68
CH_4 (without LULUCF)	53 665.03	41 032.63	76.46
N_2O (with LULUCF)	40 334.29	30 134.92	74.71
N_2O (without LULUCF)	40 333.53	29 589.58	73.36
HFCs	26.44	7 700.22	29121.91
PFCs	250.18	41.81	16.71
SF_6	23.77	42.06	176.97
TOTAL net emission (with LULUCF)	530 466.09	367 413.33	69.26
TOTAL without LULUCF	563 442.77	399 267.97	70.86

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

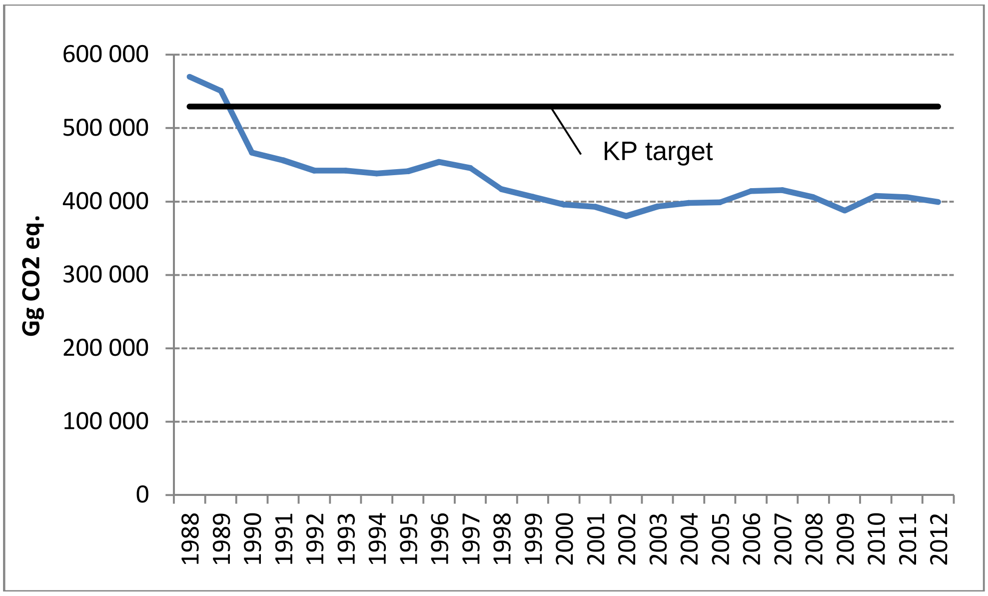

Figure 2.7. Trend of aggregated GHG emissions in 1988-2012 relative to Poland's Kyoto Protocol target

Carbon dioxide

CO_2 emission (excluding category 5) had decreased by app. 31.6% from the base year to 2012.

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

- share of solid fuels decreased from 82.1% in base year 1988 to 55.0% in 2012,
- share of liquid fuels increased from 11.1% (base year 1988) to 23.2% (2012),
- share of gaseous fuels increased from 6.0% (base year 1988) to 12.3% (2012).

Methane

CH_4 emission (excluding category 5) had decreased by app. 23.5% from the base year to 2012. The reasons for that are as follow:

- the decrease in emission from *Enteric Fermentation* by 42.8%,
- the decrease in *Fugitive Emission* by 45.9%,
- the increase in emission from *Waste* by 107.8%.

Nitrous oxide

The nitrous oxide emissions (excluding category 5) in 2012 were app. 26.6% lower than the respective figure for the base year. The share in *Manure Management* decreased from 23.1% in the base year 1988 to 16.5% in 2012, in *Agricultural Soils* increased from 55.5% in the base year 1988 to 68.6% in 2012 and in *Chemical Industry* decreased from 12.4% in the base year 1988 to 3.6% in 2012.

Industrial gases: HFCs, PFCs and SF_6

HFCs emissions in 2012 were 291.2 times higher than in base year (1995). This significant growth in HFCs emission is mainly due to the increase in emission from refrigeration and air conditioning equipment. PFCs emissions in 2012 were 83.3% lower than in base year (1995). The PFCs emission changes between 2012 and the preceding years depend on the aluminium production levels (main PFC source) and the use of C_4F_{10} in fire extinguishers.

SF_6 emissions in 2012 were about 77.0% higher than in base year (1995). Leakage from electrical equipment during its use and production is the main SF_6 emission.

Large percentage increase of industrial gases emissions, compared to the base year (1995), does not influence significantly the national total GHG emission trend, because all the fluorinated industrial gases together contributed merely app. 1.9% to the national total in 2012.

2.3. Description and interpretation of emission trends by category

Table 2.9 includes emissions of greenhouse gases from all categories for the base year 1988/1995 (fixed for the purpose of accounting the Kyoto Protocol reduction) and for year 2012 according to main categories. In 2012 total GHG emissions accounted for 399.27 million tons CO_2 eq. excluding sector 5. LULUCF. Comparing to the fixed base year emissions in 2012 decreased by 29.1%.

Table 2.9. GHG emissions according to main sectors in base year (1988) and 2012

	Total [Gg eq. CO_2]		(2012-base)/base [%]
	Base year	2012	
TOTAL with LULUCF	530 516.30	367 413.33	-30.7
TOTAL without LULUCF	563 442.77	399 267.97	-29.1
1. Energy	470 309.06	319 657.56	-32.0
2. Industrial Processes	32 832.19	26 958.32	-17.9
3. Solvent and Other Product Use	1 006.46	759.67	-24.5
4. Agriculture	50 893.90	36 653.86	-28.0
5. Land-Use Change and Forestry	-32 926.48	-31 854.64	-3.3
6. Waste	8 401.16	15 238.55	81.4

2.3.1. Energy (IPCC category 1)

The emission of GHGs from *Energy* sector in 2012 was 319.7 million tons of CO_2 equivalent. CO_2 emission share exceeded 94.5% of the total GHG emissions within 1. *Energy* category (table 2.10). The most emission intensive category was 1.A.1. *Fuel combustion activities* related mostly to heavy industry sector, highly energy consuming.

Table 2.10. GHG emissions from sub-sectors in category 1. *Energy* in 2012

GHG emission categories	GHG emission [Gg CO_2-eq]	% share in the total emission from Energy	% share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
1. TOTAL ENERGY	319 657.56	100.0	94.5	4.8	0.7
A. Fuel Combustion	303 640.45	95.0	93.4	1.0	0.7
1. Energy Industries	169 603.08	53.1	52.8	0.0	0.3
2. Manufacturing Industries and Construction	30 901.85	9.7	9.6	0.0	0.1
3. Transport	46 824.53	14.6	14.4	0.0	0.2
4. Other Sectors	56 311.00	17.6	16.6	0.9	0.2
5. Other	0.00	0.0	0.0	0.0	0.0
B. Fugitive Emissions from Fuels	16 017.12	5.0	1.2	3.8	0.0
1. Solid Fuels	9 415.32	2.9	0.6	2.4	0.0
2. Oil and Natural Gas	6 601.79	2.1	0.6	1.5	0.0

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

Table 2.11 shows detailed information on emissions of CO_2, CH_4, N_2O as well as HFCs, PFCs, SF_6 in 2. *Industrial Processes* sector and in 3. *Solvent and Other Product Use* sector in 2012. CO_2 is dominating among GHGs – it's contribution exceeds 66.1%. The main GHG emission sources in this category were: production processes of cement, nitric acid and ammonia.

The emissions of GHG from 3. *Solvent and Other Product Use* sector includes N_2O emissions from anaesthesia (16.3%) and CO_2 emissions (recalculated from NMVOC) (83.7%).

Table 2.11. The emissions of CO_2, CH_4 and N_2O from sub-sectors in categories: 2. *Industrial Processes* and 3. *Solvents and Other Product Use* in 2012

GHG emission categories	GHG emission [Gg CO_2-eq]	% share in the total emission from Industrial Processes	% share in total GHG emission from a given sub-sector			
			CO_2	CH_4	N_2O	HFC, PFC and SF_6
2. TOTAL INDUSTRIAL PROCESSES	26 958.32	100.0	66.1	1.1	3.9	28.9
A. Mineral Products	10 064.05	37.3	37.3	0.0	0.0	
B. Chemical Industry	5 644.81	20.9	16.0	1.0	3.9	
C. Metal Production	2 357.40	8.7	8.5	0.1	0.0	0.1
D. Other Production	9.54	0.0	0.0	0.0	0.0	
F. Consumption of Halocarbons and SF6	7 750.11	28.7				28.7
G. Other	1 132.41	4.2	4.2	0.0	0.0	
3. TOTAL SOLVENT AND OTHER PRODUCT USE	759.67	100	83.7	0.0	16.3	

2.3.3. Agriculture (IPCC category 4)

The main sources of GHG in category 4. *Agriculture* were: 4.D. *Agricultural Soils,* 4.A. *Enteric Fermentation* and 4.B. *Manure Management* (table 2.12). N_2O emission share was the largest in total GHG emission from 4. *Agriculture* in 2012 and came from both – direct (mineral and organic fertilization) and indirect (volatilization, leaching and runoff from applied synthetic fertilizer and animal manure) N_2O emissions from soils.

Table 2.12. GHG emissions from sub-sectors in category 4. *Agriculture* in 2012

GHG emission categories	GHG emission [Gg CO_2-eq]	% share in the total emission from Agriculture	% share in total GHG emission from a given sub-sector	
			CH_4	N_2O
4. TOTAL AGRICULTURE	36 653.86	100.0	31.3	68.7
A. Enteric Fermentation	8 977.07	24.5	24.5	0.0
B. Manure Management	7 335.93	20.0	6.7	13.3
D. Agricultural Soils	20 311.34	55.4	0.0	55.4
F. Field Burning of Agricultural Residues	29.53	0.1	0.1	0.0

2.3.4. Waste (IPCC category 6)

As it can be seen in table 2.13, the emission of CH_4 dominated in this sector in 2012 (almost 90.8%). The main part of GHG emissions came from 6.A. *Solid waste disposal on land* and 6.B. *Wastewater handling*.

Table 2.13. GHG emissions from sub-sectors in category 6. *Waste* in 2012

GHG emission categories	GHG emission [Gg CO_2-eq]	% share in the total emission from Waste	% share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
6. TOTAL WASTE	15 238.55	100	1.8	90.8	7.4
A. Solid Waste Disposal on Land	8 560.37	56.2	0.0	56.2	0.0
B. Wastewater Handling	6 383.42	41.9	0.0	34.6	7.3
C. Waste Incineration	294.76	1.9	1.8	0.0	0.1

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

Emissions of all GHG precursors have significantly diminished since 1990. In case of SO_2 emissions, which amounted to 853.3 Gg in 2012, the decrease was noted by about 70% between 1990 and 2012 what was caused by the decline of the heavy industry in the late 1980s and early 1990s. In late 1990s the emissions declined because of the diminished share of coal and lignite among fuels used for power and heat generation. Wider application of flue gases desulphurisation installations had the essential impact for ongoing SO_2 emissions decrease.

Emissions of NO_X in 2012 amounted 817.3 Gg and significantly decreased between 1990 and 2012. Similar to sulphur dioxide, most of the reductions were triggered by the decline of the heavy industry in the late 1980s and early 1990s as well as the lower share of hard coal and lignite in fuel used in 1990s. Increasing emissions from road transport cause comparatively lower (36%) total emission reductions than in case of SO_2 (*ca.* 70%).

CO emissions in 2012 amounted to 2818.4 Gg and dropped by more than 60% between 1990 - 2012 triggered by the decrease of fuel used in non-industrial combustion sector (services households and agricultural combustion sources), also road transport.

Emissions of NMVOC were about 630.3 Gg in 2012 and dropped by approximately 24% between 1990 and 2012 due to decreases in: road transport (*ca* 48%), non-industrial combustion and industrial combustion.

Trends of emissions of: SO_2, NO_x, NMVOC and CO for 2000-2012, for which recalculations were made in 2013, are presented below.

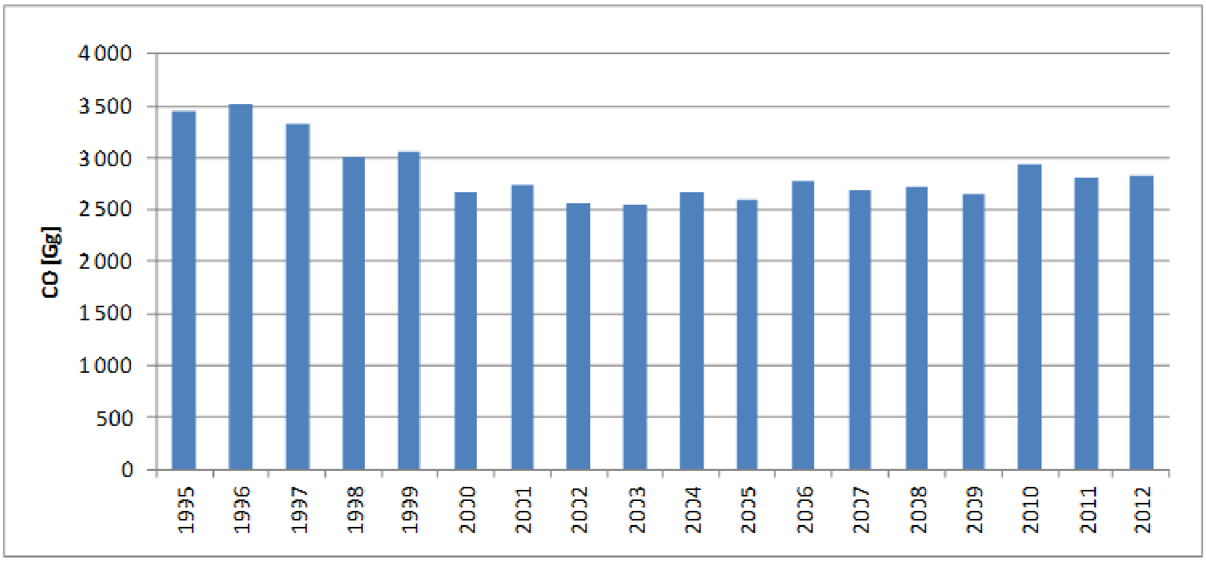

Figure 2.8. Emissions of CO in 1995-2012

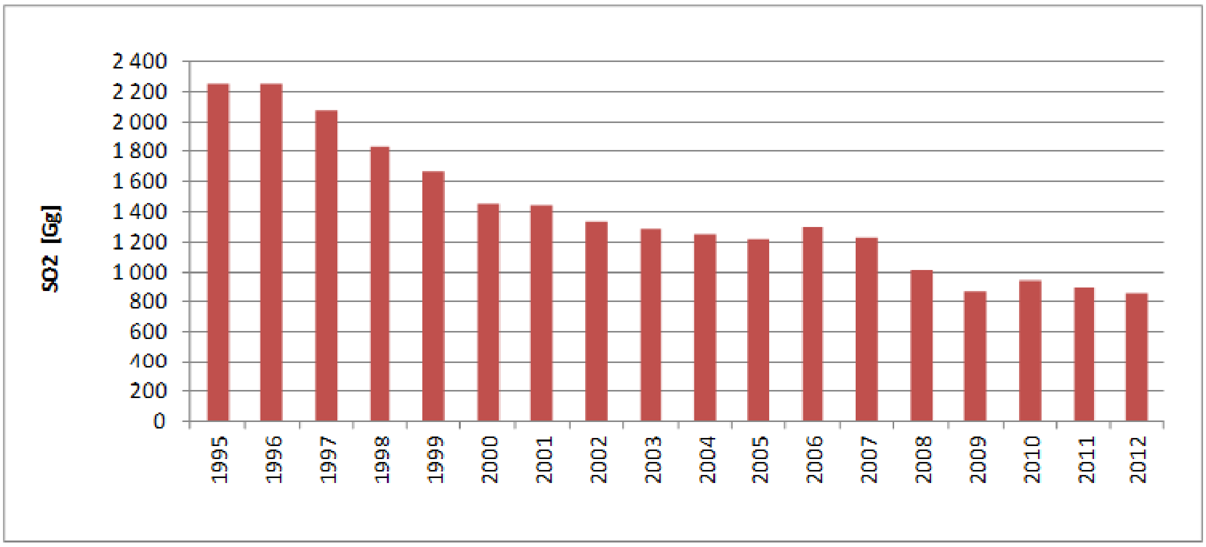

Figure 2.9. Emissions of SO_2 in 1995-2012

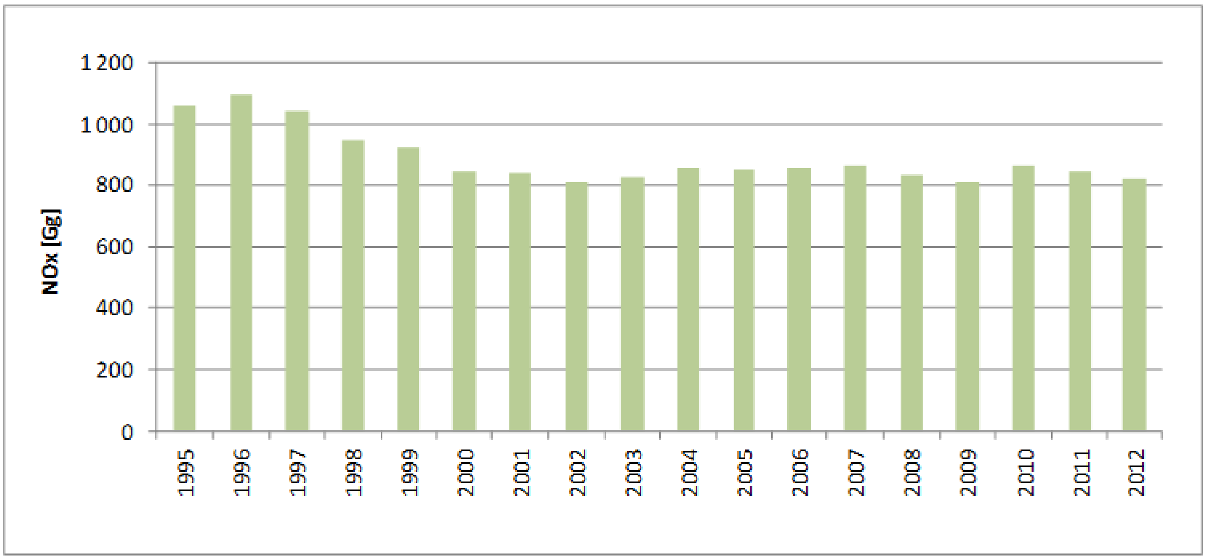

Figure 2.10. Emissions of NO_x in 1995-2012

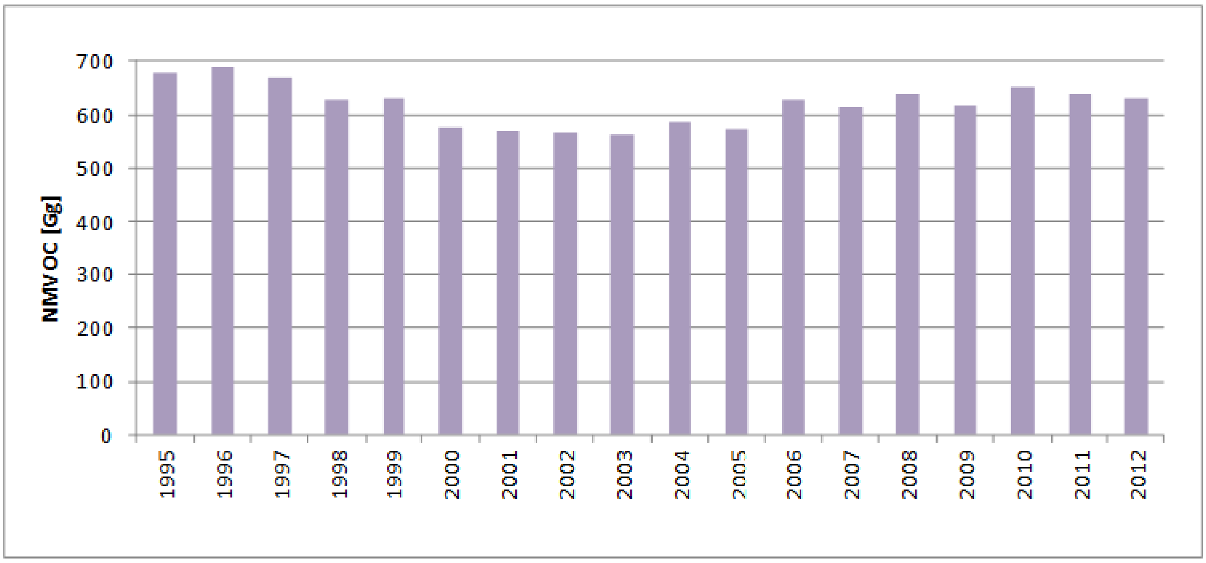

Figure 2.11. Emissions of NMVOC in 1995-2012

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

Estimated emissions and removals of greenhouse gases for the period 2008-2012, related to the LULUCF activities under Article 3.3 and 3.4 of the Kyoto Protocol are presented in Table 2.14. For activities related to afforestation/reforestation and forest management estimated balance is negative, what means the activity is considered as a net CO_2 sink.

Table 2.14. The emissions and removals balance of greenhouse gases for the period 2008-2012, to the related activities of land use, land use change and forestry (LULUCF) [Gg.]

Kyoto Protocol	Activity	[Gg]	2008	2009	2010	2011	2012
art. 3.3	Afforestation/ reforestation	CO_2 eq.	-2 349.17	-2 420.36	-2 554.16	-2 641.66	-2 777.73
		CO_2	-2 340.27	-2 422.03	-2 555.04	-2 642.66	-2 780.78
		CH_4	0.04	0.06	0.03	0.04	0.12
		N_2O	0.00	0.00	0.00	0.00	0.00
	Deforestation	CO_2 eq.	350.62	375.80	322.76	353.44	289.64
		CO_2	350.62	375.80	322.76	353.44	289.64
		CH_4	NO	NO	NO	NO	NO
		N_2O	NO	NO	NO	NO	NO
art. 3.4	Forest management	CO_2 eq.	-36 191.85	-34 806.89	-34 113.55	-40 403.57	-36 450.47
		CO_2	-36 520.09	-35 142.42	-34 438.20	-40 729.47	-36 800.13
		CH_4	0.59	0.86	0.43	0.46	1.37
		N_2O	1.02	1.02	1.02	1.02	1.03
	Cropland management	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*
	Grazing land management	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*
	Revegetation	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*	*not applicable*

Estimated sink associated with the afforestation activity, increased by 18.2% as compared to 2008. The emissions associated with deforestation as compared to 2008, decreased by 17.4 %. Relatively high drop was caused by the smaller forest land exclusions for non-forestry and non agricultural purposes. The size of net absorption for forest management activity for the year 2012 is approximately 0.8% higher than in 2008.

3. ENERGY (CRF SECTOR 1)

3.1. Overview of sector

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

1.A.1, 1.A.2, 1.A.4 Stationary combustion of solid, liquid and gaseous fuels (CO_2 emission), share in total GHG emission	62.3%
1.A.1, 2, 4 - Stationary Combustion - Other Fuels (CO_2 emission), share in total GHG emission	0.8%
1.A.3.b - Transport Road Transportation (CO_2 emission), share in total GHG emission	11.3%
1.B.1.a - Coal Mining and Handling (CH_4 emission), share in total GHG emission	1.8%
1.B.2.b - Natural Gas (CH_4 emission), share in total GHG emission	1.2%
1.A.1, 2, 4 - Stationary Combustion - Solid Fuels (CH_4 emission), share in total GHG emission	0.5%

Share of these categories in total Poland's GHG emissions is 78.0%.

Figure 3.3.1 shows emission trend in *Energy* sector while figure 3.1.2 shows emission trend according to subcategories 1.A. *Fuel combustion* and 1.B. *Fugitive emission*. Emission from subcategory 1.A. *Fuel combustion* is the largest contributor to emissions from sector 1. *Energy* – in 2012 almost 95%.

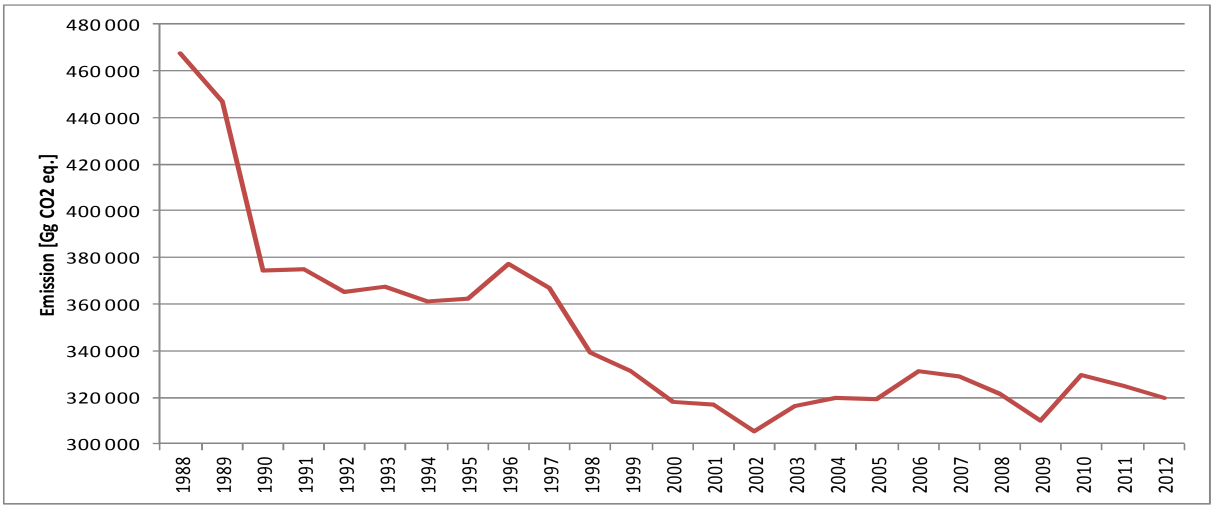

Figure 3.1.1. GHG emission trend in period 1988 – 2012 in sector *Energy*

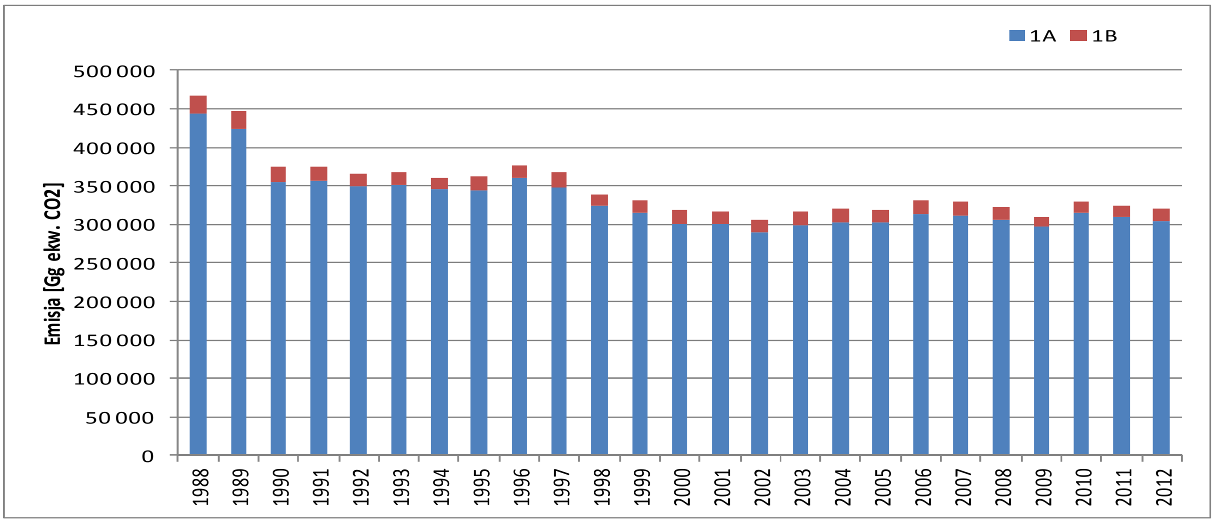

Figure 3.1.2. GHG emission trend in period 1988 - 2012 in subsectors 1.A and 1.B

3.1.1 Fuel combustion (CRF sector 1.A)

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

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

Share of that sector in total GHG emission in 2012 is over 76%. Subsector 1.A.1. *Energy Industries* is by far the largest contributor to emissions from fuel combustion (see figure 3.1.3).

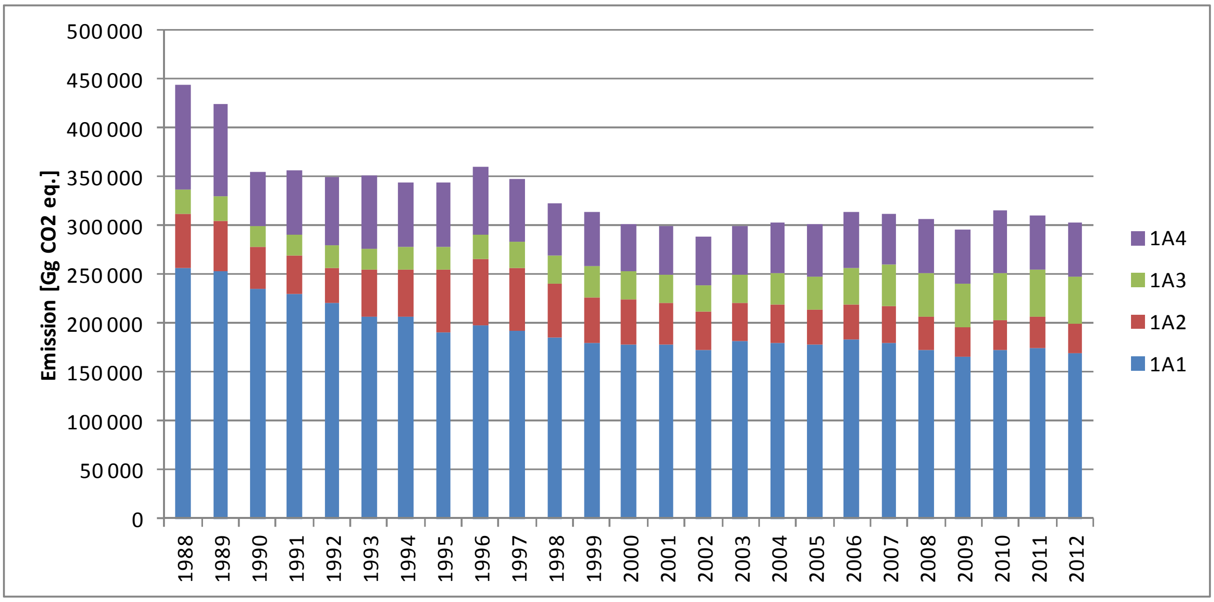

Figure 3.1.3. GHG emissions from fuel combustion in 1988-2012 according to subcategories

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

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

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

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

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

a) *Iron and Steel* - 1.A.2.a
b) *Non-Ferrous Metals* - 1.A.2.b
c) *Chemicals* - 1.A.2.c

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

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

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

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

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

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

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

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

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

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

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

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

- domestic emission factors for hard coal and lignite;

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

- for hard coal:

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

where:

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

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

- for lignite:

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

where:

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

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

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

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

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

The following values are used:

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

Emissions of CH_4 and N_2O from fuel combustion in stationary sources are based on fuel quantities submitted by GUS to Eurostat (Eurostat database) and the corresponding emission factors [IPCC 1996, IPCC 2006].

Trend of fuel use and methodology over the years 1988-2012

Estimation of CO_2 emission from fuel combustion in stationary sources for the years 1988-2011 is based on methodology corresponding to methodology applied for 2012 (that methodology is presented above). For the years: 1990-2011 fuel consumptions from the Eurostat database were applied. The Eurostat database does not cover fuel use data for Poland for the years before 1990. Therefore, fuel use data for the period: 1988-1989 were taken from IEA database [IEA]. Amounts of particular fuel consumptions in individual subsectors: 1.A.1, 1.A.2 and 1.A.4 were presented in the tables 1-12 (Annex 2). CO_2 emission factors from fuel combustion in stationary sources for hard coal and lignite are the country specific EFs. These EFs for the entire time series are based on the same empirical functions described above.
The values of CO_2 EFs changed over the years following the changes of the respective net calorific values for hard coal and lignite (Annex 2 -table 13-24). GHG emission factors for other fuels are the IPCC default EFs [IPCC 1997, IPCC 2006]. Values of applied emission factors were tabulated in annex 2 (emission factors of CO_2, CH_4 and N_2O for particular fuel are presented in tables 25-27 of this annex).

The time series of fuel use and GHG emissions for the main subsectors of 1.A *Fuel combustion* are presented below (in the following chapters). Detailed data on particular fuel consumption in the main subcategories of 1.A IPCC category for entire period 1988-2012 and GHG EFs for individual fuels are presented in Annex 2 .

3.1.2. Fugitive emissions (CRF sector 1.B)

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

Total emission of GHGs as carbon dioxide equivalent in 1.B subcategory amounted to 16 017 Gg in 2012 and decreased since 1988 by 31%. Table 3.1.4. shows emissions from 1.B.1 and 1.B.2 subcategories in period 1988-2012.

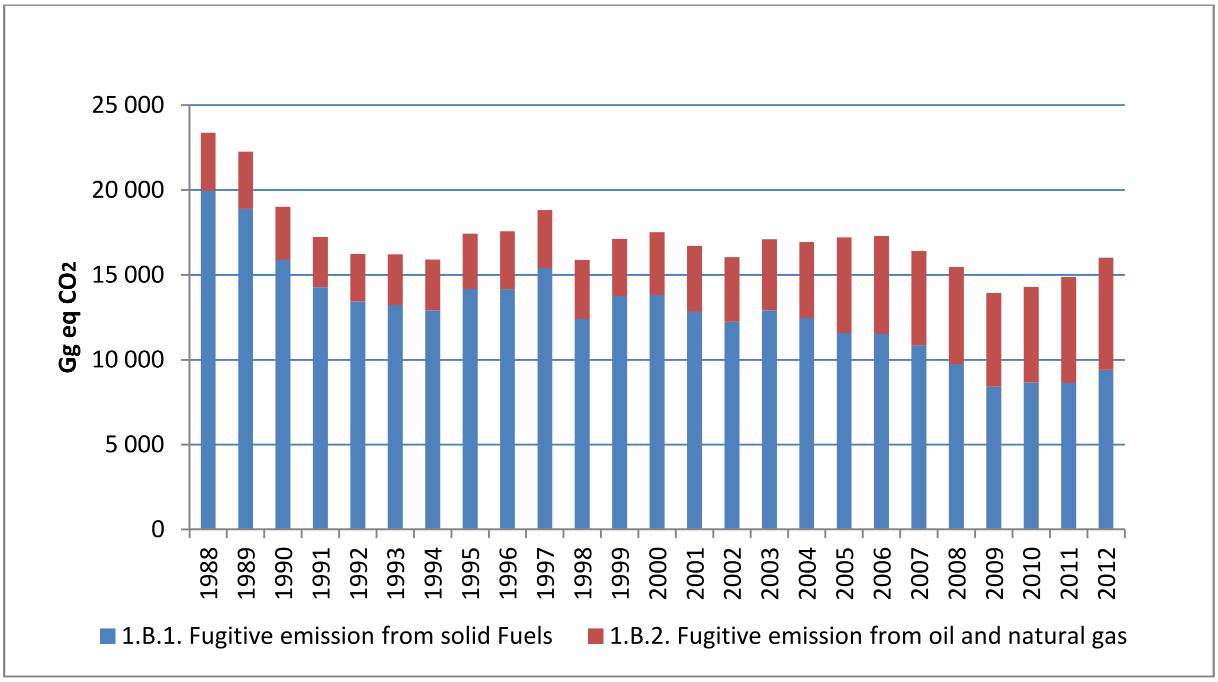

Figure 3.1.4. GHG emissions from 1.B.1 and 1.B.2 subcategories in 1988-2012.

3.2. Fuel combustion (CRF 1.A)

3.2.1. Comparison of the sectoral approach with the reference approach

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

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

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

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

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

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

- statistical differences - is the difference between energy available for final consumption covering the energy placed at the disposal of final users and final energy consumption covering energy supplied to the final consumer's door for all energy uses (see figure 3.2.1);
- distribution loses - losses due to transport or distribution of natural gas;
- differences in NCVs used in reference and sectoral approaches, especially for hard and brown coal, where NCV affects emission factors;
- part of emission from solid fuel use was included in sector Industrial processes (2.C.1: production of sinter, pig iron and steel).

Correlation between difference in solid fuel apparent consumption in reference and sectoral approach and statistical differences for hard coal (which is predominant fuel among solid fuels) is shown on figure below.

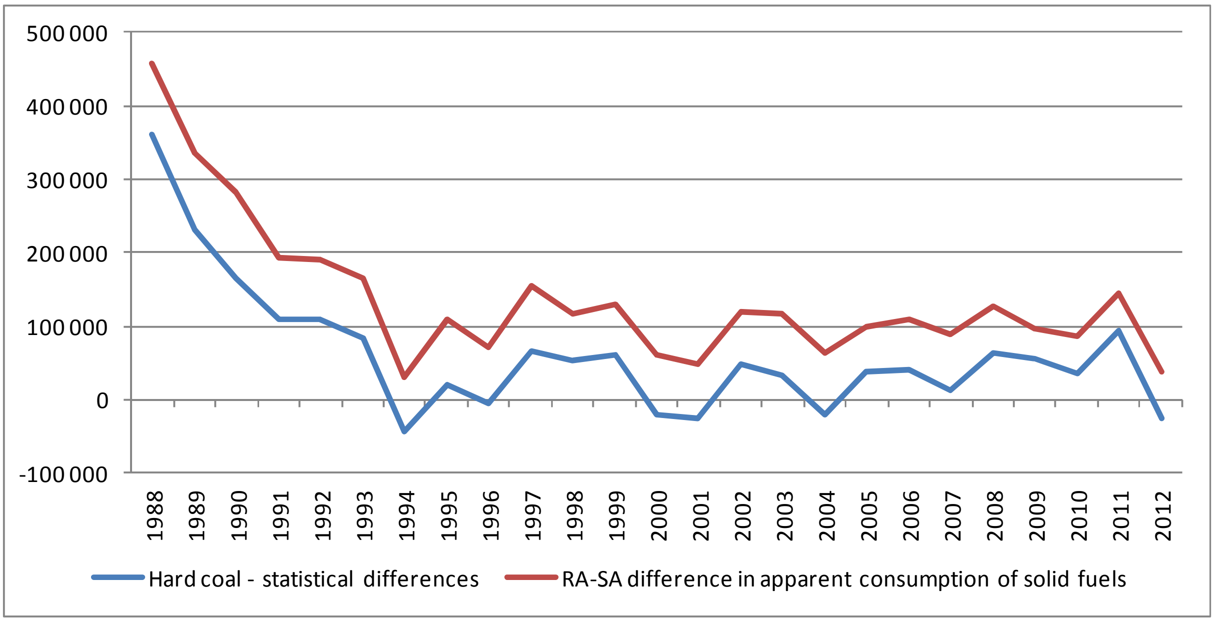

Figure 3.2.1. Correlation between statistical differences and differences between RA and SA for solid fuels in period 1988 - 2012

Calculating CO_2 emissions with the two approaches can lead to different results. In 2012 the difference between reference and sectoral approaches in CO_2 emissions is equal 0.03%. Comparison of both methods is given in table 3.2.1.

Table 3.2.1. Differences between CO_2 emissions in sectoral and reference approach

Year	Reference approach [Gg]	Sectoral approach [Gg]	Difference [%]
2012	298 499	298 404	0.03
2011	313 542	304 709	2.90
2010	313 164	309 430	1.21
2009	294 841	291 363	1.19
2008	308 316	301 363	2.31
2007	308 830	307 577	0.41
2006	314 192	308 827	1.74
2005	303 236	297 549	1.91
2004	301 823	298 299	1.18
2003	304 215	295 093	3.09
2002	295 318	285 250	3.53
2001	297 648	295 617	0.69
2000	295 406	296 475	-0.36
1999	314 440	309 290	1.67
1998	322 840	318 559	1.34
1997	349 016	342 803	1.81
1996	354 477	353 754	0.20
1995	340 937	338 994	0.57
1994	331 951	339 364	-2.18
1993	354 787	344 945	2.85
1992	356 593	343 888	3.69
1991	366 891	352 523	4.08
1990	370 496	350 820	5.61
1989	440 479	418 330	5.29
1988	469 659	437 293	7.40

3.2.2. International bunker fuels

1990-2012 fuel use data for fuels classified to the international marine bunker were taken from the Eurostat database. For the years 1988-1989, the respective data were taken from the database of the International Energy Agency (IEA).

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

For 2012 the energy balance, for the first time, indicated 'Domestic aviation' and 'International aviation' separately and these data has been used for calculations, what resulted in change of emission trend.
The amounts of fuels for the aviation international bunker in years 1988 – 2011 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. This is in accordance with the initial estimations based on EUROCONTROL data on fuel use share of jet kerosene used for international aviation in Poland(see section 3.2.8.2.1). For the years 1990-2011 aviation fuel data are those of the Eurostat database, while for the base year and 1989 are those of the IEA database.

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

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

Table 3.2.2. Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2012

AVIATION BUNKER												
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Fuel consumption – jet fuel [Gg]	331.55	456.00	204.25	210.90	228.95	228.00	230.85	248.90	292.60	262.20	266.95	238.45
Fuel consumption – jet fuel [PJ]	14.26	19.61	8.78	9.07	9.84	9.80	9.93	10.70	12.58	11.27	11.48	10.25
Calorific value [MJ/kg]	44.58	44.58	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
CO_2 potential emission factor [g/kg]	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150
CO_2 potential emission factor [kg/GJ]	70.64	70.64	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26
CO_2 potential emission factor [Gg]	1 044	1 436	643	664	721	718	727	784	922	826	841	751
CH_4 emission factor [kg/GJ]	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
CH_4 emission [Gg]	0.007	0.010	0.004	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.005
N_2O emission factor [g/kg]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N_2O emission factor [kg/GJ]	0.0022	0.0022	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
N_2O emission [Gg]	0.033	0.046	0.020	0.021	0.023	0.023	0.023	0.025	0.029	0.026	0.027	0.024
NAVIGATION BUNKER												
	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Fuel consumption – diesel oil [PJ]	14.23	11.16	6.01	2.70	3.18	2.45	1.29	1.20	1.76	2.53	2.87	4.42
Fuel consumption - diesel oil [PJ]	9.00	9.37	10.48	3.76	6.76	3.16	4.24	4.60	5.08	6.28	8.08	10.80
CO_2 potential emission - ON [Gg]	1054	827	445	200	235	181	95	89	130	188	213	327
CO_2 potential emission - OP [Gg]	698	727	813	292	525	245	329	357	394	487	627	838
Total CO_2 potential emission [Gg]	1753	1554	1258	492	760	426	424	446	525	675	840	1166
CH_4 emission - ON [Gg]	0.100	0.078	0.042	0.019	0.022	0.017	0.009	0.008	0.012	0.018	0.020	0.031
CH_4 emission - OP [Gg]	0.063	0.066	0.073	0.026	0.047	0.022	0.030	0.032	0.036	0.044	0.057	0.076
Total CH_4 potential emission [Gg]	0.163	0.144	0.115	0.045	0.070	0.039	0.039	0.041	0.048	0.062	0.077	0.107
N_2O emission - ON [Gg]	0.028	0.022	0.012	0.005	0.006	0.005	0.003	0.002	0.004	0.005	0.006	0.009
N_2O emission - OP [Gg]	0.018	0.019	0.021	0.008	0.014	0.006	0.008	0.009	0.010	0.013	0.016	0.022
Total N_2O potential emission [Gg]	0.046	0.041	0.033	0.013	0.020	0.011	0.011	0.012	0.014	0.018	0.022	0.030

Table 3.2.2. (cont.) Fuel consumption and CO_2, CH_4 and N_2O emissions in international aviation and navigation bunker in 1988-2012

AVIATION BUNKER													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Fuel consumption – jet fuel [Gg]	253.65	249.85	245.10	265.05	260.30	295.45	394.25	410.40	493.05	446.50	470.25	460.75	524.00
Fuel consumption – jet fuel [PJ]	10.91	10.74	10.54	11.40	11.19	12.70	16.95	17.65	21.20	19.20	20.22	19.81	22.53
Calorific value [MJ/kg]	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00	43.00
CO_2 potential emission factor [g/kg]	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150
CO_2 potential emission factor [kg/GJ]	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26	73.26
CO_2 potential emission factor [Gg]	799	787	772	835	820	931	1 242	1 293	1 553	1 406	1 481	1 451	1 651
CH_4 emission factor [kg/GJ]	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.0005
CH_4 emission [Gg]	0.005	0.005	0.005	0.006	0.006	0.006	0.008	0.009	0.011	0.010	0.010	0.010	0.011
N_2O emission factor [g/kg]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N_2O emission factor [kg/GJ]	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023
N_2O emission [Gg]	0.025	0.025	0.025	0.027	0.026	0.030	0.039	0.041	0.049	0.045	0.047	0.046	0.052
NAVIGATION BUNKER													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Fuel consumption – diesel oil [PJ]	1.89	0.94	1.85	1.97	1.67	4.98	3.73	2.15	2.10	2.75	2.32	2.87	2.88
Fuel consumption – diesel oil [PJ]	9.92	9.80	9.32	9.80	8.80	8.48	8.56	8.16	9.32	7.60	6.68	4.24	3.20
CO_2 potential emission - ON [Gg]	140	70	137	146	124	369	277	159	156	203	172	213	214
CO_2 potential emission - OP [Gg]	770	760	723	760	683	658	664	633	723	590	518	329	248
Total CO_2 potential emission [Gg]	910	830	860	907	807	1027	941	792	879	793	690	542	462
CH_4 emission - ON [Gg]	0.013	0.007	0.013	0.014	0.012	0.035	0.026	0.015	0.015	0.019	0.016	0.020	0.020
CH_4 emission - OP [Gg]	0.069	0.069	0.065	0.069	0.062	0.059	0.060	0.057	0.065	0.053	0.047	0.030	0.022
Total CH_4 potential emission [Gg]	0.083	0.075	0.078	0.082	0.073	0.094	0.086	0.072	0.080	0.072	0.063	0.050	0.043
N_2O emission - ON [Gg]	0.004	0.002	0.004	0.004	0.003	0.010	0.007	0.004	0.004	0.005	0.005	0.006	0.006
N_2O emission - OP [Gg]	0.020	0.020	0.019	0.020	0.018	0.017	0.017	0.016	0.019	0.015	0.013	0.008	0.006
Total N_2O potential emission [Gg]	0.024	0.021	0.022	0.024	0.021	0.027	0.025	0.021	0.023	0.021	0.018	0.014	0.012

3.2.3. Feedstocks and non-energy use of fuels

As the use of energy products for non-energy purposes can lead to emissions, Poland has calculated such emissions and report them under category 2G *Other* (following the ERT recommendation).

3.2.4. CO_2 capture from flue gases and subsequent CO_2 storage

Not applicable in Poland.

3.2.5. Country-specific issues

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

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

3.2.6.1. Source category description

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

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

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

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

Subsector 1.A.1.a *Public Electricity and Heat Production* is by far the largest contributor to emissions from this category (see figure 3.2.6.1) – about 95% in 2012.

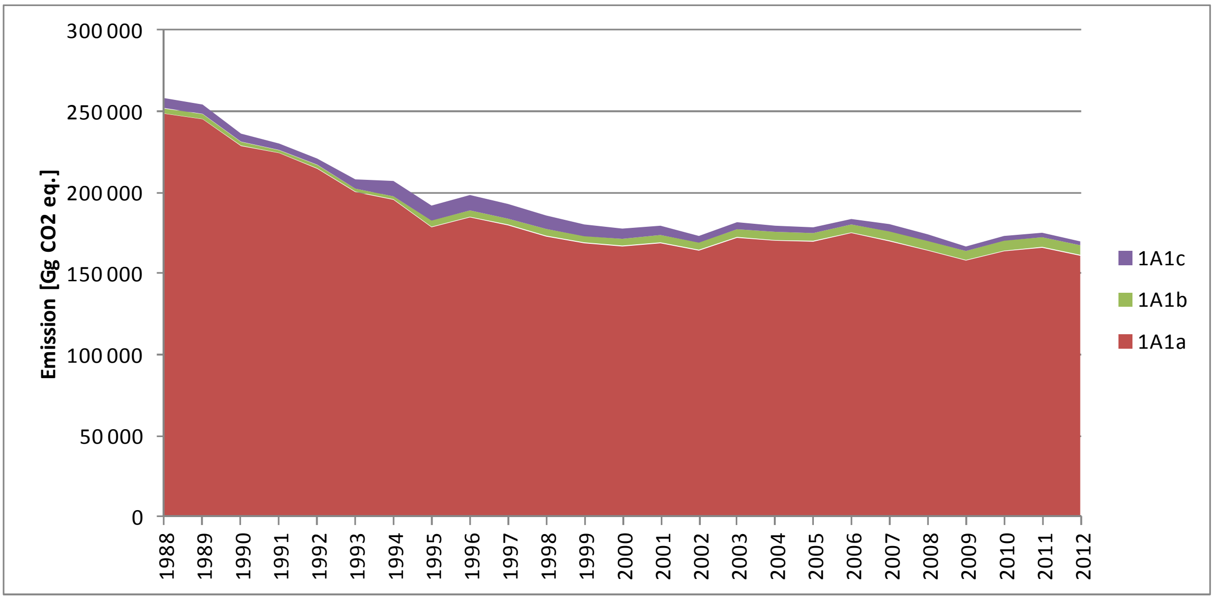

Figure 3.2.6.1. GHG emissions from *Energy Industries* in years 1988-2012 according to subcategories

3.2.6.2. Methodological issues

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

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

Table 3.2.6.1 presents the structure and amounts of fuel used in the sub-category 1.A.1.a *Public Electricity and Heat Production* for the years 1988-2012.

Table 3.2.6.1. Fuel consumption for the years 1988-2012 in 1.A.1.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	75.134	72.672	66.951	62.623	57.602	56.351	57.225	26.233
Gaseous Fuels	21.274	21.900	21.641	16.329	9.561	3.107	4.094	4.738
Solid Fuels	2374.674	2346.290	2197.782	2169.776	2086.989	1942.858	1890.625	1760.175
Biomass	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878
Other Fuels	16.699	15.129	14.585	14.387	17.289	13.783	14.057	1.447
TOTAL	**2491.522**	**2459.864**	**2306.224**	**2272.029**	**2178.795**	**2022.757**	**1972.877**	**1796.471**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	28.878	29.000	19.329	18.538	15.837	16.923	15.701	14.154
Gaseous Fuels	7.156	7.949	10.768	16.210	21.627	28.242	38.700	45.496
Solid Fuels	1824.672	1776.913	1711.756	1669.246	1646.568	1663.270	1608.461	1687.678
Other Fuels	3.393	3.267	3.809	3.082	3.273	3.369	4.629	2.964
Biomass	2.793	3.381	3.877	3.747	3.904	5.449	5.424	6.642
TOTAL	**1866.892**	**1820.510**	**1749.539**	**1710.823**	**1691.209**	**1717.253**	**1672.915**	**1756.934**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	11.585	9.281	9.119	8.010	8.215	7.664	8.338	8.070
Gaseous Fuels	53.667	57.039	52.808	49.653	51.052	51.828	52.230	58.669
Solid Fuels	1660.616	1658.759	1712.612	1672.642	1609.848	1549.568	1603.600	1609.167
Other Fuels	4.038	5.219	5.205	4.783	1.320	1.214	1.481	1.553
Biomass	10.198	19.320	23.201	27.739	41.289	58.206	69.772	82.069
TOTAL	**1740.104**	**1749.618**	**1802.945**	**1762.827**	**1711.724**	**1668.480**	**1735.421**	**1759.528**
	2012							
Liquid Fuels	7.230							
Gaseous Fuels	63.579							
Solid Fuels	1552.527							
Other Fuels	1.287							
Biomass	109.706							
TOTAL	**1734.329**							

The data in table 3.2.6.1 shows that the use of solid fuels is dominant in 1.A.1.a – mainly hard coal and lignite. In 2012, the use of hard coal was app. 993 PJ i.e. about 57% of the entire energy of all fuels used in that sub-sector. Lignite made app. 30% of the energy, accordingly. Despite the significant share of solid fuels (app. 90%) in the total energy related fuel use in 1.A.1.a, a slow decreasing trend can be noticed since the late 1990s (from app. 98% in 1998 till 90% in 2012). At the same time in last decade increased the share of gas as well as the share of biomass. Detailed data concerning individual fuel consumptions in 1.A.1.a subcategory for the entire period 1988-2012 was presented in Annex 2 (tab. 1).

Figure 3.2.6.2 shows CO_2 emission changes over the period 1988-2012. A significant emission decrease took place over the years 1988-1995 followed by a period of emission stabilization.

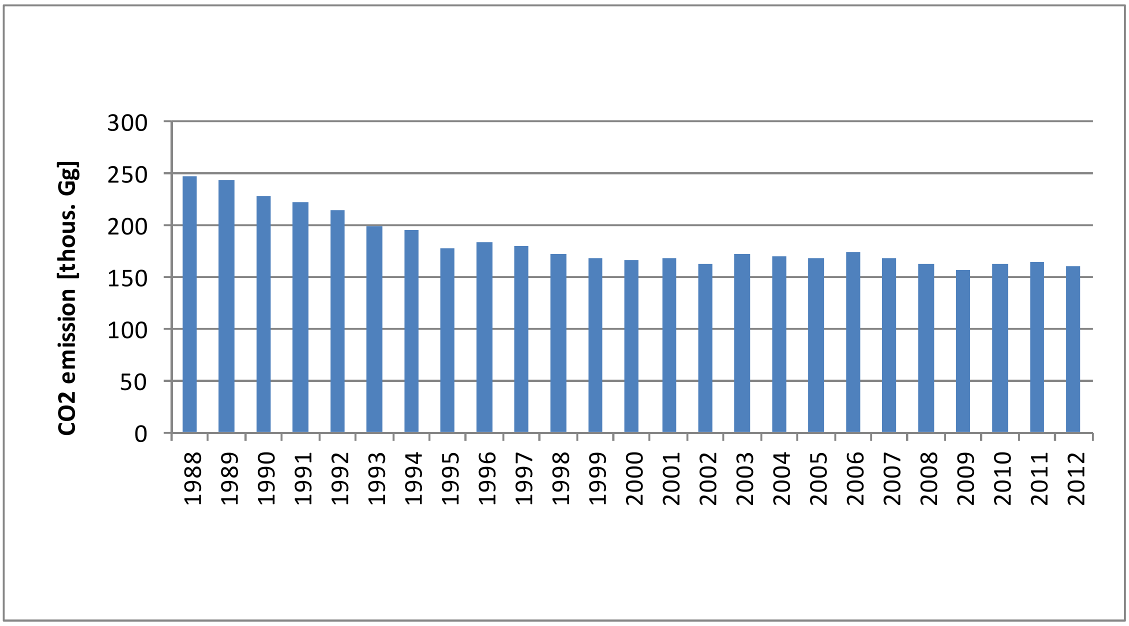

Figure 3.2.6.2. CO_2 emission for 1.A.1.a category in 1988-2012

Figure 3.2.6.3 shows emission trends for CH_4 and N_2O between the base year and 2012. Similarly to CO_2 a significant emission decrease for these gases happened in the period 1988-1995. Since 2002 is noticeable increase of CH_4 emission connected with a growth of biomass consumption. That emission increase is the result of relatively high value of CH_4 EF for solid biomass.

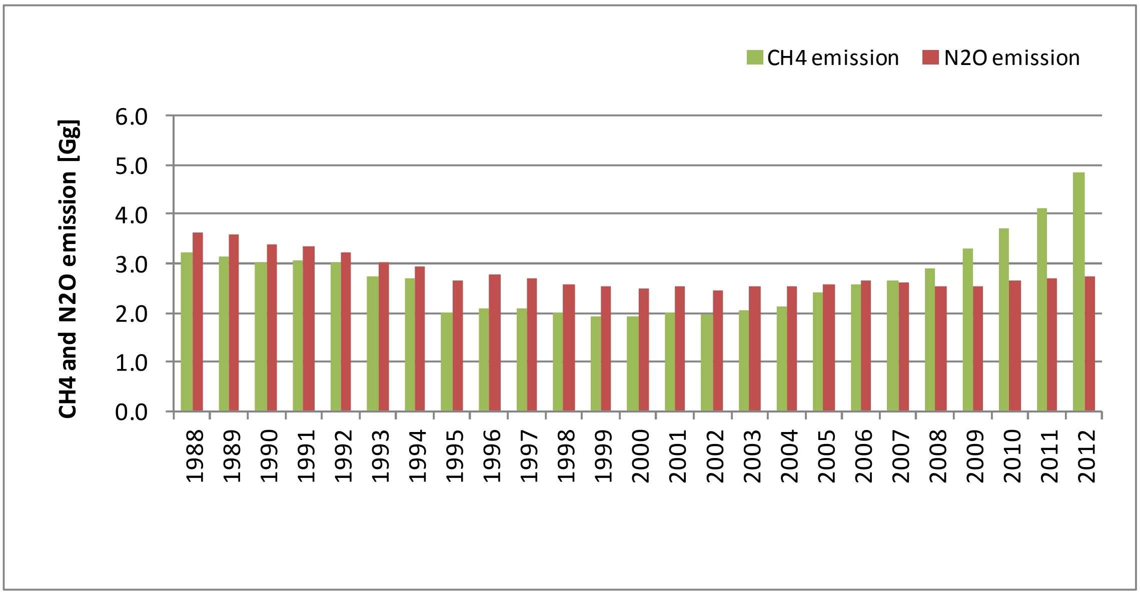

Figure 3.2.6.3. CH_4 and N_2O emissions for 1.A.1.a category in 1988-2012

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

Table 3.2.6.2 shows fuel consumption data in sub-category 1.A.1.b *Petroleum Refining* for the years 1988-2012. Detailed data on fuel consumptions in 1.A.1.b subcategory for the entire period 1988-2012 was presented in Annex 2 (table 2).

Table 3.2.6.2. Fuel consumption in 1988-2012 in 1.A.1.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	23.660	23.106	18.957	18.226	24.274	22.185	22.490	44.643
Gaseous Fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562
Solid Fuels	0.142	0.140	0.046	0.118	0.069	0.245	0.068	1.302
Other Fuels	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**33.921**	**33.129**	**25.896**	**20.155**	**26.533**	**24.040**	**24.408**	**49.426**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	50.172	43.737	47.441	43.546	47.002	53.150	53.552	54.178
Gaseous Fuels	1.749	2.529	8.244	10.832	12.110	11.354	10.124	12.770
Solid Fuels	1.451	1.349	0.710	0.637	0.277	0.140	0.023	0.000
Other Fuels	0.350	0.163	0.438	0.310	0.219	0.095	0.253	0.176
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**53.722**	**47.778**	**56.833**	**55.325**	**59.608**	**64.739**	**63.952**	**67.124**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	55.859	53.915	55.858	61.194	62.253	61.100	70.158	61.876
Gaseous Fuels	15.454	14.482	14.900	20.816	18.816	17.381	19.232	26.893
Solid Fuels	0.000	0.000	0.000	0.000	0.000	0.023	0.023	0.073
Other Fuels	0.221	0.285	0.224	0.000	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**71.534**	**68.682**	**70.982**	**82.010**	**81.069**	**78.504**	**89.413**	**88.842**
	2012							
Liquid Fuels	61.434							
Gaseous Fuels	29.020							
Solid Fuels	0.045							
Other Fuels	0.000							
Biomass	0.000							
TOTAL	**90.499**							

Figure 3.2.6.4 shows CO_2 emission changes in 1988-2012 in sub-category 1.A.1.b.

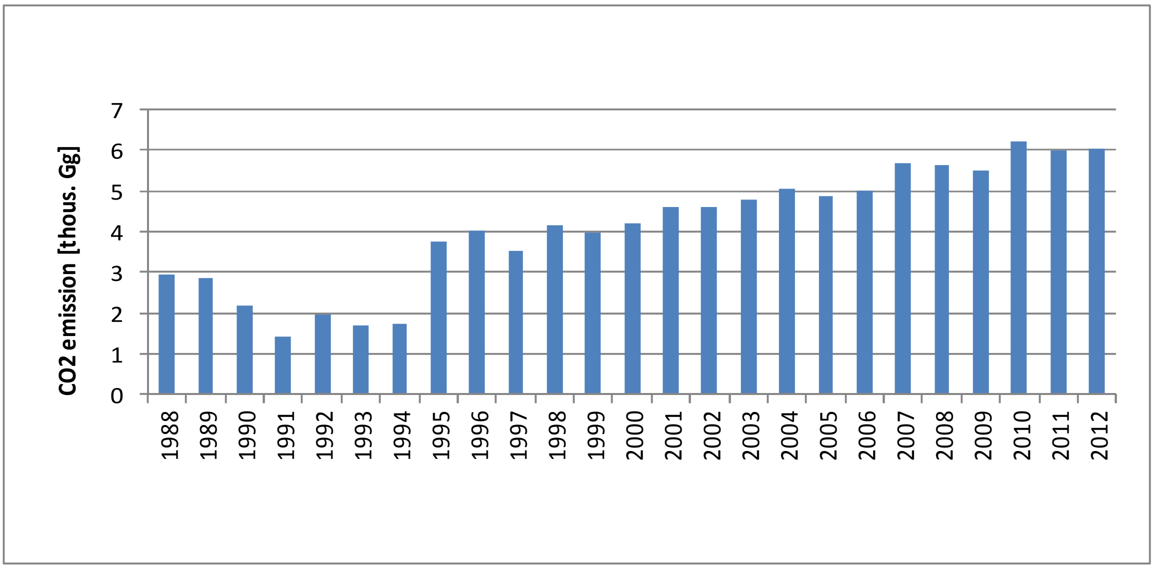

Figure 3.2.6.4. CO_2 emission for 1.A.1.b category in 1988-2012

Figure 3.2.6.5 shows the corresponding CH_4 and N_2O emission in that source sub-category between the base year and 2012.

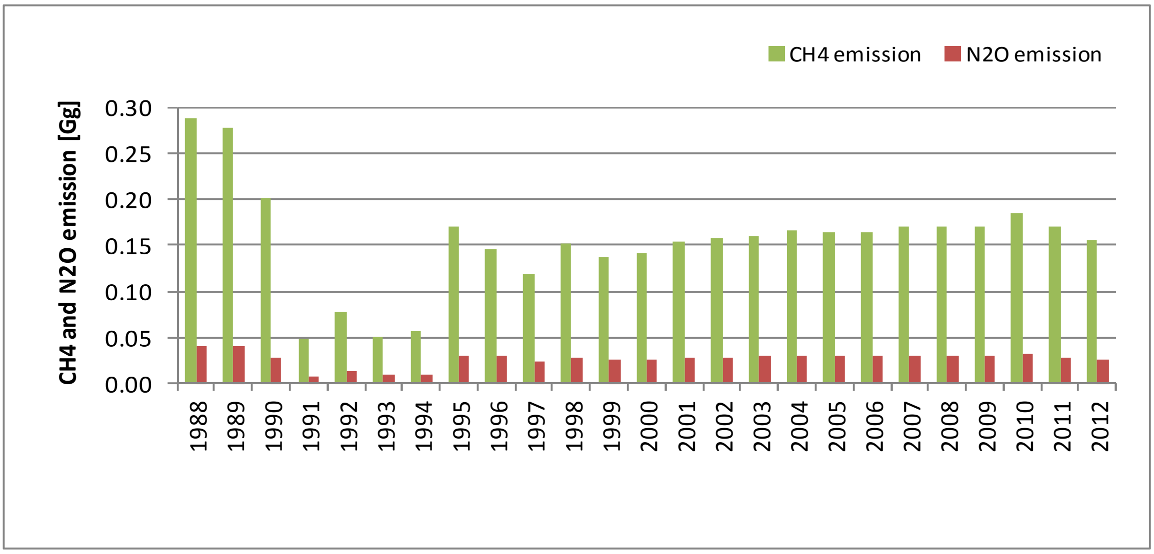

Figure 3.2.6.5. CH_4 and N_2O emissions for 1.A.1.b category in 1988-2012

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

Table 3.2.6.3 shows the fuel use data in the sub-category 1.A.1.c over the period: 1988-2012. Particular fuel consumptions in 1.A.1.c subcategory for the entire period 1988-2012 were tabulated in Annex 2 (table 3).

Table 3.2.6.3. Fuel consumption in 1988-2012 in 1.A.1.c subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	2.550	2.180	2.110	2.410	2.579	5.047	4.243	4.293
Gaseous Fuels	13.736	15.364	12.371	12.432	14.665	12.354	17.401	14.850
Solid Fuels	70.465	66.330	58.694	49.265	47.123	61.209	102.119	98.936
Other Fuels	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004
TOTAL	**86.815**	**83.875**	**73.181**	**64.107**	**64.371**	**78.929**	**124.009**	**118.267**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	3.716	3.164	3.008	2.259	2.208	1.712	1.730	1.652
Gaseous Fuels	23.269	21.155	17.779	19.458	19.491	12.986	12.515	9.741
Solid Fuels	97.647	95.586	89.086	76.059	68.737	66.257	49.936	56.476
Other Fuels	0.158	0.138	0.151	0.155	0.014	0.008	0.005	0.013
Biomass	0.014	0.031	0.026	0.027	0.037	0.052	0.047	0.026
TOTAL	**124.804**	**120.074**	**110.050**	**97.958**	**90.487**	**81.015**	**64.233**	**67.908**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	1.441	1.690	1.413	1.490	1.453	1.628	1.750	2.179
Gaseous Fuels	11.190	10.106	10.363	9.680	9.239	8.858	10.321	9.949
Solid Fuels	50.943	45.375	46.204	58.784	54.457	36.427	42.000	40.024
Other Fuels	0.000	0.000	0.029	0.042	0.051	0.015	0.016	0.022
Biomass	0.020	0.014	0.026	0.085	0.037	0.137	0.349	0.162
TOTAL	**63.594**	**57.185**	**58.035**	**70.081**	**65.237**	**47.065**	**54.436**	**52.336**
	2012							
Liquid Fuels	1.565							
Gaseous Fuels	11.414							
Solid Fuels	34.862							
Other Fuels	0.010							
Biomass	0.160							
TOTAL	**48.011**							

The emission trends of CO_2, CH_4 and N_2O in the 1988-2012 period are shown in figures 3.2.6.6 and 3.2.6.7.

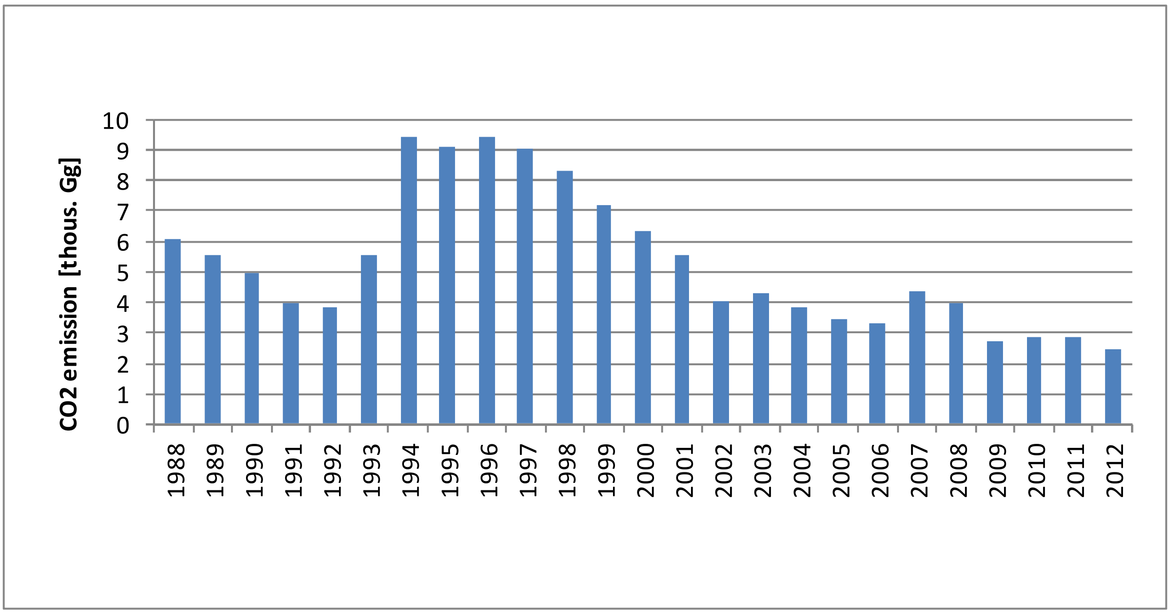

Figure 3.2.6.6. CO_2 emission for 1.A.1.c category in 1988-2012

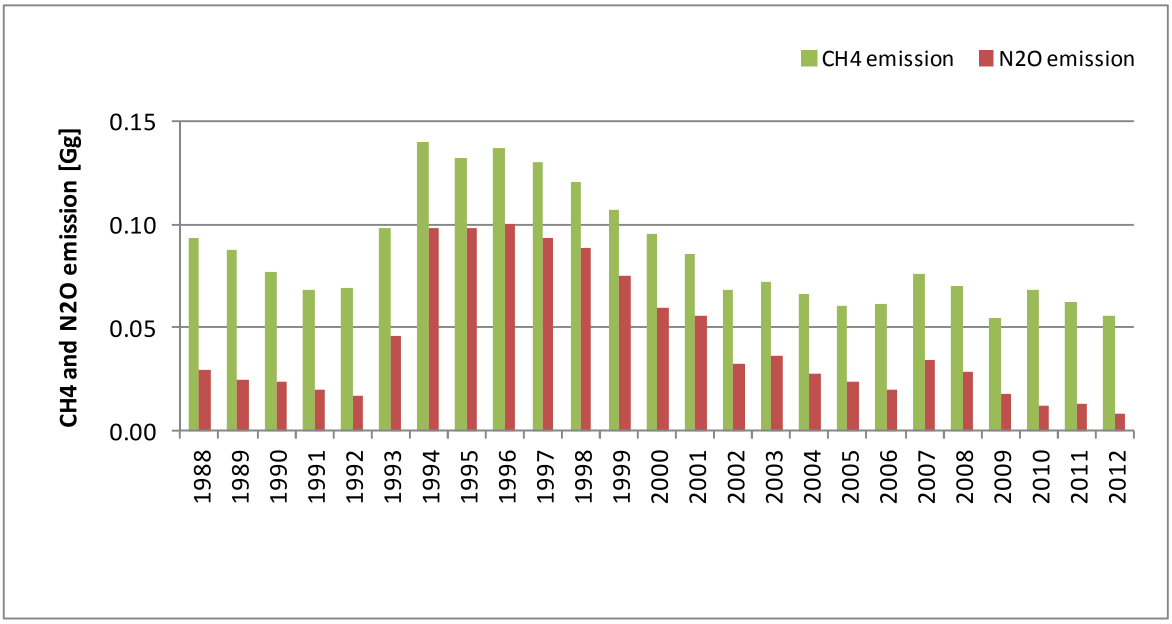

Figure 3.2.6.7. CH_4 and N_2O emissions for 1.A.1.c category in 1988-2012

3.2.6.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2012 for IPCC sector *1.Energy* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 8.
Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

2012	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
1. Energy	**302,127.65**	**734.85**	**6.77**	2.2%	24.0%	22.1%
A. Fuel Combustion	**298,403.80**	**149.46**	**6.77**	2.2%	11.8%	22.1%
1. Energy Industries	168,641.71	5.07	2.76	3.4%	18.4%	11.6%
2. Manufacturing Industries and Construction	30,635.46	4.49	0.56	2.4%	10.6%	14.5%
3. Transport	46,148.22	4.89	1.85	5.8%	10.4%	75.0%
4. Other Sectors	52,978.41	135.01	1.60	2.9%	13.1%	28.0%
5. Other	0.00	0.00	0.00	0.0%	0.0%	0.0%
B. Fugitive Emissions from Fuels	**3723.85**	**585.38**	**0.00**	7.9%	30.0%	0.0%
1. Solid Fuels	1869.44	359.33	0.00	15.0%	48.8%	0.0%
2. Oil and Natural Gas	1854.41	226.06	0.00	4.6%	5.4%	100.1%

3.2.6.4. Source-specific QA/QC and verification

Activity data used in the GHG inventory concerning energy sector come from Eurostat Database which is fed by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. Activity data applied in GHG inventory are regularly checked and updated if necessary according to adjustments made in Eurostat Database.
One of the elements of quality control of activity data correction is fuel balances prepared for the purpose of national GHG inventories (see Annex 4). For the main fuels (i.e. coal, lignite) calorific values are analysed for avoiding significant errors. Close cooperation is developed between inventory experts and institutions responsible for energy data. Any doubtful fuel consumption values are systematically verified - it is often required to obtain additional confirmation of data by installations/entities submitting the energy questionnaire. In case of any doubts energy data are also validated based on Central Statistical Office's Energy Statistics published annually.
Natural verification of data in an energy sector is comparison of sectoral and reference approaches within the GHG inventory.
Calculations in energy sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 7.

3.2.6.5. Source-specific recalculations

- fuel consumptions for the years 1988-2011 were updated according to current IEA database and Eurostat database respectively;

Table.3.2.6.4. Changes of GHG emission values in 1.A.1 subcategory as a result of recalculations

Changes	1988	1989	1990	1991	1992	1993	1994	1995
				CO2				
Gg	-6371.29	-6250.49	1.34	1.36	1.44	2.70	2.47	2.48
%	-2.4	-2.4	0.0	0.0	0.0	0.0	0.0	0.0
				CH4				
Gg	-0.072	-0.071	0.000	0.000	0.000	0.000	0.000	0.000
%	-2.0	-2.0	0.0	0.0	0.0	0.0	0.0	0.0
				N2O				
Gg	-0.107	-0.105	0.000	0.000	0.000	0.000	0.000	0.000
%	-2.8	-2.8	0.0	0.0	0.0	0.0	0.0	0.0
Changes	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
				CO2				
Gg	1.91	2.22	-27.54	-4.27	-0.39	-1.42	2.20	-4.24
%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				CH4				
Gg	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				N2O				
Gg	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Changes	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
				CO2				
Gg	-38.27	-24.41	-32.56	-38.80	-564.69	-608.84	-612.35	94.01
%	0.0	0.0	0.0	0.0	-0.3	-0.4	-0.4	0.1
				CH4				
Gg	-0.002	-0.001	-0.001	-0.002	-0.115	-0.128	-0.131	-0.152
%	-0.1	0.0	0.0	-0.1	-3.6	-3.5	-3.2	-3.4
				N2O				
Gg	0.000	0.000	0.000	0.000	-0.015	-0.017	-0.018	-0.012
%	0.0	0.0	0.0	0.0	-0.6	-0.7	-0.6	-0.4

3.2.6.6. Source-specific planned improvements

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

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

3.2.7.1. Source category description

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

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

Subsector 1.A.2.f *Other* is the largest contributor to emissions from this category (see figure 3.2.7.1) – about 34% in 2012. Subcategory 1.A.2.c *Chemicals* ranked second place in this respect (its share in total emission from 1.A.2 - over 24%).

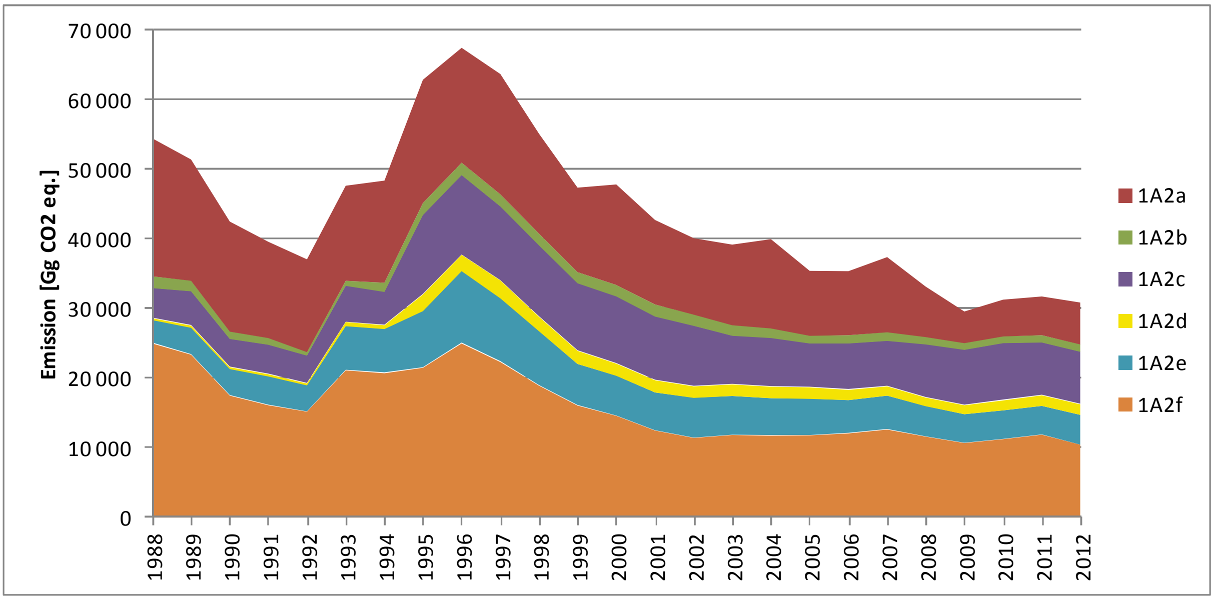

Figure 3.2.7.1. Emissions from *Manufacturing Industries and Construction* category in years 1988-2012 according to subcategories

3.2.7.2. Methodological issues

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

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

Table 3.3.7.1 shows the fuel use data in the sub-category 1.A.2.a *Iron and Steel* for the period: 1988-2012. As you can see in the table solid fuels is the dominant fuel type in that sub-category. Detailed data on fuel consumptions in 1.A.2.a subcategory for the entire period 1988-2012 was presented in Annex 2 (table 4).

Table 3.3.7.1. Fuel consumption in 1988-2012 in 1.A.2.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	18.248	15.528	11.172	7.929	5.452	4.623	3.518	2.855
Gaseous Fuels	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239
Solid Fuels	95.323	82.955	76.433	75.020	78.771	85.990	95.465	117.273
Other Fuels	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005
TOTAL	**190.236**	**165.159**	**144.535**	**123.679**	**117.288**	**120.463**	**128.241**	**147.313**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.904	5.969	1.943	2.189	1.825	0.996	0.359	0.313
Gaseous Fuels	25.898	28.278	23.993	21.440	22.024	18.328	15.463	14.827
Solid Fuels	112.053	112.843	99.056	81.393	93.750	80.051	73.111	77.078
Other Fuels	0.498	0.000	0.000	0.008	0.000	0.277	0.706	1.195
Biomass	0.006	0.004	0.006	0.004	0.003	0.006	0.003	0.004
TOTAL	**140.359**	**147.094**	**124.998**	**105.034**	**117.602**	**99.658**	**89.642**	**93.417**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	0.267	0.086	0.129	0.086	0.132	0.131	0.131	0.131
Gaseous Fuels	19.969	20.460	21.008	22.724	20.401	16.597	16.922	17.209
Solid Fuels	83.220	59.113	55.988	60.232	39.316	24.603	29.920	34.063
Other Fuels	1.654	0.965	1.015	1.313	0.000	0.000	0.000	0.000
Biomass	0.004	0.002	0.001	0.001	0.001	0.001	0.000	0.000
TOTAL	**105.114**	**80.626**	**78.141**	**84.356**	**59.850**	**41.332**	**46.973**	**51.403**
	2012							
Liquid Fuels	0.135							
Gaseous Fuels	16.906							
Solid Fuels	38.404							
Other Fuels	0.000							
Biomass	0.000							
TOTAL	**55.445**							

Blast furnaces transformation efficiency in Eurostat energy balance is very high and it is the reason, that there is too little amount of coke use in „Transformation input in Blast Furnaces” compared with real technological demand. Because of that, some part of coke, classified in *Final energy consumption – Iron and Steel* in Eurostat database (1.A.2.a IPCC subcategory) was reallocated into blast furnace input and use in C mass balance prepared in 2 IPCC sector for pig iron production.
Amounts of coke [PJ] moved from 1.A2.a to 2.C.1 subcategory for individual years were as follow:

1988	12.050	1997	62.244	2006	43.408
1989	14.549	1998	51.563	2007	51.917
1990	95.533	1999	42.349	2008	36.780
1991	64.926	2000	55.666	2009	20.151
1992	61.701	2001	47.883	2010	22.328
1993	57.678	2002	43.125	2011	24.183
1994	66.679	2003	46.532	2012	23.660
1995	68.741	2004	50.745		
1996	58.875	2005	35.144		

CO_2 emission from reallocated coke was included in emission from 2.C.1 subcategory. Emissions of CH_4 and N_2O were included in 1.A.2.a category.

Figure 3.3.7.2 shows CO_2 emissions in the 1988-2012 period. Emissions of CH_4 and N_2O in the same time period are shown in figure 3.3.7.3. Emission trends for all three gases follow closely the trends in fuel use.

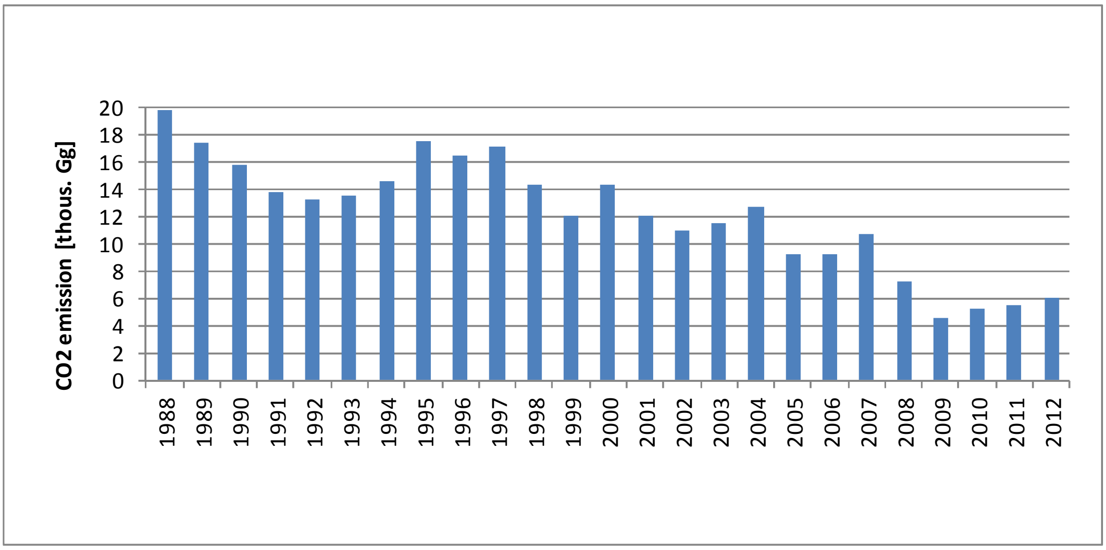

Figure 3.3.7.2. CO_2 emission for 1.A.2.a category in 1988-2012

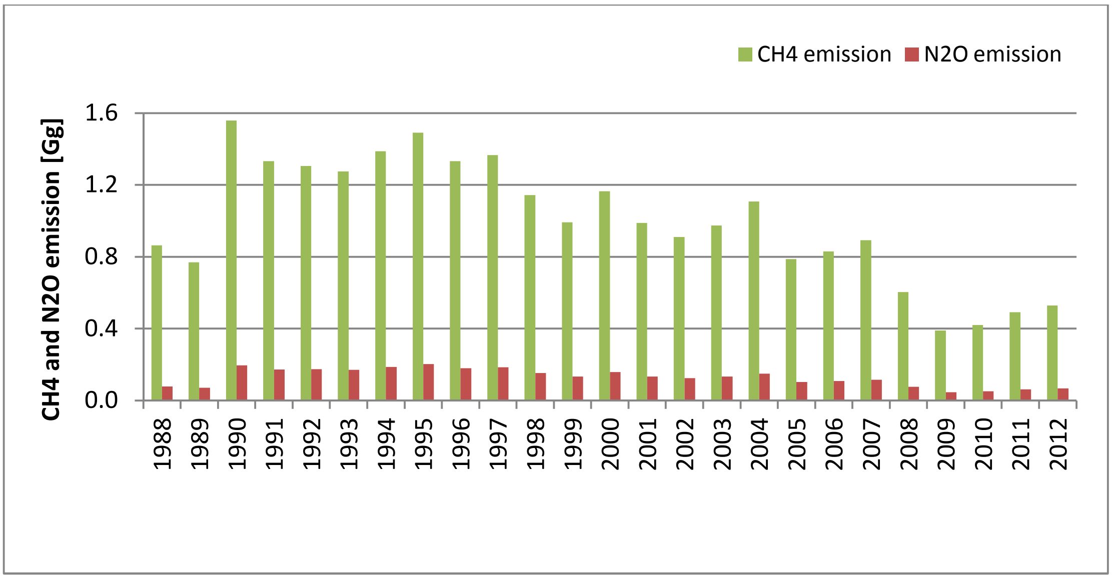

Figure 3.3.7.3. CH_4 and N_2O emissions for 1.A.2.a category in 1988-2012

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

The data on fuel type use in the sub-category 1.A.2.b *Non-Ferrous Metals* over the 1988-2012 period are presented in table 3.3.7.2. More detailed data concerning fuel consumptions was tabulated in Annex 2 (table 5).

Table 3.3.7.2. Fuel consumption in 1988-2012 in 1.A.2.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	0.683	0.803	0.803	0.843	0.929	0.846	0.929	0.892
Gaseous Fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447
Solid Fuels	12.001	10.832	6.908	5.965	3.316	4.752	8.183	10.499
Other Fuels	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000
TOTAL	**19.191**	**17.823**	**12.749**	**11.924**	**5.972**	**8.073**	**15.257**	**18.988**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	0.940	0.897	0.777	0.732	0.863	0.784	0.618	0.495
Gaseous Fuels	5.108	5.424	5.638	5.660	5.814	5.700	5.589	5.868
Solid Fuels	10.897	10.491	9.715	9.045	9.178	9.946	8.716	8.043
Other Fuels	2.411	2.361	2.164	2.070	2.268	2.551	2.739	2.539
Biomass	0.149	0.042	0.026	0.010	0.011	0.005	0.001	0.000
TOTAL	**19.505**	**19.215**	**18.320**	**17.517**	**18.134**	**18.986**	**17.663**	**16.945**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	0.658	0.618	0.618	0.378	0.378	0.378	0.380	0.338
Gaseous Fuels	6.405	6.468	6.884	6.743	6.542	5.852	6.048	6.670
Solid Fuels	7.048	5.838	6.066	7.030	6.640	6.270	6.042	6.502
Other Fuels	1.800	1.003	1.004	0.982	0.000	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL	**15.911**	**13.927**	**14.572**	**15.133**	**13.560**	**12.500**	**12.470**	**13.510**
	2012							
Liquid Fuels	0.295							
Gaseous Fuels	6.890							
Solid Fuels	6.541							
Other Fuels	0.000							
Biomass	0.000							
TOTAL	**13.726**							

Emissions of the main greenhouse gases in 1.A.2.b between the base year and 2012 are shown in figures 3.3.7.4 and 3.3.7.5.

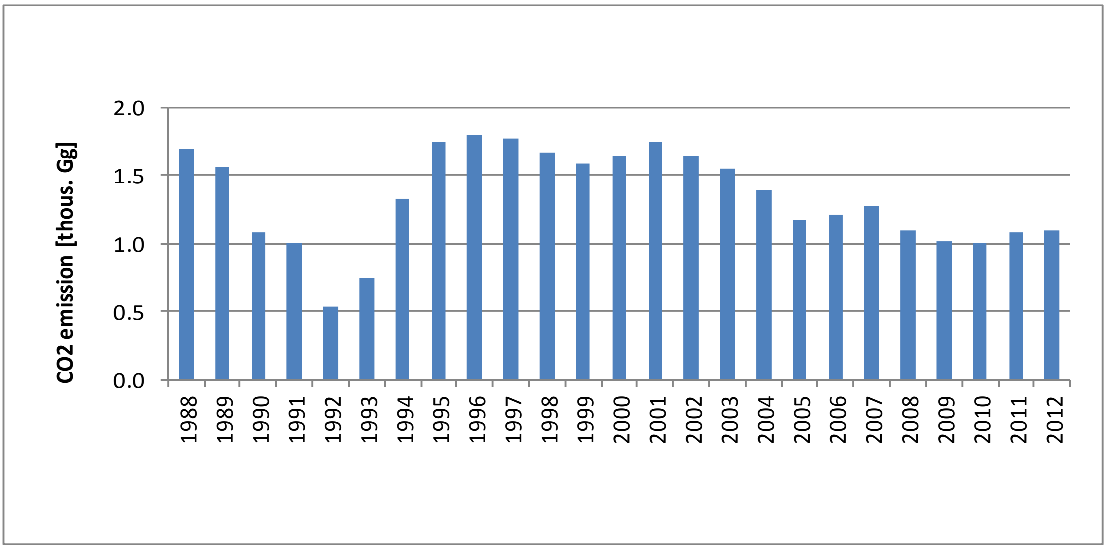

Figure 3.3.7.4. CO_2 emission for 1.A.2.b category in 1988-2012

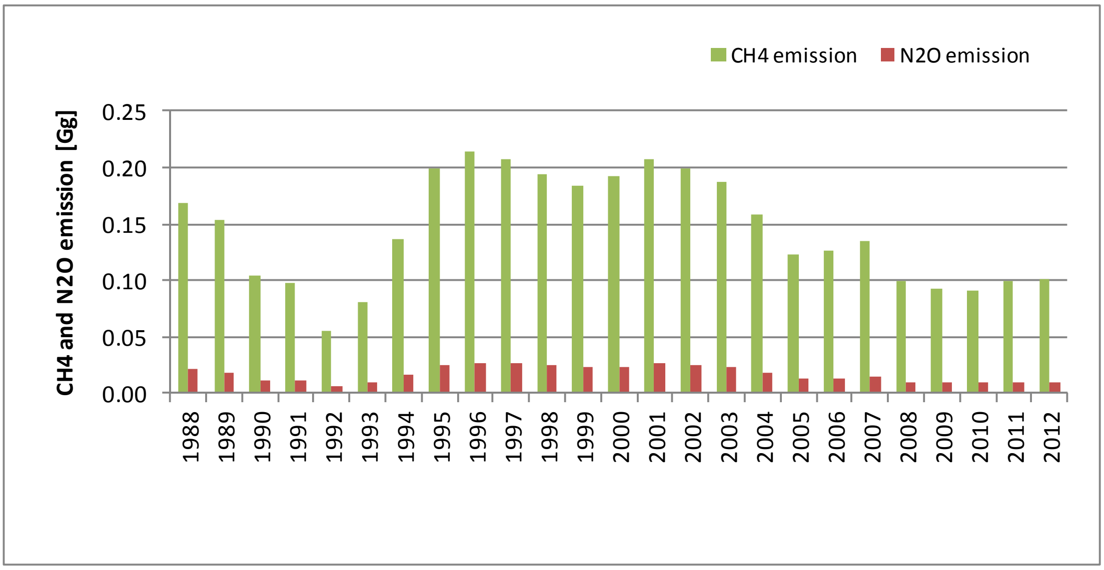

Figure 3.3.7.5. CH_4 and N_2O emissions for 1.A.2.b category in 1988-2012

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

Detailed data on fuel consumptions in 1.A.2.c subcategory for the entire period 1988-2012 was presented in Annex 2 (table 6).
The data on fuel type use in the sub-category 1.A.2.c *Chemicals* over the 1988-2012 period are presented in table 3.3.7.3.

Table 3.3.7.3. Fuel consumption in 1988-2012 in 1.A.2.c subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	14.825	13.968	4.103	6.203	8.977	7.753	4.527	10.946
Gaseous Fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356
Solid Fuels	12.407	14.986	10.896	9.351	7.008	16.738	10.312	74.948
Other Fuels	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007
TOTAL	**46.241**	**50.503**	**37.118**	**38.519**	**37.466**	**52.572**	**41.972**	**113.803**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	19.920	23.136	41.015	39.175	38.344	33.187	32.950	33.483
Gaseous Fuels	6.191	11.024	9.408	9.041	9.464	8.481	7.199	6.457
Solid Fuels	75.455	65.909	57.138	52.421	51.772	50.353	47.485	30.174
Other Fuels	17.374	14.356	9.593	9.808	10.332	10.968	10.093	9.914
Biomass	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.153
TOTAL	**118.940**	**114.425**	**117.155**	**110.445**	**109.912**	**102.989**	**97.728**	**80.181**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	33.648	26.001	29.370	29.805	23.485	26.738	22.115	20.397
Gaseous Fuels	7.498	8.104	9.053	8.771	8.037	9.762	12.043	13.755
Solid Fuels	31.215	32.175	31.194	31.381	47.901	45.428	51.159	45.954
Other Fuels	8.749	6.901	7.851	6.875	7.233	8.575	8.137	7.259
Biomass	0.102	0.165	0.000	0.121	0.000	0.058	0.058	0.053
TOTAL	**81.212**	**73.346**	**77.468**	**76.953**	**86.656**	**90.561**	**93.512**	**87.418**

	2012
Liquid Fuels	16.455
Gaseous Fuels	13.568
Solid Fuels	47.502
Other Fuels	7.748
Biomass	0.131
TOTAL	**85.404**

Figure 3.3.7.6 shows CO_2 emissions in the sub-category 1.A.2.c in the 1988-2012 period. Emissions of CH_4 and N_2O, in turn, are shown in figure 3.3.7.7.

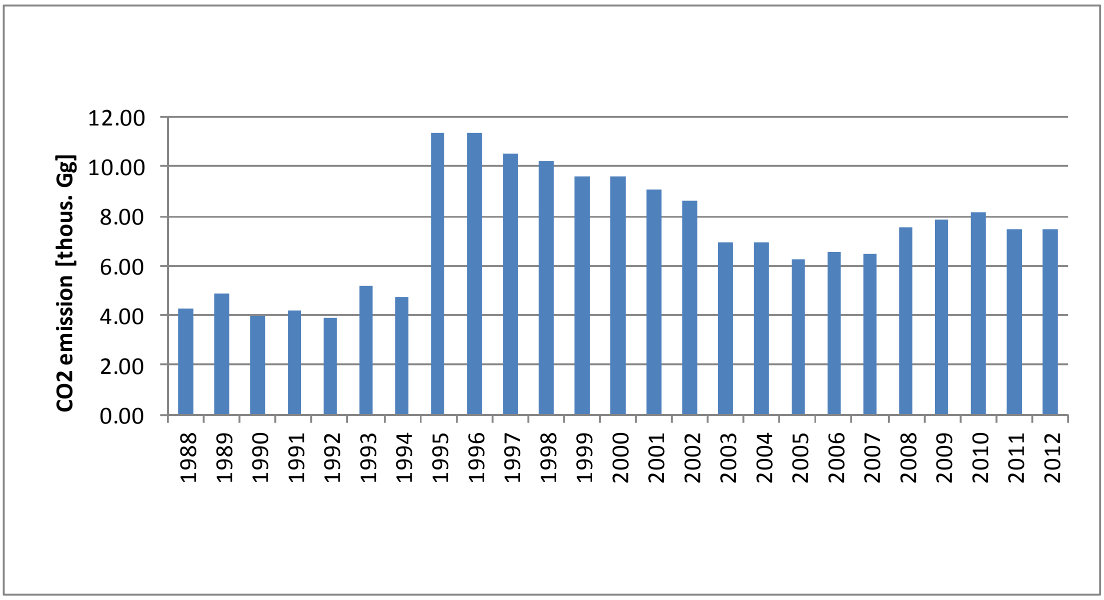

Figure 3.3.7.6. CO_2 emission for 1.A.2.c category in 1988-2012

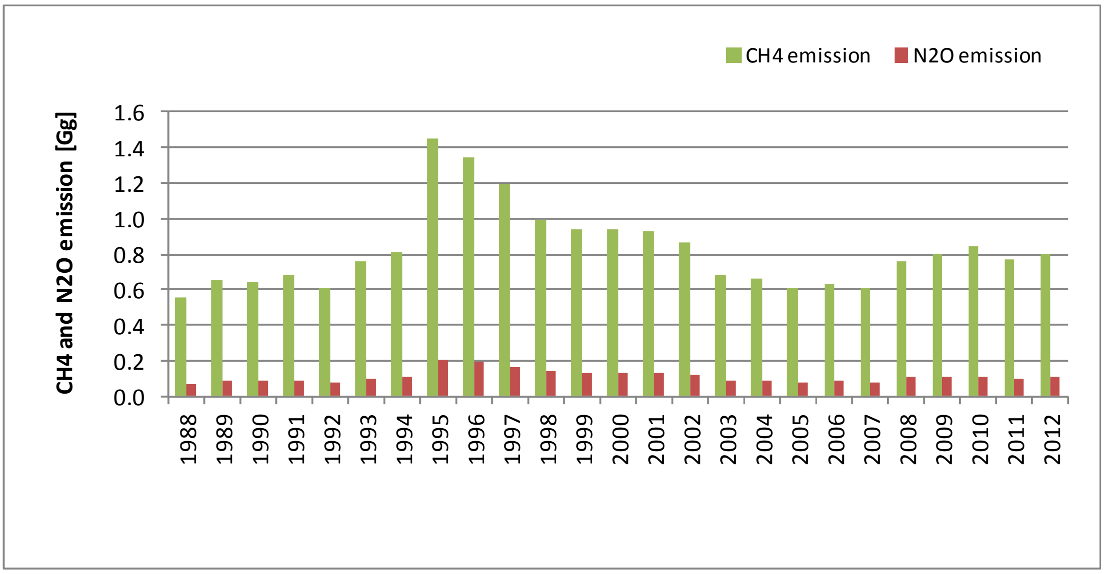

Figure 3.3.7.7. CH_4 and N_2O emissions for 1.A.2.c category in 1988-2012

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

The data on fuel type use in the sub-category 1.A.2.d *Pulp, Paper and Print* over the 1988-2012 period are presented in table 3.3.7.4. Characteristic for that sub-sector is relatively large share of biomass in the total fuel use. Detailed data on fuel consumptions in 1.A.2.d subcategory was presented in Annex 2 (table 7).

Table 3.3.7.4. Fuel consumption in 1988-2012 in 1.A.2.d subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	1.371	1.291	1.369	1.332	1.409	1.692	1.532	2.621
Gaseous Fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232
Solid Fuels	1.976	2.192	1.810	2.043	1.639	4.841	4.123	22.605
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437
TOTAL	**3.803**	**3.850**	**3.281**	**3.436**	**3.074**	**8.179**	**7.515**	**40.895**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	1.687	2.119	2.619	2.227	2.185	2.044	2.035	2.208
Gaseous Fuels	0.455	1.096	0.563	1.007	1.210	1.445	1.461	2.094
Solid Fuels	22.494	24.121	19.022	17.528	15.724	15.592	14.345	14.107
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.011	0.106	0.109
Biomass	16.243	16.472	16.476	15.545	15.938	15.138	16.622	17.950
TOTAL	**40.879**	**43.808**	**38.680**	**36.307**	**35.057**	**34.230**	**34.569**	**36.468**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	2.244	2.029	2.118	2.333	1.986	1.992	1.989	1.986
Gaseous Fuels	2.657	2.288	2.976	4.087	4.822	4.834	5.030	4.587
Solid Fuels	13.825	13.458	11.620	9.480	7.878	8.515	9.978	11.096
Other Fuels	0.150	0.125	0.123	0.118	0.137	0.155	0.158	0.169
Biomass	18.957	18.611	19.379	18.644	19.729	19.189	19.166	18.758
TOTAL	**37.833**	**36.511**	**36.216**	**34.662**	**34.552**	**34.685**	**36.321**	**36.596**
	2012							
Liquid Fuels	1.787							
Gaseous Fuels	5.535							
Solid Fuels	10.643							
Other Fuels	0.153							
Biomass	19.172							
TOTAL	**37.290**							

Figures 3.3.7.8 and 3.3.7.9 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.d in the period: 1988-2012.

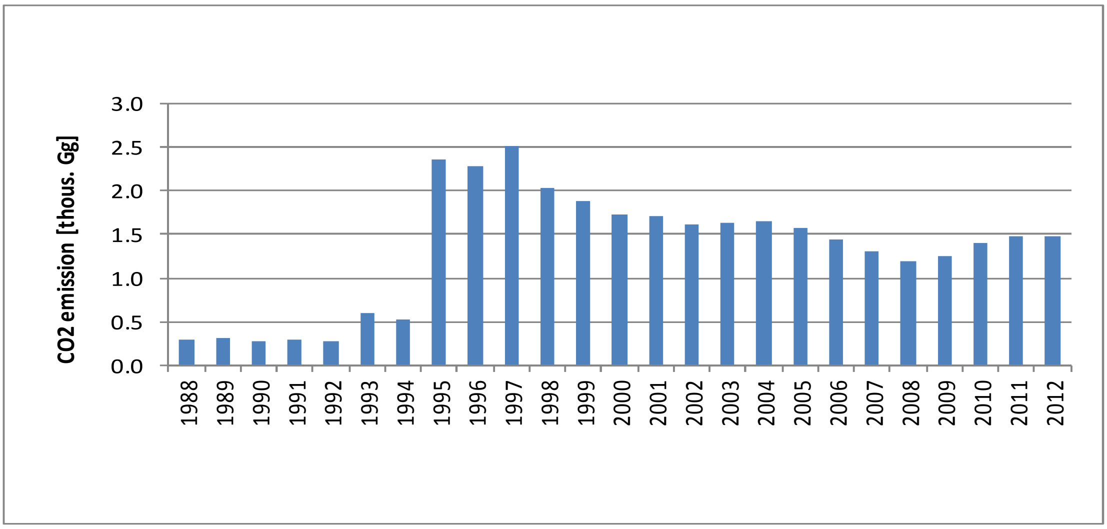

Figure 3.3.7.8. CO_2 emission for 1.A.2.d category in 1988-2012

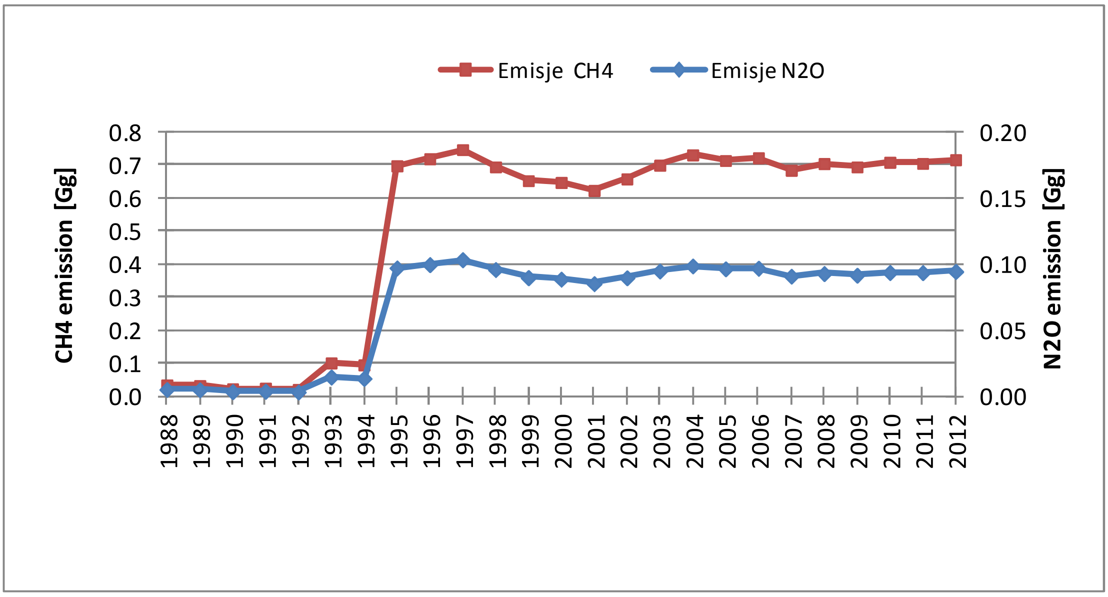

Figure 3.3.7.9. CH_4 and N_2O emissions for 1.A.2.d category in 1988-2012

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

The data on fuel type use in the sub-category 1.A.2.e *Food Processing, Beverages and Tobacco* over the 1988-2012 period are presented in table 3.3.7.5. Detailed data on fuel consumption was tabulated in Annex 2 (table 8).

Table 3.3.7.5. Fuel consumption in 1988-2012 in 1.A.2.e subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	4.413	3.484	3.065	2.646	2.402	4.707	5.219	7.425
Gaseous Fuels	1.965	1.910	1.970	1.984	2.339	3.171	7.180	3.839
Solid Fuels	29.280	35.542	35.468	39.034	35.517	59.569	56.912	75.938
Other Fuels	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082
TOTAL	**35.775**	**41.043**	**40.594**	**43.758**	**40.361**	**67.601**	**69.370**	**87.284**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	8.612	7.900	9.907	10.250	10.681	10.889	11.340	11.374
Gaseous Fuels	15.051	12.927	10.694	9.255	10.494	11.363	12.490	15.075
Solid Fuels	92.385	81.307	67.056	48.274	45.232	41.557	43.534	40.545
Other Fuels	0.000	0.000	0.000	0.000	0.001	0.014	0.000	0.000
Biomass	0.094	0.075	0.104	0.089	0.112	0.104	0.097	0.386
TOTAL	**116.142**	**102.209**	**87.761**	**67.868**	**66.520**	**63.927**	**67.461**	**67.380**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	11.022	10.036	8.665	7.801	7.561	5.583	4.987	4.502
Gaseous Fuels	16.164	17.456	18.623	20.614	20.725	20.950	21.610	22.128
Solid Fuels	37.450	36.955	31.793	32.094	27.434	26.470	26.534	26.156
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.447	0.282	0.311	0.248	0.459	0.301	0.542	0.679
TOTAL	**65.083**	**64.729**	**59.392**	**60.757**	**56.179**	**53.304**	**53.673**	**53.465**
	2012							
Liquid Fuels	5.369							
Gaseous Fuels	23.704							
Solid Fuels	26.463							
Other Fuels	0.000							
Biomass	0.651							
TOTAL	**56.187**							

Figures 3.3.7.10 and 3.3.7.11 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.e in the period: 1988-2012.

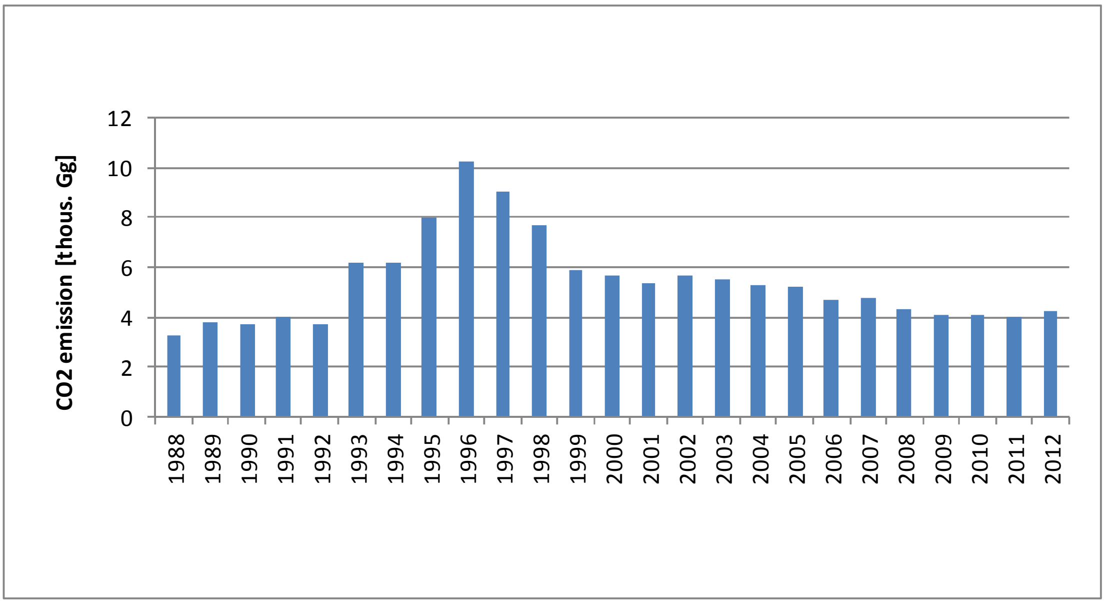

Figure 3.3.7.10. CO_2 emission for 1.A.2.e category in 1988-2012

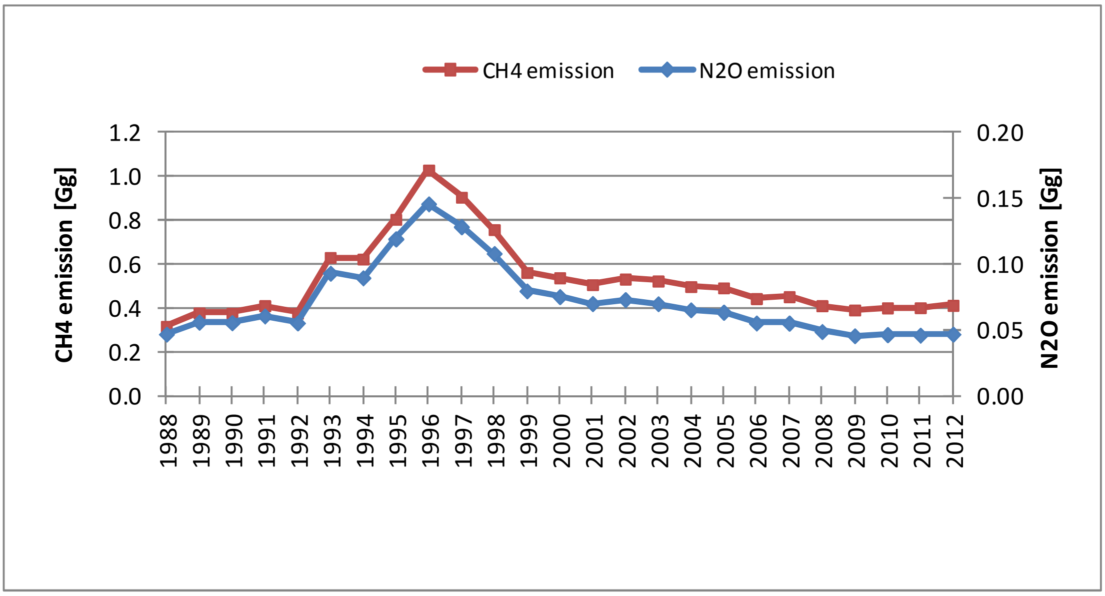

Figure 3.3.7.11. CH_4 and N_2O emissions for 1.A.2.e category in 1988-2012

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

The data on fuel type use in stationary sources in the sub-category 1.A.2.f *Other* over the 1988-2012 period are presented in table 3.3.7.6. Detailed data concerning total fuel consumption in 1.A.2.f subcategory was tabulated in Annex 2 (table 9).

Table 3.3.7.6. Fuel consumption in 1988-2012 in stationary sources of 1.A.2.f subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	27.169	25.868	18.948	15.686	15.187	17.024	17.088	22.504
Gaseous Fuels	52.767	50.455	40.219	34.461	36.058	39.907	38.844	40.694
Solid Fuels	210.395	195.448	146.242	137.808	126.087	183.864	178.464	180.009
Other Fuels	0.464	0.504	0.090	0.035	0.401	0.548	1.738	2.491
Biomass	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.980
TOTAL	**300.909**	**281.743**	**212.480**	**193.963**	**182.810**	**246.371**	**239.548**	**250.678**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	28.485	30.743	29.101	25.088	22.538	21.428	22.380	27.065
Gaseous Fuels	40.860	41.717	44.738	40.269	46.523	50.178	52.506	56.740
Solid Fuels	211.248	183.835	145.860	122.294	103.954	81.410	68.102	62.975
Other Fuels	2.819	1.180	2.300	2.045	2.624	2.337	2.595	3.987
Biomass	6.530	8.200	8.239	8.606	10.111	10.991	12.592	11.999
TOTAL	**289.942**	**265.675**	**230.238**	**198.302**	**185.750**	**166.344**	**158.175**	**162.766**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	26.322	29.281	24.142	18.738	17.935	18.663	17.663	16.371
Gaseous Fuels	60.829	62.287	65.056	66.426	66.574	64.617	68.129	68.590
Solid Fuels	62.045	56.016	55.061	67.472	56.192	41.715	44.342	50.182
Other Fuels	3.504	5.130	10.460	8.683	8.938	13.527	15.051	16.816
Biomass	12.445	12.028	11.169	13.036	14.001	14.067	17.882	21.787
TOTAL	**165.145**	**164.742**	**165.888**	**174.355**	**163.640**	**152.589**	**163.067**	**173.746**
	2012							
Liquid Fuels	12.804							
Gaseous Fuels	65.556							
Solid Fuels	39.680							
Other Fuels	16.152							
Biomass	23.440							
TOTAL	**157.632**							

Figures 3.3.7.12 and 3.3.7.13 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.2.f in the period: 1988-2012.

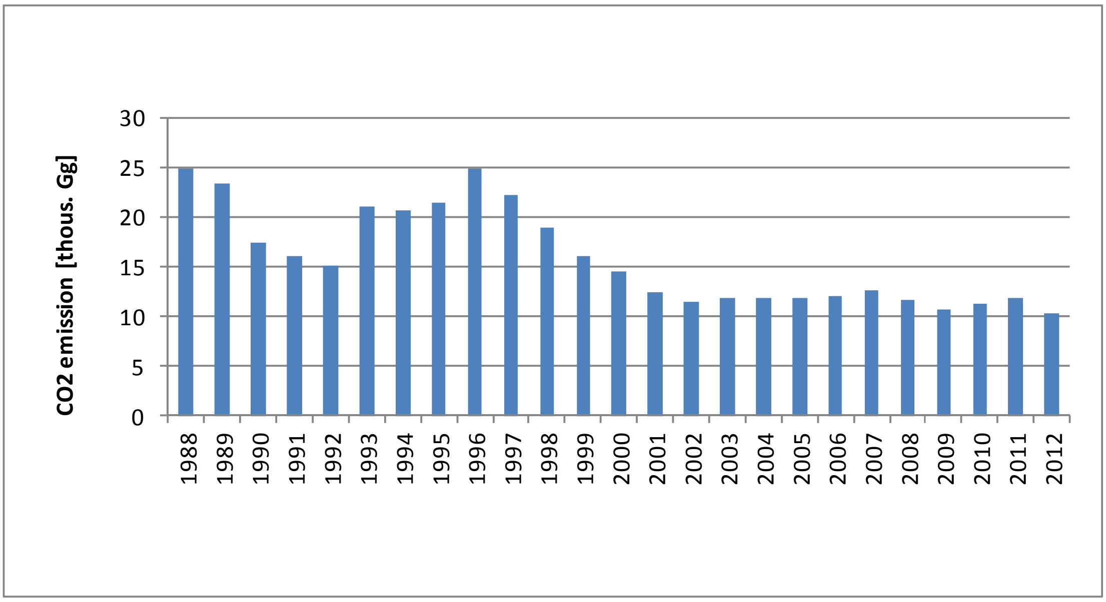

Figure 3.3.7.12. CO_2 emission from stationary sources in 1.A.2.f category in 1988-2012

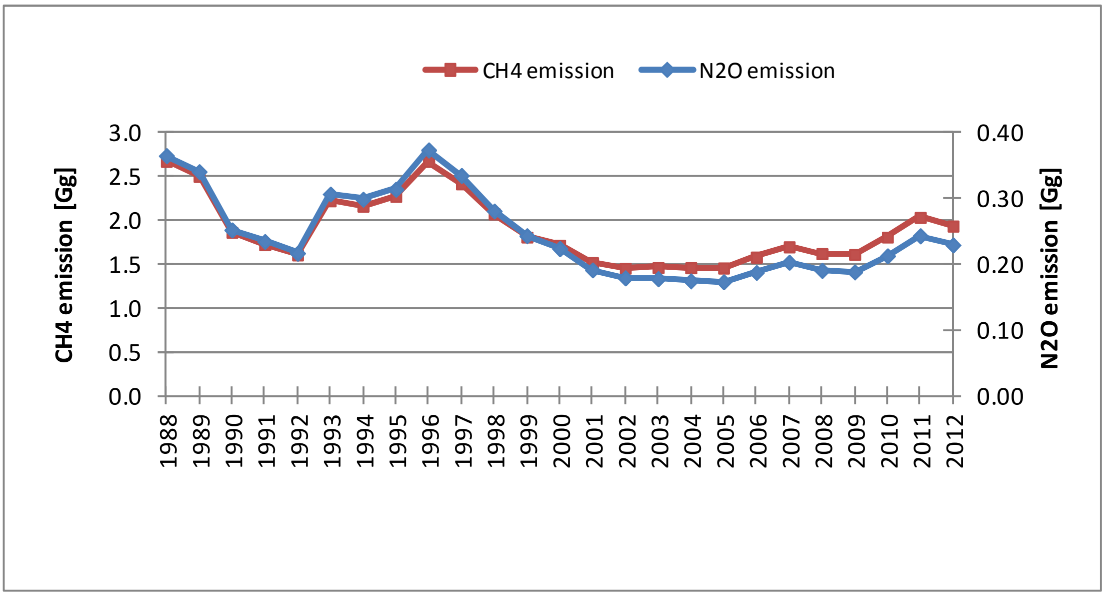

Figure 3.3.7.13. CH_4 and N_2O emissions from stationary sources in 1.A.2.f category in 1988-2012

3.2.7.3. Uncertainties and time-series consistency

See chapter 3.2.6.3.

3.2.7.4. Source-specific QA/QC and verification

See chapter 3.2.6.4.

3.2.7.5. Source-specific recalculations

- fuel consumptions for the years 1988-2011 were updated according to current IEA database and Eurostat database respectively;
- values of coke consumption was corrected for the period 1988-2011 due to reallocation part of this fuel from 1.A.2.a subcategory to the 2.C.1 category as the input into blast furnaces (mentioned reallocation concerns also transfer of CO_2 emission from 1.A.2.a to 2.C.1; emissions of CH_4 and N_2O from transferred coke were included in 1.A.2.a subcategory).
- AD and GHG emissions relating to consumption of hard coal, coke, natural gas, coke oven gas and blast furnace gas were changed for the years 2005-2011; the fuels listed above are used i.a. in iron and steel processes (i.e. in sintering plants, blast furnaces, steel plants) and consumptions of these fuels as a transformation input into mentioned processes were reported in previous inventories for the years 2005-2011 in 2.C.1 subcategory; emission from listed fuels for these years was included in 1.A.2.a category in the current inventory (except for coke added to blast furnace input, what was described in chapter 3.2.7.2.1 *Iron and steel production*).

Table. 3.2.7.7. Changes in GHG emissions in 1.A.2 subsector as a result of recalculations

Changes	1988	1989	1990	1991	1992	1993	1994	1995
				CO2				
Gg	95.24	-145.10	23.84	19.74	10.68	22.44	20.12	12.96
%	0.2	-0.3	0.1	0.1	0.0	0.0	0.0	0.0
				CH4				
Gg	0.119	0.115	0.957	0.651	0.618	0.579	0.668	0.688
%	2.6	2.6	26.5	18.0	18.4	12.9	14.7	11.1
				N2O				
Gg	0.017	0.017	0.144	0.098	0.093	0.087	0.100	0.103
%	3.0	3.0	31.2	20.5	20.8	14.3	16.3	12.0
Changes	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
				CO2				
Gg	21.44	23.75	28.12	29.24	64.67	57.89	51.75	68.98
%	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.2
				CH4				
Gg	0.590	0.624	0.518	0.426	0.562	0.484	0.435	0.471
%	8.8	10.1	9.7	9.0	12.1	11.3	10.4	11.6
				N2O				
Gg	0.089	0.094	0.078	0.064	0.084	0.073	0.065	0.071
%	9.5	11.0	10.7	10.0	13.7	12.9	11.9	13.5
Changes	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
				CO2				
Gg	73.28	1900.91	1834.81	852.88	809.57	83.43	268.21	425.17
%	0.2	5.7	5.5	2.3	2.5	0.3	0.9	1.4
				CH4				
Gg	0.514	0.511	0.590	0.576	0.387	0.181	0.216	0.267
%	12.5	13.9	15.8	14.8	10.2	4.8	5.3	6.3
				N2O				
Gg	0.077	0.074	0.088	0.085	0.059	0.027	0.032	0.040
%	14.8	16.2	19.1	17.9	12.6	5.9	6.5	7.7

3.2.7.6. Source-specific planned improvements

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

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

3.2.8.1. Source category description

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

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

Share of that sector in total GHG emission in 2012 is about 11.5%. Road transport is by far the largest contributor to transport emissions (see figure 3.2.8.1) - in year 2012 about 98%.

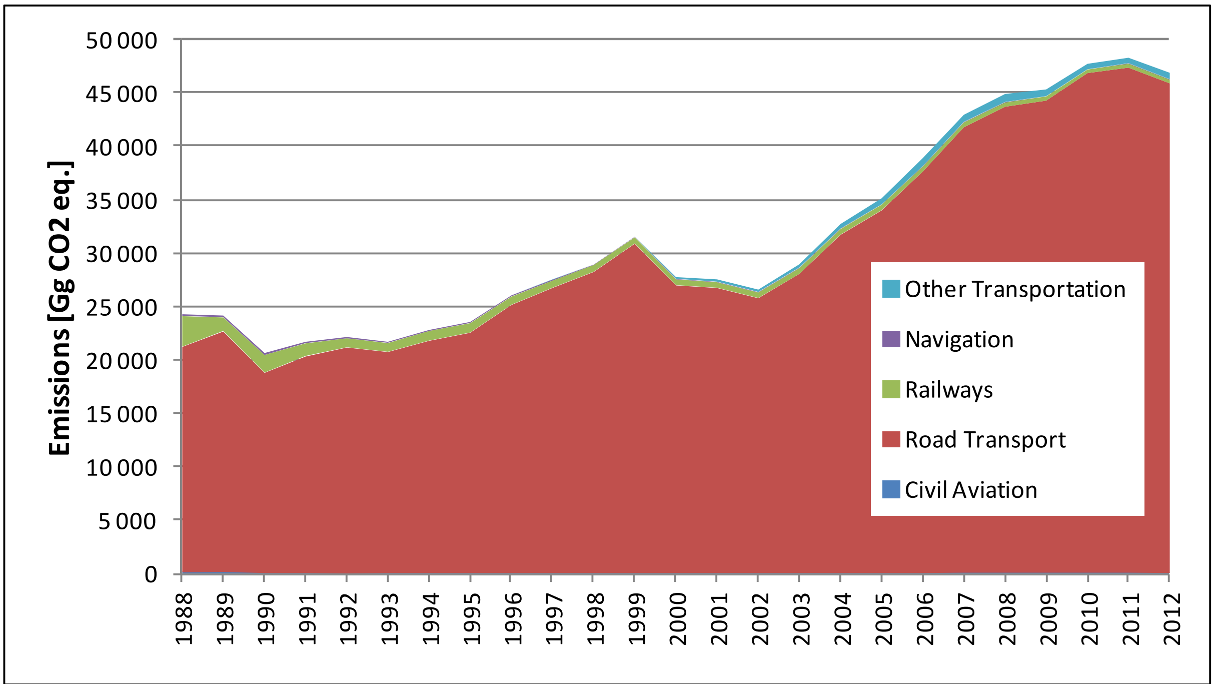

Figure 3.2.8.1. Emissions from transport in years 1988-2012

3.2.8.2. Methodological issues

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

<u>Origin of CO_2 emission factors in Road transportation</u>

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

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

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

To estimate amount of carbon in motor gasoline it was assumed by ITS that hydrogen carbon ratio is equal 1.85 [Directive 93/116]. It was taken into account that gasoline, except hydrocarbons, include:

- ethyl fluid,
- sulphur (average content in 1992 was about 0.06%),
- additives,
- oxygen (due to the addition of oxygenates).

Content of substances other than carbon and hydrogen was assumed as about 0.7% of mass. Due to this carbon content was about 88.0% of mass (99.3/13.85x12).

In 1993 and 1994 gasoline content significantly changed, e.g. the amount of oxygenates was higher. In some gasoline types oxygen content was almost 3% of mass. In this case new analyses were made. In one of Warsaw petrol stations there were taken 2 samples of each type of gasoline: E94, E98, E94EA (leaded petrol with ethyl alcohol) , B95 and B98. For each samples content of carbon and hydrogen was measured. Analyses were made in Institute of Organic Chemistry – Polish Academy of Sciences. Results of carbon content are presented below (average value from 2 samples):
E94 – 86.8%
E98 – 86.4%
E94EA – 85.2%
B95 – 85.9%
B98 – 85.3%
Weighted average carbon content in motor gasoline in 1994 is then equal 86.45%. Total error of estimation of above analysis is assumed as 0.6%, therefore the value of carbon content which was assumed in previous estimation (equal 86.0%) is in the limit of error. For that reason for all calculation the amount of 86.0% was taken.

In case of diesel oil it was assumed that hydrogen carbon ratio is equal 1.86. Taken into account that diesel oil, except hydrogen and carbon, contain also sulphur, additives, oxygen and water, it was assumed that carbon content is similar to gasoline – 86.0%.

The LPG content is constantly changing, that is why literature value was taken at 81.4%.

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

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

Origin of other emission factors

All other emission factors for mobile sources were taken from IPCC guidelines and have constant values over the entire time series 1988-2012. The values of the EFs in 2012 are those in table 3.2.8.1. Exception is N_2O emission factor from gasoline for passenger cars with catalyst, which is based on COPERT IV (following recommendation made by ERT).

Table 3.2.8.1. Emission factors [kg/GJ] for transport types (means) in 2012

Type of transport	Category code	EF CO_2	EF CH_4	EF N_2O
1.A.3.a.ii International Aviation - bunker	PL	73.26	0.0005	0.0023
1.A.3.a.ii Civil Aviation. Domestic	PL	73.26	0.0005	0.0023
	BL	72.10	0.0600	0.0009
1.A.3.b.i Passenger Cars without catalysts	α.BS	70.04	0.03	0.002
	α.LG	62.48	0.02	0.0002
	α.ON	72.43	0.002	0.004
	β.BS	70.04	0.02	0.001
1.A.3.b.i Passenger Cars with catalysts	γ.BS	69.60	0.007	0.003
	γ.LG	62.48	0.02	0.0002
	γ.ON	72.43	0.002	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t without catalysts	α.BS	70.04	0.02	0.001
	α.LG	62.48	0.03	0.0002
	α.ON	72.43	0.001	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t with catalysts	γ.BS	69.60	0.02	0.001
	γ.LG	62.48	0.01	0.0002
	γ.ON	72.43	0.001	0.004
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. without catalysts	α.ON	72.43	0.006	0.003
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. with catalysts	γ.ON	72.43	0.006	0.003
1.A.3.b.iii Buses	α.ON	72.43	0.0039	0.0013
	γ.ON	72.43	0.0039	0.0013
1.A.3.b.iv Motorcycles	BS	70.04	0.1	0.001
1.A.3.b.iv Mopeds	BS	70.04	0.1	0.001
1.A.3.b.vi Tractors	ON	72.43	0.004	0.0039
1.A.3.b - different types of vehicles	biodiesel	70.80	0.003	0.0006
1.A.3.b - different types of vehicles	bioethanol	70.80	0.003	0.0006
1.A.3.c. Railways	ON	75.00	0.005	0.0006
1.A.3.d.ii Domestic Navigation - inland	ON	73.00	0.004	0.030
1.A.3.d.ii Domestic Navigation - marine	ON	74.10	0.007	0.002
	OP	77.60	0.007	0.002
1.A.3.d.i Domestic Navigation - bunker	ON	74.10	0.007	0.002
	OP	77.60	0.007	0.002
1.A.4.c.iii Fishery	ON	74.10	0.007	0.002
	OP	77.60	0.007	0.002
1.A.4.c.ii Agriculture - Off-Road Vehicles	ON	73.00	0.004	0.0039
1.A.4.c.ii Agriculture - Machines	ON	73.00	0.004	0.030
1.A.2.f.ii Off-Road Vehicles in Industry, Other	ON	73.00	0.004	0.030
1.A.3.e.ii Other Off-Road Transport	BS	71.00	0.120	0.002
	LG	63.10	0.062	0.0002
	ON	73.00	0.004	0.0300

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

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

- Eurostat database – use of fuels (according to Energy Market Agency fuel used is equal to fuel sold) in the following sub-categories: 1.A.3.a – *Civil Aviation*, 1.A.3.b. -*Road Transportation*, 1.A.3.c – *Railways*, in part of the sub-category 1.A.3.d – *Navigation – i.e. inland water navigation*, in part of the sub-category 1.A.4.c – vehicles and machinery in agriculture, use of fuels included in the international maritime bunker,
- report of the Motor Transport Institute [ITS 2011],
- GUS G-03 reports – selected aggregated data from the energy balance statistics [GUS 2013e] – used for estimation of fuel use for part of the sub-category 1.A.3.d – *Navigation* - for maritime shipping,
- Statistical Yearbook [GUS 2013] – data on fishing used for fuel use estimation in the sub-category 1.A.4.c. iii – Fishing,
- report [ITS 2001] – data used for fuel use estimation in the sub-category 1.A.4.c. iii – Fishing.

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

This category include emissions from passenger and freight traffic that departs and arrives in the same country (commercial, private, agriculture, etc.). Exclude use of fuel at airports for ground transport, fuel for stationary combustion at airports.

Jet fuel consumption in 2012 comes from statistics. The energy balance, for the first time, indicated 'Domestic aviation' and this data has been used for calculations, what results in decreasing the emission trend. Previously it was given together with 'International aviation', therefore when assessing the amount of jet fuel used for civil aviation in years 1988-2011, it was assumed that 5% of it is used in domestic aviation. The entire amount of aviation kerosene given in the national aviation transport statistics is used in domestic aviation.

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

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

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

Emissions from aviation come from the combustion of jet fuel and aviation gasoline. Data on fuel use in domestic aviation are shown in table 3.2.8.2 and figure 3.2.8.2. Figures 3.2.8.3 and 3.2.8.4 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.a in the period 1988-2012.

Table 3.2.8.2. Fuel consumption and GHG emission in years 1988 - 2012

		1988	1989	1990	1991	1992	1993	1994	1995	1996
Aviation gasoline	TJ	879.98	836.02	352.00	220.00	88.00	176.00	440.00	308.00	176.00
Jet fuel	TJ	750.35	1032.00	462.25	477.30	518.15	516.00	522.45	563.30	662.20
CO2 emission	Gg	118.41	135.88	59.24	50.83	44.30	50.49	70.00	63.47	61.20
CH4 emission	Gg	0.053	0.051	0.021	0.013	0.006	0.011	0.027	0.019	0.011
N2O emission	Gg	0.003	0.003	0.001	0.001	0.001	0.001	0.002	0.002	0.002
		1997	1998	1999	2000	2001	2002	2003	2004	2005
Aviation gasoline	TJ	264.00	176.00	132.00	132.00	132.00	176.00	176.00	132.00	132.00
Jet fuel	TJ	593.40	604.15	539.65	574.05	565.45	554.70	599.85	589.10	668.65
CO2 emission	Gg	62.50	56.95	49.05	51.57	50.94	53.32	56.63	52.67	58.50
CH4 emission	Gg	0.016	0.011	0.008	0.008	0.008	0.011	0.011	0.008	0.008
N2O emission	Gg	0.002	0.002	0.001	0.001	0.001	0.001	0.002	0.001	0.002
		2006	2007	2008	2009	2010	2011	2012		
Aviation gasoline	TJ	132.00	176.00	132.00	176.00	176.00	220.00	220.00		
Jet fuel	TJ	892.25	928.80	1115.85	1010.50	1064.25	1042.75	559.00		
CO2 emission	Gg	74.88	80.73	91.26	86.71	90.65	92.25	56.81		
CH4 emission	Gg	0.008	0.011	0.008	0.011	0.011	0.014	0.013		
N2O emission	Gg	0.002	0.002	0.003	0.003	0.003	0.003	0.001		

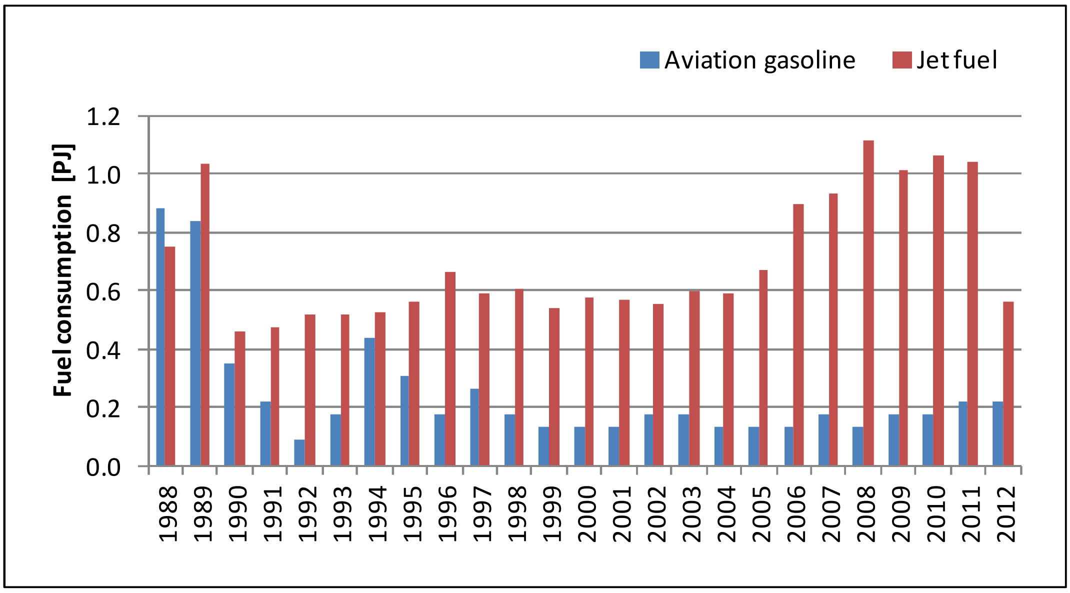

Figure 3.2.8.2. Fuel consumption in 1.A.3.a category for 1988-2012

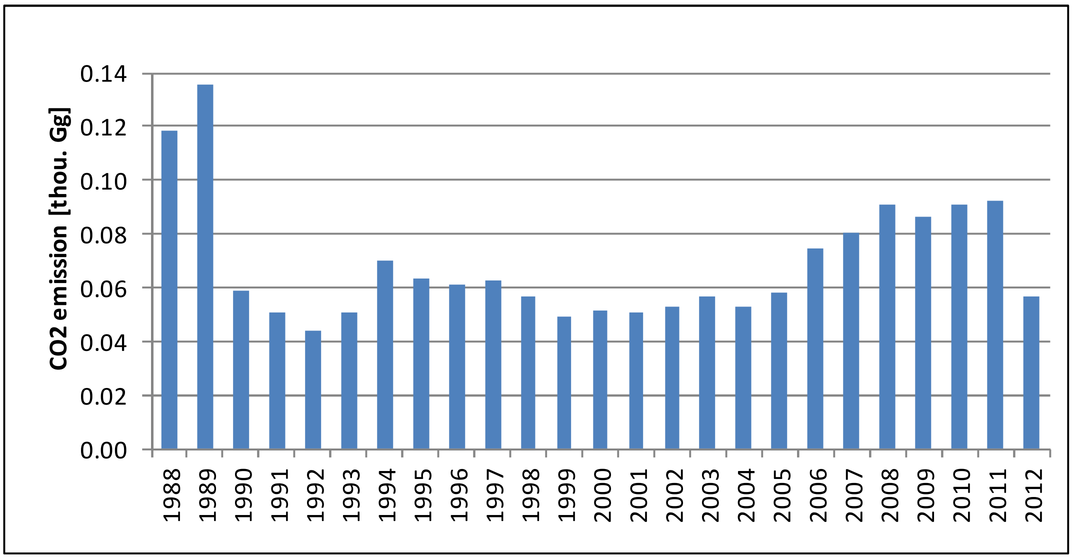

Figure 3.2.8.3. CO_2 emission for 1.A.3.a category in 1988-2012

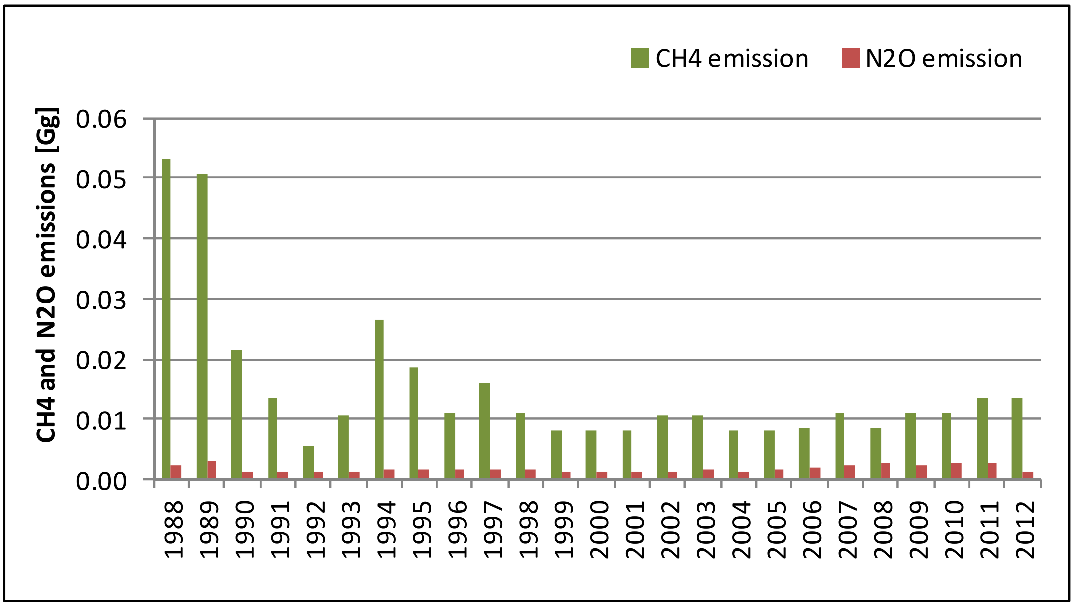

Figure 3.2.8.4. CH_4 and N_2O emissions for 1.A.3.a category in 1988-2012

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

Emission estimates from this category are based on fuel consumed by different vehicle types – including passenger cars, light and heavy duty vehicles, buses, tractors, motorcycles and mopeds. Data on fuel consumption for years 1990-2012 comes from Eurostat database, and for years 1988-1989 from IEA. Consumption of each type of fuel (used in road transport) in statistics is given without distinguishing on individual vehicle type. Therefore, for the purpose of this report fuel consumption was disaggregated based on ITS report [ITS 2011]. Table 3.2.8.3 shows fuel consumption and GHG emissions in 2012 by vehicle categories.

Table 3.2.8.3. Fuel consumption and GHG emissions in 2012 by vehicle categories.

Vehicle category	Oznaczenie paliwa	Ilość zużytego paliwa [TJ]	Emisja CO_2 [Gg]	Emisja CH_4 [Gg]	Emisja N_2O [Gg]
1.A.3.b.i Passenger Cars without catalysts	α.BS	15 990	1120.05	0.480	0.032
	α.LPG	10 627	663.91	0.213	0.002
	α.ON	13 692	991.72	0.027	0.055
	β.BS	81	5.70	0.002	0.000
1.A.3.b.i Passenger Cars with catalysts	γ.BS	126 051	8773.54	0.882	0.378
	γ.LPG	52 357	3271.08	1.047	0.010
	γ.ON	107 327	7773.44	0.215	0.429
1.A.3.b.ii Light Duty Vehicles < 3.5 t without catalysts	α.BS	2 482	173.85	0.050	0.002
	α.LPG	1 024	63.95	0.031	0.000
	α.ON	7 257	525.63	0.007	0.029
	β.BS	0	0.00	0.000	0.000
1.A.3.b.ii Light Duty Vehicles < 3.5 t with catalysts	γ.BS	14 037	977.04	0.281	0.014
	γ.LPG	9 869	616.59	0.099	0.002
	γ.ON	62 876	4553.98	0.063	0.252
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. without catalysts	α.BS	0	0.00	0.000	0.000
	α.ON	43 984	3185.66	0.264	0.132
	β.ON	0	0.00	0.000	0.000
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. with catalysts	γ.ON	132 712	9612.02	0.796	0.398
1.A.3.b.iii Buses	α.ON	7 226	523.38	0.028	0.009
	γ.ON	17 332	1255.34	0.068	0.023
1.A.3.b.iv Motorcycles	BS	1 017	71.25	0.102	0.001
1.A.3.b.iv Mopeds	BS	366	25.65	0.037	0.000
1.A.3.b.vi Tractors	ON	12 973	939.57	0.052	0.051

catalyst - catalytic converter; BS - motor gasoline; ON - diesel oil; LG – liquid gas; α – 4-stroke, old generation; β - 2-stroke, old generation; γ – new generation (Euro).

The amount of vehicles according to categories in 2012 [GUS T 2013] is given in table below.

Table 3.2.8.4. Amount of vehicles according to categories in 2012

Category	Amount [thous. pcs.]
Passenger cars	18 744
Trucks	2 921
Buses	100
Motorcycles	1 107
Tractors	1 595

Consumption of main fuels in road transport (gasoline. diesel oil and LPG) and GHG emissions in 1988-2012 period is shown in table 3.2.8.5.

Table 3.2.8.5. Fuel consumption and GHG emission in years 1988 - 2012

		1988	1989	1990	1991	1992	1993	1994	1995	1996
Motor gasoline	PJ	130.33	144.36	136.14	158.81	168.42	172.06	190.42	193.03	201.78
Diesel oil	PJ	155.40	161.03	117.85	116.77	118.15	107.85	101.42	104.89	136.47
LPG	PJ	0	0	0	0	0	1.10	3.27	8.10	11.64
Biodiesel	PJ	0	0	0	0	0	0	0	0	0
Bioethanol	PJ	0	0	0	0	0	0	0	0	0
CO2 emission	Gg	20 771	22 179	18 429	19 961	20 776	20 356	21 354	22 108	24 683
CH4 emission	Gg	4.580	5.014	4.549	5.198	5.433	5.550	6.109	6.049	6.177
N2O emission	Gg	0.713	0.755	0.603	0.637	0.662	0.646	0.676	0.712	0.855
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Motor gasoline	PJ	217.90	222.17	247.13	222.70	206.63	189.21	180.72	183.46	177.09
Diesel oil	PJ	139.25	155.34	162.08	134.79	140.58	134.84	164.18	200.99	229.82
LPG	PJ	15.46	16.10	21.48	19.55	26.96	38.13	49.22	61.69	71.25
Biodiesel	PJ	0	0	0	0	0	0	0	0	0.65
Bioethanol	PJ	0	0	0	0	0	0	1.18	0.56	1.42
CO2 emission	Gg	26 234	27 717	30 341	26 519	26 274	25 346	27 570	31 203	33 436
CH4 emission	Gg	6.130	5.655	6.032	4.566	4.384	4.269	4.386	4.780	4.610
N2O emission	Gg	0.922	1.014	1.108	0.967	0.949	0.894	0.975	1.111	1.206
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
Motor gasoline	PJ	181.62	181.40	179.20	179.42	177.27	167.66	160.03		
Diesel oil	PJ	268.77	323.21	352.55	362.59	399.10	417.63	405.38		
LPG	PJ	78.20	80.50	79.07	76.04	76.36	73.97	73.88		
Biodiesel	PJ	1.46	1.02	12.88	19.58	29.22	31.60	28.01		
Bioethanol	PJ	2.31	3.00	5.31	8.15	7.90	7.48	6.45		
CO2 emission	Gg	37 008	41 076	42 957	43 511	46 025	46 548	45 123		
CH4 emission	Gg	4.956	5.036	5.043	4.989	5.073	4.994	4.845		
N2O emission	Gg	1.351	1.548	1.666	1.731	1.868	1.906	1.841		

The decrease in fuel consumption (especially petrol and LPG) for road transport in recent years may be due to the economic downturn, rising of fuel prices and rationalization of transportation by transport companies. There is a growing trend of consumption of biofuels in road transport – shere in 2012 was about 5%. Amounts of biofuels used in years 2005 - 2011 are given in table 3.1.8.3. 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.

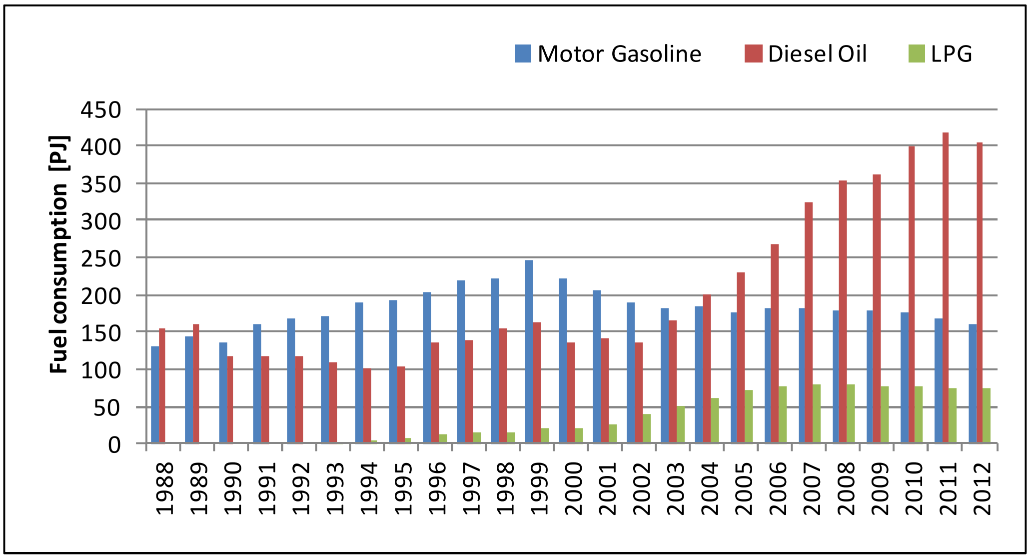

Figure 3.2.8.5. Fuel consumption in 1.A.3.b category for 1988-2012

Figure 3.2.8.6 shows CO_2 emissions in sub-category 1.A.3.b in period 1988-2012. Emissions of CH_4 and N_2O in the same sub-category are shown in figure 3.2.8.7.

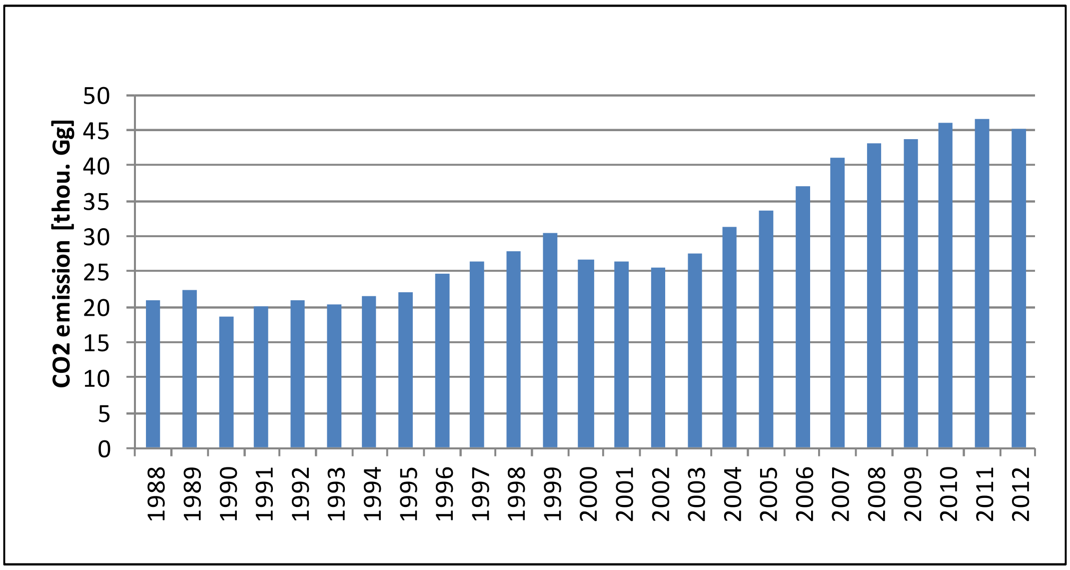

Figure 3.2.8.6. CO_2 emission for 1.A.3.b category in 1988-2012

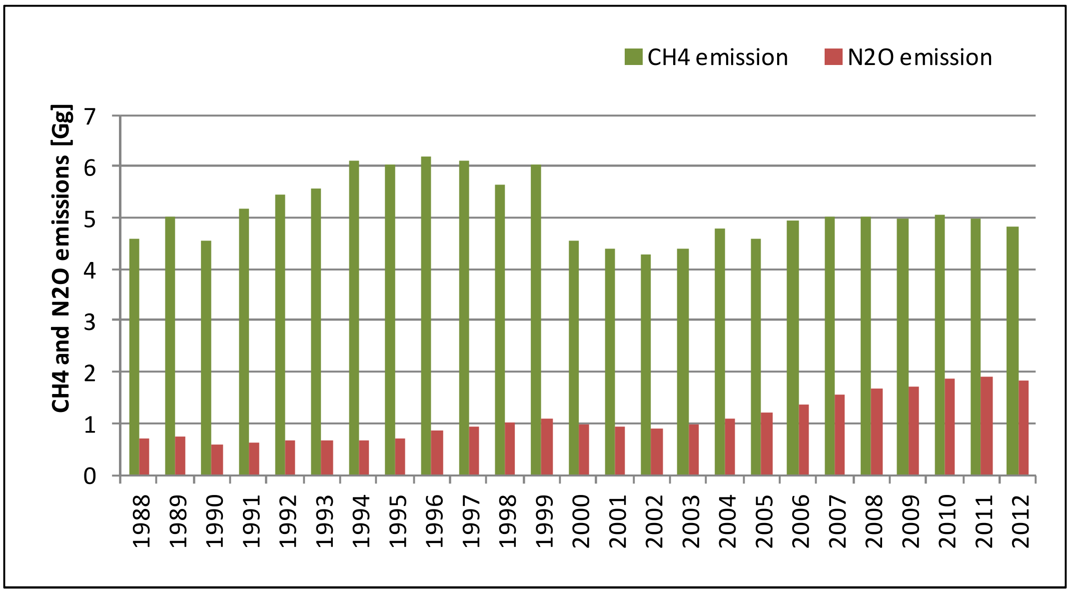

Figure 3.2.8.7. CH_4 and N_2O emissions for 1.A.3.b category in 1988-2012

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

Category include emissions from railway transport for both freight and passenger traffic routes. Railway locomotives used in Poland are diesel and electric. Up to year 1998 coal was used in steam locomotives. Electric locomotives are powered by electricity generated at stationary power plants as well as other sources. The corresponding emissions are covered under the Stationary Combustion sector. The amounts of fuels used in railway transport in the 1988-2012 period are shown table 3.2.8.6 and in figure 3.2.8.8.

Table 3.2.8.6. Fuel consumption and GHG emission in years 1988 - 2012

		1988	1989	1990	1991	1992	1993	1994	1995	1996
Hard coal	TJ	10 972	5 785	3 169	1 686	350	293	156	132	192
Diesel oil	TJ	23 600	9 585	17 761	13 556	10 596	10 425	11 798	11 497	9 652
CO2 emission	Gg	2 829	1 277	1 638	1 179	828	810	900	875	742
CH4 emission	Gg	0.228	0.106	0.120	0.085	0.056	0.055	0.061	0.059	0.050
N2O emission	Gg	0.030	0.014	0.015	0.010	0.007	0.007	0.007	0.007	0.006
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Hard coal	TJ	181	138	0	0	0	0	0	0	0
Diesel oil	TJ	8 666	8 151	7 722	7 078	6 907	6 564	6 907	6 907	6 778
CO2 emission	Gg	667	625	579	531	518	492	518	518	508
CH4 emission	Gg	0.045	0.042	0.039	0.035	0.035	0.033	0.035	0.035	0.034
N2O emission	Gg	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004	0.004
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
Hard coal	TJ	0	0	0	0	0	0	0		
Diesel oil	TJ	6 220	6 135	5 362	5 148	4 762	4 934	4 673		
CO2 emission	Gg	467	460	402	386	357	370	350		
CH4 emission	Gg	0.031	0.031	0.027	0.026	0.024	0.025	0.023		
N2O emission	Gg	0.004	0.004	0.003	0.003	0.003	0.003	0.003		

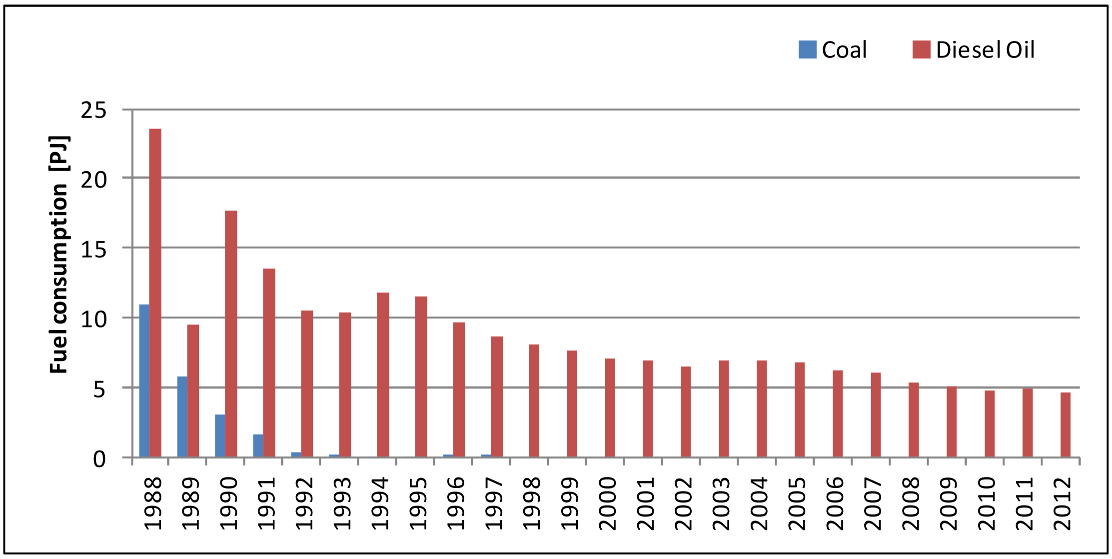

Figure 3.2.8.8. Fuel consumption in 1.A.3.c category for 1988-2012

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

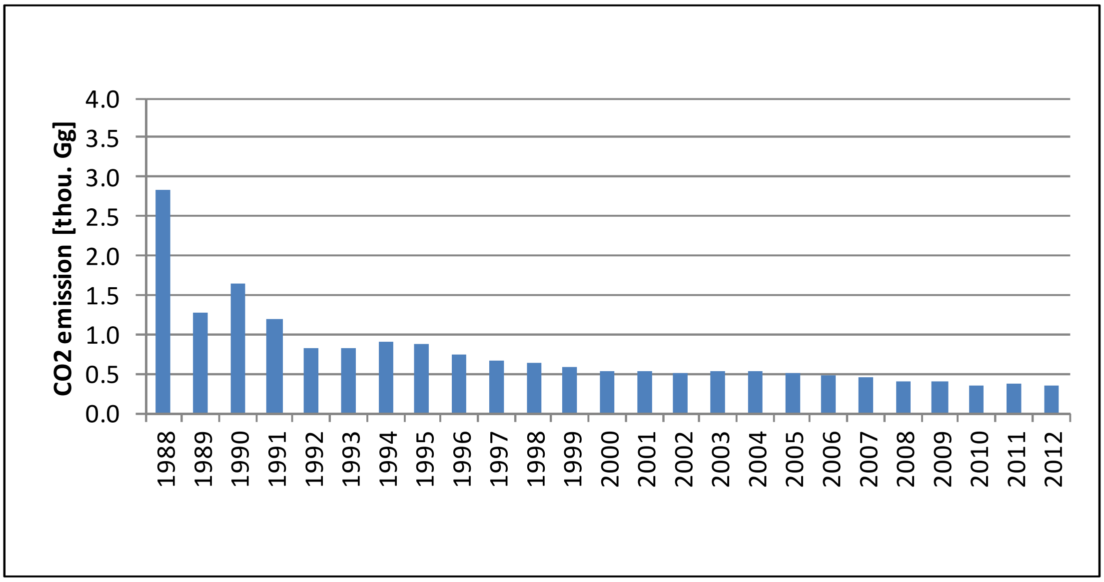

Figure 3.2.8.9. CO_2 emission for 1.A.3.c category in 1988-2012

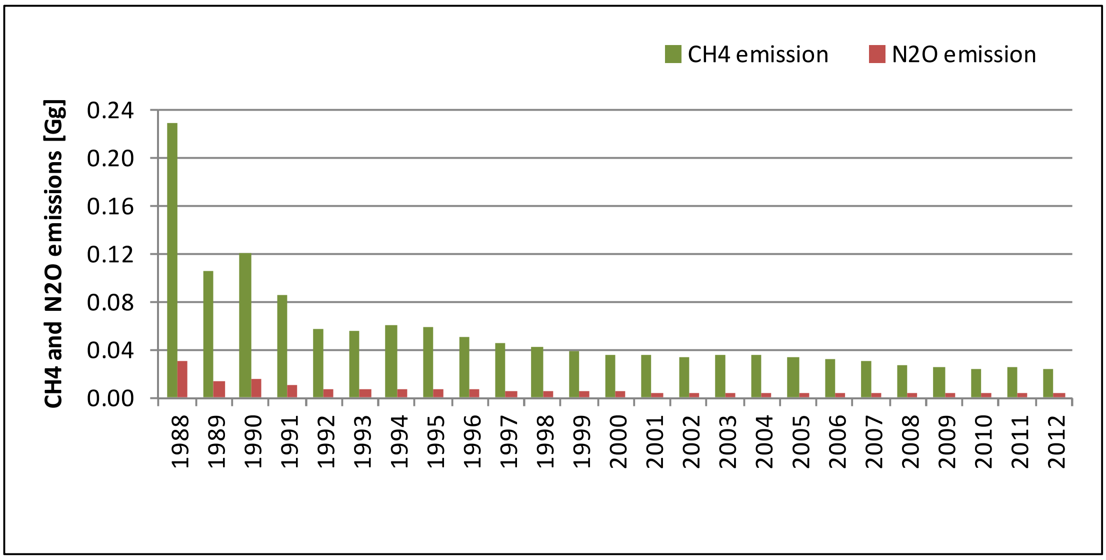

Figure 3.2.8.10. CH_4 and N_2O emissions for 1.A.3.c category in 1988-2012

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

Category relates to inland and marine domestic navigation and include emissions from fuels used by vessels of all flags that depart and arrive in the same country. Exclude fishing, which should be reported under 1 A 4 c iii.

The structure of fuels used in Navigation has been recalculated based on G-03 questionnaires and statistical data on levels of international vs. domestic shipping activity. The amounts of fuels (diesel and fuel oil) used in both inland water and maritime navigation in the 1988-2012 period are shown in table 3.2.8.7 and figure 3.2.8.11.

Table 3.2.8.7. Fuel consumption and GHG emission in years 1988 - 2012

		1988	1989	1990	1991	1992	1993	1994	1995	1996
Diesel oil-inland navigation	TJ	968.83	681.61	858.00	686.00	815.00	686.00	300.00	686.00	686.00
Diesel oil - maritime	TJ	239.59	236.54	232.96	183.59	119.30	82.08	97.98	93.40	72.68
Fuel oil - maritime	TJ	894.34	878.75	900.55	825.50	546.35	340.58	425.53	428.31	399.10
CO2 emission	Gg	157.88	135.48	149.78	127.74	110.73	82.59	62.18	90.24	86.43
CH4 emission	Gg	0.012	0.011	0.011	0.010	0.008	0.006	0.005	0.006	0.006
N2O emission	Gg	0.031	0.023	0.028	0.023	0.026	0.021	0.010	0.022	0.022
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Diesel oil-inland navigation	TJ	644.00	386.00	300.00	257.00	257.00	214.00	300.00	257.00	214.00
Diesel oil - maritime	TJ	27.93	27.25	25.20	24.52	19.76	19.60	31.67	22.84	30.42
Fuel oil - maritime	TJ	127.94	156.91	142.74	138.76	133.80	133.37	182.04	85.41	60.55
CO2 emission	Gg	59.01	42.37	34.84	31.35	30.61	27.42	38.37	27.08	22.57
CH4 emission	Gg	0.004	0.003	0.002	0.002	0.002	0.002	0.003	0.002	0.001
N2O emission	Gg	0.020	0.012	0.009	0.008	0.008	0.007	0.009	0.008	0.007
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
Diesel oil-inland navigation	TJ	257.00	214.00	214.00	129.00	0.00	129.00	131.00		
Diesel oil - maritime	TJ	31.48	24.15	26.70	16.49	9.22	10.46	10.14		
Fuel oil - maritime	TJ	80.26	65.28	63.97	38.21	12.78	14.79	11.06		
CO2 emission	Gg	27.32	22.48	22.56	13.60	1.68	11.34	11.17		
CH4 emission	Gg	0.002	0.001	0.001	0.001	0.000	0.001	0.001		
N2O emission	Gg	0.008	0.007	0.007	0.004	0.000	0.004	0.004		

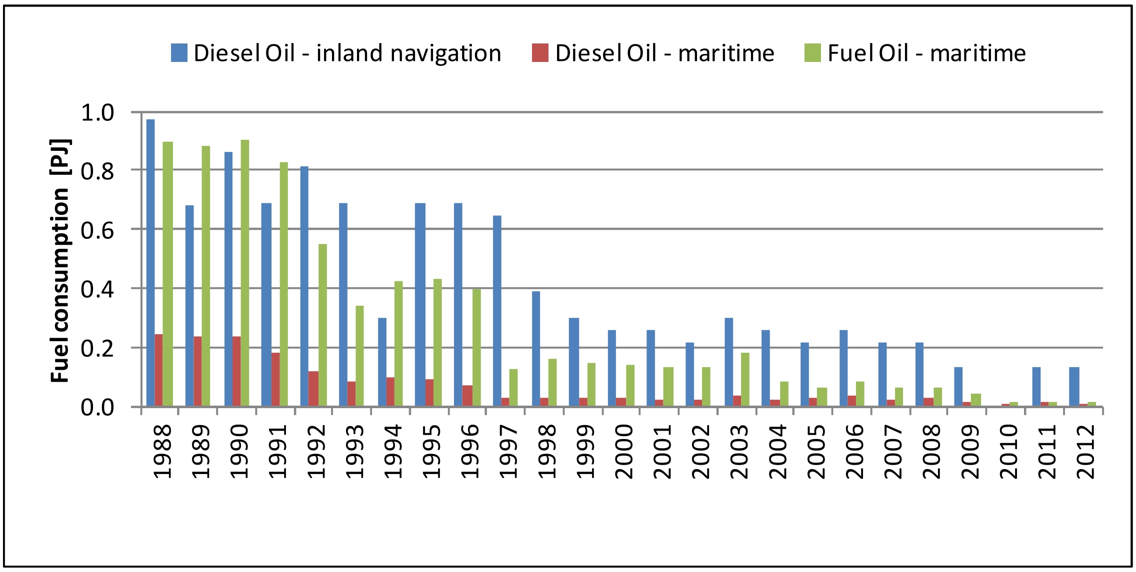

Figure 3.2.8.11. Fuel consumption in 1.A.3.d category for 1988-2012

Figures 3.2.8.12 and 3.2.8.13 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.3.d for the entire time series 1988-2012.

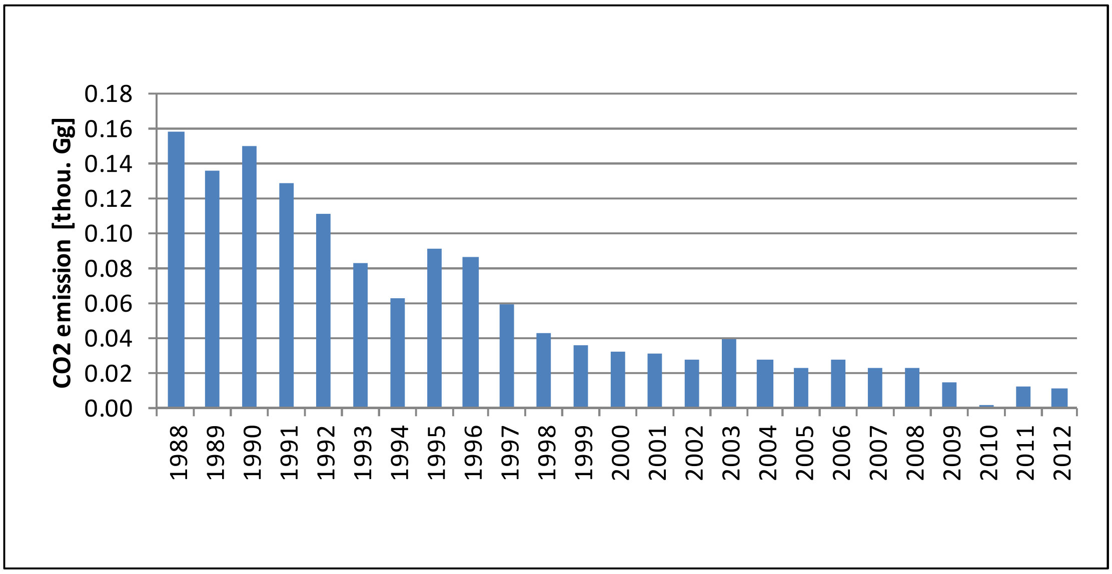

Figure 3.2.8.12. CO_2 emission for 1.A.3.d category in 1988-2012

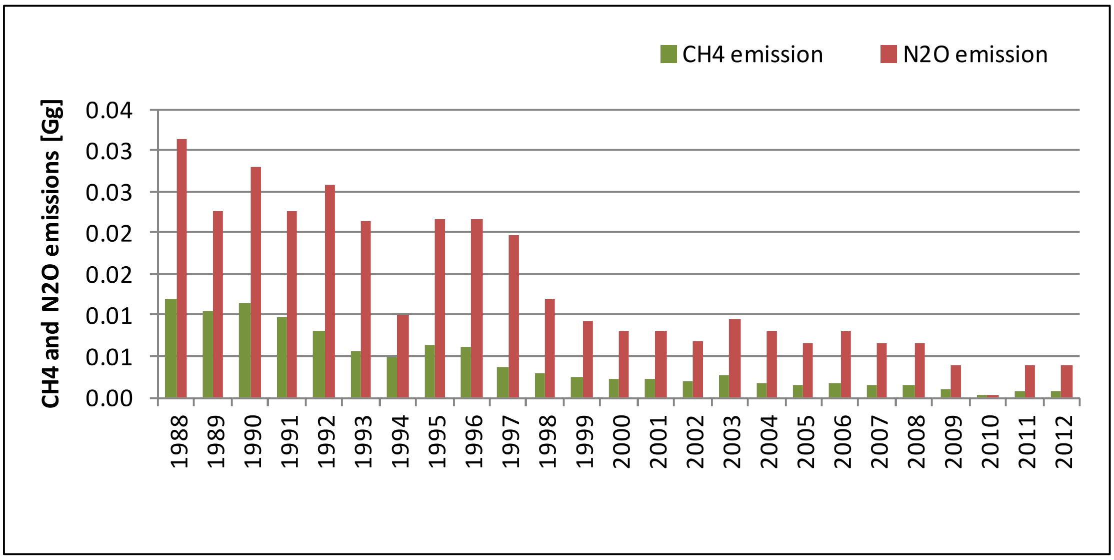

Figure 3.2.8.13. CH_4 and N_2O emissions for 1.A.3.d category in 1988-2012

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

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

The amounts of fuels consumption in the sub-category 1.A.3.e.i. *Pipelines transport* in the 1988-2012 period are shown in table 3.2.8.8 Natural gas consumption is shown on figure 3.2.8.14.

Table 3.2.8.8. Fuel consumption and GHG emission in years 1988 - 2012

		1988	1989	1990	1991	1992	1993	1994	1995	1996
Gasoline	TJ	0	0	0	0	0	0	0	0	0
Diesel oil	TJ	0	0	0	0	0	0	0	0	0
Natural gas	TJ	0	0	0	0	0	0	1	7	24
CO2 emission	Gg	0	0	0	0	0	0	0.06	0.39	1.34
CH4 emission	Mg	0	0	0	0	0	0	0.001	0.007	0.024
N2O emission	Mg	0	0	0	0	0	0	0.0001	0.001	0.002
		1997	1998	1999	2000	2001	2002	2003	2004	2005
Gasoline	TJ	0	0	0	0	45	45	45	45	45
Diesel oil	TJ	0	0	0	43	43	0	43	43	43
Natural gas	TJ	26	23	21	2 498	3 262	3 502	5 257	7 381	9 866
CO2 emission	Gg	1.45	1.28	1.17	142.59	188.32	198.57	299.68	418.24	556.96
CH4 emission	Mg	0.026	0.023	0.021	2.627	3.526	3.637	5.521	7.645	10.130
N2O emission	Mg	0.003	0.002	0.002	0.276	0.379	0.377	0.579	0.791	1.039
		2006	2007	2008	2009	2010	2011	2012		
Gasoline	TJ	0	45	0	45	0	0	0		
Diesel oil	TJ	43	43	43	43	43	43	44		
Natural gas	TJ	12 912	11 828	13 442	11 084	9 269	9 299	10 806		
CO2 emission	Gg	723.89	666.47	742.79	619.04	513.43	522.22	606.41		
CH4 emission	Mg	13.041	12.092	13.571	11.348	9.398	9.428	10.938		
N2O emission	Mg	1.317	1.236	1.370	1.161	0.953	0.956	1.107		

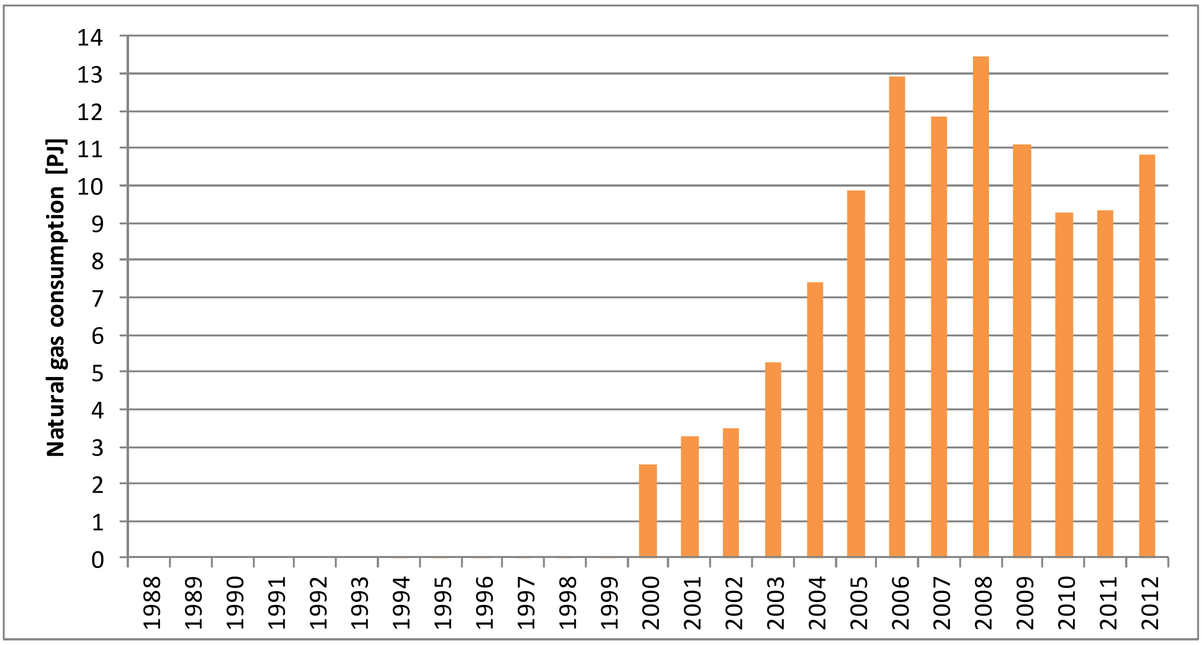

Figure 3.1.8.14. Natural gas consumption in *Pipelines transport* category for 1988-2012

Figures 3.2.8.15 and 3.2.8.16 show respectively emissions of CO_2, CH_4 and N_2O, in the sub-category 1.A.3.e from Pipelines for the entire time series 1988-2012.

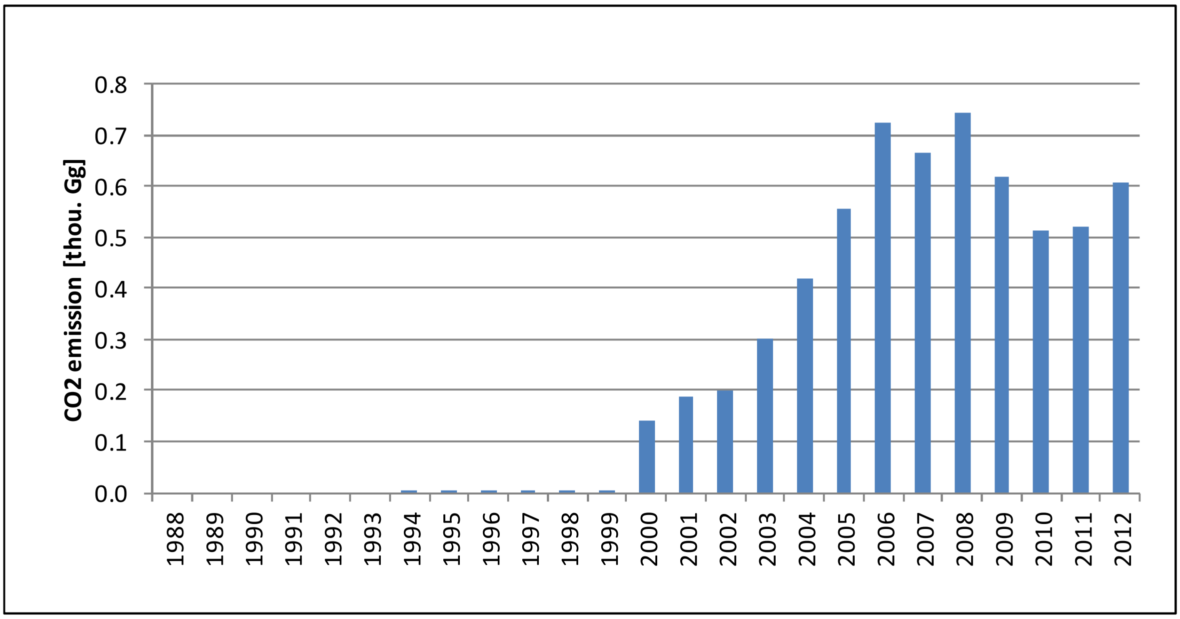

Figure 3.2.8.16. CO_2 emission from Pipelines category in 1988-2012

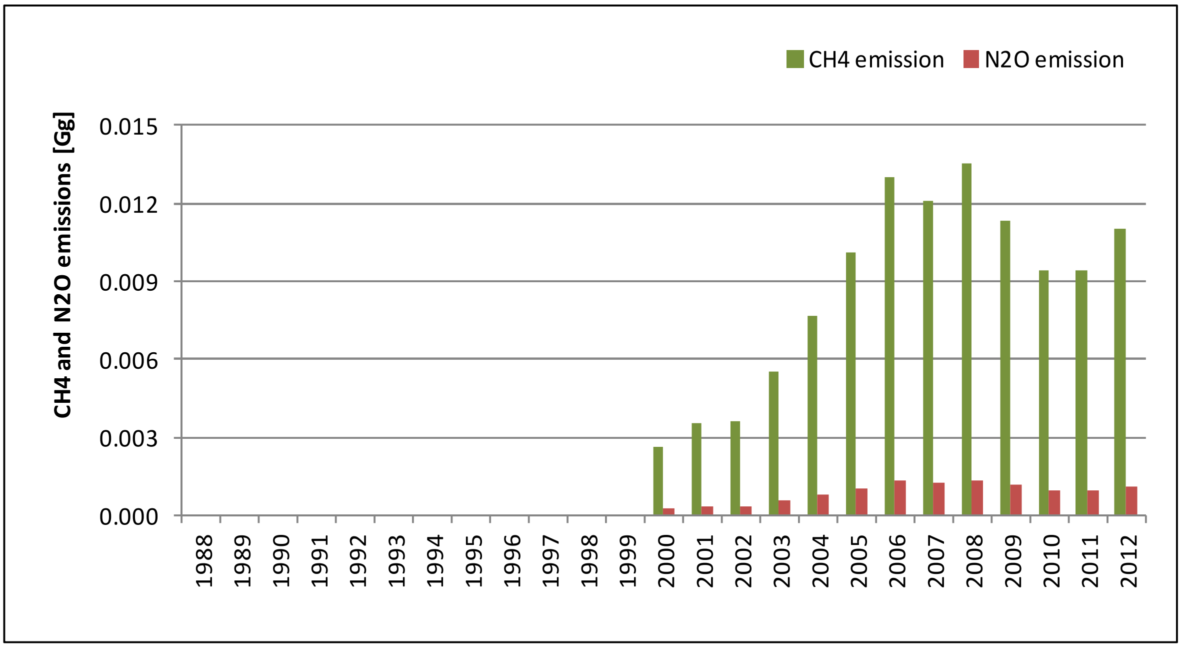

Figure 3.2.17. CH_4 and N_2O emissions from Pipelines category in 1988-2012

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

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

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

The amounts of fuels used in the above listed sub-categories in the 1988-2012 period are presented in table 3.2.8.4 and figure 3.2.8.17. The amounts of corresponding emissions of CO_2, CH_4 and N_2O are shown in tables 3.2.8.0–3.2.8.11 and figures 3.2.8.18 and 3.2.8.19.

Table 3.2.8.9. Fuel consumption in 1988-2012 in mobile sources in subcategories other than 1.A.3

		1988	1989	1990	1991	1992	1993	1994	1995	1996
ON-1.A.4.c.ii	PJ	49.42	47.82	50.54	48.70	57.22	72.17	78.16	82.29	91.78
ON-1.A.4.c.iii	PJ	4.55	4.15	3.43	3.30	3.44	2.82	3.22	3.16	2.60
OP-1.A.4.c.iii	PJ	7.54	6.87	5.67	5.46	5.69	4.67	5.33	5.24	4.24
		1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
ON-1.A.4.c.ii	PJ	106.78	97.15	99.50	110.24	102.76	102.45	103.66	105.59	108.01
ON-1.A.4.c.iii	PJ	2.70	1.95	1.96	1.73	1.83	1.79	1.44	1.62	1.38
OP-1.A.4.c.iii	PJ	4.41	3.18	3.19	2.83	2.98	2.93	2.36	2.65	2.25
		2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
ON-1.A.4.c.ii	PJ	80.21	73.73	73.78	71.00	71.21	71.81	73.67		
ON-1.A.4.c.iii	PJ	1.30	1.35	1.30	1.93	1.59	1.64	1.66		
OP-1.A.4.c.iii	PJ	2.13	2.20	2.11	3.14	2.60	2.67	2.71		

Table 3.2.8.10. GHG emission in 1988-2012 in subcategory 1.A.4.c.ii.

1.A.4.c.ii		1988	1989	1990	1991	1992	1993	1994	1995	1996
CO2 emission	Gg	3 607	3 491	3 690	3 555	4 177	5 268	5 706	6 007	6 700
CH4 emission	Gg	0.198	0.191	0.202	0.195	0.229	0.289	0.313	0.329	0.367
N2O emission	Gg	0.322	0.311	0.329	0.317	0.373	0.470	0.509	0.536	0.597
1.A.4.c.ii		**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO2 emission	Gg	7 795	7 092	7 264	8 047	7 502	7 479	7 567	7 708	7 885
CH4 emission	Gg	0.427	0.389	0.398	0.441	0.411	0.410	0.415	0.422	0.432
N2O emission	Gg	0.695	0.632	0.648	0.718	0.669	0.667	0.675	0.687	0.703
1.A.4.c.ii		**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
CO2 emission	Gg	5 855	5 382	5 386	5 183	5 198	5 242	5 378		
CH4 emission	Gg	0.321	0.295	0.295	0.284	0.285	0.287	0.295		
N2O emission	Gg	0.522	0.480	0.480	0.462	0.464	0.467	0.480		

Table 3.2.8.11. GHG emission in 1988-2012 in subcategory 1.A.4.c.iii.

1.A.4.c.iii		1988	1989	1990	1991	1992	1993	1994	1995	1996
CO2 emission	Gg	923	840	694	668	697	571	652	641	522
CH4 emission	Gg	0.085	0.077	0.064	0.061	0.064	0.052	0.060	0.059	0.048
N2O emission	Gg	0.024	0.022	0.018	0.018	0.018	0.015	0.017	0.017	0.014
1.A.4.c.iii		**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
CO2 emission	Gg	543	391	393	348	367	360	290	325	277
CH4 emission	Gg	0.050	0.036	0.036	0.032	0.034	0.033	0.027	0.030	0.025
N2O emission	Gg	0.014	0.010	0.010	0.009	0.010	0.009	0.008	0.009	0.007
1.A.4.c.iii		**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
CO2 emission	Gg	261	270	260	386	319	329	333		
CH4 emission	Gg	0.024	0.025	0.024	0.035	0.029	0.030	0.031		
N2O emission	Gg	0.007	0.007	0.007	0.010	0.008	0.009	0.009		

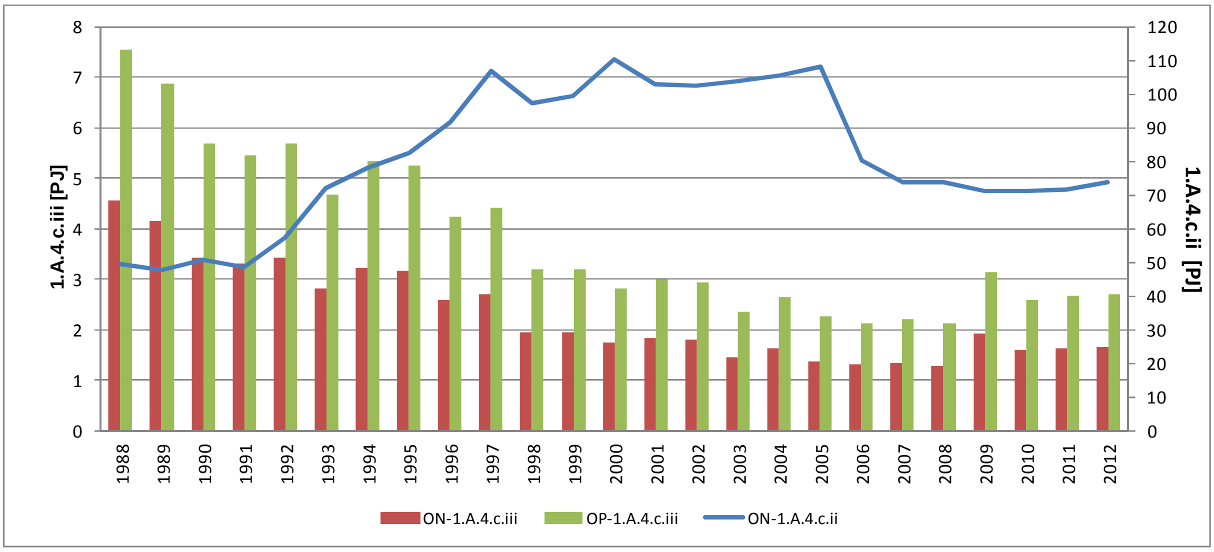

Figure 3.2.8.17. Fuel consumption in 1988-2012 in mobile sources in subcategories other than 1.A.3

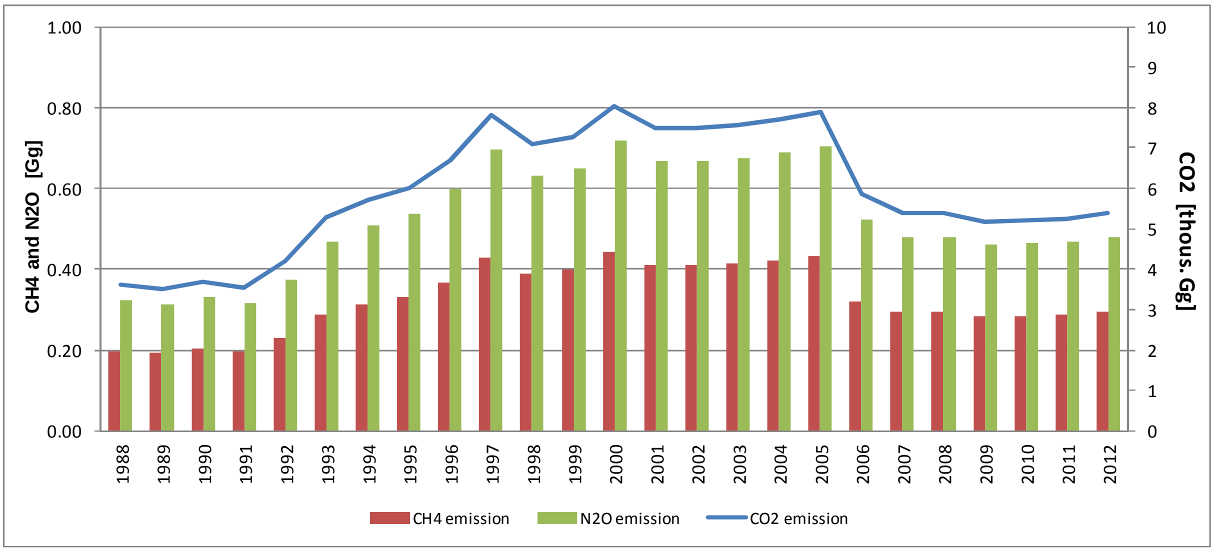

Figure 3.2.8.18. GHG emission in 1988-2012 in subcategory 1.A.4.c.ii.

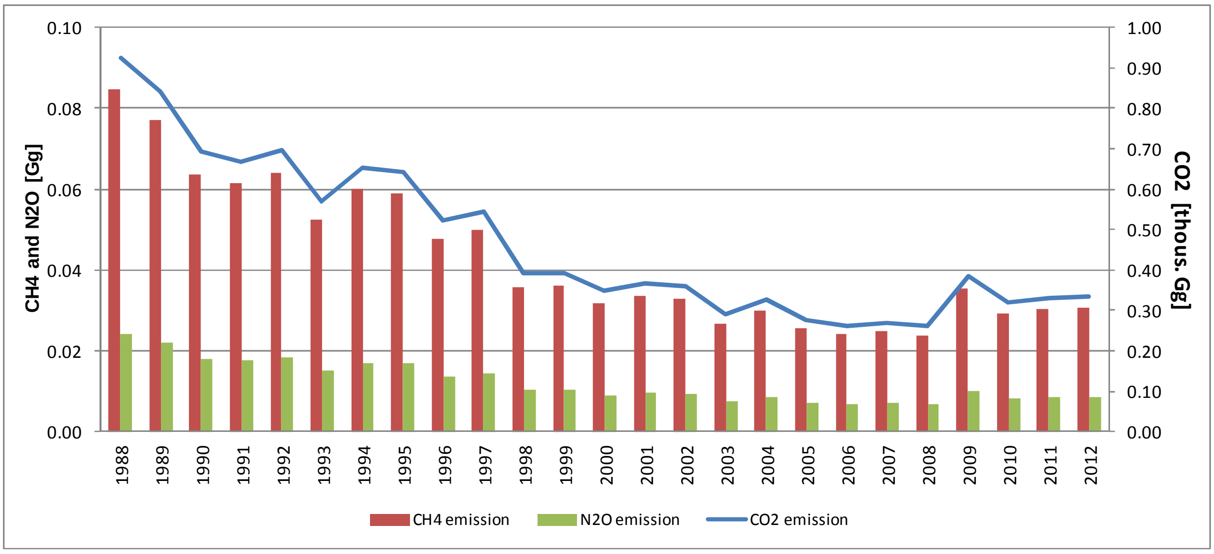

Figure 3.2.8.19. GHG emission in 1988-2012 in subcategory 1.A.4.c.iii.

3.2.8.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.2.8.4. Source-specific QA/QC and verification

See chapter 3.2.6.4

3.2.8.5. Source-specific recalculations

- fuel consumption in 1988 and 1989 were updated based on IEA database and in period 1990-2011 on actual Eurostat (table 3.2.8.12);
- in subcategory 1.A.3.b. *Road transportation* oxidation factor equal 0.99 was implemented, which changed CO_2 emission factors in whole period 1988-2011 (recommended by ERT) (table 3.2.8.13);
- in subcategory 1.A.3.d. *Domestic navigation*, fuel consumption share in domestic maritime were recalculated based on data on levels of international vs domestic shipping activity (table 3.2.8.14);

Table 3.2.8.12. Changes in GHG emission resulting from recalculations.

Difference	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Gg eq. CO_2	3756.43	3664.47	102.55	115.48	97.89	98.01	134.87	129.77
%	18.36	17.95	0.50	0.54	0.45	0.46	0.60	0.56
Difference	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Gg eq. CO_2	120.28	120.12	121.45	135.63	126.67	111.91	93.57	25.46
%	0.47	0.44	0.42	0.43	0.46	0.41	0.35	0.09
Difference	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg eq. CO_2	36.38	-10.77	-64.88	-97.74	-357.58	-385.61	-437.80	-443.38
%	0.11	-0.03	-0.17	-0.23	-0.79	-0.84	-0.91	-0.91

Table 3.2.8.13. Changes in CO_2 emission in subsector 1.A.3.b. *Road transportation* resulting from recalculations.

Difference	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Gg	4702.93	5467.03	73.41	90.00	97.02	101.22	114.69	112.54
%	29.27	32.71	0.40	0.45	0.47	0.50	0.54	0.51
Difference	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Gg	106.08	114.30	113.26	125.86	115.66	101.36	83.28	10.58
%	0.43	0.44	0.41	0.42	0.44	0.39	0.33	0.04
Difference	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg	24.33	-21.96	-76.81	-108.20	-365.10	-391.14	-441.22	-453.04
%	0.08	-0.07	-0.21	-0.26	-0.84	-0.89	-0.95	-0.96

Table 3.2.8.14. Changes in GHG emission in subsector 1.A.3.d. *Domestic navigation* resulting from recalculations.

Difference	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Gg eq. CO_2	15.27	15.02	15.27	13.61	-9.90	-13.81	8.50	5.52
%	21.00	21.00	21.00	21.00	-16.05	-29.61	26.41	15.75
Difference	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Gg eq. CO_2	3.04	-5.29	-2.57	-1.27	1.38	1.27	1.53	6.67
%	9.04	-30.37	-15.21	-8.84	12.13	11.86	14.70	66.85
Difference	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg eq. CO_2	3.13	2.80	4.23	2.55	3.68	1.93	0.56	0.95
%	59.41	66.43	95.89	58.33	110.31	83.90	50.08	95.52

3.2.8.6. Source-specific planned improvements

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

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

3.2.9.1. Source category description

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

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

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

Subsector 1.A.4.b *Residential* is by far the largest contributor to emissions from this category (see figure 3.2.9.1) – about 64 % in 2012.

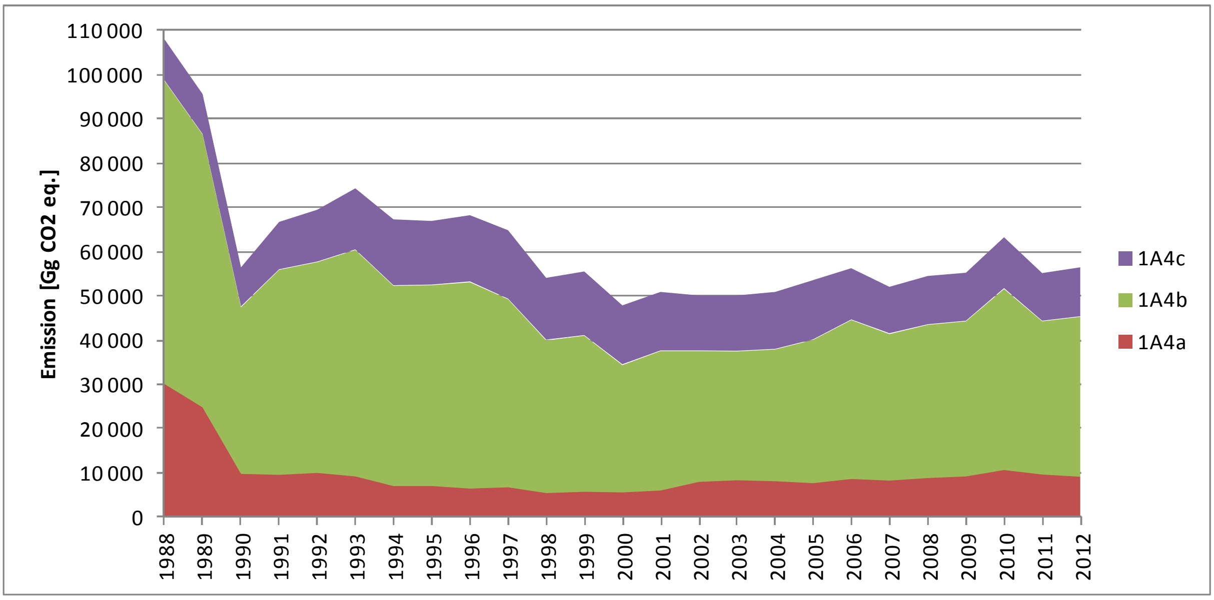

Figure 3.2.9.1. GHG emissions from 1.A.4. *Other sectors* in years 1988-2012 according to subcategories

3.2.9.2. Methodological issues

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

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

The data on fuel type use in stationary sources in the sub-category 1.A.4.a *Other Sectors – Commercial/Institutional* over the 1988-2012 period are presented in table 3.5.9.1. Detailed data concerning fuel consumption in 1.A.4.a subcategory was tabulated in Annex 2 (table 10).

Table 3.5.9.1. Fuel consumption in 1988-2012 in 1.A.4.a subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	0.000	0.000	0.000	0.000	0.000	0.000	1.334	1.255
Gaseous Fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260
Solid Fuels	297.025	244.614	91.215	92.072	95.735	86.052	64.046	62.499
Other Fuels	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000
Biomass	0.084	0.123	4.880	3.132	0.206	12.374	11.968	11.983
TOTAL	**312.322**	**257.481**	**110.386**	**106.262**	**107.142**	**110.326**	**87.010**	**88.997**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	2.328	7.881	9.848	12.238	18.285	21.926	23.195	24.272
Gaseous Fuels	18.771	24.256	32.769	37.696	38.567	49.971	61.001	67.057
Solid Fuels	52.142	48.086	29.849	27.864	22.004	17.283	29.822	29.723
Other Fuels	0.124	0.000	0.003	0.004	0.024	0.091	0.101	0.071
Biomass	10.625	9.627	9.085	9.216	9.211	6.596	6.440	6.466
TOTAL	**83.990**	**89.850**	**81.554**	**87.018**	**88.091**	**95.867**	**120.559**	**127.589**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	21.300	17.813	28.496	27.788	27.371	25.565	30.763	28.792
Gaseous Fuels	69.570	68.410	63.517	65.488	71.250	75.746	83.433	78.134
Solid Fuels	28.433	28.087	32.202	27.900	30.862	33.550	40.119	33.742
Other Fuels	0.002	0.022	0.000	0.000	0.037	0.123	0.024	0.046
Biomass	6.599	6.544	5.113	5.802	5.896	7.946	8.923	10.248
TOTAL	**125.904**	**120.876**	**129.328**	**126.978**	**135.416**	**142.930**	**163.262**	**150.962**
	2012							
Liquid Fuels	22.694							
Gaseous Fuels	77.360							
Solid Fuels	33.895							
Other Fuels	0.036							
Biomass	9.497							
TOTAL	**143.482**							

Figures 3.5.9.2 and 3.5.9.3 show emissions of CO_2, CH_4 and N_2O, respectively in the sub-category 1.A.4.a in the period 1988-2012.

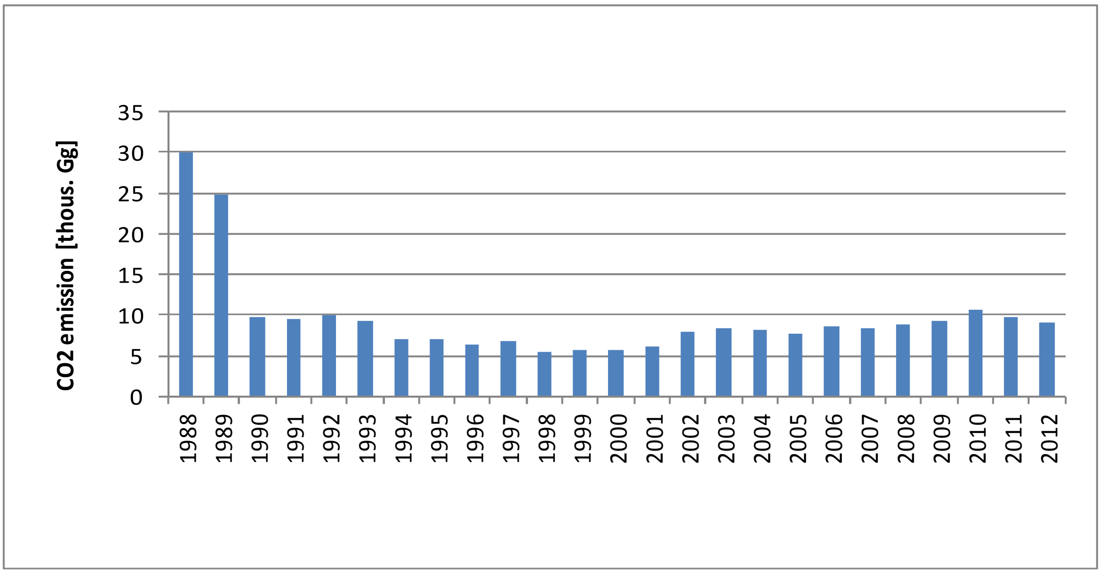

Figure 3.5.9.2. CO_2 emission for 1.A.4.a category in 1988-2012

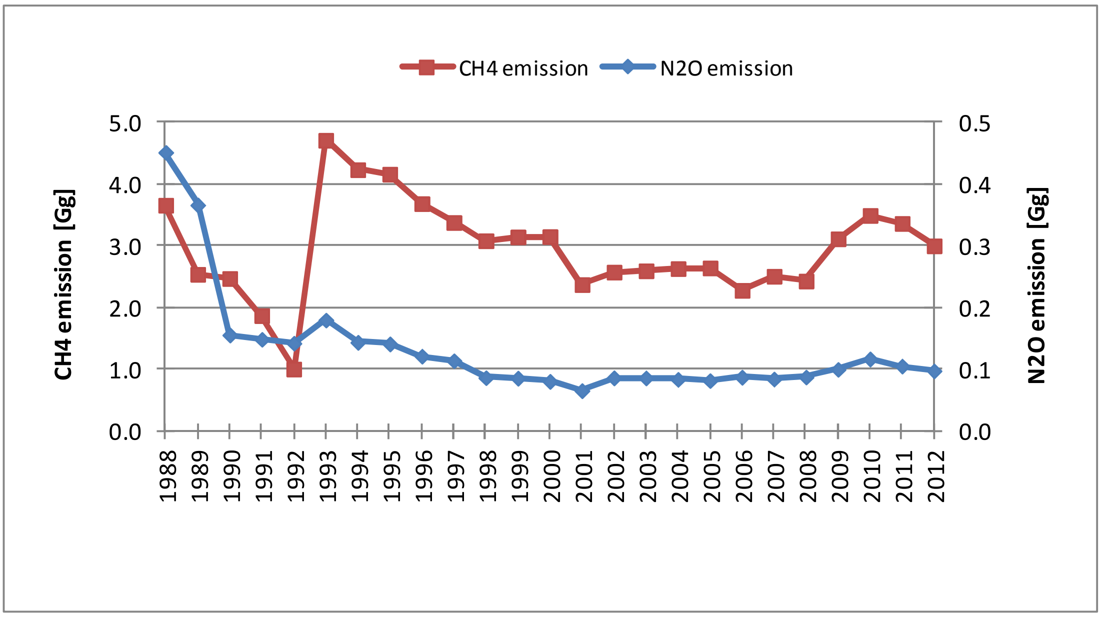

Figure 3.5.9.3. CH_4 and N_2O emissions for 1.A.4.a category in 1988-2012

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

The data on fuel type use in stationary sources in the sub-category 1.A.4.b *Residential* over the 1988-2012 period are presented in table 3.5.2. Detailed information on fuel consumption for 1.A.4.b subcategory are presented in Annex 2 (table 11).

Table 3.5.2. Fuel consumption in 1988-2012 in 1.A.4.b subcategory [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	6.762	7.452	1.702	1.012	1.840	6.072	8.970	12.834
Gaseous Fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559
Solid Fuels	617.874	546.675	307.564	385.686	390.347	413.265	346.089	339.463
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	33.615	32.351	34.335	27.721	33.969	106.000	104.715	105.000
TOTAL	**760.831**	**694.097**	**465.805**	**548.093**	**567.368**	**666.927**	**611.445**	**616.856**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	18.245	24.835	26.980	29.101	37.400	42.150	44.342	48.252
Gaseous Fuels	143.057	150.022	138.268	135.995	127.611	133.737	127.093	127.629
Solid Fuels	358.593	307.562	235.470	243.304	179.024	198.224	181.875	174.738
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	101.000	100.000	100.700	95.000	95.000	104.500	104.500	103.075
TOTAL	**620.895**	**582.419**	**501.418**	**503.400**	**439.035**	**478.611**	**457.810**	**453.694**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	45.370	42.305	42.305	39.364	35.963	33.190	29.344	27.719
Gaseous Fuels	126.376	135.111	138.686	132.622	131.450	134.857	148.427	135.471
Solid Fuels	184.880	208.686	242.209	219.897	238.001	241.865	295.283	240.129
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	103.360	100.700	104.500	102.000	102.500	102.500	112.746	115.000
TOTAL	**459.986**	**486.802**	**527.700**	**493.883**	**507.914**	**512.412**	**585.800**	**518.319**
	2012							
Liquid Fuels	26.799							
Gaseous Fuels	141.397							
Solid Fuels	252.773							
Other Fuels	0.000							
Biomass	116.850							
TOTAL	**537.819**							

Figure 3.5.9.4 show emissions of CO_2 in 1.A.4.b in the 1988-2012 period while CH_4 and N_2O, emissions in the same sub-category are shown in figure 3.5.9.5.

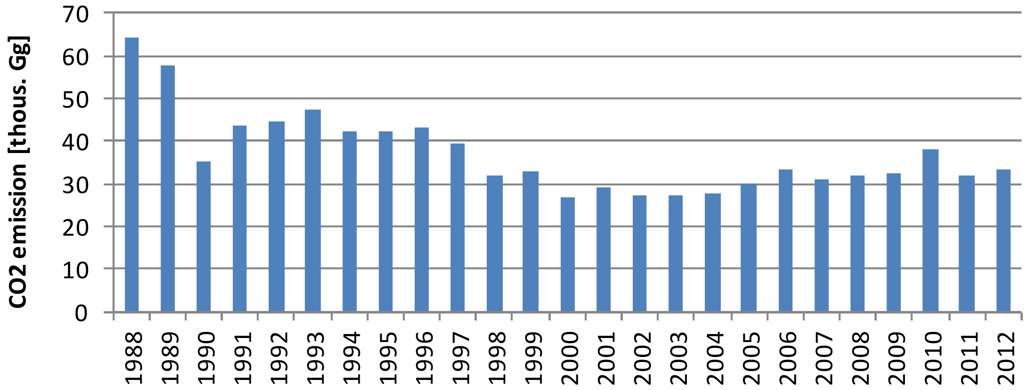

Figure 3.5.9.4. CO_2 emission for 1.A.4.b category in 1988-2012

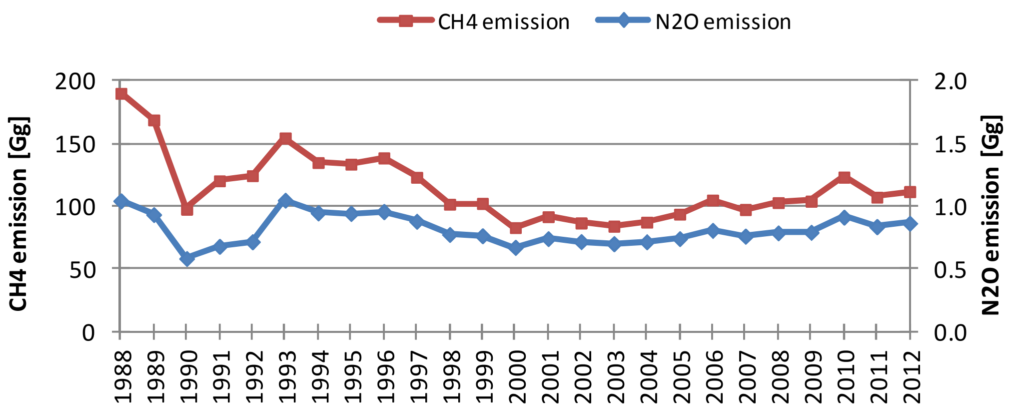

Figure 3.5.9.5. CH_4 and N_2O emissions for 1.A.4.b category in 1988-2012

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

The data on fuel type use in stationary sources in the sub-category 1.A.4.c Agriculture/Forestry/ Fishing over the 1988-2012 period are presented in table 3.5.9.3. Detailed data concerning total fuel consumption in 1.A.4.c subcategory (including fuel consumption related to off-road vehicles and other machinery in agriculture and fuel use in fishing) was tabulated in Annex 2 (table 12).

Table 3.5.9.3. Fuel consumption in stationary sources in 1.A.4.c subcategory for years 1988-2012 [PJ]

	1988	1989	1990	1991	1992	1993	1994	1995
Liquid Fuels	2.720	2.600	3.560	2.720	1.440	14.074	18.302	10.532
Gaseous Fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243
Solid Fuels	42.691	42.026	39.465	59.710	64.662	63.946	66.261	64.299
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.039	0.113	0.039	0.278	0.583	20.057	18.367	18.500
TOTAL	**45.956**	**45.185**	**43.512**	**62.983**	**66.740**	**98.209**	**103.142**	**93.574**
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid Fuels	6.272	9.152	8.182	8.437	8.832	8.483	6.909	9.374
Gaseous Fuels	0.428	0.571	0.868	0.476	0.536	0.777	0.914	1.197
Solid Fuels	68.014	58.905	53.170	55.389	37.590	41.916	35.065	34.071
Other Fuels	0.000	0.000	0.000	0.006	0.012	0.011	0.000	0.000
Biomass	17.567	17.000	17.100	17.106	17.113	19.053	19.010	19.017
TOTAL	**92.281**	**85.628**	**79.320**	**81.414**	**64.083**	**70.240**	**61.898**	**63.659**
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid Fuels	9.404	10.689	4.334	3.724	3.930	3.494	3.265	3.671
Gaseous Fuels	1.182	1.084	1.492	1.840	1.900	1.577	1.486	1.531
Solid Fuels	35.838	39.001	46.028	40.728	45.335	44.947	53.241	43.882
Other Fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	19.878	19.038	19.977	19.060	19.024	19.030	21.088	24.202
TOTAL	**66.302**	**69.812**	**71.831**	**65.352**	**70.189**	**69.048**	**79.080**	**73.286**
	2012							
Liquid Fuels	3.705							
Gaseous Fuels	1.796							
Solid Fuels	45.398							
Other Fuels	0.000							
Biomass	21.348							
TOTAL	**72.247**							

Figures 3.5.9.6 and 3.5.9.7 show emissions of CO_2, and CH_4 and N_2O, respectively in the sub-category 1.A.4.c in the period: 1988-2012.

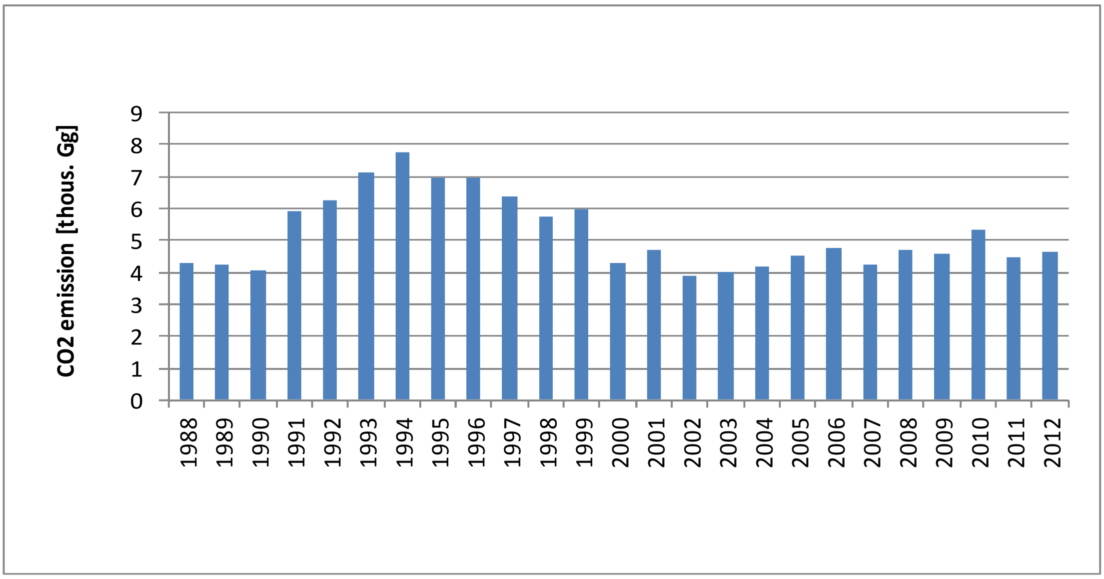

Figure 3.5.9.6. CO_2 emission for stationary sources in 1.A.4.c category in 1988-2012

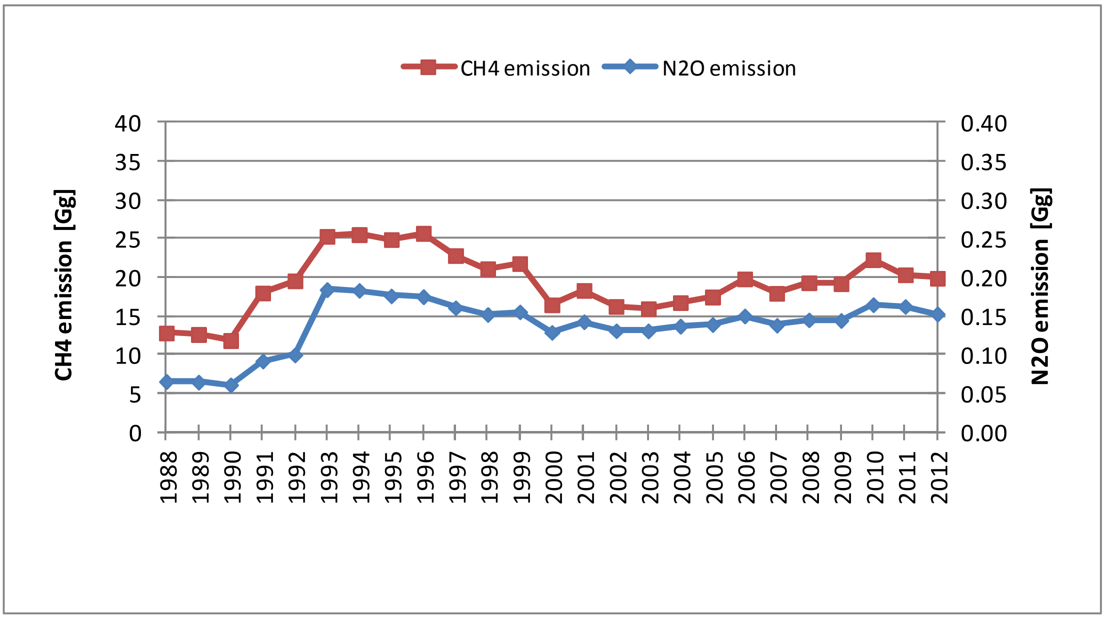

Figure 3.5.9.7. CH_4 and N_2O emissions for stationary sources in 1.A.4.c category in 1988-2012

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

3.2.9.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.2.9.4. Source-specific QA/QC and verification

See chapter 3.2.6.4

3.2.9.5. Source-specific recalculations

- activity data on fuel consumption for years 1989-2011 were updated according to current IEA database (for 1988-1989) and Eurostat database (for 1990-2011).

Table. 3.2.9.4. Changes in GHG emissions in 1.A.4 subsector as a result of recalculations

Changes	1988	1989	1990	1991	1992	1993	1994	1995
				CO2				
Gg	-73.98	-80.35	27.41	26.37	31.02	39.21	42.94	78.43
%	-0.1	-0.1	0.1	0.0	0.0	0.1	0.1	0.1
				CH4				
Gg	-0.002	-0.007	1.352	0.884	0.002	0.002	0.002	0.007
%	0.0	0.0	1.2	0.6	0.0	0.0	0.0	0.0
				N2O				
Gg	-0.006	-0.006	0.020	0.014	0.003	0.003	0.004	0.004
%	-0.3	-0.3	1.8	1.1	0.2	0.2	0.2	0.2
Changes	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
				CO2				
Gg	90.87	187.75	205.55	196.25	199.22	118.84	102.50	92.71
%	0.1	0.3	0.4	0.4	0.4	0.2	0.2	0.2
				CH4				
Gg	0.009	0.022	0.025	0.023	0.023	0.012	0.010	0.008
%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				N2O				
Gg	0.005	0.006	0.006	0.006	0.006	0.005	0.005	0.005
%	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3
Changes	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
				CO2				
Gg	73.36	72.73	207.37	230.46	288.87	374.54	39.72	65.71
%	0.2	0.1	0.4	0.5	0.6	0.7	0.1	0.1
				CH4				
Gg	0.006	0.005	0.017	0.019	0.023	0.039	0.003	0.014
%	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
				N2O				
Gg	0.005	0.005	0.004	0.004	0.004	0.004	0.003	0.004
%	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2

3.2.9.6. Source-specific planned improvements

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

3.3. Fugitive emissions (CRF sector 1.B)

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

3.3.1.1. Source category description

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

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

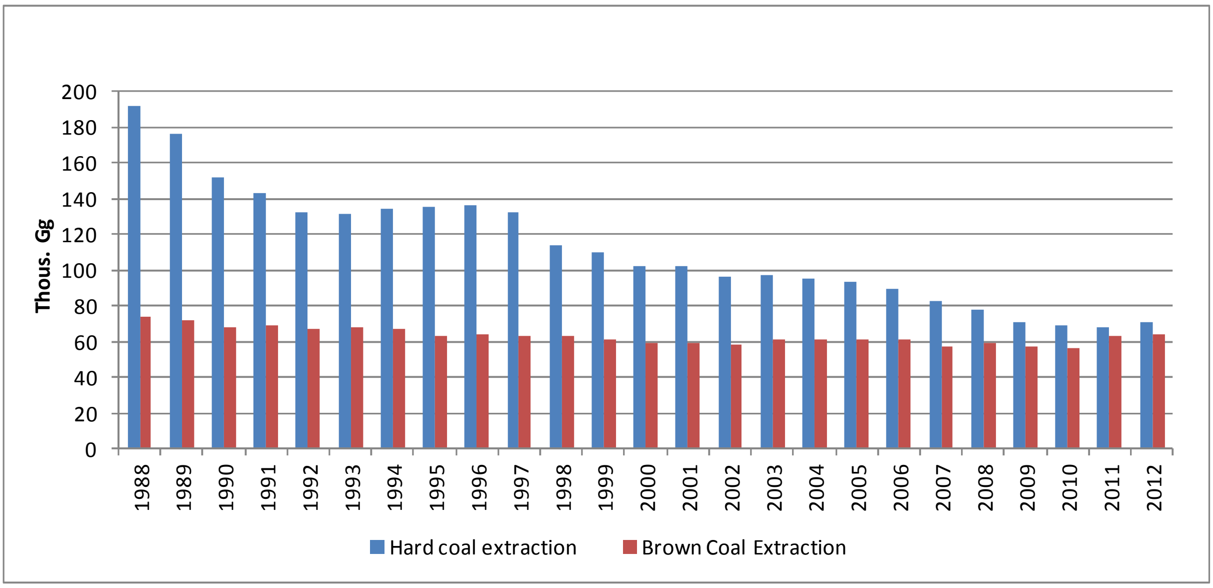

Figure 3.3.1. Hard coal and lignite extraction in 1988-2012.

3.3.1.2. Methodological issues

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

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

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

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

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

The set of Polish emissions factors used in the national inventory for the above listed emission sources are presented in table 3.3.1. This table includes results from more recent study: [Kwarciński et al. 2005] done in 2005, in which emission factors were estimated for the year 2003 – once again – based on detailed data and measurements. Also an in-depth analysis was carried out and the resulting EFs were compared with those from earlier studies. For the domestic inventory purposes emissions factors were calculated for one tonne of extracted coal. Data on coal extracted (see below) are publicly available e.g. in publications of the Polish Geological Institute [PIG, 2013].

Table 3.3.1. Domestically derived methane emission factors

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

After analysis, a selection of the respective EFs was made for: venting systems, methane capture systems, post-mining processes, production waste and closed mines for each year over the period: 1988-2012 based on the above mentioned three domestic studies. For the years 1988-1991, the 1992 EFs (Gawlik et. al. 1994) were applied. For the years 1993-1998 and 2000-2002, emission factors were calculated by linear interpolation of EFs from [Gawlik et. al. 1994], [Gawlik & Grzybek 2001] and [Kwarciński et al. 2005] following recommendation given in 7.3.2.2 of GPG 2000. The estimation of 1999 CH_4 emissions from closed mines were applied to years: 2000-2012.

Table 3.3.2 shows data on hard coal extraction and total methane emissions from coal mines in 1988-2012. The total CH_4 emissions include estimates from: venting systems, methane capture systems, post-mining processes, production waste and closed mines.

Table 3.3.2. Hard coal extraction and total methane emissions from coal mines in 1988-2012.

Year	Hard coal extraction [Gg]	CH_4 Emissions [Gg]
1988	191 624	782.22
1989	175 947	727.29
1990	151 321	622.67
1991	143 131	587.41
1992	132 730	545.70
1993	131 400	545.51
1994	134 078	583.46
1995	135 523	597.74
1996	136 272	608.79
1997	132 576	613.39
1998	113 859	540.60
1999	109 986	554.56
2000	102 081	521.28
2001	102 477	505.99
2002	96 160	469.68
2003	97 274	476.11
2004	95 623	468.09
2005	93 006	455.38
2006	89 342	437.57
2007	82 779	405.69
2008	77 989	382.41
2009	70 500	346.03
2010	69 186	339.66
2011	67 637	332.12
2012	71 339	350.11

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

Fugitive emission of CH_4 from surface mining was estimated based on the activity data concerning lignite extraction amount from the study published by Polish Geological Institute [PIG. 2013] and country specific emission factor, which was taken from the study [Radwański 1995]. The value of these emission factors are as follow:
- Ventilation emission from coal seam - 0.007 m^3 CH_4 / t of extracted lignite.
- Ventilation emission from surrounding rocks - 0.012 m^3 CH_4 / t of extracted lignite.

The conversion factor applied for recalculation of emitted methane volume to mass of CH_4 is 0.67 kg/m^3.

In table 3.3.3 are shown data on lignite extraction and total related methane emissions in 1988-2012.

Table 3.3.3. Lignite extraction and total methane emissions from lignite mines in 1988-2012.

Year	Lignite extraction [Gg]	CH_4 Emissions [Gg]
1988	73 970	0.94
1989	72 000	0.92
1990	67 680	0.86
1991	68 720	0.87
1992	66 900	0.85
1993	68 200	0.87
1994	66 780	0.85
1995	63 550	0.81
1996	63 850	0.81
1997	63 200	0.80
1998	62 880	0.80
1999	60 860	0.77
2000	59 490	0.76
2001	59 550	0.76
2002	58 240	0.74
2003	60 920	0.78
2004	61 190	0.78
2005	61 610	0.78
2006	60 850	0.77
2007	57 700	0.73
2008	59 500	0.76
2009	57 060	0.73
2010	56 520	0.72
2011	62 890	0.80
2012	64 297	0.82

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

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

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

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

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

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

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

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

CH_4 emission in the period 1990-2012 was estimated based on coke production volume from [Eurostat], while for 1988 and 1989 from [IEA]. For the entire period emission factor equal 0.5 kg CH_4/Mg coke produced [IPCC 1997; Workbook table 2-9] was applied.

Table 3.3.4. Carbon balance for coke production in years 1988-2012.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
INPUT [TJ]													
Coking coal	**656592**	**637742**	**535538**	**448105**	**437665**	**405168**	**436596**	**451761**	**403902**	**423800**	**377787**	**338208**	**366814**
High Methane Natural Gas	0	1239	0	0	0	0	0	0	0	0	0	0	0
Coke			969	542	1767	1568	2394	2337	1824	1682	2109	1482	2024
Blast furnace gas	0	152	0	0	0	0	0	0	0	0	0	0	0
Tar	0	0	0	0	0	0	0	0	0	0	0	0	0
Industrial waste	7	0	0										
NCV [MJ/kg]													
Coking coal	29.41	29.41	29.41	29.41	29.41	29.41	28.49	29.36	29.36	29.45	29.54	29.48	29.62
INPUT – Material-specific carbon content [kg C/GJ]													
Coking coal	26.02	26.02	26.02	26.02	26.02	26.02	26.06	26.03	26.03	26.02	26.02	26.02	26.02
High Methane Natural Gas	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Blast furnace gas	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Tar	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Industrial waste	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
INPUT – Carbon contents in charge components [Gg]													
Coking coal	17087.6	16597.0	13937.2	11661.8	11390.1	10544.3	11378.1	11757.8	10512.1	11028.5	9829.9	8800.9	9543.2
High Methane Natural Gas	0.0	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coke	0.0	0.0	28.6	16.0	52.1	46.3	70.6	68.9	53.8	49.6	62.2	43.7	59.7
Blast furnace gas	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial waste	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Carbon contents in charge – SUM [Gg]	**17087.8**	**16626.0**	**13965.7**	**11677.7**	**11442.2**	**10590.6**	**11448.7**	**11826.7**	**10565.9**	**11078.2**	**9892.1**	**8844.6**	**9602.9**
OUTPUT [TJ]													
Coke	**471501.8**	**455831.8**	385206.0	323646.0	315381.0	292838.0	326468.0	329973.0	294662.0	300248.0	277761.0	238488.0	255702.0
Coke-Oven Gas	**118914.6**	**117040.4**	96832.0	84743.0	82307.0	75753.0	84002.0	84767.0	76036.0	79286.0	73457.0	62989.0	68849.0
Tar	27580.0	27429.3	22885.3	20268.2	20648.1	19071.4	21146.6	21265.0	19831.9	19600.4	17949.6	16264.8	17003.0
Benzol	7701.5	7230.9	6166.9	5150.7	5646.2	5159.1	6010.6	6056.5	5446.7	5428.6	4856.9	4524.7	2498.5
OUTPUT – Material-specific carbon content [kg C/GJ]													
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Coke-Oven Gas	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Tar	22	22	22	22	22	22	22	22	22	22	22	22	22
Benzol	23	23	23	23	23	23	23	23	23	23	23	23	23
OUTPUT – Carbon content in products [Gg]													
Coke	13909.3	13447.0	11363.6	9547.6	9303.7	8638.7	9630.8	9734.2	8692.5	8857.3	8193.9	7035.4	7543.2
Coke-Oven Gas	1545.9	1521.5	1258.8	1101.7	1070.0	984.8	1092.0	1102.0	988.5	1030.7	954.9	818.9	895.0
Tar	606.8	603.4	503.5	445.9	454.3	419.6	465.2	467.8	436.3	431.2	394.9	357.8	374.1
Benzol	177.1	166.3	141.8	118.5	129.9	118.7	138.2	139.3	125.3	124.9	111.7	104.1	57.5
Carbon content in products – SUM [Gg]	**16239.1**	**15738.3**	**13267.7**	**11213.6**	**10957.9**	**10161.7**	**11326.3**	**11443.3**	**10242.6**	**10444.1**	**9655.5**	**8316.1**	**8869.8**
C process emission[Gg]	**848.8**	**887.7**	**698.0**	**464.2**	**484.3**	**428.8**	**122.4**	**383.4**	**323.3**	**634.1**	**236.6**	**528.4**	**733.2**
CO_2 process emission[Gg]	**3112.1**	**3254.8**	**2559.5**	**1701.9**	**1775.9**	**1572.4**	**448.8**	**1405.9**	**1185.5**	**2324.9**	**867.5**	**1937.6**	**2688.3**
Coke output [Gg]	17007	16499	13516	11356	11066	10275	11455	11578	10339	10535	9746	8368	8972
EF [kg CO_2/Mg of coke]	**183**	**197**	**189**	**150**	**160**	**153**	**39**	**121**	**115**	**221**	**89**	**232**	**300**

Table 3.3.4. (cont.) Carbon balance for coke production in years 1988-2012.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
INPUT [TJ]												
Coking coal	362343	353752	410854	405806	335694	383094	405666	392453	277057	383177	366592	352548
High Methane Natural Gas	0	0	0	0	0	0	0	0	0	0	0	0
Coke	1055	1710	1568	1710	2138	2366	2651	3050	1938	3021	2964	2366
Blast furnace gas	0	0	0	0	0	0	0	0	0	0	0	0
Tar	0	0	0	0	0	0	0	0	0	0	0	0
Industrial waste										3.5		
NCV [MJ/kg]												
Coking coal	29.53	29.53	29.56	29.55	29.51	29.59	29.50	29.57	29.56	29.49	29.52	29.60
INPUT – Material-specific carbon content [kg C/GJ]												
Coking coal	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.02	26.0	26.0
High Methane Natural Gas	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3	15.3
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Blast furnace gas	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
Tar	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0	22.0
Industrial waste	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0	39.0
INPUT – Carbon contents in charge components [Gg]												
Coking coal	9428.2	9204.6	10689.9	10558.7	8735.0	9967.2	10555.8	10211.0	7208.7	9970.8	9538.8	9172.3
High Methane Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coke	31.1	50.4	46.3	50.4	63.1	69.8	78.2	90.0	57.2	89.1	87.4	69.8
Blast furnace gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Tar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Industrial waste	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Carbon contents in charge – SUM [Gg]	**9459.3**	**9255.1**	**10736.2**	**10609.1**	**8798.1**	**10037.0**	**10634.0**	**10301.0**	**7265.9**	**10060.1**	**9626.3**	**9242.1**
OUTPUT [TJ]												
Coke	254961.0	248606.0	288192.0	287765.0	239514.0	273971.0	289788.0	287138.0	202094.0	280554.0	267245.0	253450,0
Coke-Oven Gas	69008.0	65570.0	75091.0	72947.0	61947.0	71712.0	76950.0	73935.0	53376.0	73008.0	69642.0	65321,0
Tar	17232.6	16462.6	18188.1	17417.0	14590.0	16211.0	17342.0	15721.0	11838.0	16475.0	15269.0	14175,0
Benzol	4788.6	4474.8	5253.3	5358.3	4403.2	3803.7	5315.6	4711.9	3373.4	4892.6	4518.8	4125.1
OUTPUT – Material-specific carbon content [kg C/GJ]												
Coke	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Coke-Oven Gas	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
Tar	22	22	22	22	22	22	22	22	22	22	22	22
Benzol	23	23	23	23	23	23	23	23	23	23	23	23
OUTPUT – Carbon content in products [Gg]												
Coke	7521.3	7333.9	8501.7	8489.1	7065.7	8082.1	8548.7	8470.6	5961.8	8276.3	7883.7	7476.8
Coke-Oven Gas	897.1	852.4	976.2	948.3	805.3	932.3	1000.4	961.2	693.9	949.1	905.3	849.2
Tar	379.1	362.2	400.1	383.2	321.0	356.6	381.5	345.9	260.4	362.5	335.9	311.9
Benzol	110.1	102.9	120.8	123.2	101.3	87.5	122.3	108.4	77.6	112.5	103.9	94.9
Carbon content in products – SUM [Gg]	**8907.7**	**8651.4**	**9998.8**	**9943.8**	**8293.2**	**9458.5**	**10052.9**	**9886.0**	**6993.7**	**9700.4**	**9228.9**	**8732.7**
C process emission[Gg]	**551.6**	**603.7**	**737.4**	**665.3**	**504.9**	**578.4**	**581.2**	**415.0**	**272.2**	**359.7**	**397.4**	**509.5**
CO_2 process emission[Gg]	**2022.6**	**2213.4**	**2703.8**	**2439.6**	**1851.2**	**2120.9**	**2130.9**	**1521.8**	**998.1**	**1318.7**	**1457.0**	**1868.0**
Coke output [Gg]	8946	8723	10112	10097	8404	9613	10168	10075.0	7091	9844	9377	8 893
EF [kg CO_2/Mg of coke]	**226**	**254**	**267**	**242**	**220**	**221**	**210**	**151**	**141**	**134**	**155**	**210**

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

Tier 1 method has been used for calculation of fugitive emissions from coke oven gas system [IPCC 2000] while emission factors presented in table 3.3.5. have been taken from domestic case study [Steczko 1994]. Activity data for 1990-2012 come from [EUROSTAT]. For years: 1988-1989 the activity data come from [IEA] database.

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

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

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

3.3.1.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.3.1.4. Source-specific QA/QC and verification

QA/QC and verification are integral parts of the inventory and has been elaborated in line with the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories(2000)*.
Activity data used in the GHG inventory concerning sector 1.B.1 come from Eurostat database which is fed by the Central Statistical Office (GUS) and from Polish Geological Institute - National Research Institute (PIG-PIB). GUS and PIG-PIB are responsible for QA/QC of collected and published data. Activity data applied in GHG inventory are regularly checked and updated if necessary according to adjustments made in Eurostat database.
Generally QC procedures follow QA/QC plan presented in Annex 7.

3.3.1.5. Source-specific recalculations

Recalculations for the years 1988-1989 was made as result of the correction of IEA activity data. The correction of calculation of processing emission of CO_2 was made, in accordance with the recommendations in-country review of the 2013 annual submission.
Recalculations for the 1990-2011 year was made as result of the correction of activity data from EUROSTAT(19.III.2014).
Emission changes for subcategory 1.B.1 are presented in table below.

Tabele 3.3.6. Emission changes for subcategory 1.B.1. Fugitive emissions from fuels.

Difference	1988	1989	1990	1991	1992	1993	1994	1995
Gg eq CO_2	71.78	85.75	49.93	26.58	12.67	9.26	6.62	15.56
%	0.36	0.45	0.31	0.19	0.09	0.07	0.05	0.11
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Gg eq CO_2	0.00	0.00	1.23	0.00	0.00	0.11	0.00	0.00
%	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg eq CO_2	-0.44	-1.06	-0.71	-1.87	0.74	0.33	303.35	633.47
%	0.00	-0.01	-0.01	-0.02	0.01	0.00	3.50	7.33

3.3.1.6. Source-specific planned improvements

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

The possibility of using data for estimating emissions from recovered / combusted methane from coal mines on the basis of data submitted to the National Database on emissions of greenhouse gases and other substances under the Act of 17 July 2009 on the System to Manage the Emissions of Greenhouse Gases and Other Substances (Journal of Laws No. 130, item. 1070, as amended. amended.) is currently analysed.

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

3.3.2.1. Source category description

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

3.3.2.2. Methodological issues

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

Tier 1 method has been used for calculation of fugitive emissions from oil system [IPCC 2000]. Activity data come from [EUROSTAT]. For years: 1988-1989 the activity data come from [IEA] database. Activity data for 1990-2012 come from Eurostat.

Table 3.3.7. Activity data for emission from oil system.

Year	Production [PJ]	Production [Gg]	Import [Gg]	Transport [Gg]	Input to oil refineries [PJ]
1988	6.58	156	14 681	14 838	618.67
1989	6.48	154	14 422	14 576	628.44
1990	6.59	160	13 126	13 286	528.78
1991	6.45	158	11 454	11 612	478.33
1992	7.98	200	13 052	13 252	524.72
1993	9.49	235	13 674	13 909	539.96
1994	10.97	284	12 721	13 005	519.25
1995	11.28	292	12 957	13 249	519.06
1996	12.70	317	14 026	14 343	584.98
1997	11.92	289	14 713	15 002	613.70
1998	14.88	360	15 367	15 727	662.31
1999	18.03	434	16 022	16 456	694.72
2000	26.55	653	18 002	18 655	742.97
2001	31.64	767	17 558	18 325	740.95
2002	29.72	728	17 942	18 670	726.13
2003	32.59	765	17 448	18 213	743.69
2004	37.33	886	17 316	18 202	763.30
2005	35.17	848	17 912	18 760	753.40
2006	32.85	796	19 813	20 609	827.25
2007	30.29	721	20 885	21 606	844.88
2008	31.34	755	20 787	21 542	863.62
2009	28.85	687	20 098	20 785	852.61
2010	28.55	687	22 688	23 375	949.19
2011	25.50	617	23 792	24 409	992.10
2012	28.27	681	24 633	25 314	1044.01

CO_2 and CH_4 factors used for estimation of emissions from oil production have been taken from country study [Żebrowski 1994] while for oil transmission and refining default factors were used from [IPCC 2000] (tab. 3.3.8).

Table 3.3.8. Emission factors for CO_2 and CH_4 from oil production and transmission.

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

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

Estimation of CO_2 and CH_4 emissions from systems of high-methane and nitrified natural gases was carried out based on *Tier 1* method [IPCC 2000]. Activity data for 1990-2012 come from [EUROSTAT]. For years 1988-1989 activity data come from [IEA] database. Activity data are given in table 3.3.9.

Table 3.3.9. Activities for natural gas system [TJ]

Year	Production [TJ]	Total consumption [TJ]
1988	156 573	350 712
1989	144 980	342 968
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	136 012	398 344
1999	129 883	387 832
2000	138 724	416 992
2001	146 204	434 447
2002	149 433	423 419
2003	151 197	471 462
2004	164 428	497 416
2005	162 630	512 234
2006	162 463	526 764
2007	163 147	523 124
2008	154 487	526 108
2009	153 980	505 027
2010	154 617	536 108
2011	161 186	537 434
2012	160 250	569 447

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

Table 3.3.10. Emission factors for CO_2 and CH_4 from high-methane gas system.

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

Table 3.3.11. Emission factors for CO_2 and CH_4 from nitrified natural gas system.

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

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

Venting and Flaring in oil subsystem

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

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

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

CO_2 process emission from refineries and flaring was included into sub-category 1.B.2.C.2. This emission were estimated based on the verified reports for refineries. which participate in EU ETS [KOBiZE 2012]. These values amounted to: 1671.1Gg for 2012, 1553.6 Gg for 2011, 991.9 Gg for 2010, 1093.0 Gg for 2009, 1091.6 Gg for 2008, 956.5 Gg for 2007, 1143.1 Gg CO_2 in 2006 and 1082.3 Gg CO_2 in 2005 respectively. CO_2 emission from refineries reported as process emission mainly resulted from the following processes: hydrogen production, regeneration of catalysts and after-burning gases from asphalt production.

Flaring in natural gas subsystem

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

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

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

3.3.2.3. Uncertainties and time-series consistency

See chapter 3.2.6.3

3.3.2.4. Source-specific QA/QC and verification

See chapter 3.3.1.4.

3.3.2.5. Source-specific recalculations

Recalculations for the years 1988-1989 was made as result of the correction of IEA activity data. The correction of calculation of processing emission of CO_2 was made,
Recalculations for the 1990-2011 year was made as result of the correction of activity data from EUROSTAT(19.III.2014) and in accordance with the recommendations in-country review of the 2013 annual submission.
Emission changes for subcategory 1.B.2 are presented in table below.

Tabele 3.3.12. Emission changes for subcategory 1.B.2. Fugitive emissions from oil and natural gas.

Difference	1988	1989	1990	1991	1992	1993	1994	1995
Gg eq CO_2	75.64	66.51	1.38	1.91	4.37	4.00	9.00	9.11
%	2.21	1.99	0.04	0.06	0.16	0.13	0.30	0.28
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Gg eq CO_2	5.89	2.82	3.28	3.34	10.26	8.44	10.11	-0.22
%	0.17	0.08	0.09	0.10	0.28	0.22	0.27	-0.01
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg eq CO_2	3.60	8.07	9.03	3.68	6.93	3.84	6.17	6.20
%	0.08	0.14	0.16	0.07	0.12	0.07	0.11	0.10

3.3.2.6. Source-specific planned improvements

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

4. INDUSTRIAL PROCESSES (CRF SECTOR 2)

4.1. Source category description

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

2.A.1 - Cement Production (CO_2 emission), share in total GHG emission	1.6%
2.B.1 - Ammonia Production (CO_2 emission), share in total GHG emission	1.1%
2.F.1 - Refrigeration and Air Conditioning Equipment (HFC emission), share in total GHG emission	1.9%

Share of these categories in total Poland's GHG emissions is 4.5%.

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

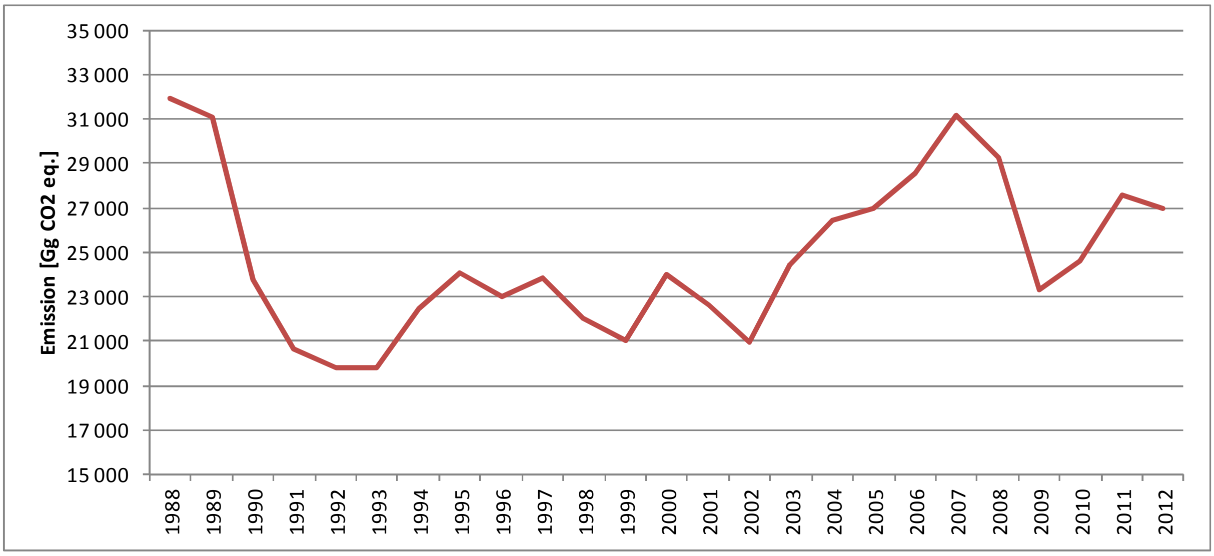

Figure 4.1.1. Emission trend in *Industrial processes* sector in period 1988 – 2012

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

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

For estimation of the 2012 emission in sector 2. *Industrial Processes,* CO_2 process emission data were used from installations which take part in the EU ETS. Emissions based on such data were estimated in the following subcategories:

- subcategory 2.A. *Mineral Products*: 2.A.1. *Clinker Production*, 2.A.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*

Emissions in individual subcategories in period 1988 – 2012 are shown in figure 4.1.2

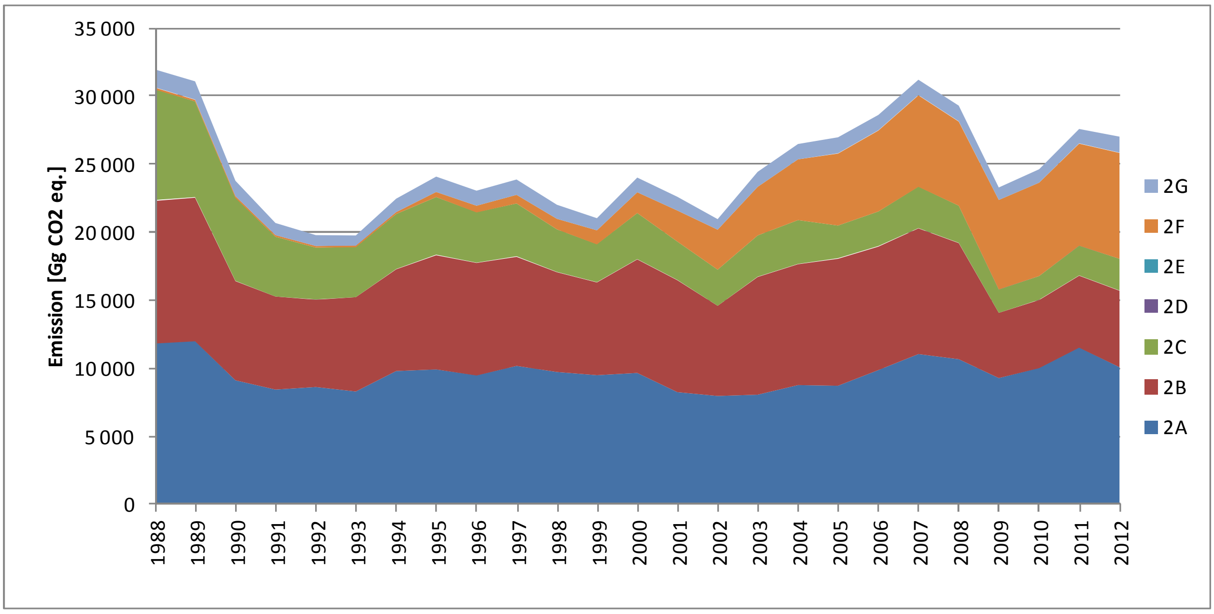

Figure 4.1.2. GHG emissions from *Industrial processes* in 1988-2012 according to subcategories

4.2. Mineral Products (CRF sector 2.A)

4.2.1. Source category description

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

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

Subsector 2.A.1. *Cement Production* is by far the largest contributor to emissions from this category (see figure 4.2.1) – over 63% in 2012.

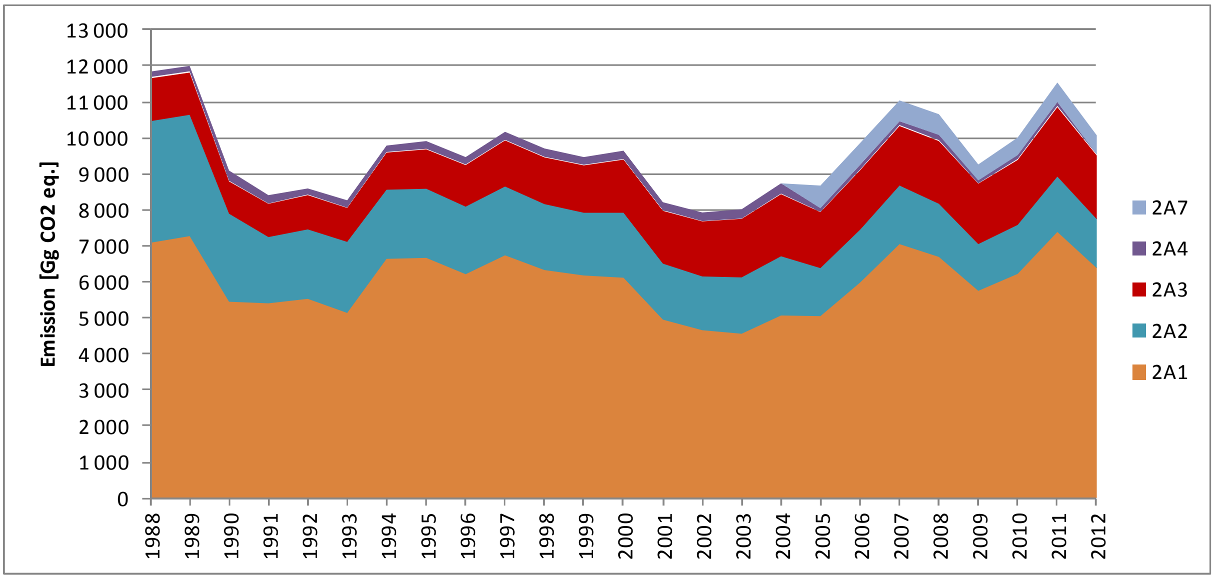

Figure 4.2.1. Emissions from *Mineral Products* sector in years 1988-2012 according to subcategories.

4.2.2. Methodological issues

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

CO_2 emission from clinker production is the sum of the process emissions given in the verified reports for 2012 for installation of clinker production, which participate in the EU ETS [KOBiZE 2013]. This emission was estimated as 6384,3 Gg CO_2. Data on clinker production was taken from [GUS 2013b].

The clinker production in period 1988-2012 is shown on figure 4.2.2. Data on clinker production for the entire inventoried period was taken from [GUS 1989b-2013b].

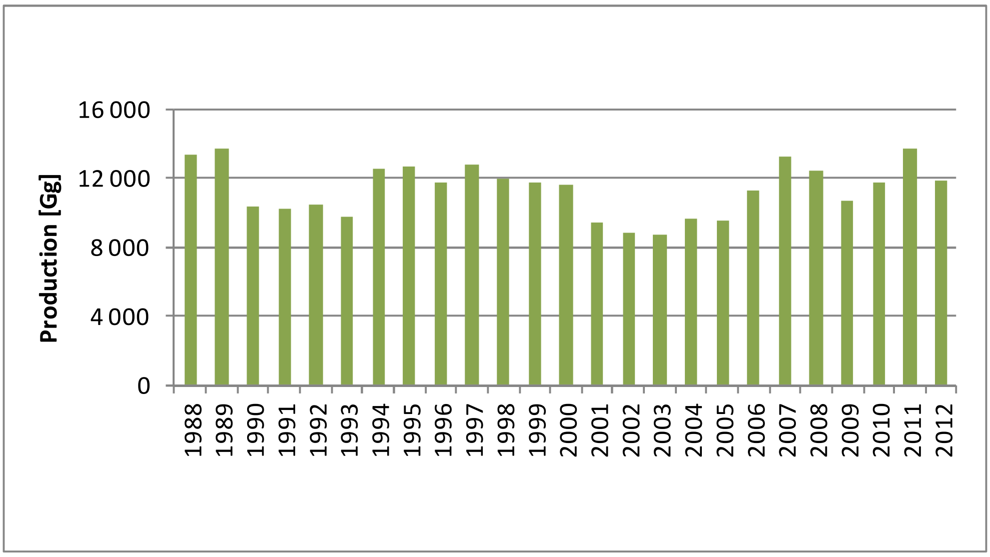

Figure 4.2.2. Clinker production in 1988-2012

CO_2 emission from clinker production was taken from the verified reports for the years: 2005-2012 for installations which participate in EU ETS. For other years emissions were estimated based on clinker production and emission factors. Emission factors which were used to estimate CO_2 process emissions from subcategory 2.A.1 are given bellow:

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

CO_2 emissions from clinker production in period 1988-2012 are shown on figure 4.2.3.

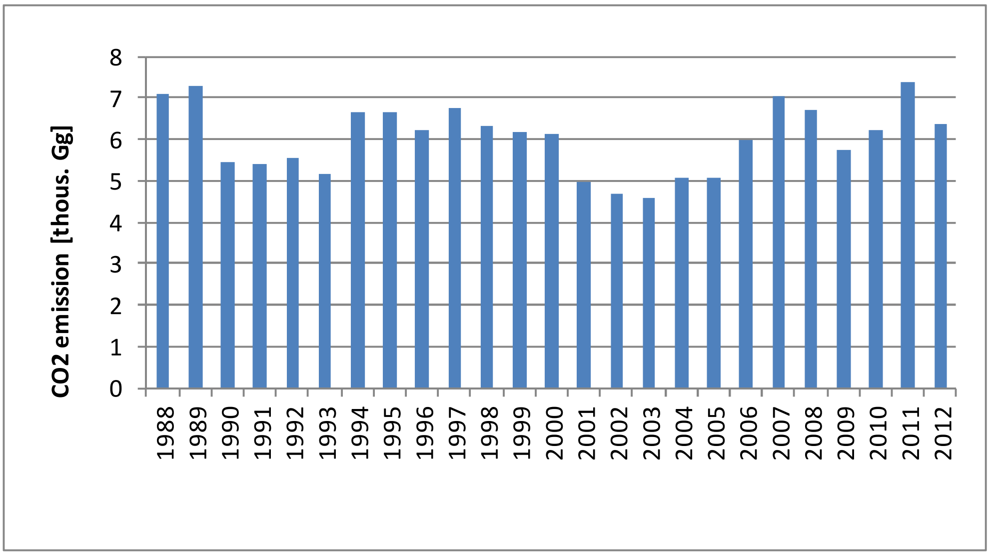

Figure 4.2.3. CO_2 process emission for clinker production in 1988-2012

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

Emission of CO_2 from lime production was calculated based on data on lime production from [GUS 2013b]. The applied emission factor is estimated according to IPCC recomendations [IPCC 2000] as following:

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

Data about production was taken from statistical yearbooks [GUS 1989b-2013b] – for entire period (figure 4.2.4). The same value of emission factor equal 767 kg CO_2/Mg of lime was used for all years. CO_2 emissions in period 1988-2012 are shown in the figure 4.2.5.

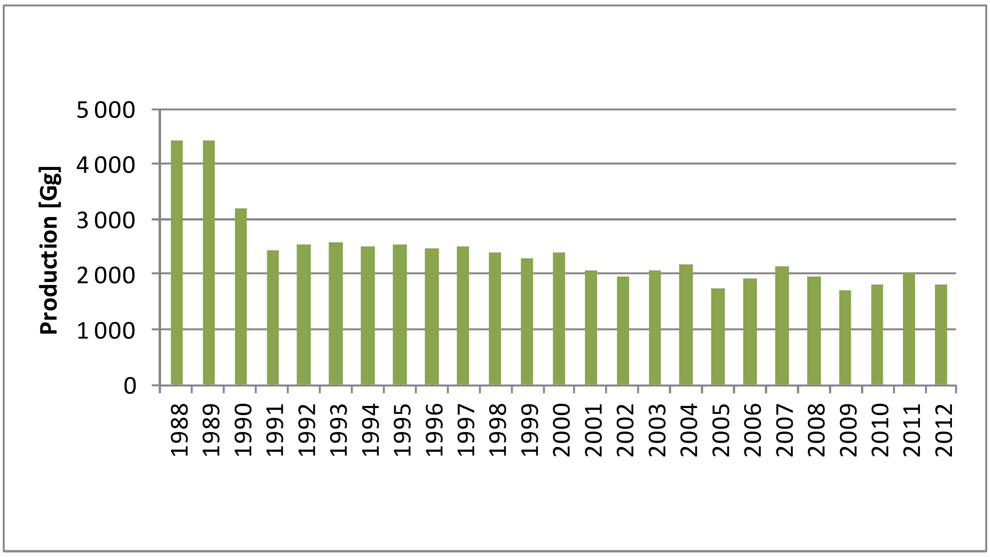

Figure 4.2.4. Lime production in 1988-2012

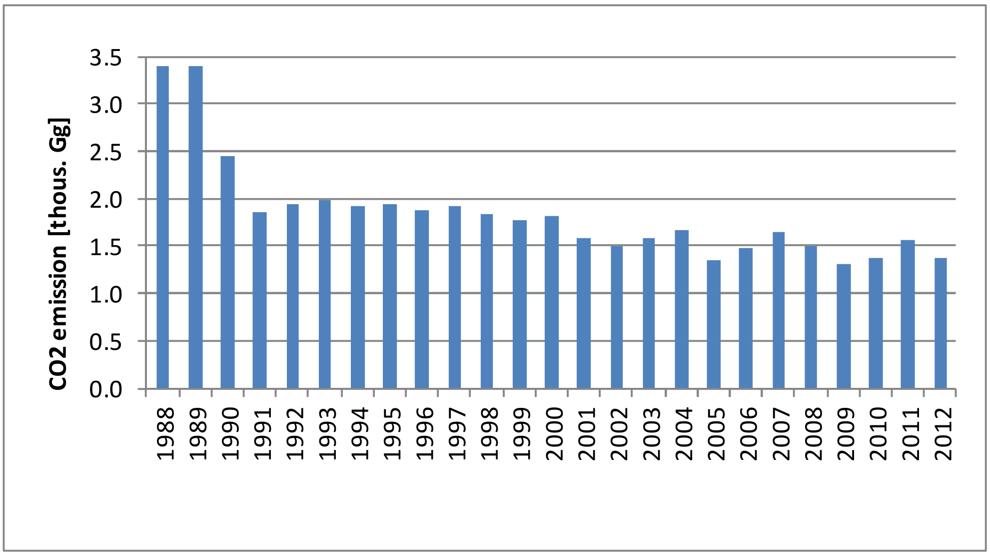

Figure 4.2.5. CO_2 process emission for lime production in 1988-2012

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

CO_2 emission in this category was estimated based on study [Galos 2013]. Emission from high temperature processes with limestone and dolomite use was considered.
Limestone and dolomite use in following processes was included in 2.A.3 subcategory:

- dolomite use in dead burned dolomite and calcined dolomite production
- limestone and dolomite use in glass production
- limestone use as a sorbent in lime wet flue-gas desulfurization, FGD in FBB (fluid bad boiler) and other method of flue gas desulfurization

Production of iron, steel, cement and lime was also the source of CO_2 emission from dolomite and limestone decomposition, but this emission was included in other IPCC subcategories. Emission from use of dolomites and limestone as fluxes in metallurgy was included in 2.1.C *Iron and steel production* subcategory. In case of cement and lime production, the CO_2 emission was categorized into 2.A.1 *Cement production* and 2.A.2 *Lime production* subsectors respectively, according to IPCC guidelines.

The results of CO_2 emission estimation in 2.C.3 category were presented in figure 4.2.6. Details concerning calculations were provided in the Annex 3.1.

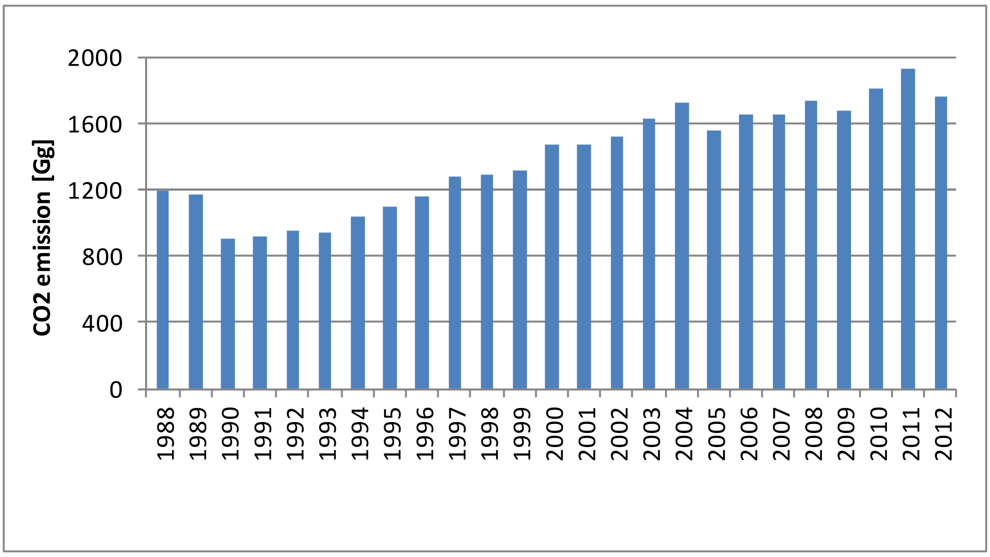

Figure 4.2.6. CO_2 emission from limestone and dolomites included in 2.A.3 subcategory in 1988-2012

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

In Poland, soda ash is produced in the Solvay Process. Emission of CO_2 from this process was assumed as 0. CO_2 emission from soda ash use was estimated based on annually consumption of soda ash, which was published in GUS yearbook: *Materials Management in 2012* [GUS 2013f]. 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].

CO_2 emission values from soda ash use in 2.A.4 subcategories, for entire period 1988-2012, were presented in figure 4.2.7. CO_2 emission for the years 1992-2012 was estimated based on data concerning soda ash consumption taken from *Materials Management* [GUS 1994f-2013f]. For years before 1992, due to lack of the published statistical data, the assumption was made, that soda ash consumption amounts to 50% of soda ash production. That assumption was based on the analysis, which considered production [GUS 1998e-2000e] and use of soda ash in the period 1992-1999. Soda ash consumption values for entire period were presented in the figure 4.2.8.

For the years 2005-2012, emissions of CO_2 from soda carbonates included in other subcategories (2.A.7 and 2.D) were subtracted from sub-sector 2.A.4. These subtracted CO_2 emission values are following: for 2012: 201.4, Gg, for 2011: 182.0, for 2010: 164.7 Gg, for 2009: 148.4 Gg, for 2008: 137.4 Gg, for 2007: 187.3 Gg, for 2006: 144.2 Gg and for 2005: 184.8 Gg . Activity data were reduced respectively to subtracted emission as well (it is the reason, that AD for the years 2005-2012 are not corresponding to the bars in the figure 4.2.8).

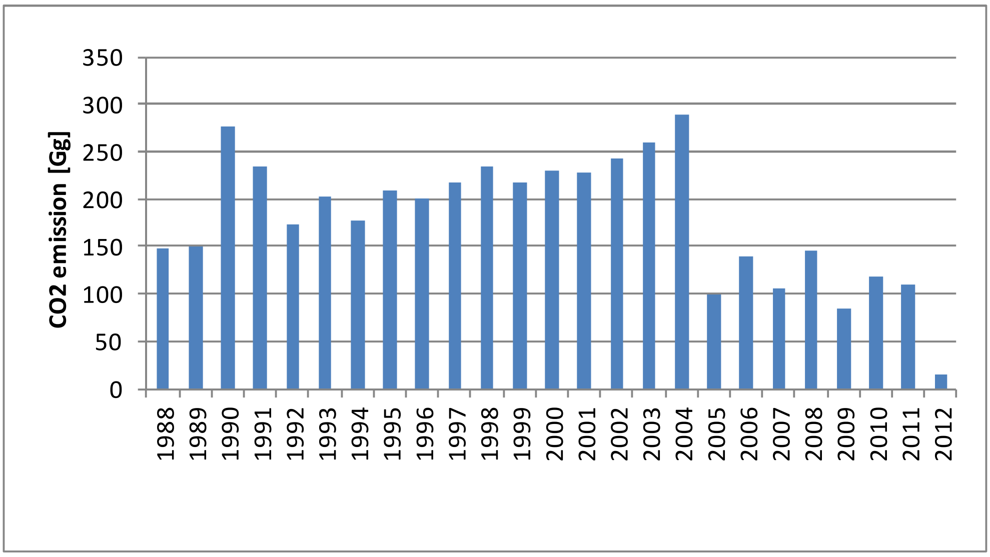

Figure 4.2.7. CO_2 emission from soda ash use and production in 1988-2012 (excluding soda ash use accounted in glass, ceramics and paper productions)

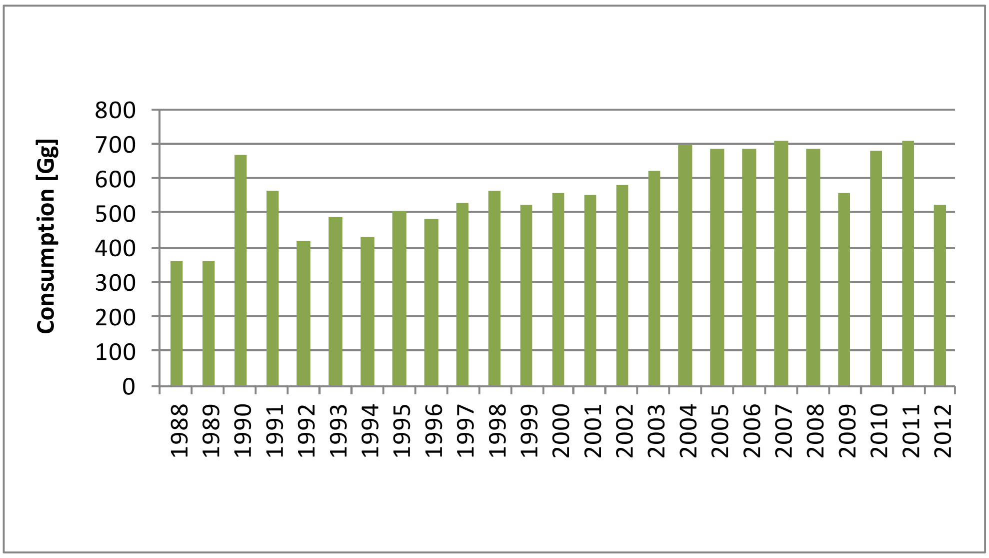

Figure 4.2.8. Total soda ash consumption in 1988-2012.

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

- Glass production

CO_2 emission from glass production was taken from the verified reports for 2012 for installation of glass and glass wool production, which participate in the emission trading scheme [KOBIZE 2013]. In 2012 this emission amounted to 377.7 Gg.
CO_2 emission values for the years 2005-2011, taken also from the verified reports for installations participating in the emission trading scheme were following: for year 2011: 365,5 Gg, 2010: 304.2 Gg, 2009: 273.4 Gg, 2008: 344.9 Gg CO_2, 350.1 Gg CO_2, for 2007, 339.2 Gg for 2006 while 343.5 Gg CO_2 in 2005. For years 1988-2004 this emission was not available.

- Ceramics materials production

CO_2 emission from production of ceramics materials was calculated based on the verified reports for 2012 for installation of ceramics production, which participate in EU ETS [KOBIZE 2013]. This emission value was equal to 143.1 Gg. For the years 2005-2011, the emissions were also taken from the verified reports for installations participating in EU ETS and amounted as follows: 166.1 Gg for 2011, 172.4 Gg for 2010, 169.1 Gg CO_2 for 2009, 228.2 Gg CO_2 for 2008, 228.5 Gg CO_2 for 2007, 260.9 Gg CO_2 for 2006 and 284.7 Gg CO_2 for 2005. For years: 1988-2004 the emissions in this subcategory were not available.

4.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2012 for IPCC sector *2.Industrial processes* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 8.
Recalculation of data for years 1988-2012 ensured consistency for whole time-series.

2012	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
2. Industrial Processes	**17,819.61**	**14.47**	**3.39**	6.1%	17.9%	30.1%
A. Mineral Products	10,064.05			10.4%		
B. Chemical Industry	4,316.53	13.21	3.39	7.1%	19.5%	30.1%
C. Metal Production	2,297.08	1.25	0.00	4.5%	11.9%	0.0%
D. Other Production	9.54			5.0%		
G. Other	1,132.41			5.0%		

4.2.4. Source-specific QA/QC and verification

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

Data relating to EUETS installations are verified by independent reviewers and by verification unit established in the National Centre for Emissions Management (KOBiZE). Additionally data on industrial production is compared with public statistics in case where entire sector is covered by EUETS.
Calculations in industry sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 7.

4.2.5. Source-specific recalculations

- for the entire period 1988-2011 activity data for CO_2 emission estimation from soda ash use (in 2.A.4 category) was changed; emission was estimated based on soda ash consumption while previously production amount of soda ash was applied for this calculation.

Table. 4.2.2. Changes of GHG emission values in 2.A. subcategory as a result of recalculations

Change	1988	1989	1990	1991	1992	1993	1994	1995
CO2								
Gg	-148.5	-150.2	-277.0	-233.4	-284.3	-215.2	-390.5	-220.1
%	-1.2	-1.2	-3.0	-2.7	-3.2	-2.5	-3.8	-2.2
Change	1996	1997	1998	1999	2000	2001	2002	2003
CO2								
Gg	-198.3	-196.9	-94.7	-98.9	-144.1	-156.6	-134.3	-122.1
%	-2.1	-1.9	-1.0	-1.0	-1.5	-1.9	-1.7	-1.5
Change	2004	2005	2006	2007	2008	2009	2010	2011
CO2								
Gg	-116.9	-128.9	-143.1	-201.7	-307.9	-137.5	-154.0	-156.9
%	-1.3	-1.5	-1.4	-1.8	-2.8	-1.5	-1.5	-1.3

4.2.6. Source-specific planned improvements

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

4.3. Chemical Industry (CRF sector 2.B)

4.3.1. Source category description

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

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

Subsectors 2.B.1. *Ammonia Production* is the largest contributors to emissions from this category (see figure 4.3.1) – almost 81% in 2012. Adipic acid was produced up to 1994.

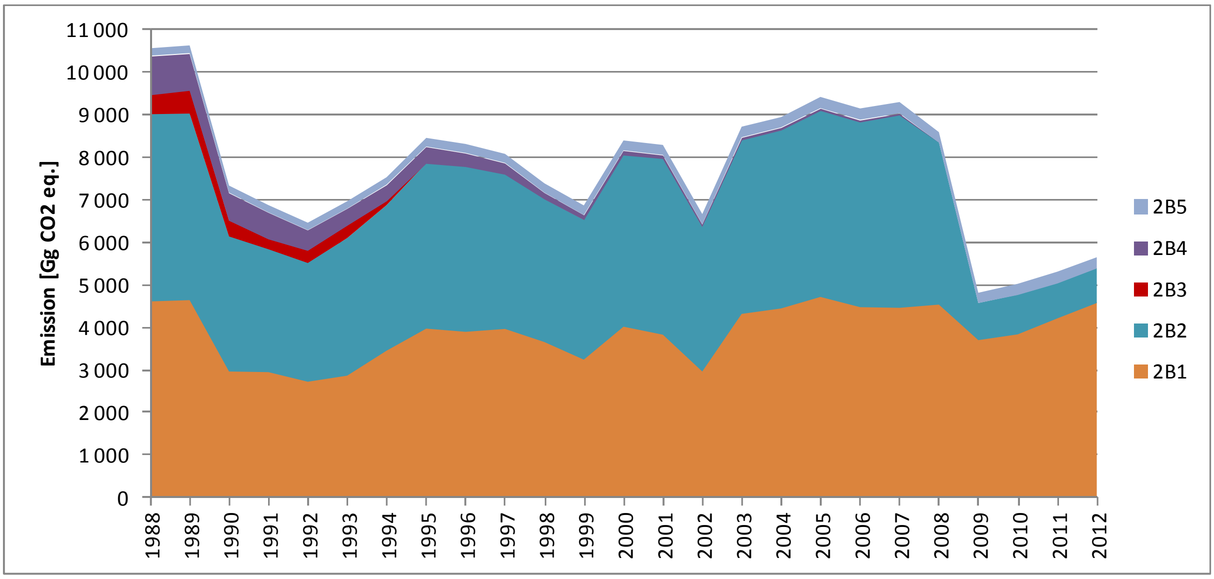

Figure 4.3.1. Emissions from *Chemical Industry* category in years 1988-2012 according to subcategories

4.3.2. Methodological issues

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

CO_2 emissions for ammonia production are estimated based on the data on natural gas use in this process (natural gas consumption for the years 1988-2012 was presented in Annex 3.2). The amount of natural gas consumption expressed in volume units was taken from [GUS 2013e]. To estimate carbon content in natural gas, the emission factor 0.525 kg C/m^3 from IPCC [IPCC 1997] was used. So the process emission was calculated using the following formula:

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

where:

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

This method was used for all years: 1988-2012. In years 1989-1990, also coke-oven gas was used for ammonia production and this fact was reflected in the inventory calculations (Annex 3.2). 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: 1988-2012 are shown in figure 4.3.2.

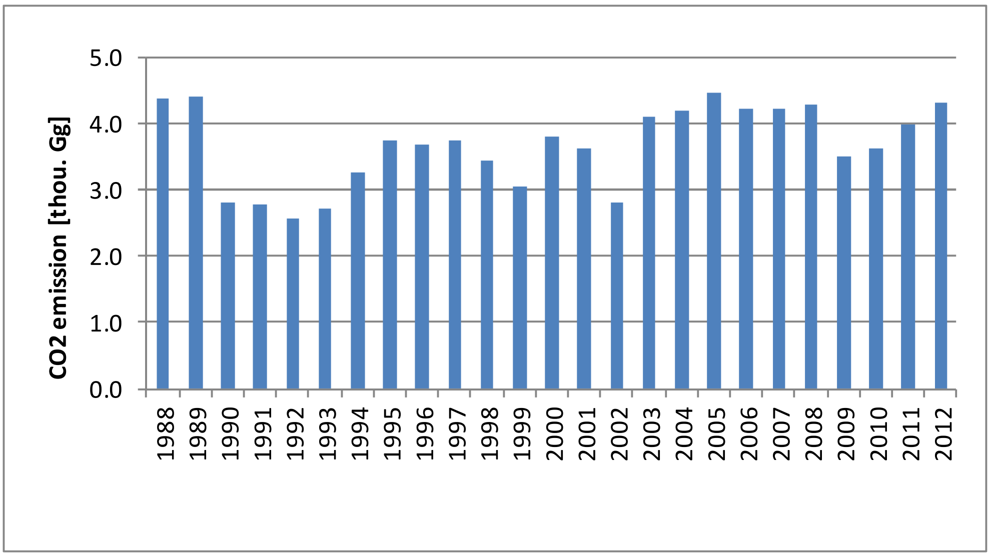

Figure 4.3.2. CO_2 process emission for ammonia production in 1988-2012

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

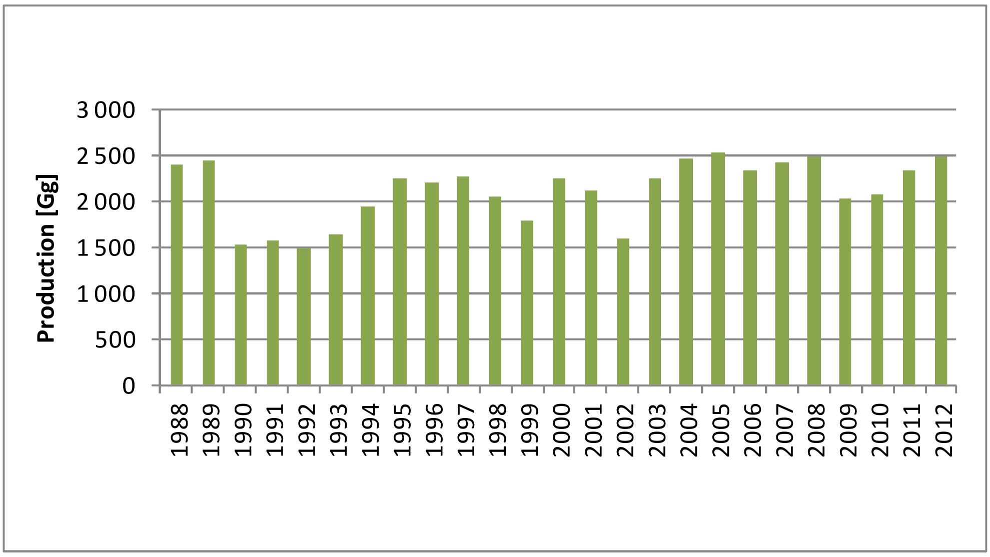

Figure 4.3.3. Production of ammonia in 1988-2012

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

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

Estimation of N_2O emission from nitric acid production for 2012 was based on annual HNO_3 production data from [GUS 2013b]. The applied country specific emission factor: 1.13 kg/Mg nitric acid was estimated based on the reports from all producers of HNO_3 [KOBiZE 2013]. The N_2O emission factors for years 2005-2011 were calculated also based on mentioned reports provided by installations of nitric acid production. The values of N_2O EFs applied for the years 2005-2011 were as follows: for 2005: 6.36 kg/Mg nitric acid, for 2006: 6.37 kg/Mg HNO_3, for 2007: 6.43 kg/Mg nitric acid, for 2008: 5.40 kg/Mg $HNO_{3,}$ 1.31 kg/Mg nitric acid for 2009, 1.35 kg/Mg HNO_3 for 2010 and 1.23 kg/Mg nitric acid for 2011.

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

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

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

Activity data (i.e. HNO_3 production) for estimation of nitrous oxide emissions in 2.B.2 subcategory were taken from [GUS 1989b-2013b] for the entire period 1988-2012. The amount of production and N_2O emissions from nitric acid production are shown in figures 4.3.4 and 4.3.5, respectively.

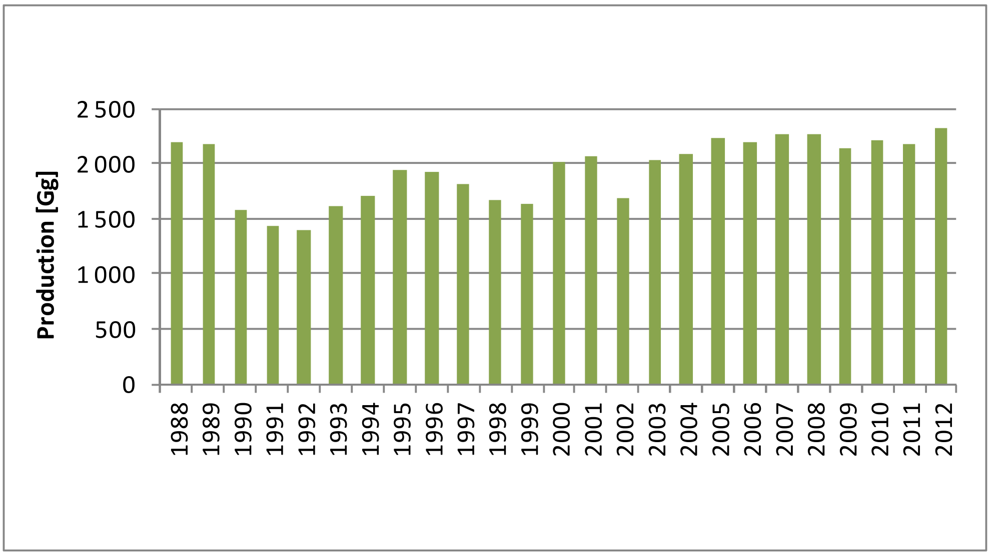

Figure 4.3.4. Production of nitric acid in 1988-2012

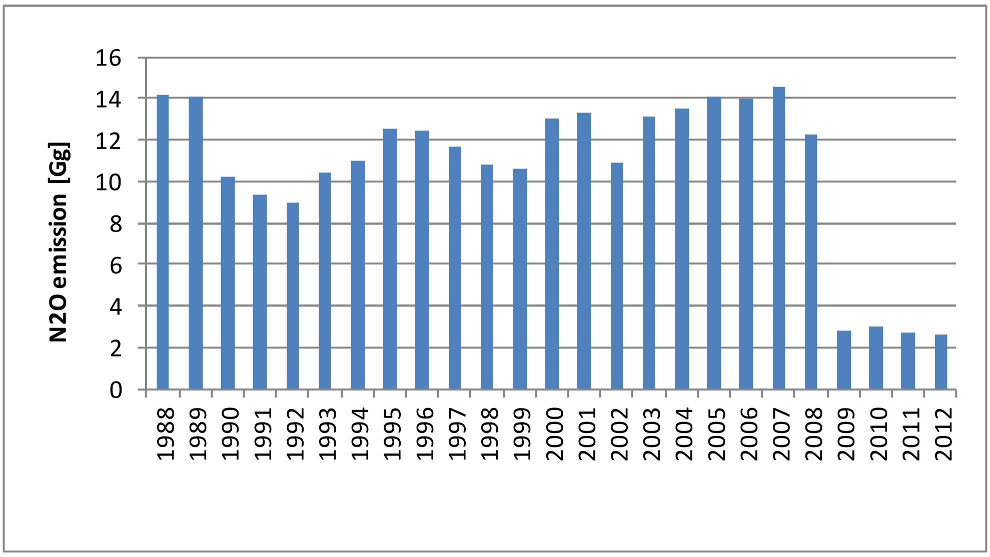

Figure 4.3.5. N_2O process emission for nitric acid production in 1988-2012

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

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

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

- Carbon Black Production

CH_4 emission from production of carbon black was estimated based on annual carbon black production from [GUS 2013e]. 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-2013e].
The emission factor of 11 kg CH_4/Mg was applied for calculation of CH_4 emission for the entire period 1988-2012.

- Ethylene Production

Emission of CO_2 from ethylene production was calculated based on ethylene annual production from [GUS 2013b]. Emission factor was taken from [CITEPA 1992]. Its value is 0.3 kg CO_2/Mg ethylene produced.

For the entire time series 1988–2012 the same activity data source – GUS publications [GUS 1989b-2013b] 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 1988-2012.

- Caprolactam Production

Data on annual caprolactam production for inventory calculation purpose was taken from [GUS 2013b]. 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-2013b] 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 2013b] and CH_4 EF equal 2 kg CH_4/Mg [IPCC 1997]. For all years the same emission factor of 2 kg CH_4/Mg methanol was used [IPCC 1997] while data on methanol production were taken from national statistics [GUS 1989b-2013b].

- Styrene Production

Methane emissions from styrene production for the entire period 1988-2012 were estimated by applying the same emission factor of 4 kg CH_4/Mg styrene [IPCC 1997]. Data on styrene production applied for emission estimation was taken from: National database [KOBiZE 2013] for 2012, G-03 questionnaires [GUS 1996e-2012e] for 1995-2011, while for previous years (1988-1994) the activity data were obtained directly from the only styrene producer (personal communication).

4.3.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.3.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.3.5. Source-specific recalculations

- methanol production amount for the years 2011 was updated according to data from GUS yearbook [GUS 2013b]

Table. 4.3.1. Changes of GHG emission values in 2.B. subcategory as a result of recalculations

Change	2011
CH4	
Gg	0.000026
%	0.0

4.3.6. Source-specific planned improvements

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

4.4. Metal Production (CRF sector 2.C)

4.4.1. Source category description

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

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

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

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

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

Subsector 2.C.1. *Iron and Steel Production* is by far the largest contributor to emissions from this category (see figure 4.4.1) – about 74% in 2012.

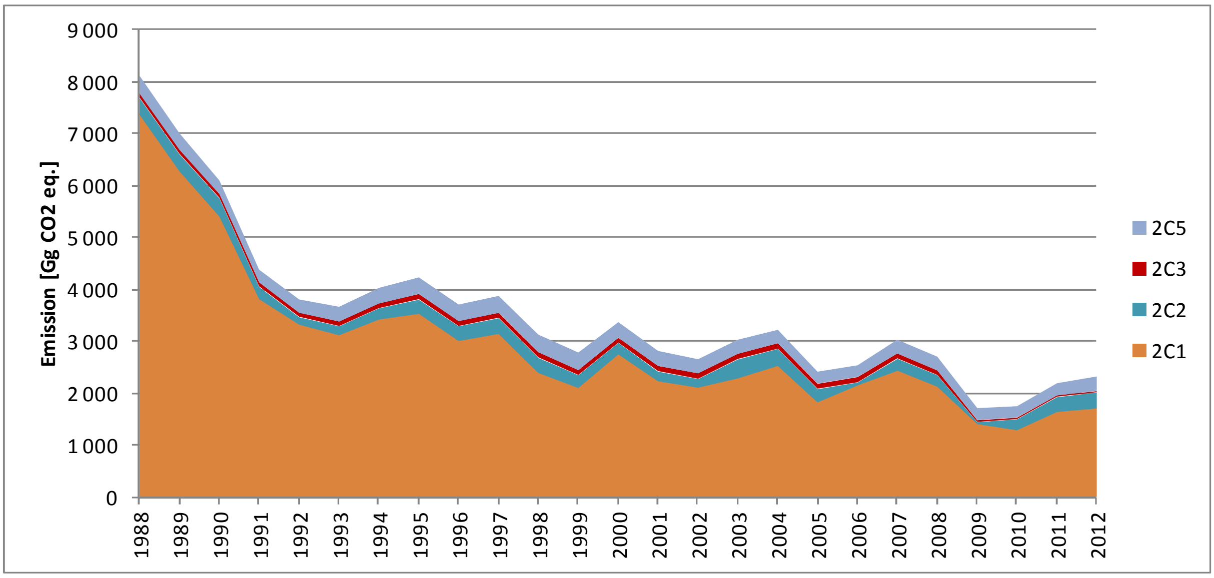

Figure 4.4.1. Emissions from *Metal Production* sector in years 1988-2012 according to subcategories

4.4.2. Methodological issues

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

Estimation of carbon dioxide process emissions from iron ore sinter production for 2012 was based on the data from the verified reports on annual emissions of CO_2 from iron ore sinter installations in EU ETS [KOBiZE 2013]. Sinter production amounts (not published from 2000 in statistical materials), data relating to main components of input and output in the sintering process were accepted according to mentioned EU ETS reports in order to estimate of country specific CO_2 emission factor for inventory purpose. Values of CO_2 emission and sinter production for 2005-2011 were also estimated in accordance with EU ETS reports.

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

The values of iron ore sinter production, CO_2 EFs and CO_2 emissions were presented in the table 4.4.1.

For the entire period 1988-2012 emissions of CH_4 were also estimated from iron ore sinter production. The default emission factor for CH_4 (0.07 kg/Mg), was taken from [IPCC 2006].

Table 4.4.1. Iron ore sinter production [Gg], CO_2 emission factors [kg/Mg of sinter] and CO_2 emission values from sinter production in the years 1988-2012 [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 emission factor	78.05	56.72	71.41	79.08	72.97	75.70	73.10	79.77	79.81	74.89
CO_2 emission	1101.14	736.98	841.16	681.13	629.08	577.45	642.35	689.76	663.94	672.58
	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 emission factor	73.55	83.21	79.00	72.36	73.92	85.08	76.79	72.59	84.59	88.28
CO_2 emission	506.20	538.89	638.21	532.01	563.07	657.86	659.70	447.73	584.31	613.91
	2008	**2009**	**2010**	**2011**	**2012**					
Production	6306.4	4362.6	5837.3	6512.8	6672.5					
CO_2 emission factor	91.11	82.25	75.77	69.29	52.63					
CO_2 emission	574.59	358.80	442.32	451.29	351.14					

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

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

- metal yield for particular years from period 1988-2012 equals 41.7-46.1% (cast steel production was calculated based on the yield value and steel cast production published in [*Modern Casting*]);

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

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

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

Data applied for estimation of CO_2 process emission from steel casts and CO_2 emissions values for entire period 1988-2012 were presented in table 4.4.2.

Table 4.4.2. Activity data for estimation of CO_2 process emission from steel casting in 1988-2012

Year	Liquid steel Mg	Liquid steel melted in electric arc furnace, Mg	Liquid steel melted in induction furnace, Mg	Electrode consumption, Mg	CO_2 emission from burning out of electrodes, Mg	Amount of carbon burn out, Mg	CO_2 emission from burn out of carbon, Mg	Total CO_2 emission from melting of steel, Gg
1988	641 892	622635	19 257	4981	18 264	3113	11 415	29.679
1989	538 289	522 140	16 149	4177	15 316	2611	9573	24.889
1990	434 685	421 644	13 041	3373	12 368	2108	7730	20.098
1991	225 968	219 189	6779	1754	6430	1096	4018	10.448
1992	165 766	160 793	4973	1286	4717	804	2948	7.664
1993	150 473	145 959	4514	1168	4281	730	2676	6.957
1994	159 910	155 113	4797	1241	4550	776	2844	7.394
1995	175 901	170 624	5277	1365	5005	853	3128	8.133
1996	193 919	188 101	5818	1505	5518	941	3449	8.966
1997	178 378	173 027	5351	1384	5075	865	3172	8.248
1998	140 090	135 887	4203	1087	3986	679	2491	6.477
1999	123 874	120 158	3716	961	3525	601	2203	5.728
2000	124 775	121 032	3743	968	3550	605	2219	5.769
2001	122 748	119 066	3682	953	3493	595	2183	5.675
2002	109 009	105 739	3270	846	3102	529	1939	5.040
2003	111 511	108 166	3345	865	3173	541	1983	5.156
2004	117 354	113 833	3521	911	3339	569	2087	5.426
2005	133 187	129 191	3996	1034	3790	646	2369	6.158
2006	132 747	128 765	3982	1030	3777	644	2361	6.138
2007	142 198	137 932	4266	1103	4046	690	2529	6.575
2008	140 349	136 139	4210	1089	3993	681	2496	6.489
2009	123 538	119 832	3706	959	3515	599	2197	5.712
2010	148 132	143 688	4444	1150	4215	718	2634	6.849
2011	156 923	152 215	4708	1218	4465	761	2791	7.256
2012	113 187	109 791	3396	878	3221	549	2013	5.233

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

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

- metal yield values for given types of cast iron in period 1988-2012 were as follow: 67-72% for gray iron, 47.9-50.7% for ductile cast iron, 32.3-34.5% for malleable cast iron (total amount of melted cast iron for particular year was calculated based on iron cast production [*Modern Casting*] and metal yield value);
- part of coke in charge is 15% (150 kg/Mg metal charge),
- part of $CaCO_3$ in charge is 25% of coke addition (3.75% of metal charge),
- yield of liquid metal from cupola is 95% (melting loss 5%),
- part of cast iron melted in cupola was assumed at 80% for the years: 1988 – 1998; for the following years this share significantly dropped from 77.3% in 2000 to approx. 40% lately.
- C content in coke for charge was 85-90%.

Data applied for calculation of CO_2 process emission from iron casting production and CO_2 process emission value for 1988-2012 were presented in the table 4.4.3.

Table 4.4.3. CO_2 process emission from cast iron production in years 1988-2012

Year	Liquid cast iron Mg	Liquid cast iron melted in cupola, Mg	Metal charge into cupola Mg	Coke consumption Mg	$CaCO_3$ consumption Mg	CO_2 emission from $CaCO_3$ decomposition Mg
1988	2 185 633	1 748 506	1 840 533	276 080	69 020	30.369
1989	1 855 655	1 484 524	1 562 657	234 399	58 560	25.784
1990	1 525 676	1 220 541	1 284 780	192 717	48 179	21.199
1991	1 039 006	831 205	874 952	131 243	32 811	14.437
1992	1 013 144	810 405	653 058	127 959	31 990	14.075
1993	1 005 974	804 779	847 136	127 070	31 768	13.978
1994	1 057 558	846 046	890 575	133 586	33 397	14.694
1995	1 137 438	909 950	957 842	143 676	35 919	15.804
1996	1 073 413	858 730	903 927	135 589	33 897	14.915
1997	1 054 730	843 784	888 194	133 229	33 307	14.655
1998	904 220	723 376	761 448	114 217	28 554	12.564
1999	882 894	589 000	620 000	93 000	23 250	10.230
2000	982 735	760 000	800 000	120 000	30 000	13.200
2001	984 608	519 334	546 667	82 000	20 500	9.020
2002	876 968	456 000	480 000	72 000	18 000	7.920
2003	865 238	412 934	434 667	65 200	16 300	7.172
2004	893 865	395 200	416 000	62 400	15 600	6.864
2005	914 745	369 835	389 300	58 400	14 600	6.424
2006	962 163	367 334	386 667	58 000	14 500	6.380
2007	1 019 085	383 800	404 000	60 600	15 150	6.666
2008	1 084 065	437 532	460 560	69 084	17 271	7.599
2009	805 076	279 145	293 837	44 076	11 019	4.848
2010	968 676	368 472	387 865	58 180	14 545	6.400
2011	1 029 929	391 772	412 391	61 859	15 465	6.804
2012	1 022 158	405 232	426 560	63 984	15 996	7.038

CH_4 emission for entire period 1988-2012 was estimation based on EF = 0.20 kg CH_4/Mg. This EF was taken from [Radwański 1995].

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

CO_2 process emission from pig iron production for the years 1988-2012 was estimated based on carbon balance in blast furnace process. Balances for individual years were founded on the statistical data for main components of input and output. Pig iron production values for entire period were accepted according to G-03 questioners [GUS 1989e-2013e]. Output of blast furnace gas was taken from IEA database [IEA] for the years 1988-1989. For the period 1990-2012 this data came from Eurostat database. In case of coke input source of data was derived respectively: for the years 1988-1989 – data from the *Energy statistic* [GUS 1989a-1990a] corrected by Energy Market Agency (ARE), for the period 1990-2012 – IEA database [IEA]. (Data from Eurostat database was not applied to C balance for process of pig iron production, because of blast furnaces transformation efficiency in Eurostat energy balance is very high and it is the reason, that there is too little amount of coke use in „Transformation input in Blast Furnaces" compared with real technological demand. This problem was also mentioned in chapter 3.2.7.2.1. *Iron and steel* (1.A.2.a)). Amounts of other components were estimated according to technological factors taken from literature [Szargut J. 1978]. These coefficients enabled to estimate amounts i.a.: dolomite (0,0885 kg/kg pig iron), limetone (0,0974 kg/kg pig iron) and iron ore (0,188 kg roasted ore/kg pig iron 0,0716 manganese ore/kg pig iron). In case of iron ore sinter was assumed (in accordance with data from steel plants), that total annual sinter production is consumed in given year for pig iron production. 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).

Carbon balance for blast furnace process for the years 1988-2012 and estimated emissions for entire period were presented in the table 4.4.4.

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

Amount of CO_2 process emission from steel production in basic oxygen furnace was estimated based on the carbon balance in converter process (table 4.4.5). For the years 1988-2006 the Polish Steel Association (HIPH) study [HIPH 2007] was the main source of data for C balance purpose. The HIPH data was supplemented for the years 1988-2004 with the information from questionnaires collected by the National Centre for Emissions Management (KOBiZE) for installations covered by EU ETS and starting from 2005 with the data from verified reports concerning CO_2 emission, prepared as part of EU ETS. Based on mentioned verified reports, C balances for basic oxygen steel plants were prepared for the years not included in the HIPH study, it means for the period 2007-2012. Steel production amounts applied in the C balance were in accordance with data published in GUS yearbook [2005b-2013b].

Table 4.4.4. Carbon balance for blast furnace process in years: 1988-2012

	1988	1989	1990	1991	1992	1993	1994	1995	1996
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	157 399	106 999	101 994	95 370	110 384	113 854	97 640
Coking coal [TJ]									
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
Coking coal [kg/GJ]									
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	4 643.3	3 156.5	3 008.8	2 813.4	3 256.3	3 358.7	2 880.4
Coking coal									
C IN CHARGE – SUM	5 791.4	5 566.3	4 891.5	3 342.6	3 193.9	2 992.8	3 458.5	3 570.5	3 067.9
OUTPUT IN GIVEN YEAR									
Pig iron [Gg]	**10 262.4**	**9 487.6**	**8 656.7**	**6 501.5**	**6 462.0**	**6 292.9**	**7 081.2**	**7 443.5**	**6 561.9**
Blast furnace gas [TJ]	74 521	71 771	62 970	42 811	40 802	38 157	44 162	45 545	39 062
OUTPUT – C content									
Pig iron [kg/kg]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Blast furnace gas [kg/GJ]	66	66	66	66	66	66	66	66	66
OUTPUT – total C content [Gg]									
Pig iron	410.5	379.5	346.3	260.1	258.5	251.7	283.2	297.7	262.5
Blast furnace gas	4 918.4	4 736.9	4 156.0	2 825.5	2 692.9	2 518.4	2 914.7	3 006.0	2 578.1
C IN OUTPUT – SUM	5 328.9	5 116.4	4 502.3	3 085.6	2 951.4	2 770.1	3 197.9	3 303.7	2 840.6
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [Gg]	462.5	449.9	389.2	257.0	242.5	222.7	260.5	266.8	227.3
CO_2 EMISSION [Gg]	**1 696**	**1 650**	**1 427**	**942**	**889**	**817**	**955**	**978**	**833**
CO_2 EMISSION FACTOR [kg/Mg]	**165**	**174**	**165**	**145**	**138**	**130**	**135**	**131**	**127**

Table 4.4.4. (cont.) Carbon balance for blast furnace process in years: 1988-2012

	1997	1998	1999	2000	2001	2002	2003	2004
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]	103 274	85 714	70 423	92 603	79 737	71 875	77 563	84 581
Coking coal [TJ]								
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
Coking coal [kg/GJ]								
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	3 046.6	2 528.5	2 077.5	2 731.8	2 352.3	2 120.3	2 288.1	2 495.1
Coking coal								
C IN CHARGE – SUM	3 258.0	2 706.8	2 228.2	2 917.5	2 508.3	2 272.6	2 450.1	2 679.3
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]	234.3	192.5	157.1	211.8	184.9	163.1	176.2	189.0
CO_2 EMISSION [Gg]	**859**	**706**	**576**	**777**	**678**	**598**	**646**	**693**
CO_2 EMISSION FACTOR [kg/Mg]	**116**	**112**	**109**	**119**	**125**	**113**	**114**	**108**

Table 4.4.4. (cont.) Carbon balance for blast furnace process in years: 1988-2012

	2005	2006	2007	2008	2009	2010	2011	2012
CHARGE – amount used in process in given year								
Sinter [Gg]	6 168.4	6 907.8	6 954.0	6 306.4	4 362.6	5 837.3	6 512.8	6 672.5
Roasted ore [Gg]	842.5	1 042.1	1 091.2	927.6	560.9	683.9	747.3	741.0
Dolomite [Gg]	396.4	490.3	513.4	436.4	263.9	321.8	351.6	348.6
Limestone [Gg]	436.5	539.9	565.4	480.6	290.6	354.3	387.2	383.9
Manganese ore [Gg]	320.9	396.9	415.6	353.3	213.6	260.5	284.6	282.2
Coke [TJ]	58 590	72 356	86 543	71 351	44 020	50 809	52 396	52 144
Coking coal [TJ]						948	2 338	5 957
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
Coking coal [kg/GJ]						25.8	25.8	25.8
CHARGE – total C content [Gg]								
Sinter	6.8	7.6	7.6	6.9	4.8	6.4	7.2	7.3
Roasted ore	9.5	11.7	12.3	10.4	6.3	7.7	8.4	8.3
Dolomite	51.5	63.7	66.7	56.7	34.3	41.8	45.7	45.3
Limestone	52.4	64.8	67.8	57.7	34.9	42.5	46.5	46.1
Manganese ore	8.4	10.4	10.9	9.2	5.6	6.8	7.4	7.4
Coke	1 728.4	2 134.5	2 553.0	2 104.9	1 298.6	1 498.9	1 545.7	1 538.2
Coking coal						24.5	60.3	153.7
C IN CHARGE – SUM	1 857.0	2 292.8	2 718.4	2 245.9	1 384.5	1 628.6	1 721.2	1 806.4
OUTPUT IN GIVEN YEAR								
Pig iron [Gg]	**4 481.2**	**5 543.4**	**5 804.4**	**4 933.8**	**2 983.5**	**3 638.0**	**3 974.9**	**3 941.4**
Blast furnace gas [TJ]	23 446	28 948	34 626	28 551	17 610	22 022	22 271	22 684
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	179.2	221.7	232.2	197.4	119.3	145.5	159.0	157.7
Blast furnace gas	1 547.4	1 910.6	2 285.3	1 884.4	1 162.3	1 453.5	1 469.9	1 497.1
C IN OUTPUT – SUM	1 726.7	2 132.3	2 517.5	2 081.7	1 281.6	1 599.0	1 628.9	1 654.8
DIFFERENCE BETWEEN C IN INPUT and C IN OUTPUT [Gg]	130.3	160.4	200.9	164.2	102.9	29.6	92.3	151.6
CO_2 EMISSION [Gg]	**478**	**588**	**737**	**602**	**377**	**109**	**339**	**556**
CO_2 EMISSION FACTOR [kg/Mg]	**107**	**106**	**127**	**122**	**126**	**30**	**85**	**141**

Table 4.4.5. Carbon balance for steel production in basic oxygen process in years 1988-2012

	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
Carbon pick-up agent [Mg]	0	0	0	0	0	0	0	0	0
Ferroalloys [Mg]	61 135	58 311	57 193	45 416	48 066	46 278	53 217	57 027	51 883
Dolomite [Mg]	187 960	182 054	189 020	144 459	155 741	144 853	163 776	177 073	156 867
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
Carbon pick-up agent	0	0	0	0	0	0	0	0	0
Ferroalloys	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.007	0.008
Dolomite	0.025	0.025	0.026	0.025	0.025	0.024	0.023	0.023	0.023
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
Carbon pick-up agent [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Ferroalloys [Mg C/Mg]	0.033	0.033	0.033	0.033	0.032	0.033	0.033	0.033	0.032
Dolomite [Mg C/Mg]	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
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
Carbon pick-up agent	0	0	0	0	0	0	0	0	0
Ferroalloys	2 019	1 936	1 868	1 481	1 557	1 518	1 741	1 862	1 686
Dolomite	24 435	23 667	24 573	18 780	20 246	18 831	21 291	23 019	20 393
Carbon contents in charge – SUM [Mg]	**291 526**	**283 959**	**282 299**	**219 564**	**239 357**	**234 850**	**265 136**	**290 349**	**255 762**
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**
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	29 699	28 849	28 828	23 000	24 991	24 640	28 134	30 742	27 030
Carbon content in products – SUM [Mg]	**29 699**	**28 849**	**28 828**	**23 000**	**24 991**	**24 640**	**28 134**	**30 742**	**27 030**
C emission from steel production [Mg]	261 827	255 109	253 471	196 564	214 366	210 210	237 002	259 607	228 732
CO_2 process emission from steel production [Gg]	**960.033**	**935.401**	**929.394**	**720.734**	**786.009**	**770.769**	**869.006**	**951.893**	**838.684**
CO_2 EMISSION FACTOR [kg CO_2/Mg of steel]	**129.30**	**129.69**	**128.96**	**125.34**	**125.81**	**125.12**	**123.55**	**123.86**	**124.11**

Table 4.4.5. Carbon balance (cont.) for steel production in basic oxygen process in years 1988-2012

	1997	1998	1999	2000	2001	2002	2003	2004	2005
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	4 538 670
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	1 147 906
Carbon pick-up agent [Mg]	0	0	0	0	1 201	2 645	4 286	1 689	1 205
Ferroalloys [Mg]	59 896	50 915	45 285	57 840	50 035	49 610	48 197	57 157	56 566
Dolomite [Mg]	188 810	157 145	141 317	174 301	156 426	161 404	127 127	162 673	191 374
Technological indicator [Mg/Mg of steel]									
Pig iron	0.838	0.841	0.851	1.047	1.070	1.095	1.078	1.088	1.078
Scrap	0.2554	0.2554	0.2391	0.2437	0.2346	0.2346	0.2346	0.2346	0.2346
Carbon pick-up agent	0	0	0	0	0.0002	0.0005	0.0007	0.0002	0.0002
Ferroalloys	0.008	0.008	0.008	0.009	0.009	0.009	0.008	0.008	0.012
Dolomite	0.025	0.025	0.026	0.026	0.027	0.028	0.021	0.024	0.039
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
Carbon pick-up agent [Mg C/TJ]	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5	29.5
Ferroalloys [Mg C/Mg]	0.033	0.033	0.032	0.033	0.032	0.032	0.032	0.033	0.031
Dolomite [Mg C/Mg]	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130	0.130
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	181 547
Steel scrap	7 693	6 356	5 216	6 628	5 464	5 442	5 696	6 436	4 592
Carbon pick-up agent	0	0	0	0	992	2 184	3 539	1 395	995
Ferroalloys	1 951	1 659	1 466	1 905	1 623	1 598	1 560	1 860	1 779
Dolomite	24 545	20 429	18 371	22 659	20 335	20 983	16 527	21 147	24 879
Carbon contents in charge – SUM [Mg]	**286 637**	**237 769**	**210 665**	**290 867**	**246 016**	**242 063**	**252 514**	**283 008**	**213 791**
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**	**4 892 671**
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	30 125	24 890	21 811	27 199	23 290	23 196	24 280	27 430	19 571
Carbon content in products – SUM [Mg]	**30 125**	**24 890**	**21 811**	**27 199**	**23 290**	**23 196**	**24 280**	**27 430**	**19 571**
C emission from steel production [Mg]	256 512	212 879	188 854	263 668	222 726	218 867	228 234	255 578	194 220
CO_2 process emission from steel production [Gg]	**940.545**	**780.557**	**692.464**	**966.782**	**816.662**	**802.513**	**836.857**	**937.119**	**712.141**
CO_2 EMISSION FACTOR [kg CO_2/Mg of steel]	**124.89**	**125.44**	**126.99**	**142.18**	**140.26**	**138.39**	**137.87**	**136.65**	**145.55**

Table 4.4.5. (cont.) Carbon balance for steel production in basic oxygen process in years 1988-2012

	2006	2007	2008	2009	2010	2011	2012
CHARGE							
Pig iron [Mg]	5 338 401	5 723 961	4 892 172	2 988 979	3 599 854	3 942 754	3 934 606
Scrap [Mg]	1 352 895	1 414 926	1 105 439	727 586	965 296	1 106 613	912 706
Carbon pick-up agent [Mg]	1 036	753	8 270	12 826	16 033	24 905	8 845
Ferroalloys [Mg]	68 765	71 480	65 149	40 273	53 926	59 738	53 477
Dolomite [Mg]	35 776	37 149	18 930	10 786	16 375	14 220	15 560
Technological indicator [Mg/Mg of steel]							
Pig iron	1.080	0.924	0.936	0.924	0.901	0.891	0.908
Scrap	0.2346	0.228	0.212	0.225	0.242	0.250	0.211
Carbon pick-up agent	0.0002	0.000	0.002	0.004	0.004	0.006	0.002
Ferroalloys	0.012	0.012	0.012	0.012	0.013	0.014	0.012
Dolomite	0.006	0.006	0.004	0.003	0.004	0.003	0.004
Material-specific carbon content							
Pig iron [Mg C/Mg]	0.04	0.042	0.042	0.043	0.042	0.042	0.043
Scrap [Mg C/Mg]	0.004	0.003	0.008	0.008	0.009	0.009	0.008
Carbon pick-up agent [Mg C/Mg]	0.826	0.899	0.820	0.845	0.823	0.806	0.823
Ferroalloys [Mg C/Mg]	0.029	0.032	0.035	0.035	0.033	0.028	0.031
Dolomite [Mg C/Mg]	0.130	0.130	0.124	0.125	0.125	0.125	0.126
Carbon contents in charge components [Mg C]							
Pig iron	213 536	239 730	207 333	127 337	150 438	165 971	167 334
Steel scrap	5 412	4 297	8 457	5 785	9 109	9 865	7 292
Carbon pick-up agent	855	677	6 783	10 839	13 198	20 075	7 277
Ferroalloys	2 021	2 288	2 249	1 427	1 761	1 673	1 681
Dolomite	4 649	4 829	2 341	1 345	2 047	1 780	1 960
Carbon contents in charge – SUM [Mg]	**226 474**	**251 821**	**227 163**	**146 733**	**176 553**	**199 365**	**185 544**
OUTPUT							
Steel [Mg]	**5 766 375**	**6 197 910**	**5 225 075**	**3 235 666**	**3 994 650**	**4 423 604**	**4 333 168**
Material-specific carbon content							
Steel [Mg C/Mg]	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Carbon content in products [Mg C]							
Steel	23 066	18 304	41 662	25 760	38 441	40 780	34 990
Carbon content in products – SUM [Mg]	**23 066**	**18 304**	**41 662**	**25 760**	**38 441**	**40 780**	**34 990**
C emission from steel production [Mg]	203 408	233 516	185 501	120 974	138 111	158 585	150 554
CO_2 process emission from steel production [Gg]	**745.831**	**856.227**	**680.171**	**443.570**	**506.409**	**581.478**	**552.032**
CO_2 EMISSION FACTOR [kg CO_2/Mg of steel]	**129.34**	**138.15**	**130.17**	**137.09**	**126.77**	**131.45**	**127.40**

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

Process emissions of CO_2 from steel production in electric furnaces for particular years in the period 1988-2006 were estimated based on the data from Polish Steel Association study [HIPH 2007]. For the last years information from verified reports, prepared as part of EU ETS, was applied for emission calculation. Steel production amounts was taken from Central Statistical Office yearbook [2008b-2013b].

Results of CO_2 emission estimation, AD and emission factors applied for calculation are presented in the table 4.4.6.

Table 4.4.6. Values of steel production in electric furnace [Gg] as well as CO_2 emission factors [kg/Mg of steel] and CO_2 emission [Gg] connected with that process for the years 1988-2012.

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production	2572.4	2264.3	2308.6	1950.9	1727.3	2044.2	2368.1	2581.9	2648.4	2906.3
CO_2 emission factor	34.75	36.94	36.94	36.11	33.21	37.82	36.44	33.05	33.05	33.05
CO_2 emission	89.38	83.63	85.27	70.45	57.36	77.32	86.29	85.34	87.54	96.07
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Production	3116.9	2825.1	3283.9	2809.1	2561.2	2916.6	3720.9	3443.2	4225.3	4432.8
CO_2 emission factor	35.83	29.15	44.13	44.10	45.64	41.90	55.10	46.97	48.88	44.76
CO_2 emission	111.66	82.35	144.91	123.89	116.90	122.20	205.00	161.74	206.53	198.41
	2008	**2009**	**2010**	**2011**	**2012**					
Production	4502.3	3892.8	4001.4	4352.9	4206.1					
CO_2 emission factor	53.44	52.84	50.70	54.98	52.70					
CO_2 emission	240.58	205.68	202.88	239.30	221.67					

CH_4 emission from steel production in electric furnaces was assessed for entire time series 1988-2012 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].

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

Process emission of CO_2 from coking plants for the entire reporting period was allocated into 1.B.1 *Fugitive emission from solid fuels* subcategory.

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

Emission of CO_2 concerning ferroalloys production was estimated based on annual ferrosilicon production taken from [GUS 2013b]. Applied emission factor of 3900 kg CO_2/Mg ferrosilicon, was taken from [IPCC 1997] – *Workbook*, tab. 2-17 for ferrosilicon – 75% Si.

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

In the period 1988-2011 CO_2 and CH_4 process emission from ferroalloys production was estimated also based on annual ferrosilicon production taken from [GUS 1989b-2012b] (figure 4.4.2) and emission factors as in year 2012.

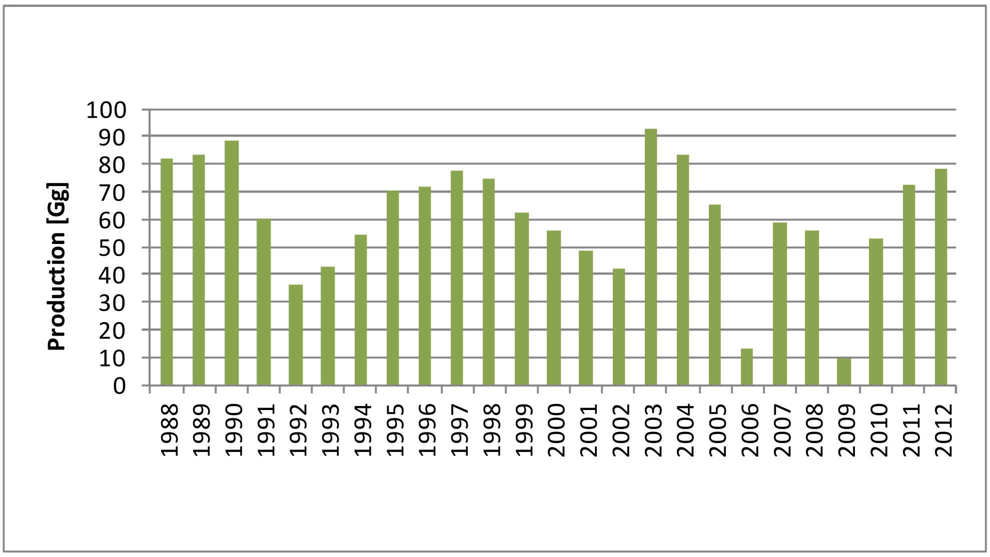

Figure 4.4.2. Production of ferrosilicon in 1988-2012

Coal consumption in ferroalloys production is submitted in national energy statistics as non-energy use of fuel. This means that coal consumed as reducer in mentioned process is not included in energy consumption of coal in 1.A.2.a subsector, so double counting is avoided.

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

Calculation of CO_2 emission from primary aluminium production for 2012 is based on the data on aluminium production published in [GUS 2013b]. 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 1988-2012 were estimated according to the above mentioned description. The amount of emissions for the entire trend is shown in figure 4.4.3.

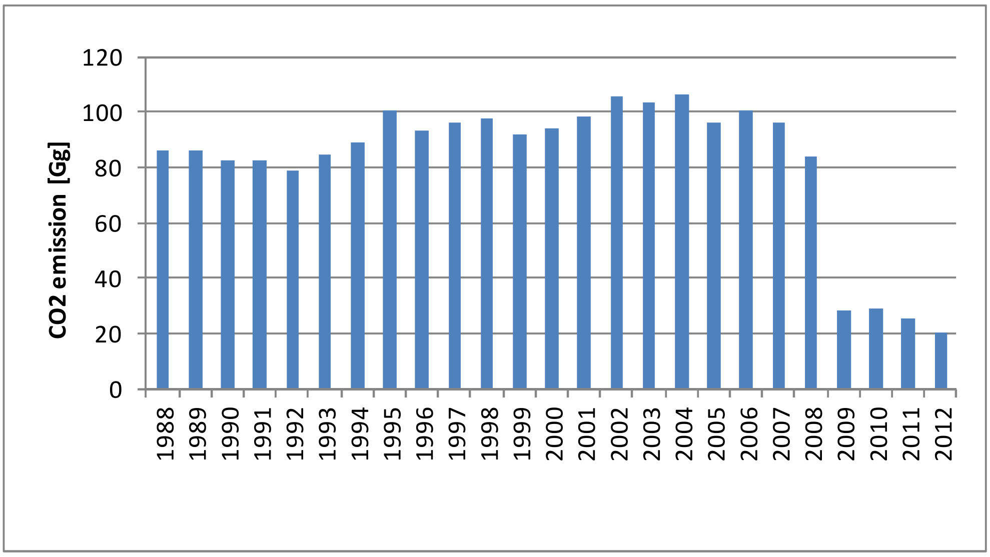

Figure 4.4.3. CO_2 process emission for aluminium production in 1988-2012

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

- *Zinc production*

Process emission of CO_2 from zinc production was estimated based on annual zinc production taken from GUS [GUS 2013b]. The emission factor comes from [IPCC 2006] – table 4.24 and is 1.72 Mg CO_2/Mg zinc.

For the entire period 1988-2012 data source on zinc production as well as the emission factor remain the same. The trend of process emissions from zinc production is given in figure 4.4.4.

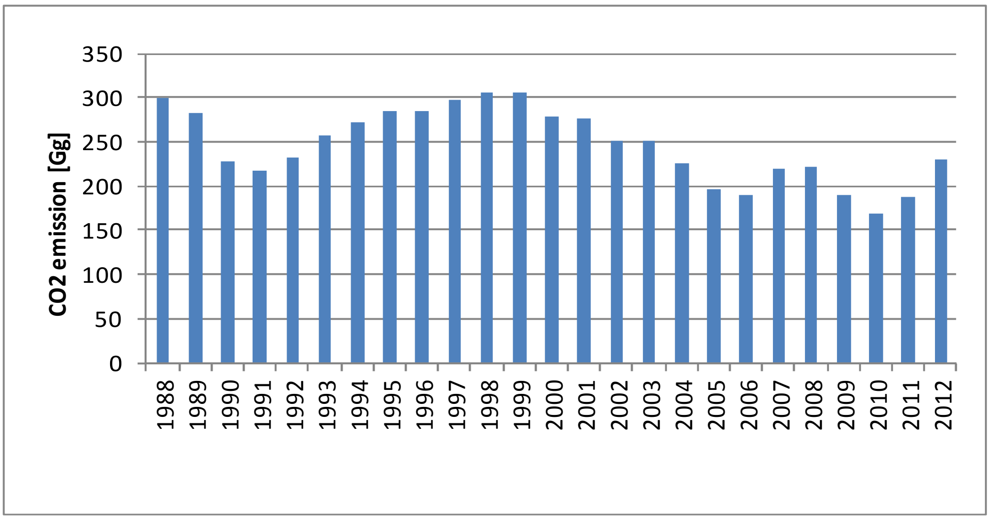

Figure 4.4.4. CO_2 process emission for zinc production in 1988-2012

- *Lead production*

Process emission of CO_2 from lead production was estimated based on annual lead production taken from GUS [GUS 2013b]. The default emission factor of 0.52 Mg CO_2/Mg lead from [IPCC 2006] – table 4.21 was applied.

For the entire period 1988-2012 the same emission factor was used. Data on lead production come from [GUS 1989b-2013b]. The trend of process emissions from lead production is given in figure 4.4.5.

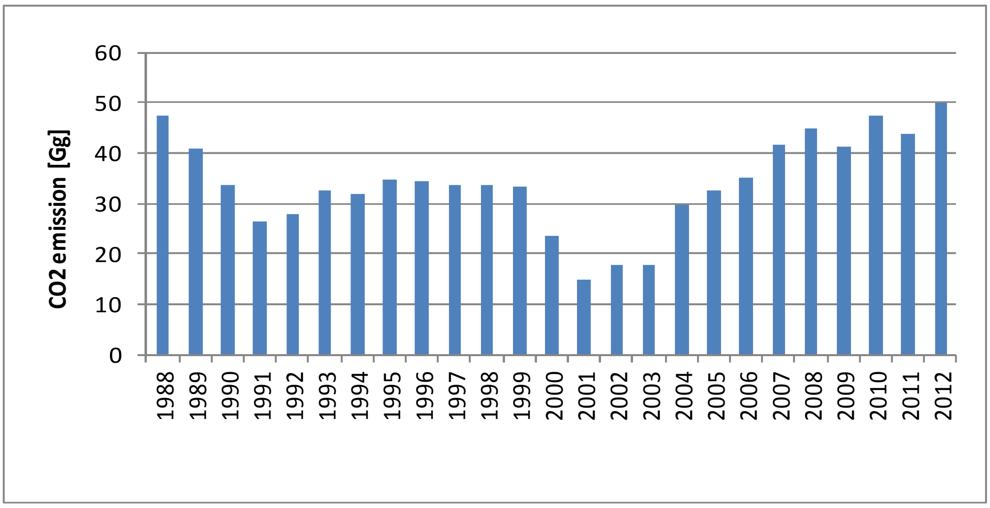

Figure 4.4.5. CO_2 process emission for lead production in 1988-2012

4.4.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.4.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.4.5. Source-specific recalculations

- process emissions were recalculated in the 2.C.1 subsector for the following processes: iron ore production (for the entire period 1988-2011), pig iron production (for the years 1990-2011), steel production in the basic oxygen furnaces (for the entire period 1988-2011) and steel production in the electric furnaces (for the years 2005-2011); recalculation was the result of the ERT recommendations and aimed at the harmonisation of methodology (between the period 1988-2004 and the years 2005-2011, where data was accepted according to EU ETS reports) as well as at the improvement of data consistency.

Table. 4.4.7. Changes of GHG emission values in 2.C. subcategory as a result of recalculations.

Change	1988	1989	1990	1991	1992	1993	1994	1995
				CO2				
Gg	564.6	518.3	524.3	418.4	455.7	441.3	506.1	553.6
%	7.5	8.0	9.4	10.6	13.7	13.8	14.4	15.1
Change	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
				CO2				
Gg	487.5	546.4	459.0	407.1	504.2	435.3	440.1	442.1
%	15.2	16.5	17.3	17.3	17.7	18.5	20.1	17.2
Change	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
				CO2				
Gg	499.9	-3308.4	-4166.7	-4024.4	-4731.3	-2713.5	-3811.2	-3841.3
%	18.6	-58.1	-62.4	-57.3	-63.8	-61.6	-68.8	-64.0
				CH4				
Gg	0.000	-0.497	-0.580	-0.565	-0.521	-0.284	-0.305	-0.406
%	0.0	-31.2	-32.6	-30.6	-29.3	-23.1	-21.1	-24.4
				N2O				
Gg	0.000	-0.074	-0.088	-0.085	-0.077	-0.042	-0.045	-0.061
%	0.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0	-100.0

4.4.6. Source-specific planned improvements

- Further attempt to obtain the updated technological coefficient for pig iron production

4.5. Other Production (CRF sector 2.D)

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

CO_2 process emissions from pulp and paper production for 2012 and for 2005-2011 were taken from the verified reports for installations of paper and cardboard production, which participate in EU ETS [KOBiZE 2013]. These emissions were as follows: 9.5 Gg for the year 2012, 8.2 Gg for 2011, 8.6 Gg CO_2 for years 2010 and 2009, 6.3 Gg CO_2 for 2008 and below 0.1 Gg CO_2 for the years 2005-2007.

Source of CO_2 process emission reported in 2.D.1 sector was calcinations process of carbonates in pulp and paper production. Limestone is used by the paper-making industry for the production of cellulose in the sulfite process. Some pulp and paper producers produce also the burnt lime for own purposes. Burnt lime is used mainly in the cellulose and paper making industries for softening water and boiling rags.

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

4.6.1 Source category description

Emissions of HFC, PFCs and SF_6 are estimated based on official activity data available at public statistics (GUS) and data collected by surveys among importers and exporters of CFCs and F-gases. In case of refrigeration and air-conditioning equipment containing HFCs, some information concerning e.g. amounts of gas used, are collected by experts among main domestic producers and importers/exporters [Mąkosa 2012, Popławska-Jach 2014]. This chapter also includes description of PFC emission from IPCC 2.C.3 Aluminum production described under PFC section below. Most of the emission factors used in the national GHG inventory are default IPCC values, except CF4 and C2F6 emission from aluminum production, where country specific factors where applied.

4.6.2 Methodological issues

HFC

The national GHG inventory covers the following emission sources for HFCs:
- aerosols (technical and medical),
- foams,
- fire-fighting equipment (fire extinguishers),
- solvents (introduced in submission 2013)
- and the dominating sub-sector in terms of emission volume: refrigeration and air-conditioning equipment (2.F.1).

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

Table 4.6.1. Amount of input in each equipment type

Equipment type	F-gas input per piece of equipment [kg]
Domestic refrigerators	0.285
Domestic freezers	0.285
Commercial refrigeration	3.1
Stationary air-conditioning	3.0
Passenger cars with air-conditioning	1.2
Public transport	1.5
Trucks	1.5
Trailers	5.5
Wagon, tank, cold rooms	5.5
Cargo railway cars	5.5
Tram cars	5.5
Equipment used for refrigeration	5.5

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

Table 4.6.2. Share of gases and mixes for commercial refrigerators

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

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

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

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

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

Type of equipment	Percent of equipment in which HFC-32 was used																	
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Stationary air-conditioning	0	0	0	0	0	25	30	35	35	35	35	35	35	35	35	35	35	35

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

Type of equipment	**Percent of equipment in which HFC-125 was used**																	
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Commercial air-conditioning	0	0	5	10	15	20	20	25	30	25	30	30	30	30	29	28	27	27
Stationary air-conditioning	0	0	0	0	0	25	30	35	35	35	38	38	38	38	38	38	38	38

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

Type of equipment	**Percent of equipment in which HFC-134a was used**																	
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Domestic refrigerators	50	70	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0
Domestic freezers	50	70	100	100	100	100	100	100	0	0	0	0	0	0	0	0	0	0
Commercial air-conditioning	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
Stationary air-conditioning	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Passenger cars with air-conditioning	15	20	25	30	40	50	60	60	70	70	80	80	90	90	100	100	100	100
Public transport	10	10	20	25	30	30	30	30	40	40	40	50	50	50	60	60	60	60
Trucks	0	0	15	20	25	25	25	30	30	30	0	40	40	50	50	50	50	50
Trailers	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Wagon, tank, cold rooms	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Cargo railway cars	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Tram cars	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25	25
Equipment used for refrigeration	0	0	0	0	25	25	25	25	25	25	25	25	25	25	25	25	25	25

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

Type of equipment	Percent of equipment in which HFC-143a was used																	
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Commercial air-conditioning	0	0	7	15	20	25	25	35	35	35	40	40	40	40	39	39	38	38
Stationary air-conditioning	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	2	2	2

Table 4.6.8 shows aggregated national total HFCs emissions over 1995-2012 expressed in CO_2 equivalents and HFCs emission in sub-sector: 2.F.1 Refrigeration and Air Conditioning Equipment. Prior to 1995, HFCs were not used in Poland.

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

Year	HFCs emissions in 2.F.1 Refrigeration and Air Conditioning Equipment [Gg CO_2 eq.]	Total HFCs emissions [Gg CO_2 eq.]
1995	181.10	197.03
1996	232.72	307.83
1997	353.33	467.51
1998	481.88	591.18
1999	739.29	848.88
2000	1251.28	1352.23
2001	1926.50	2084.35
2002	2553.81	2734.23
2003	3284.19	3375.58
2004	3890.98	4256.05
2005	4454.60	5100.46
2006	4889.86	5741.02
2007	5704.15	6522.37
2008	5393.71	6019.53
2009	5977.50	6468.37
2010	6473.38	6755.80
2011	7118.11	7394.47
2012	7437.48	7700.22

PFC

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

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

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

Table 4.6.9 shows aggregated national total PFCs emissions over 1988-2012 expressed in CO2 equivalents and PFCs emission in sub-sector: 2.C.3 Aluminium Production. The use of PFCs in fire extinguishers began in 1996. Prior to 1996, the only known source of PFCs was primary aluminium production.

Table 4.6.9. PFCs emissions in 2.C.3 Aluminium Production compared to national total

Year	PFCs emissions in 2.C.3 Aluminium Production [Gg CO_2 eq.]	Total PFCs emissions [Gg CO_2 eq.]
1988	127.55	127.55
1989	127.77	127.77
1990	122.88	122.88
1991	122.40	122.40
1992	116.61	116.61
1993	125.47	125.47
1994	132.33	132.33
1995	148.96	148.96
1996	138.79	139.45
1997	143.30	149.56
1998	144.79	150.87
1999	136.25	145.27
2000	139.89	151.88
2001	145.94	168.74
2002	157.17	177.61
2003	153.00	172.31
2004	157.52	175.86
2005	143.22	160.65
2006	149.52	166.08
2007	142.68	158.41
2008	124.90	139.85
2009	45.04	59.24
2010	42.64	56.13
2011	37.07	49.88
2012	29.63	41.81

SF_6

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

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

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

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

Table 4.6.10 includes the activity data used for estimation of PFC and SF6 emissions over the period: 1988-2012.

Table 4.6.10. Activity data used for estimation of PFCs in 2.C.3 and 2.C.4 and SF_6 emissions in 2.F.8

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

Activity characteristic for the source sector	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
2.C. Metal production											
3. Aluminium Production [Gg]	58.80	57.24	58.93	53.58	55.94	62.51	46.73	16.85	15.95	13.87	11.09
4. SF_6 Used in Magnesium foundries – amount of imported SF_6 [Mg]	72	46	20	30	65	100	100	100	100	100	100
2.F Consumption of HFC, PFC and SF_6											
8. Electrical equipment – amount of SF_6 in use [Mg]	32.04	33.75	36.45	40.57	46.23	48.63	51.32	55.80	57.97	61.50	64.72
8. Electrical equipment –amount of imported SF_6 [Mg]	4.16	2.50	3.59	5.16	6.89	3.54	3.89	5.86	3.50	4.99	4.73

Table 4.6.5 shows aggregated national total SF6 emissions over 1994-2012 expressed in tones compared to SF_6 emission in most important sub-sector: 2.F.8 *Electrical Equipment*. The use of SF6 in magnesium foundries began in 1994. There is no data available on SF6 use prior to 1994.

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

Year	**SF_6 emissions in 2.F.8 Electrical Equipment [t]**	**Total SF_6 emissions [t]**
1994	-	0.58
1995	0.55	1.28
1996	0.32	1.04
1997	0.38	1.00
1998	0.52	1.05
1999	0.60	1.03
2000	0.68	1.01
2001	0.77	1.00
2002	0.89	1.02
2003	0.82	0.91
2004	0.94	0.98
2005	1.12	1.18
2006	1.34	1.46
2007	1.18	1.37
2008	1.26	1.44
2009	1.47	1.65
2010	1.37	1.55
2011	1.53	1.71
2012	1.58	1.76

4.6.3. Uncertainties and time-series consistency

Simplified analysis were made for industrial gases HFC, PFC and SF6, where uncertainty assumptions were applied directly to emission values of each pollutant. Due to lack of available information, simplified approach has to be used and country recognizes need of additional analysis in this sector as planned improvement for future inventories. More details on uncertainty assessment of whole inventory are given in annex 8.

	HFC Emission [Gg of CO_2 eq.]	PFC Emission [Gg of CO_2 eq.]	SF_6 Emission [Gg of CO_2 eq.]	HFC Emission uncertainty [%]	PFC Emission uncertainty [%]	SF_6 Emission uncertainty [%]	HFC Emission absolute uncertainty [Gg of CO_2 eq.]	PFC Emission absolute uncertainty [Gg of CO_2 eq.]	SF_6 Emission absolute uncertainty [Gg of CO_2 eq.]
TOTAL	7,700.22	41.81	42.06	48.3%	76.6%	90.3%	3,719.60	41.81	37.72
2. Industrial Processes	**7,700.22**	**41.81**	**42.06**	**48.3%**	**76.6%**	**90.3%**	**3,719.60**	**41.81**	**37.72**
C. Metal Production		**29.63**	**4.35**		**100.0%**	**100.0%**		**29.63**	
3. Aluminium Production		29.63	4.35		100.0%	100.0%		29.63	4.35
F. Consumption of Halocarbons and SF6	**7,700.22**	**12.17**	**37.72**	**48.3%**	**100.0%**	**100.0%**	**3,719.60**	**12.17**	**37.72**
1. Refrigeration and Air Conditioning Equipment	7,437.48			50.0%			3,718.74		
2. Foam Blow ing	105.33			50.0%			52.67		
3. Fire Extinguishers	44.24	12.17		50.0%	100.0%		22.12	12.17	
4. Aerosols/ Metered Dose Inhalers	111.89			50.0%			55.94		
5. Solvents	1.28			50.0%			0.64		
8. Electrical Equipment			37.72			100.0%			37.72

4.6.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.6.5. Source-specific recalculations

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

- aerosols (technical and medical),
- foams,
- fire-fighting equipment (fire extinguishers),
- solvents (introduced since submission 2013)
- and refrigeration and air-conditioning equipment (new analysis of equipment size distribution in stationary air conditioning).

Following the recommendations of UNFCCC Expert Review Team reviewing submission 2013 some of the assumptions were changed to more conservative:

- initial charge for domestic refrigeration was changed from 0.14kg to 0.285kg
- product life factor in transport refrigeration was changed from 20% to 32.5%
- initial charge for stationary air-conditioning was changed from 2kg to 3kg
- formula error was rectified in mobile air conditioning

Example results of the recalculations for 2011 were presented in table below:

Gg of CO2 eq.	HFCs	PFCs	SF6
Previous sub.	8,119.47	49.88	40,90
Latest sub.	7,394.47	49.88	40,90
Difference	-725,00	0	0
%	-0,20%	0%	0%

4.6.6. Source-specific planned improvements

Continuing ongoing project on revision and extending dataset for f-gases. Improving description of methodology and assumptions in NIR. Further analysis of filling amounts in equipment containing HFCs, PFCs and SF6.

4.7. Other Processes (CRF sector 2.G)

4.7.1. Source category description

In this category associated CO_2 emissions concerning non-energy use of fuels in the period 1988-2012 were included.

4.7.2. Methodological issues

Associated CO_2 emissions concerning non-energy use of fuels were estimated according to the method described in chapter 3.2.1.

4.7.3. Uncertainties and time-series consistency

See chapter 4.2.3

4.7.4. Source-specific QA/QC and verification

See chapter 4.2.4

4.7.5. Source-specific recalculations

- for the entire period 1988-2011 CO_2 emissions from 2.G subsector were recalculated because of methodology development (the extended list of fuels was taken into consideration)

Table. 4.4.8. Changes of GHG emission values in 2.G. subcategory as a result of recalculations.

Change	1988	1989	1990	1991	1992	1993	1994	1995
				CO2				
Gg	1550.3	1377.5	1272.7	1037.6	892.2	1074.8	972.4	1015.9
%	195.2	187.1	236.4	277.3	250.1	305.8	261.3	240.8
Change	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
				CO2				
Gg	1063.6	1031.5	985.1	833.8	998.4	834.3	921.4	845.9
%	283.3	266.8	186.5	162.7	168.1	133.4	175.5	156.8
Change	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
				CO2				
Gg	845.1	847.7	1064.7	1169.4	1063.7	925.7	1134.9	947.6
%	185.9	219.1	294.0	325.1	278.9	236.6	346.4	283.0

4.7.6. Source-specific planned improvements

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

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

5.1. Overview of sector

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

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

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

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

- CO_2 emission from the following activities: 3.A Paint application, 3.B Degreasing and dry cleaning, 3.C Chemical Products, Manufacture and Processing, 3.D Other solvents use (Fat edible and non-edible oil extraction, Other non-specified),
- N_2O emission from D.1.Use of N_2O for Anaesthesia. N_2O emission from anaesthesiology was estimated based on: Strategy of reduction of GHG emission until 2020 in the division into separate gases (N_2O, HFCs, PFCs and SF6) and sectors - Institute of Environmental Protection [IOŚ 2001].

Emission trend is consistent with the submission to:

- the European Union in the framework of reporting to the Directive 2001/81/EC of European Parliament and the Council of 23 October 2001 on national emission ceilings for certain pollutants
- the Convention on Long-range Transboundary Air Pollution (LRTAP).

Total emission of GHG in this sector in 2012 was estimated to 760 Gg CO_2 equivalent. This emission decreased by 24,5% from year 1988 to 2012 (Figure 5.1). This is mostly due to decrease of using solvents in paint applications (by 36%) (Figure 5.2).

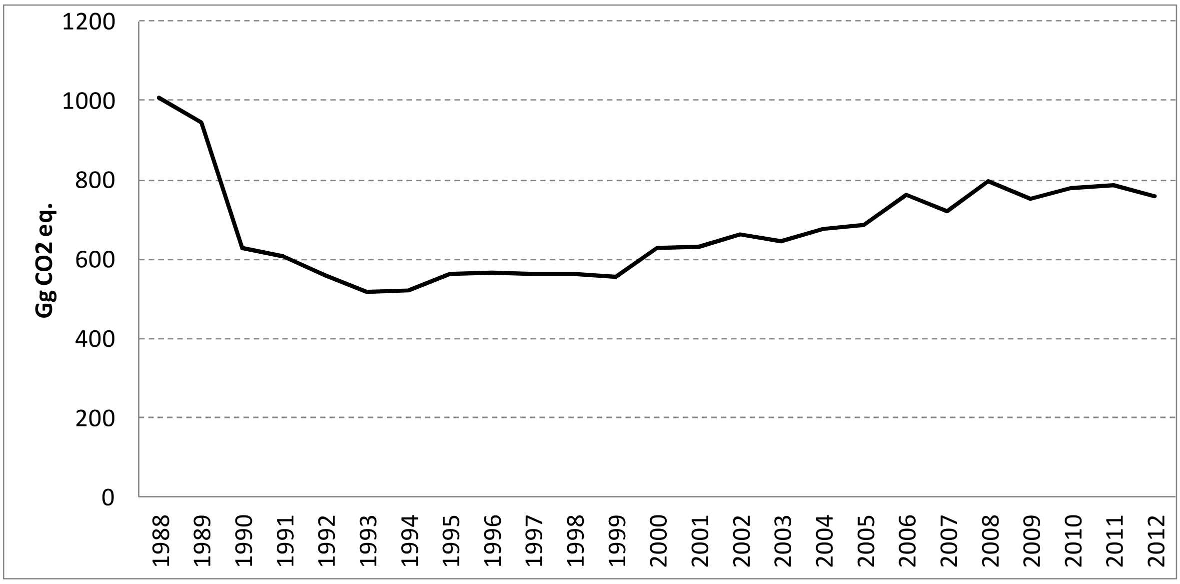

Figure 5.1. GHG emission from Solvent and Other Product Use sector in 1988-2012.

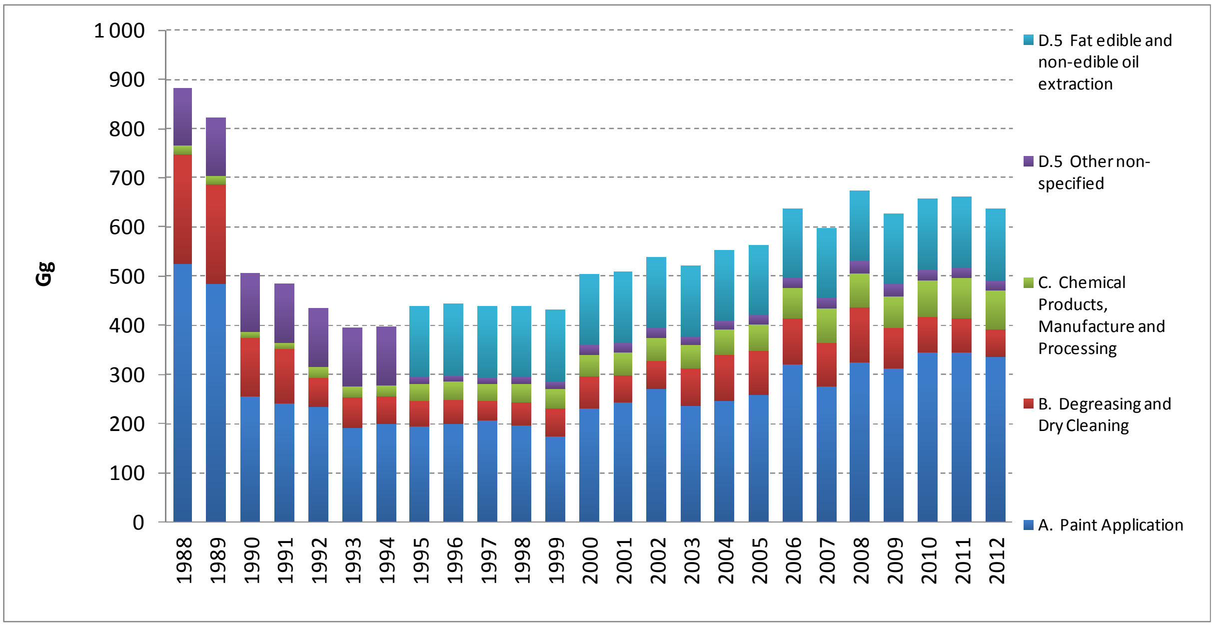

Figure 5.2. CO_2 emission from Solvent and Other Product Use sector in 1988-2012.

5.2 Paint application (CRF sector 3.A)

5.2.1. Source category description

Paint application includes the following processes:

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

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

5.2.2. Methodological issues

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

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

where:

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

5.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2012 for IPCC sector *3. Solvent and Other Product Use* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 8.
Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

2012	CH_4 [Gg]	N_2O [Gg]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
3. Solvent and Other Product Use	**635.67**	**0.40**	15.0%	50.0%

5.2.4. Source-specific QA/QC and verification

Activity data concerning solvent use for period 1988-1994 was taken from Institute for Ecology of Industrial Areas which performs its own QA/QC activities.
For years 1995-2012 the activity data was estimated by the National Centre for Emission Managment (KOBIZE) based on data from Central Statistical Office and emission factors developed by the Institute for Ecology of Industrial Areas (IETU).
Comparison of methodology applied with other countries experiences was made[Estimation of national greenhouse gas emissions from the sector 3. Solvent and other product use. KCIE 2004] Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 7.

5.2.5. Source-specific recalculations

Recalculations for the 2011 year was made as result of the correction of activity data. The difference in CO_2 emission in comparison to the previous submission was 2 Gg which represents a change of 0.6%.

5.2.6. Source-specific planned improvements

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

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

5.3.1. Source category description

Degreasing and dry cleaning include:

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

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

5.3.2. Methodological issues

See chapter 5.2.2.

5.3.3. Uncertainties and time-series consistency

See chapter 5.2.3.

5.3.4. Source-specific QA/QC and verification

See chapter 5.2.4.

5.3.5. Source-specific recalculations

Not done.

5.3.6. Source-specific planned improvements

See chapter 5.2.6.

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

5.4.1. Source category description

The national inventory includes emissions from the following processes:

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

5.4.2. Methodological issues

See chapter 5.2.2.

5.4.3. Uncertainties and time-series consistency

See chapter 5.2.3.

5.4.4. Source-specific QA/QC and verification

See chapter 5.2.4.

5.4.5. Source-specific recalculations

Recalculations for the years 1995-1998 and 2011 was made as result of the correction of activity data. In table 5.2 are shown emission changes for subcategory - Chemical products, manufacture and processing (3.C) .

Table 5.2. Emission changes for subcategory 3.C. Chemical products, manufacture and processing.

Difference	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
Gg CO_2 eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50
	1996	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Gg CO_2 eq	-0.03	-0.01	-0.05	0.00	0.00	0.00	0.00	0.00
%	-0.07	-0.02	-0.13	0.00	0.00	0.00	0.00	0.00
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gg CO_2 eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03

5.4.6. Source-specific planned improvements

See chapter 5.2.6.

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

5.5.1. Source category description

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

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

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

5.5.2. Methodological issues

See chapter 5.2.2.

5.5.3. Uncertainties and time-series consistency

See chapter 5.2.3.

5.5.4. Source-specific QA/QC and verification

See chapter 5.2.4.

5.5.5. Source-specific recalculations

Recalculations for the years 1995-1999 was made as result of the correction of activity data. In table 5.3 are shown emission changes for subcategory - Other solvents use (3.D) .

Table 5.3. Emission changes for subcategory 3.D. Other solvents use

Difference	1988	1989	1990	1991	1992	1993	1994	1995
Gg CO_2 eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.28
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.03
	1996	1997	1998	1999	2000	2001	2002	2003
Gg CO_2 eq	37.28	17.41	14.24	11.06	7.35	0.00	0.00	0.00
%	31.03	12.41	9.87	7.50	4.80	0.00	0.00	0.00
	2004	2005	2006	2007	2008	2009	2010	2011
Gg CO_2 eq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

5.5.6. Source-specific planned improvements

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

6. AGRICULTURE (CRF SECTOR 4)

6.1. Overview of sector

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

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

4.A - Enteric Fermentation (CH_4 emission), share in total GHG emission	2.2%
4.B - Manure Management (CH_4 emission), share in total GHG emission	0.6%
4.B - Manure Management (N_2O emission), share in total GHG emission	1.2%
4.D.1 - Direct Soil Emissions (N_2O emission), share in total GHG emission	3.1%
4.D.3 - Indirect Soil Emissions (N_2O emission), share in total GHG emission	1.9%

Share of these categories in total Poland's GHG emissions is 9.1%.

Total emissions of methane and nitrous oxide presented as carbon dioxide equivalent amounted to 36 653.86 Gg in 2012 and decreased since 1988 by 34.2%. Strong decrease in emissions in Poland occurred after 1989 when economic transformation began shifting from centrally planned economy to the market one (Fig. 6.2). The cost-effectiveness of agricultural production deeply changed then – up to 1989 agricultural production was generally subsidised on the state level. Since 1990 the prices for agricultural products as well as for agricultural means of production (like mineral fertilisers or machines) became the market ones and the subsidies were cut off. Deterioration of macroeconomic conditions for agricultural production in early 1990-ties during the restructuring of the state economy triggered changes in structure of agricultural farms since 1989. The big state agricultural farms became economically ineffective in a new market conditions so they were constantly eliminated. Also production of many small family farms became cost-ineffective so for instance the process of leaving the animal production by small farms started. On the other hand - gradual development of private and collective farms breeding large livestock herds begun. Still almost 70% of Polish farms are smaller than 5 hectares (Fig. 6.1).

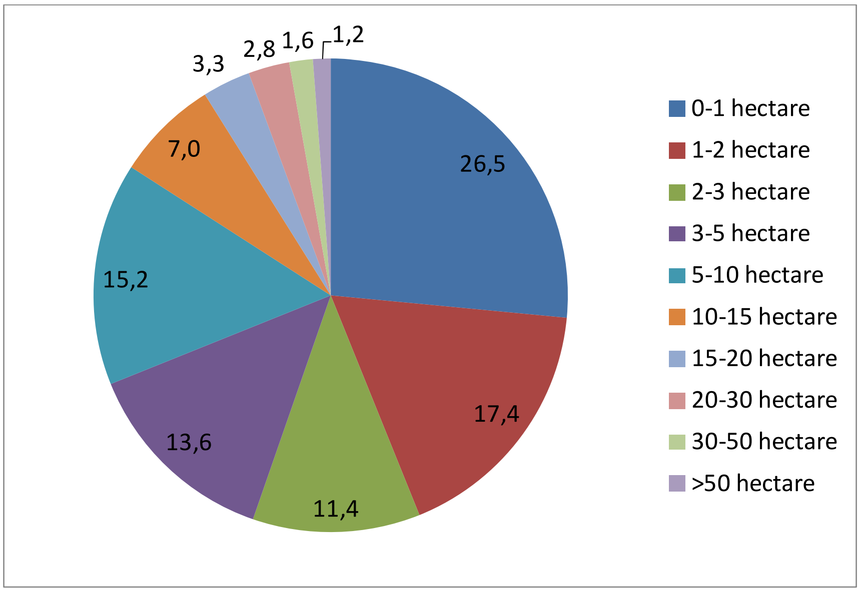

Figure 6.1. Share of farms according to area [%] [GUS R 2012]

Dramatic decrease of livestock numbers was observed after 1989 – the cattle population decreased almost by half − from over 10 million in 1988 up to 5.7 million in 2002. Since 2002, just before accessing Poland to the European Union (in 2004), population of dairy cattle stabilized when the limits of milk production were known in advance what stabilized the milk market. In same time sheep population drop by 94% (from 4 million in 1988 up to 0,27 million in 2012). Especially sheep breeding became unprofitable − the wool up to 1989 was highly subsidised so sheep farming was related mostly to wool production and over 70% of sheep farms' income was related to wool sale. Small domestic demand for sheep meat also caused retreat from sheep breeding.

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

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

In 2012, in relation to the previous year, gross agricultural output decreased for 0.4% due to lower animal output (by 1.4%), while a slight increase crop output (by 0.5%). After two years of improvement in the profitability of production, in 2012, market conditions of agricultural production deteriorated. Increase of prices for agricultural products sold by farmers did not compensate the increase of prices of goods and services purchased by farmers [GUS R1 2012].

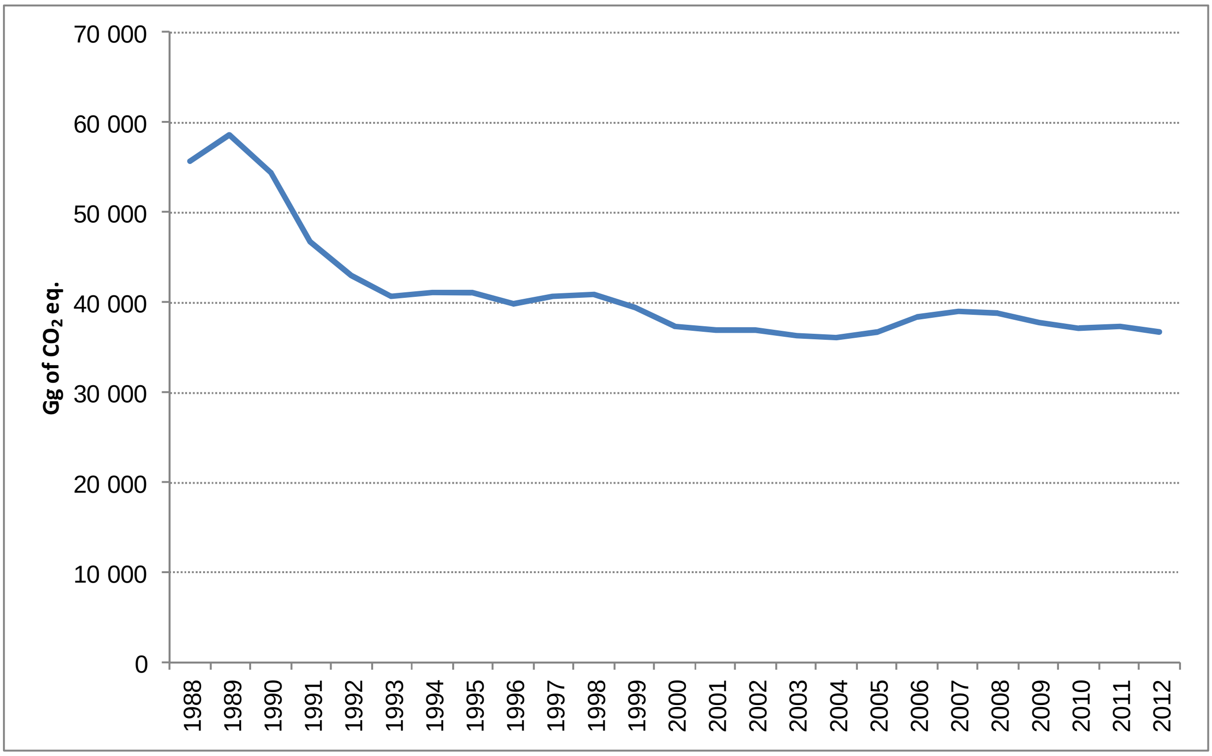

Figure 6.2. Total greenhouse gas emissions from the Polish agriculture in 1988-2012 presented in CO_2 equivalent

Most of methane emissions in 2012 originated from enteric fermentation (78.3%) and about 21.5% is related to manure management. Share of field burning of agricultural residues represent only 0.2% of emissions (Fig. 6.3).

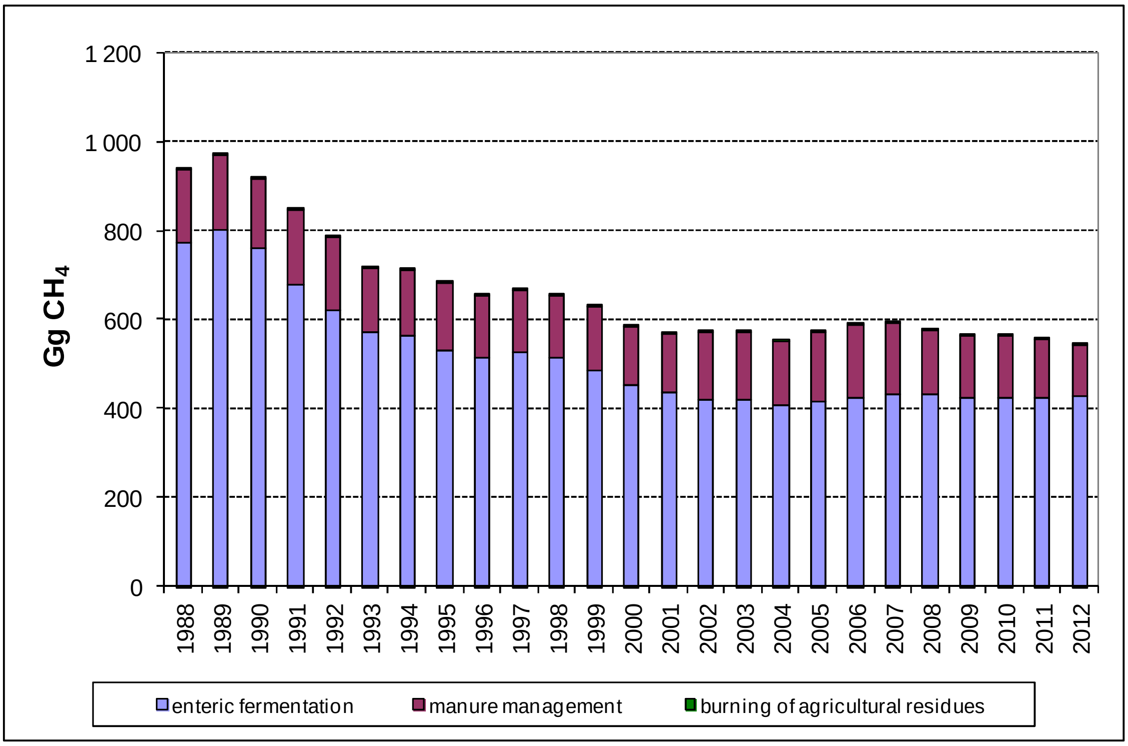

Figure 6.3. Methane emissions from the Polish agriculture in 1988-2012 according to subcategories

As concerns the nitrous oxide emissions, the main source of emissions in 2012 is agricultural soils responsible for 80.6% while manure management – for 19.3%. Emissions from field burning of agricultural residues are negligible (0.04%) (Fig. 6.4).

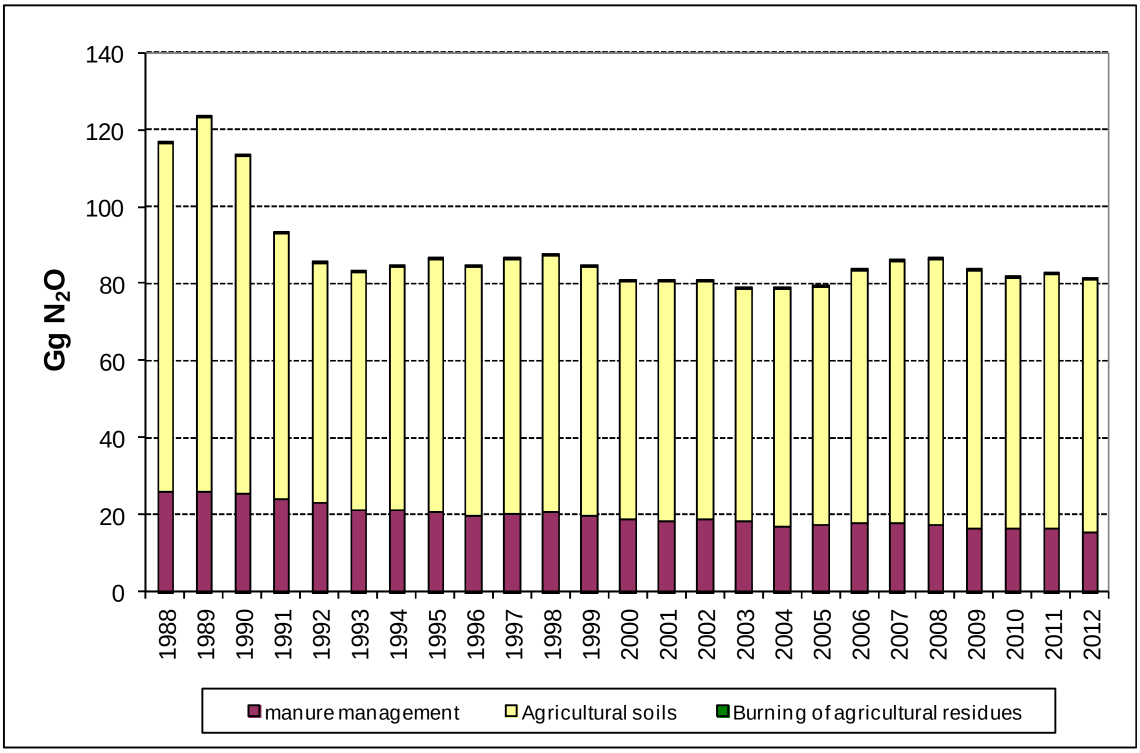

Figure 6.4. Nitrous oxide emissions from the Polish agriculture in 1988-2012 according to subcategories

6.2. Enteric Fermentation (CRF sector 4.A)

6.2.1. Source category description

CH_4 emissions from animals' enteric fermentation in 2012 amounted to 427.48 Gg CH_4 and decreased since 1988 by 44.7%. Majority of CH_4 emissions, more than 94%, come from enteric fermentation caused by cattle. The main driver influencing CH_4 emissions drop from enteric fermentation is the decrease of livestock population since 1988. The biggest change over time relates to the sheep breeding where cut of emissions is about 94% in 1988-2012. At the same time CH_4 emission reduction for dairy cattle amounted for 41%.

Table 6.1. Trends in CH_4 emissions from enteric fermentation in 1988-2012 [Gg CH4]

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Total
1988	444.8	246.1	33.3	0.9	18.9	29.4	773.5
1989	465.0	256.1	34.0	0.9	17.5	28.3	801.7
1990	450.7	228.8	32.3	0.9	16.9	29.2	758.8
1991	412.8	190.2	24.8	0.9	16.9	32.8	678.4
1992	378.5	176.7	14.8	0.9	16.2	33.1	620.1
1993	354.0	163.1	10.0	0.9	15.1	28.3	571.3
1994	344.3	170.7	6.9	0.9	11.2	29.2	563.2
1995	317.8	165.9	5.7	0.9	11.4	30.6	532.3
1996	310.0	163.5	4.4	0.9	10.2	26.9	516.0
1997	315.4	169.8	3.9	0.9	10.0	27.2	527.3
1998	319.9	150.7	3.6	0.9	10.1	28.8	513.9
1999	307.0	138.2	3.1	0.9	9.9	27.8	486.9
2000	281.2	132.0	2.9	0.9	9.9	25.7	452.5
2001	277.1	119.5	2.8	0.9	9.8	25.7	435.7
2002	265.3	119.2	2.6	1.0	5.9	27.9	422.0
2003	268.9	114.4	2.6	1.0	6.0	27.9	420.7
2004	260.8	113.2	2.5	0.9	5.8	25.5	408.7
2005	262.5	118.3	2.5	0.7	5.6	27.2	416.8
2006	266.1	123.8	2.4	0.7	5.5	28.3	426.8
2007	266.5	129.3	2.6	0.7	5.9	27.2	432.3
2008	268.4	131.0	2.6	0.7	5.9	23.1	431.6
2009	259.5	135.9	2.3	0.6	5.4	21.4	425.0
2010	256.5	138.9	2.0	0.5	4.8	22.3	425.0
2011	255.8	142.5	2.0	0.6	4.6	20.3	425.7
2012	256.9	146.7	2.1	0.4	4.0	17.4	427.5
share [%] in 2012	60.1	34.3	0.5	0.1	0.9	4.1	100.0
change [%] 1988-2012	-42.3	-40.4	-93.8	-49.9	-78.9	-40.9	-44.7

6.2.2. Methodological issues

Activity data for 2012 applied in this category come from national statistics (Central Statistical Office) [GUS R2 2012] and were compiled on the basis of:

- generalized results of the sample survey on land use, sown area, and livestock, conducted in June 2012 in individual farms,
- generalized results of panel sample surveys on livestock in individual farms, i.e. the surveys on cattle, sheep and poultry in June and the surveys on pigs at the end of July,
- statistical reports in the scope of livestock in state-owned and cooperative farms, and in companies with public and private property share,
- information from voivodship experts about the horses and goats stock.

Detail methodological information related to collecting data on livestock population is given in Annex 5. Generally activity data for entire inventoried period comes from the Central Statistical Office from analogous publication like for 2012. Due to lack of data on goats population in 1988-1995 and in 1997, data for 1996 was taken for the period 1988−1995. Additionally the mean value from 1996 and 1998 was calculated for 1997. Since 1998 goats population is available on an annual basis. Trends of animal population (excluding cattle) in 1988−2012 is given in table 6.2.

Table 6.2. Trends of selected livestock population in 1988-2012

Years	Livestock population [thousands]				
	Sheep	Goats	Horses	Swine	Poultry
1988	4 377	179	1 051	19 605	246 175
1989	4 409	179	973	18 835	265 976
1990	4 159	179	941	19 464	228 021
1991	3 234	179	939	21 868	221 088
1992	1 870	179	900	22 086	203 373
1993	1 268	179	841	18 860	198 352
1994	870	179	622	19 466	199 423
1995	713	179	636	20 418	192 438
1996	552	179	569	17 964	209 454
1997	491	182	558	18 135	203 585
1998	453	186	561	19 168	201 773
1999	392	181	551	18 538	202 904
2000	362	177	550	17 122	198 095
2001	343	172	546	17 105	206 727
2002	345	193	330	18 629	198 783
2003	338	192	333	18 605	146 321
2004	318	176	321	16 988	130 289
2005	316	142	312	18 112	125 073
2006	301	130	307	18 881	141 808
2007	332	144	329	18 129	150 620
2008	324	136	325	15 425	145 496
2009	286	119	298	14 279	140 826
2010	258	108	264	14 865	132 196
2011	251	112	254	13 509	143 557
2012	267	90	222	11 581	130 596

Trends of cattle population presented for specific subcategories is given in Table 6.3. In 1998 Central Statistical Office introduced methodological changes in collecting statistical data on cattle population (apart from dairy cattle). This change triggered some inconsistency in population trend of other cattle. So in response to recommendations of the Expert Review Team (ERT 2013) the non-dairy cattle trend for 1988-1997 was unified based on average share in 1998-2007 of specific age groups in relation to all non-dairy cattle population (italics).

Table 6.3. Trends of cattle population in 1988-2012 [thousands]

Years	Dairy cattle	Non-dairy cattle			
		young cattle < 1 year	young cattle 1-2 years	heifers > 2 years	bulls >2 years
1988	4806	*2879*	*2025*	*401*	*211*
1989	4994	*2996*	*2107*	*417*	*219*
1990	4919	*2678*	*1883*	*373*	*196*
1991	4577	*2227*	*1567*	*310*	*163*
1992	4257	*2069*	*1456*	*288*	*151*
1993	3983	*1910*	*1344*	*266*	*140*
1994	3863	*2001*	*1407*	*279*	*146*
1995	3579	*1946*	*1368*	*271*	*142*
1996	3461	*1919*	*1349*	*267*	*140*
1997	3490	*1992*	*1401*	*278*	*146*
1998	3542	1799	1235	280	99
1999	3418	1647	1108	283	99
2000	3098	1572	1101	231	81
2001	3005	1472	973	210	74
2002	2873	1384	1084	142	50
2003	2897	1349	932	229	81
2004	2796	1309	916	246	86
2005	2795	1425	978	209	76
2006	2824	1428	1040	224	90
2007	2787	1473	1072	265	99
2008	2806	1502	1102	263	83
2009	2688	1472	1204	238	99
2010	2656	1457	1244	276	92
2011	2626	1481	1300	242	113
2012	2578	1469	1344	239	147

In the estimation of CH_4 emissions from enteric fermentation two types of approaches were applied – in case of horses, goats and swine, the IPCC *Tier 1* method was applied using default CH_4 Emission Factors [IPCC 1997] as given below:

Animal	Emission Factor [kg CH_4/head/year]
Horses	18.0
Goats	5.0
Swine	1.5

Emission from poultry's enteric fermentation was not estimated as the IPCC do not provide the guidelines.

More detailed, IPCC *Tier 2* method, was applied in calculation of methane emissions from enteric fermentation from cattle and sheep. Here country specific emission factors were calculated based on specific gross energy intake (GE) values estimated for selected cattle sub-categories [IPCC 2000, equation 4.14]:

$$EF = (GE * Y_m * 365 \text{ days/yr}) / (55.65 \text{ MJ/kg } CH_4)$$

where:

EF – emission factor, kg CH4/head/yr

GE – gross energy intake, MJ/head/day

Ym – methane conversion rate which is the fraction of gross energy in feed converted to methane.

Gross energy intake (GE) was calculated [IPCC 2000, equation 4.11] separately for dairy cattle and for and non-dairy cattle disaggregated for: calves under 1 year, young cattle 1-2 years and other mature cattle (over 2 years). Parameters required for estimation of GE factor for dairy cattle like pregnancy [GUS R1 2013], milk production [GUS M 2013], percent of fat in milk [GUS R 2013] come from national statistics. Digestible energy (DE – expressed as a percent of gross energy) for dairy cattle was estimated by expert from the National Research Institute of Animal Production [Walczak 2006, 2013] and vary from 58.6% in 1988 through 60% in 1995 up to 63.3% in 2012. This change is influenced by genetic improvements of cows as well as slight increase of digestibility of fodder applied. As concerns non-dairy cattle, DE parameters are as following: young cattle up to 1 year: 71.1−71.3%, bovines between 1–2 years: 66.1−66.5%, for matured heifers – 62.4% and for bulls – 59.1%. Methane conversion rate (Y_m) was adopted from [IPCC 2000, table 4.8] as 6% for cattle and 7% for sheep.

Methane emission factor for dairy cattle, established based on the above described methodology, vary from 92.6 CH_4/animal/year in 1988 up to 99.6 kg CH_4/animal/year in 2012, following GE changes, and is slightly higher than IPCC default one (81 kg CH_4/animal/year) because of using country specific parameters for calculations (tab. 6.3). For non–dairy cattle GE factor was calculated for every subcategory based on country specific parameters like mean mass and daily weight gain [Walczak 2006]. Methane emission factors for entire trend for non-dairy cattle in form of weighted mean values, mean mass and GE are presented in table 6.4. The values of EFs vary from 44 kg CH_4/animal/year in 1988 up to 45.9 kg CH_4/animal/year in 2012. Relatively low EF (IPCC default is 56 kg CH_4/animal/year) depends on high share of youngest cattle (< 1 year) within this category (53% in 1998 and 46% in 2012) (table 6.5).

Table 6.4. Average annual milk production, daily gross energy intake (GE) and CH_4 emissions factors for dairy cattle in 1988–2012

Years	Average milk production [litres/cow/yr]	GE gross energy intake [MJ/cow/day]	EF emission factor [kg CH_4/animal/year]
1988	3165	235.17	92.55
1989	3260	236.59	93.11
1990	3151	232.82	91.62
1991	3082	229.17	90.19
1992	3015	225.91	88.90
1993	3075	225.83	88.87
1994	3121	226.49	89.13
1995	3136	225.63	88.79
1996	3249	227.60	89.57
1997	3370	229.66	90.38
1998	3491	229.49	90.31
1999	3510	228.25	89.82
2000	3668	230.65	90.77
2001	3828	234.30	92.20
2002	3902	234.66	92.35
2003	3969	235.76	92.78
2004	4082	237.05	93.29
2005	4147	238.64	93.91
2006	4200	239.46	94.24
2007	4292	243.00	95.63
2008	4351	243.05	95.65
2009	4455	245.31	96.54
2010	4487	245.43	96.58
2011	4618	247.51	97.40
2012	4845	253.18	99.64

Table 6.5. Trends of emission factors for cattle with detail breakdown of non-dairy cattle population in 1988-2012 [kg CH4/head/yr]

Years	Non-dairy cattle weighted mean EF	Non-dairy cattle			
		young cattle < 1 year	young cattle 1-2 years	heifers > 2 years	bulls >2 years
1988	44.62	30.20	63.15	45.83	61.28
1989	44.62	30.20	63.15	45.83	61.28
1990	44.60	30.19	63.13	45.80	61.24
1991	44.59	30.17	63.10	45.77	61.20
1992	44.57	30.16	63.08	45.74	61.16
1993	44.55	30.15	63.06	45.71	61.12
1994	44.52	30.14	63.04	45.68	61.08
1995	44.50	30.13	63.01	45.65	61.04
1996	44.49	30.11	62.99	45.62	61.00
1997	44.47	30.10	62.97	45.59	60.96
1998	44.14	30.09	62.95	45.55	60.92
1999	44.05	30.08	62.92	45.52	60.88
2000	44.21	30.07	62.90	45.49	60.84
2001	43.78	30.06	62.88	45.46	60.80
2002	44.81	30.04	62.86	45.43	60.76
2003	44.15	30.03	62.83	45.40	60.71
2004	44.27	30.02	62.80	45.36	60.66
2005	44.01	30.02	62.81	45.37	60.67
2006	44.50	30.01	62.80	45.35	60.65
2007	44.46	29.96	62.65	45.38	60.68
2008	44.39	29.95	62.65	45.26	60.67
2009	45.11	29.84	62.49	45.16	60.68
2010	45.27	29.76	62.33	45.17	60.52
2011	45.44	29.69	62.16	45.05	60.51
2012	45.87	29.61	62.17	45.05	60.68

For sheep GE factor was calculated for two subcategories: lambs up to 1 year and mature sheep above 1 year and presented in table 6.6 as the weighted mean value. Weighted mean emission factors for sheep for 1988–2012 oscillate around IPCC default value of 8 kg CH_4/animal/year (7.6−8.1 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 M 2013].

Table 6.6. Daily gross energy intake (GE) and CH_4 emissions factors for sheep in 1988–2012

Years	GE gross energy intake (Weighted mean) [MJ/animal/day]	EF emission factor (Weighted mean) [kg CH_4/animal/year]
1988	17.36	7.61
1989	17.55	7.72
1990	17.61	7.76
1991	17.46	7.67
1992	17.89	7.91
1993	17.80	7.87
1994	17.96	7.95
1995	17.94	7.94
1996	17.99	7.97
1997	18.07	8.02
1998	17.88	7.91
1999	17.95	7.95
2000	17.89	7.91
2001	18.28	8.12
2002	17.33	7.59
2003	17.29	7.57
2004	17.87	7.91
2005	18.05	8.02
2006	17.97	7.97
2007	17.70	7.82
2008	17.85	7.90
2009	17.84	7.90
2010	17.75	7.86
2011	18.06	8.01
2012	17.51	7.71

6.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2012 for IPCC sector *4.Agriculture* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 8.
Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

2012	**CH_4 [Gg]**	**N_2O [Gg]**	**CH_4 Emission uncertainty [%]**	**N_2O Emission uncertainty [%]**
4. Agriculture	**545.79**	**81.27**	29.0%	51.7%
A. Enteric Fermentation	427.48		34.8%	
B. Manure Management	117.43	15.71	45.3%	148.9%
D. Agricultural Soils		65.52		53.2%
F. Field Burning of Agricultural Residues	0.88	0.04	25.2%	114.1%

6.2.4. Source-specific QA/QC and verification

Activity data related to livestock population and any additional parameters like milk productivity or cattle pregnancy come from national statistics prepared by the Central Statistical Office. Data like livestock population, crop production, nitrogen fertilizers use and others are available in several publications that were cross-checked. Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 7.

6.2.5. Source-specific recalculations

- recalculation of non-dairy cattle population for 1988-1997 for consistency purposes;
- update of data on fat content in cow's milk in 2012;
- update of digestibility energy index (DE) for dairy cattle in 2007-2011 and for non-dairy cattle in 1988−2011.

Table 6.7. Changes in CH_4 emisions from enteric fermentation due to recalculations made

Change	**1988**	**1989**	**1990**	**1991**	**1992**
Gg	27.47	20.96	17.74	18.35	22.09
%	3.7	2.7	2.4	2.8	3.7
Change	**1993**	**1994**	**1995**	**1996**	**1997**
Gg	20.23	22.80	19.72	20.09	14.32
%	3.7	4.2	3.8	4.1	2.8
Change	**1998**	**1999**	**2000**	**2001**	**2002**
Gg	-11.59	-10.46	-10.27	-9.22	-9.82
%	-2.2	-2.1	-2.2	-2.1	-2.3
Change	**2003**	**2004**	**2005**	**2006**	**2007**
Gg	-8.72	-8.54	-9.16	-9.59	-10.65
%	-2.0	-2.0	-2.2	-2.2	-2.4
Change	**2008**	**2009**	**2010**	**2011**	
Gg	-11.46	-13.13	-14.37	-16.53	
%	-2.6	-3.0	-3.3	-3.7	

6.2.6. Source-specific planned improvements

No further improvements are planned at this time.

6.3. Manure Management (CRF sector 4.B)

6.3.1. Source category description

CH_4 emissions related to animal manure management in 2012 amounted to 117.4 Gg and decreased since 1988 by 28.2%. Most of CH_4 emissions in 2012 come from manure generated by swine - 55.6%. Again the biggest change over time in CH_4 emissions relates to sheep breeding where cut of emissions amounted to 94% in 1988-2012 (tab. 6.8).

Table 6.8. Trends in CH_4 emissions from manure management according to livestock categories in 1988-2012

Year	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry	Total
1988	28.16	11.84	0.70	0.02	1.46	102.21	19.20	163.60
1989	29.51	15.34	0.72	0.02	1.35	98.41	20.75	166.10
1990	27.68	8.46	0.68	0.02	1.31	101.92	17.79	157.85
1991	25.23	9.33	0.52	0.02	1.31	114.75	17.24	168.42
1992	22.41	8.57	0.31	0.02	1.25	116.15	15.86	164.57
1993	19.93	7.30	0.21	0.02	1.17	99.40	15.47	143.50
1994	19.37	7.44	0.14	0.02	0.86	102.81	15.55	146.20
1995	17.86	6.79	0.12	0.02	0.88	108.07	15.01	148.75
1996	16.52	6.29	0.09	0.02	0.79	95.28	16.34	137.61
1997	17.67	6.11	0.08	0.02	0.78	96.40	15.88	136.93
1998	16.75	5.74	0.08	0.02	0.78	102.10	15.74	141.21
1999	19.99	5.60	0.07	0.02	0.77	98.96	15.83	141.22
2000	19.26	5.58	0.06	0.02	0.76	91.59	15.45	132.73
2001	18.86	5.21	0.06	0.02	0.76	91.70	16.12	132.73
2002	26.77	5.28	0.06	0.02	0.46	100.08	15.51	148.17
2003	32.12	5.18	0.05	0.02	0.46	100.16	11.41	149.41
2004	35.92	5.67	0.05	0.02	0.45	91.65	10.16	143.91
2005	36.47	5.87	0.05	0.02	0.43	100.96	9.76	153.56
2006	36.27	6.17	0.05	0.02	0.43	106.73	11.06	160.72
2007	37.43	6.14	0.05	0.02	0.46	104.57	11.75	160.42
2008	38.08	6.30	0.05	0.02	0.45	88.92	11.35	145.17
2009	36.40	6.45	0.05	0.01	0.41	85.30	10.98	139.60
2010	34.06	6.79	0.04	0.01	0.37	87.38	10.31	138.97
2011	35.11	7.03	0.04	0.01	0.35	77.67	11.20	131.41
2012	34.45	7.17	0.04	0.01	0.31	65.26	10.19	117.43
share [%] in 2012	29.34	6.11	0.04	0.01	0.26	55.57	8.67	100.00
change [%] 1988-2012	22.33	-39.45	-93.85	-49.87	-78.86	-36.15	-46.95	-28.22

Generally decreasing trend is observed in CH_4 emission from manure management of the most livestock sub-categories except cattle. Despite decreasing cattle population, the increasing share of liquid systems in the inventoried period caused certain rise of emissions.

6.3.2. Methodological issues

The source of activity data i.e. animal population was taken from the public statistics [GUS R2 2012] (tab. 6.2, 6.3). Country specific data on the animal waste management systems (AWMS) come from [Walczak 2006, 2009, 2011, 2012, 2013].

The fractions of manure managed in given AWMS for cattle were assessed on an annual basis for period 1988-2002 and 2004–2012, data for 2003 was interpolated between 2002 and 2004. The share of pastures and solid storage were assessed for the key years: 1988-1989 and for 2004-2012 and the values in-between were interpolated (tab. 6.9).

As concerns swine manure management systems the share of liquid and solid storage was estimated based on AWMS shares and pigs population for age categories for 1988 [Walczak 2006]. Data for 2004−2012 was taken from [Walczak 2011, 2012, 2013]. Data for years between 1988 and 2004 interpolation was made.

For other animals permanent shares of AWMS for entire inventoried period were taken: for sheep - 40% on pastures and 60% solid storage, for goats respectively: 44% on pastures and 56% on solid storage and for horses: 22% and 78%. For poultry the following AWMS shares were established: 11% on liquid systems and 89% on solid storage [Walczak 2011, 2012, 2013].

Table 6.9. Fractions of manure managed in given AWMS for cattle and swine for 1988−2012 [%]

	Dairy cattle			Other cattle			swine		
	liquid	solid	pasture	liquid	solid	pasture	liquid	solid	pasture
1988	2.8	75.2	22.0	4.9	77.1	18.0	22.3	77.7	0.0
1989	2.8	75.2	22.0	6.8	75.2	18.0	22.4	77.6	0.0
1990	2.7	76.1	21.2	3.2	79.2	17.6	22.4	77.6	0.0
1991	2.7	76.9	20.4	5.1	77.7	17.2	22.5	77.5	0.0
1992	2.5	77.9	19.6	5.0	78.2	16.8	22.5	77.5	0.0
1993	2.3	78.9	18.8	4.4	79.2	16.4	22.6	77.4	0.0
1994	2.3	79.7	18.0	4.2	79.8	16.0	22.6	77.4	0.0
1995	2.3	80.4	17.2	3.8	80.6	15.6	22.7	77.3	0.0
1996	2.1	81.5	16.4	3.4	81.4	15.2	22.7	77.3	0.0
1997	2.4	82.0	15.6	3.0	82.2	14.8	22.8	77.2	0.0
1998	2.1	83.1	14.8	3.4	82.2	14.4	22.8	77.2	0.0
1999	3.3	82.7	14.0	3.7	82.3	14.0	22.9	77.1	0.0
2000	3.7	83.1	13.2	4.0	82.4	13.6	23.0	77.0	0.0
2001	3.7	83.9	12.4	4.3	82.6	13.2	23.0	77.0	0.0
2002	6.8	81.6	11.6	4.4	82.8	12.8	23.1	76.9	0.0
2003	8.6	80.5	10.8	4.5	83.1	12.4	23.1	76.9	0.0
2004	10.5	79.5	10.0	5.2	83.0	11.8	23.2	76.8	0.0
2005	10.6	79.4	10.0	5.2	82.8	12.0	24.0	76.0	0.0
2006	10.3	79.7	10.0	5.2	83.1	11.7	24.4	75.6	0.0
2007	10.7	79.2	10.0	4.8	83.1	12.0	25.0	75.0	0.0
2008	10.9	79.1	10.0	4.9	83.1	11.9	24.9	75.1	0.0
2009	10.8	79.2	10.0	4.8	83.1	12.0	25.9	74.1	0.0
2010	10.1	79.6	10.3	5.1	82.9	12.1	25.5	74.5	0.0
2011	10.6	79.1	10.3	5.2	82.9	11.9	24.9	75.1	0.0
2012	10.5	79.2	10.3	5.1	82.9	12.0	24.3	75.7	0.0

In Poland prevail small farms where drylot systems for animal management are commonly used. Liquid systems are applied only at big farms, having more than 120 animals. Development of such big milk farms in early years of 2000 influenced significant increase of CH_4 emissions from manure management for dairy cattle since 2002.

6.3.2.1. Estimation of CH_4 emissions from manure management

The *Tier 1* methodology and the default emission factors, as given below, were used for estimation of CH_4 emissions from manure management of horses, goats and poultry [IPCC 1997] (tab. 6.10). The IPCC *Tier 2* methodology was used to establish domestic CH_4 emission factors for cattle, sheep and swine applying equation 4.17 from [IPCC 2000]:

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

where:

EF – emission factor (kg CH_4/animal/year),

Vs – average daily volatile excreted solids estimated using domestic GE for cattle and sheep (for swine the default value was applied [IPCC 1997, tab. B–6],

Bo – maximum CH_4 production capacity for manure produced by animal [IPCC 1997, tab. B–3, 4, 6, 7],

MCF – methane conversion factors for each manure management system for cool climate [IPCC 2000, tab. 4.10].

MS – fraction of Animal species/category in given AWMS

Examples of above mentioned parameters and emission factors for livestock are shown in table 6.10.

Table 6.10. Methane-producing potential (B_o), volatile solids excreted (Vs) and CH_4 emission factors for manure management in 2012

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	4.63	13.36
Non-dairy cattle	0.17	1.84	2.24
Sheep	0.19	0.36	0.17
Goats	0.17	0.28	0.12
Horses	0.33	1.72	1.39
Swine	0.45	0.50	5.64
Poultry	0.32	0.10	0.08

At the figure 6.5 changes of CH_4 emission factors for dairy cows and non-dairy cattle in 1988–2012 are presented, where significant increase since 2002 is stimulated by rising share of liquid waste management systems what is in line with development of big milk farms. In case of sheep methane emission factor for entire inventoried period was round 0.17 kg CH_4/animal/year.

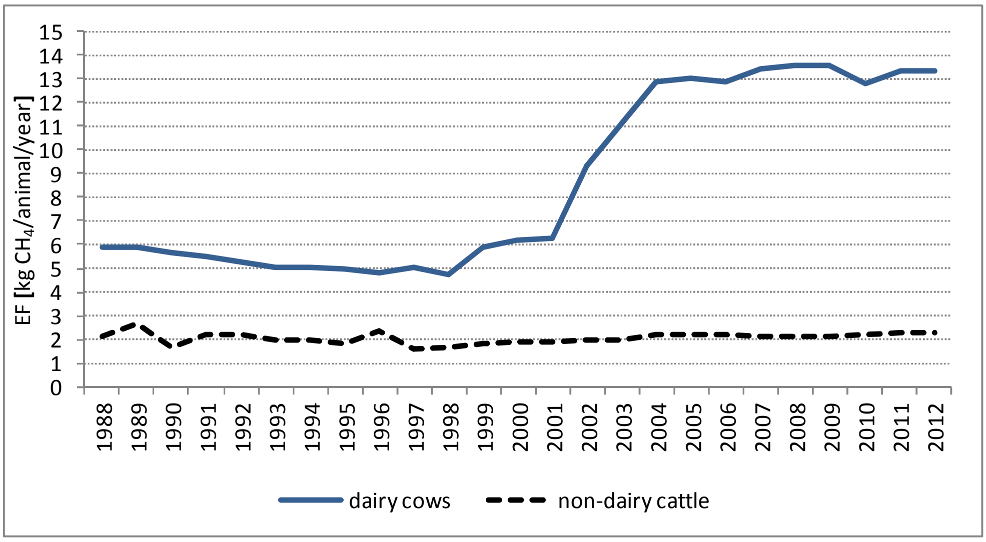

Figure 6.5. Methane emission factors from manure management for dairy cows and non-dairy cattle in 1988–2012

6.3.2.2. Estimation of N_2O emissions from manure management

Nitrous oxide emissions from manure management in 2012 were estimated based on recommended IPCC methodology [IPCC 1997] using domestic data on animal waste management systems for animal categories (tab. 6.9) [Walczak 2009, 2011, 2012, 2013]. Following the ERT recommendation made in 2009 country specific values of nitrogen content in animals manure (Nex) were applied.

The basis for assessment of Nitrogen excretion rates (Nex) applied in calculations of N_2O emissions for cattle, sheep, horses and swine constitutes the standard amounts of nitrogen in faeces and urine determined for different groups of livestock animals grounded on standard quantity, sort and digestibility of fodder applied. This information is the base for determination of amount of nutrients in organic fertilisers produced in farms using the SFOM model [Jadczyszyn i in. 2000]. For poultry Nex parameters come from publication [Jadczyszyn et al 2009]. For goats the weighted mean value estimated for sheep in 1988-2011 was used. Country specific Nex values are given in table 6.11 and they are in line with parameters published in [UNECE 2001]. These Nex parameters have been applied for entire time series as there are no updated studies performed in this area.

Table 6.11. Nitrogen excreted (Nex) in manure by livestock

Livestock	Nex [kg/head/year]
Dairy cattle*:	
up to 3.5 thous. kg milk/cow/year	70.30
3.5- 4 thous. kg milk /cow/ year	75.90
4 - 6 thous. kg milk /cow/ year	86.70
above 6 thous. kg milk /cow/ year	119.30
Non-dairy cattle*:	
calf (0-3 months)	4.09
calf (3-6 months)	8.64
heifer (6-12 months)	22.20
heifer (12-24 months)	42.40
bull (6-18 months)	22.80
bull (> 24 months)	45.70
Sheep*:	
lamb (6-12 months)	3.81
sheep (> 1 year)	7.63
Goats	6.70
Horses*:	
light weight horses	26.16
heavy weight horses	29.27
Swine*:	
sows	15.50
sows with 18 litters	37.20
suckling pigs (20-30 kg)	6.69
piglets (30-70 kg)	14.76
butcher hogs (70-110 kg)	14.76
Poultry**:	
laying hens	0.382
broilers	0.262
turkeys	0.916
ducks	0.408
geese	0.447

* [Jadczyszyn i in. 2000]
** [Jadczyszyn 2009]

Default values of N_2O emission factors for management systems from [IPCC 2000, table 4.12] were applied (table 6.12).

Table 6.12. Factors of N_2O–N emission for various manure management systems [IPCC 2000]

Animal Waste Management Systems	Emission factor [kg N_2O-N/kg N]
Liquid systems	0.001
Solid storage and dry lot	0.020

6.3.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 6.2.3.

6.3.4. Source-specific QA/QC and verification

Activity data related to livestock population come from national statistics prepared by the Central Statistical Office. Data on Animal Waste Management Systems are elaborated by the National Research Institute of Animal Production which develops activities aiming at obtaining representative data on the production of main livestock categories. Collection of this data is based on appointing a suitable monitoring for various institutions like statistical office, Farmers Chambers, Centres for Agricultural Advice and Veterinary Inspection. Partially monitoring is covered also by Institute's employees.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.3.5. Source-specific recalculations

- recalculation of non-dairy cattle population for 1988-1997 for consistency purposes;
- update of data on fat content in cow's milk in 2012;
- update of digestibility energy index (DE) for dairy cattle in 2007-2011 and for non-dairy cattle in 1988–2011;
- correction of AWMS for sheep and goats for 1988–2011.

Table 6.13.a. Changes in CH_4 emissions from manure management due to recalculations

Change	1988	1989	1990	1991	1992
Gg	0.83	0.47	0.20	0.46	0.75
%	0.51	0.29	0.13	0.27	0.46
Change	**1993**	**1994**	**1995**	**1996**	**1997**
Gg	0.63	0.73	0.54	-1.55	0.22
%	0.44	0.51	0.37	-1.13	0.16
Change	**1998**	**1999**	**2000**	**2001**	**2002**
Gg	-0.96	-0.92	-0.94	-0.88	-0.94
%	-0.67	-0.65	-0.70	-0.66	-0.63
Change	**2003**	**2004**	**2005**	**2006**	**2007**
Gg	-0.86	-0.92	-0.99	-1.03	-1.20
%	-0.57	-0.64	-0.64	-0.64	-0.74
Change	**2008**	**2009**	**2010**	**2011**	
Gg	-1.40	-1.69	-1.95	-2.35	
%	-0.96	-1.20	-1.38	-1.76	

Table 6.13.b. Changes in N_2O emissions from manure management due to recalculations

Change	1988	1989	1990	1991	1992
Gg	0.05	0.02	0.06	0.10	0.13
%	0.18	0.09	0.22	0.39	0.57
Change	**1993**	**1994**	**1995**	**1996**	**1997**
Gg	0.13	0.17	0.13	0.25	0.11
%	0.60	0.82	0.60	1.26	0.52
Change	**1998**	**1999**	**2000**	**2001**	**2002**
Gg	-0.03	-0.03	-0.02	-0.02	-0.02
%	-0.13	-0.13	-0.13	-0.13	-0.12
Change	**2003**	**2004**	**2005**	**2006**	**2007**
Gg	-0.02	-0.02	-0.02	-0.02	-0.02
%	-0.12	-0.13	-0.12	-0.11	-0.11
Change	**2008**	**2009**	**2010**	**2011**	
Gg	-0.02	-0.02	-0.02	-0.02	
%	-0.12	-0.11	-0.10	-0.10	

6.3.6. Source-specific planned improvements

Update of country specific Nitrogen excretion rates (Nex) is planned.

6.4. Agricultural Soils (CRF sector 4.D)

6.4.1. Source category description

Nitrous oxide emissions from agricultural soils amounted to 65.5 Gg N_2O in 2012 and dramatically decreased after 1989 and then stabilized since 1992 with slight increase in 2006−2008 (figure 6.6). There are a few main driving forces influencing emissions variability during entire inventoried period: nitrogen fertilizers use, livestock population, area of N–fixing crops and cultivated histosols.

As a result of economic transformation of the Polish economy in 1989 significant changes were observed in relation to crop production and usage of agricultural land. For instance the decrease of agricultural land of which share in total country area changed from 59.2% in 1989 up to 54% in 1996, also significant increase of fallow land was noted - in 1989 the share of fallow land in agricultural land was 1.1% while in 2002 - 13.6%. Between 1990 and 2002 the decrease of sown area by 3.5 million hectares occurred, also the decrease of mineral fertilisers' use drop from 164 kg per 1 ha of agricultural land in 1989/90 to 93 kg in 2001/02. Since 1988 production of certain crops in Poland changed noteworthy – potatoes cultivation dropped by 74% up to 2012 while maize production increased almost 20-fold (table 6.14).

Table 6.14. Main crops production in 1988−2012 in Poland [Gg]

	wheat	barley	maize	oats	rye	triticale	cereal mixed	millet & buckwheat	pulses edible	pulses feed	potatoes	rape & agrimony	All vegetables	All fruits
1988	7582	3804	204	2222	5501	1731	3387	73	108	457	34707	1199	5179	2168
1989	8462	3909	244	2185	6216	2404	3466	72	120	495	34390	1586	5067	2078
1990	9026	4217	290	2119	6044	2721	3554	43	116	493	36313	1206	5259	1416
1991	9270	4257	340	1873	5900	2449	3683	39	133	547	29038	1043	5637	1873
1992	7368	2819	206	1229	3981	1711	2612	36	98	282	23388	758	4518	2385
1993	8243	3255	290	1493	4992	1894	3200	50	107	304	36270	594	5823	2705
1994	7658	2686	189	1243	5300	1631	3026	30	66	149	23058	756	5198	2109
1995	8668	3278	239	1495	6288	2048	3844	45	101	167	24891	1377	5746	2115
1996	8576	3437	350	1581	5653	2130	3520	51	97	180	27217	449	5253	2781
1997	8193	3866	416	1630	5299	1841	4105	49	97	163	20776	595	5136	2887
1998	9537	3612	497	1460	5663	2058	4274	58	111	178	25949	1099	6096	2517
1999	9051	3401	599	1447	5181	2097	3914	60	99	218	19927	1132	5457	2387
2000	8503	2783	923	1070	4003	1901	3084	74	93	171	24232	958	5721	2247
2001	9283	3330	1362	1305	4864	2698	4060	58	88	123	19379	1064	5428	3413
2002	9304	3370	1962	1486	3831	3048	3608	40	95	134	15524	953	4537	3018
2003	7858	2831	1884	1182	3172	2812	2812	44	66	172	13731	793	4870	3309
2004	9892	3571	2344	1430	4281	3723	4322	72	77	193	13999	1633	5283	3521
2005	8771	3582	1945	1324	3404	3903	3916	83	66	187	10369	1450	5220	2923
2006	7060	3161	1261	1035	2622	3197	3379	59	60	146	8982	1652	4919	3212
2007	8317	4008	1722	1462	3126	4147	4257	96	75	210	11791	2130	5475	1694
2008	9275	3619	1844	1262	3449	4460	3673	82	56	179	10462	2106	5023	3843
2009	9790	3984	1706	1415	3713	5234	3884	93	60	212	9703	2497	5601	3749
2010	9408	3397	1994	1516	2852	4576	3339	146	88	268	8188	2229	4878	2826
2011	9339	3326	2392	1382	2601	4235	3373	109	84	251	9362	1862	5575	3414
2012	8608	4180	3996	1468	2888	3349	3920	128	85	395	9041	1866	5431	3286
change 1988-2012 [%]	13.5	9.9	1858.8	-33.9	-47.5	93.5	15.7	74.7	-21.1	-13.5	-73.9	55.6	4.9	51.6

More than 61% of N_2O emissions here are related to direct soil cultivation, while about 36.5% are generated in indirect emission processes. Only 2.3% come from animal manure left on pastures. The main sources of N_2O emissions estimated relate to direct soil cultivation covering:

- Synthetic fertilizers use,
- Animal manure applied to soils,
- Biological nitrogen fixation by legumes,
- Incorporation of crop residues after harvest,
- Application of sewage sludge on agricultural soils.

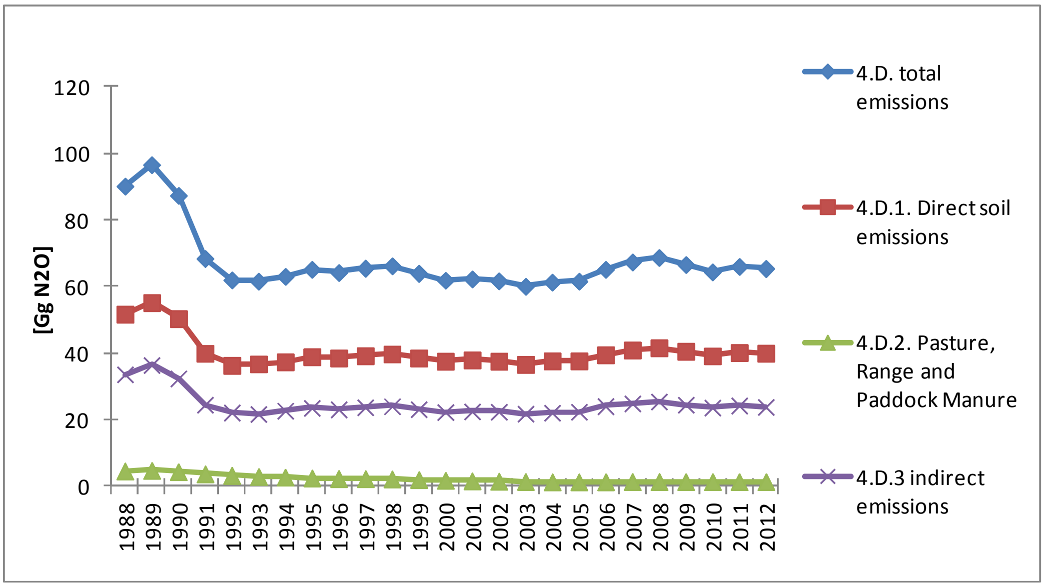

Figure 6.6. N_2O emissions from agricultural soils for 1988–2012

6.4.2. Methodological issues

6.4.2.1. Direct Soil Emissions - Synthetic Fertilizers (CRF sector 4.D.1.1)

N_2O emission from synthetic fertilizers was estimated based on the amount of nitrogen synthetic fertilizer applied to agricultural fields published in [GUS 2013]. Data regarding consumption of mineral fertilizers are elaborated on the basis of reporting from production and trade units, statistical reports of agricultural farms: state-owned, co-operatives and companies with share of public and private sector, expert's estimates as well as Central Statistical Office estimates. Present level of fertilizing is still lower than it was in 1988−1989. The drop of nitrogen fertilizers use in 1989−1992 amounted to 41% and gradually increased up to 2007. Since 2008 again slight decrease and further stabilisation is observed (table 6.15). Projected use of nitrogen fertilisers is close to the present level [5RR 2010, table 5.8]. The recommendations following agricultural good practice elaborated by the Ministry of Agriculture and Rural Development contain the rules for rational use of fertilisers, free consultancy system for farmers in this area, while the largescale farms are obliged to elaborate fertilizing plans [5RR 2010, chapter 4.9.2].

Table 6.15. Nitrogen fertilizers use in 1988–2012 in Poland [Gg N]

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1 335	1 520	1 274	735	619	683	758	836	852	890	891	862
2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
861	895	862	832	895	895	996	1 056	1 142	1095	1028	1091
2012											
1095											

The *Tier 1a* method was applied [IPCC 2000] to calculate N_2O emissions from synthetic nitrogen fertilizers use in Poland. First the amount of consumed synthetic fertilizer was adjusted by the fraction that volatilises as NH_3 and NO_x:

$$F_{SN} = N_{FERT} * (1 - Frac_{GASF})$$

where:

F_{SN} - amount of synthetic fertilizer applied to soils adjusted for volatilisation
N_{FERT} - amount of synthetic fertilizer consumed annually
$Frac_{GASF}$ - fraction of synthetic fertilizer that volatilises as NH_3 and NO_x

$Frac_{GASF}$ was taken from [IPCC 1997, table 4-19] and equals 0.1 kg NH_3-N+NO_x-N / kg synthetic fertilizer N applied. The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from synthetic fertilizers use.

Nitrous oxide emissions regarding synthetic fertilizers use in 2012 was about 19.4 Gg N_2O and was comparable to 2011 emissions. General trend in N_2O emissions follows nitrogen fertilizers use and amounts to 26.9 Gg N_2O in 1989 to 10.9 Gg N in 1992.

6.4.2.2. Direct Soil Emissions - Animal Manure applied to soils (CRF sector 4.D.1.2)

Animal manure nitrogen used as fertilizer was estimated according to *Tier 1a* method recommended in the guidelines [IPCC 2000, equation 4.23]:

$$F_{AM} = \Sigma_T(N_{(T)} * Nex_{(T)}) * (1 - Frac_{GASM}) * (1 - Frac_{GRAZ})$$

where:

F_{AM} - animal manure nitrogen used as fertilizer, adjusted for volatilisation
$\Sigma_T(N_{(T)} * Nex_{(T)})$ - total amount of animal manure nitrogen produced annually
$Frac_{GASM}$ - fraction of animal manure nitrogen that volatilises as NH_3 and NO_x
$Frac_{GRAZ}$ - fraction of animal manure nitrogen deposited onto soils by grazing livestock

$Frac_{GASM}$ was taken from [IPCC 1997, table 4-19] and equals 0.2 kg NH_3-N+NO_x-N/kg of N excreted by livestock. $Frac_{GRAZ}$ indicator is estimated as a fraction of nitrogen left on pastures by livestock in total nitrogen excreted, this parameter was modified following ERT review 2003. Trend of $Frac_{GRAZ}$ is given in table 6.16.

Table 6.16. Trend of fraction of livestock N excreted and deposited onto soil during grazing ($Frac_{GRAZ}$)

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
$Frac_{GRAZ}$	0.135	0.137	0.131	0.119	0.112	0.111	0.105	0.098	0.096	0.093	0.089	0.085
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
$Frac_{GRAZ}$	0.081	0.075	0.070	0.068	0.066	0.065	0.064	0.066	0.069	0.071	0.071	0.072
Year	**2012**											
$Frac_{GRAZ}$	0.077											

The total amount of nitrogen in animal manure was calculated based on animal population (tables 6.2, 6.3) and the country specific values of nitrogen excretion for each type of animal (table 6.11). The data on fraction of manure managed in each AWMS applied in Poland are the country specific data taken from Polish studies [Myczko 2001, Walczak 2006, 2009, 2011, 2012, 2013] (table 6.9). The fraction of animal manure burned for fuel was neglected because it is not the case in Poland. The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from animal manure applied to soils.

Nitrous oxide emissions from animal manure applied to soils in 2012 was about 9.0 Gg N_2O and constantly decreases. This is caused by decreasing trend of livestock population, mainly cattle and sheep after 1989 (see tables 6.2, 6.3).

6.4.2.3. Direct Soil Emissions - nitrogen fixed by crops (CRF sector 4.D.1.3)

Following ERT recommendation N_2O emission from N-fixing crops was calculated using *Tier1b* [IPCC 2000, equation 4.26] for each crop type:

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

where:

F_{BN} - amount of nitrogen fixed by N-fixing crop cultivated annually
$Crop_{BF}$ - N-fixing crop yield
Res/Crop - residue to crop product mass ratio specific to each crop type
$Frac_{DM}$ - fraction of dry matter in the aboveground biomass specific to each crop type
$Frac_{NCRBF}$ - fraction of total aboveground biomass of N-fixing crop that is nitrogen specific to each crop type

Data on N-fixing crops yields is published in [GUS R3 2013]. Factors like: residue/crop ratio (Res/Crop), dry matter fraction ($Frac_{Dm}$) and fraction of crop biomass that is N ($Frac_{NCRBF}$) were taken from the Polish case studies [Loboda 1994, IUNG 2012] and they are consistent with factors applied for CH_4 and N_2O emissions estimation in subcategory 4.F Field burning of crop residues (see chapter 6.5 and table 6.23). Residue/Crop ratio (Res/Crop) for crops cultivated for forage is taken as 0 according to [IPCC 2000] as the entire plants are harvested as product for forage.

The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from N-fixing crops.

Emissions from N-fixing crops in 2012 amounted for 0.4 Gg N_2O and have been at the similar level since 2003. But comparing to 1988 values N_2O emissions decreased by about 70% what is related to declining of area sawn by N-fixing plants especially those planted for forage for decreasing livestock population.

6.4.2.4. Direct Soil Emissions - Crop Residue (CRF sector 4.D.1.4)

N_2O emission from crop residue returned to soils was estimated using modified equation 4.28 following [IPCC 2000, Chapter 4.7.1.1] for every crop:

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

where:

F_{CR} - amount of nitrogen in crop residues returned to soils
$Crop_Y$ - crop yield
$Frac_{DM}$ - fraction of dry matter in the aboveground biomass specific to each crop type
Res/Crop - residue to crop product mass ratio specific to each crop type
$Frac_{NCRO}$ - fraction of crop biomass that is nitrogen
$Frac_{BURN}$ - fraction of crop residues burned
$Frac_R$ - fraction of total above-ground crop biomass that is removed from the field as a crop product

Statistics like $Frac_{DM}$, Res/Crop, $Frac_{NCRO}$ and $Frac_{BURN}$ are given in table 6.23 and were taken from country studies [Łoboda 1994, IUNG 2012] where experimental and literature data as well as default emission factors were used. Fraction of total above-ground crop biomass that is removed from the field as a crop product (FracR) were consulted with the Institute of Soil Science and Plant Cultivation – State Research Institute and is presented in table 6.17.

Table 6.17. Fraction of total above-ground crop biomass that is removed from the field as a crop product ($Frac_R$) according to crops/group of crops

crop	FracR	crop	FracR
wheat	0.70	sugar beet	0.25
rye	0.70	rape	0.10
barley	0.70	other oil-bearing	0.10
oats	0.70	flux straw	0.90
triticale	0.70	tobacco	0.65
cereal mixed	0.70	hop	0.01
millet & buckwheat	0.70	hey from greenland	0.95
maize	0.10	hey from pulses	0.95
pulses edible	0.01	hey from legumes	0.95
pulses feed	0.01	vegetables	0.10
potatoes	0.01		

In table 6.18 and CRF Table4.Ds2 the weighted mean values are presented for each year depending on crop production in a given year:

Table 6.18. Weighted mean $Frac_R$ for Poland for 1988−2012

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
$Frac_R$	0.46	0.45	0.45	0.47	0.45	0.41	0.45	0.45	0.44	0.48	0.45	0.47
Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
$Frac_R$	0.42	0.48	0.47	0.49	0.50	0.50	0.50	0.50	0.52	0.52	0.53	0.53
Year	**2012**											
$Frac_R$	0.51											

Activity data concerning crop production was taken from national statistics [GUS R3 2013] (table 6.12). The default emission factor of 0.0125 kgN_2O-N/kg N [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from N inputs from crop residues.

Emission from crop residues in 2012 was 2.5 Gg N_2O and is on the similar level since 1995.

6.4.2.5. Direct Soil Emissions - Cultivation of Histosols (CRF sector 4.D.1.5)

The area of cultivated histosols in Poland was estimated as a case study for the purposes at national inventory [Oświecimska–Piasko 2008]. Based on information collected from Computer database on peatlands in Poland "TORF" as well as from system of Spatial Information on Wetlands in Poland the area of histosols was assessed for mid–1970s and mid–1990s. The area from which N_2O emissions were calculated covers histosols as agricultural lands cultivated and/or irrigated. So the area of such area was 882.6 thousand ha in mid–1970–ties and 769 thousand ha in mid–1990–ties. The area of histosols was then interpolated for 1976−1994.

Additionally the area of cultivated histosols was assessed for 2015 for the purpose of GHG emission projections which amounts to 680 thousand ha [6 RR 2013]. Similarly to the previous period interpolation of histosol areas was applied between 1995 and 2015.

The default emission factor for Mid-Latitude Organic Soils of 8 kg N_2O-N/ha [IPCC 2000, table 4.17] was used for estimating the N_2O emissions from cultivation of histosols.

Nitrous oxide emissions from cultivated histosols in Poland in 2012 was about 8.7 Gg N_2O and is falling since 1988 because of continuous progress of mineralization of organic matter as well as increasing area of histosols occupied by forest and scrub communities following cultivation termination of these areas.

6.4.2.6. Direct Soil Emissions - Sewage Sludge applied to soils (CRF sector 4.D.1.6)

Activity data on the amount of sewage sludge applied on the fields were taken from GUS [GUS 2013d] and regards both - industrial and municipal sewage sludge applied in cultivation of all crops marketed, including crops designed to produce fodder as well as this applied in cultivation of plants intended for compost production. As the consistent reporting of data concerning application of sewage sludge in agriculture in the public statistics starts in 2003, the activities since 1988 were supplemented based on annual mean changes of AD in 2003−2012 (fig. 6.7).

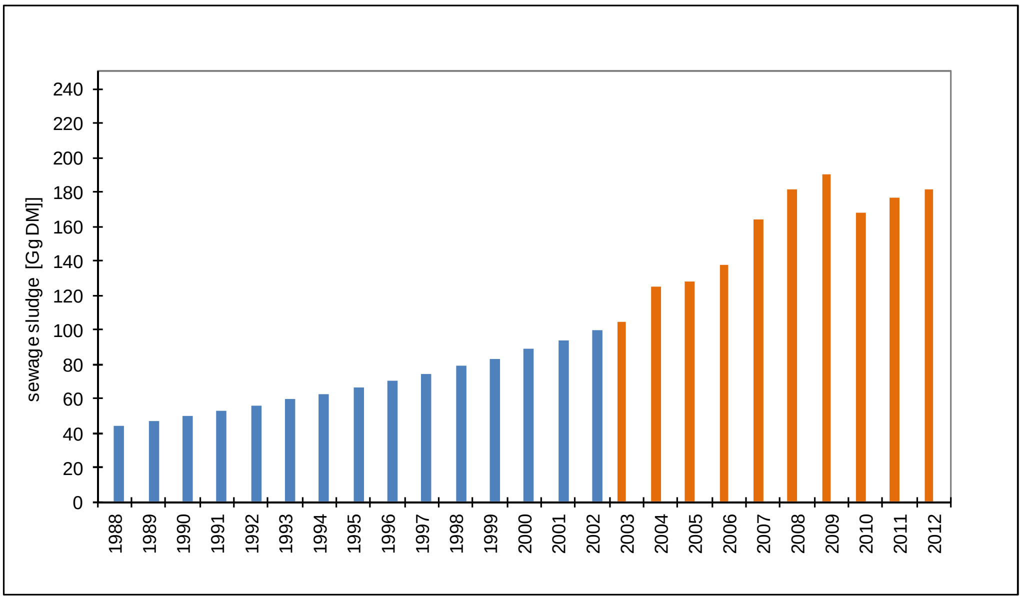

Fig. 6.7. Amounts of sewage sludge applied in agriculture [Gg DM]

The method applied for the N_2O emission estimation is the IPCC *Tier 1b* with a default emission factor of 0.0125 kgN_2O-N/kg N input to agricultural soils [IPCC 2000, table 4.17].The following formula was used for calculation of nitrogen input from sewage sludge application on agricultural soils:

$$N_{SEWSLUDGE} = S_{SLUDGE} * S_N$$

where:

$N_{SEWSLUDGE}$ - nitrogen input to agricultural soils by sewage sludge application
S_{SLUDGE} - amount of sewage sludge applied to agricultural soils
S_N - nitrogen content in dry matter

The mean N content in sewage sludge was taken as 2.61% from publication [Siebielec, Stuczyński 2008] where analysis of nitrogen content in domestic sewage sludge applied in agriculture was made. The study covered a group of 60 biosolids collected in 2001-2004 from 43 municipal sewage treatment plants. The same N content was assumed for both – municipal and industrial sewage sludge because majority of it applied in agriculture (about 76%) come from municipal treatment plants.

In Poland application of sewage sludge as fertilizer is relatively small, but is increasing – from 105 thousand tonnes of dry matter in 2003 up to 181 thousand tonnes of dry matter in 2012. Emissions of N_2O for this subcategory amounted to 0.1 Gg N_2O in 2012 and contributed only 0.1% of N_2O emissions from category 4.D Agricultural soils.

6.4.2.7. Agricultural Soils - Pasture, Range and Paddock Manure (CRF sector 4.D.2)

Emission of N_2O resulting from animal wastes left on pastures is calculated based on animal population (tables 6.2, 6.3). Total amount of nitrogen in animal excreta (Nex) was estimated based on country specific parameters presented in table 6.11. The data on fraction of manure related to grazing animals was presented in chapter 6.3.2.2, table 6.9. The following the formula was used for estimation of N_2O-N emissions from manure left on pastures:

$$N_2O\text{-}N_{GR} = Nex_{GR} * EF_{GR}$$

where:

- $N_2O\text{-}N_{GR}$ - N_2O-N emissions from animal manure
- Nex_{GR} - nitrogen excreted by livestock during grazing
- EF_{GR} - N_2O-N emission factor for manure deposited directly on soils

The default N_2O-N emission factor for pasture range and paddock is 0.02 kg N_2O-N/kg N excreted and was applied [IPCC 2000, table 4-12].

Table 6.19. Nitrogen excreted during grazing in 1988–2012

Year	N exretion - grazing [Gg N/yr]	Year	N exretion - grazing [Gg N/yr]
1988	149.855	2001	54.440
1989	154.846	2002	51.920
1990	142.676	2003	49.733
1991	122.754	2004	45.649
1992	108.201	2005	46.470
1993	96.385	2006	46.849
1994	90.942	2007	48.302
1995	83.165	2008	48.433
1996	77.623	2009	47.434
1997	76.141	2010	47.956
1998	74.101	2011	47.698
1999	67.498	2012	47.956
2000	59.842		

Emissions in 2012 from pasture, range and paddock manure were 1.5 Gg N_2O and stabilized since 2002. This value is much lower than in 1988 by about 68% what was caused by decreasing livestock population as well as decreasing percentage of livestock grazed.

6.4.2.8. Agricultural Soils - indirect N_2O emissions (CRF sector 4.D.3)

Indirect N_2O emissions - atmospheric deposition (CRF sector 4.D.3.1)

Atmospheric deposition of nitrogen compounds fertilises soils and surface waters resulting in enhanced biogenic N_2O formation.

Following ERT recommendation related to inclusion of sewage sludge applied on agricultural soils the *Tier 1b* method and equation 4.32 [IPCC 2000] were used for assessing indirect emissions of N_2O from atmospheric deposition:

$$N_2O_{(G)}\text{-}N = \{(N_{FERT} * Frac_{GASF}) + [(\Sigma_T(N_{(T)} * Nex_{(T)}) + N_{SEWSLUDGE}] * Frac_{GASM}\} * EF_{AD}$$

where:

$N_2O_{(G)}$-N – N_2O-N emissions produced from atmospheric deposition of N
N_{FERT} – total amount of synthetic nitrogen fertilizer applied to soils
$\Sigma_T(N_{(T)} * Nex_{(T)})$ – total amount of animal manure nitrogen excreted
$N_{SEWSLUDGE}$ - nitrogen input to agricultural soils by sewage sludge application
$Frac_{GASF}$ - fraction of synthetic fertilizer that volatilises as NH_3 and NO_x
$Frac_{GASM}$ - fraction of animal manure nitrogen that volatilises as NH_3 and NO_x
EF_{AD}– emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces

Nitrogen amounts from synthetic fertilizers, livestock manure amounts and sewage sludge applied to soils correspond to values presented in chapters 6.4.2.1, 6.4.2.2 and 6.4.2.6 respectively. $Frac_{GASF}$ equals 0.1 kg NH_3-N+NO_x-N/kg synthetic fertilizer N applied and $Frac_{GASM}$ equals 0.2 kg NH_3-N+NO_x-N/kg of N excreted by livestock and both are default values taken from [IPCC 1997, table 4-19]. The default emission factor EF_{AD} equal 0.01 kg N_2O-N/kg NH_4-N and NO_x-N deposited was used for calculation of N_2O-N emissions produced from atmospheric deposition of N [IPCC 2000, table 4.18].

Table 6.20. Volatized nitrogen from fertilizers, animal manure and sewage sludge applied to soils

Year	Volatized N [Gg N/yr]	Year	Volatized N [Gg N/yr]
1988	346.725	2001	232.321
1989	369.429	2002	233.845
1990	335.395	2003	227.874
1991	271.563	2004	226.637
1992	249.445	2005	230.451
1993	238.271	2006	245.357
1994	246.058	2007	251.307
1995	250.629	2008	252.909
1996	243.930	2009	242.908
1997	249.710	2010	236.912
1998	253.564	2011	240.399
1999	244.043	2012	234.380
2000	232.647		

Indirect N_2O emissions - Nitrogen Leaching and Run-off (CRF sector 4.D.3.2)

Part of the nitrogen is lost from agricultural soils through leaching and runoff, and gets to the groundwater, rivers and wetlands resulting in biogenic production of N_2O.

Following ERT recommendation related to inclusion of sewage sludge applied on agricultural soils the *Tier 1b* method and equation 4.36 [IPCC 2000] were used for assessing indirect emissions of N_2O from leaching and runoff:

$$N_2O_{(L)}\text{-}N = [N_{FERT} + (\Sigma_T(N_{(T)} * Nex_{(T)}) + N_{SEWSLUDGE}] * Frac_{LEACH} * EF_{LR}$$

where:

$N_2O_{(L)}$-N – N_2O-N emissions produced from leaching and runoff of N
N_{FERT} – total amount of synthetic nitrogen fertilizer applied to soils
$\Sigma_T(N_{(T)} * Nex_{(T)})$ – total amount of animal manure nitrogen excreted
$N_{SEWSLUDGE}$ - nitrogen input to agricultural soils by sewage sludge application
$Frac_{LEACH}$ - fraction of nitrogen applied on soils that leaches as NH_3 and NO_x
EF_{LR}– emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces

Nitrogen amounts from synthetic fertilizers, livestock manure amounts and sewage sludge applied to soils correspond to values presented in chapters 6.4.2.1, 6.4.2.2 and 6.4.2.6 respectively. $Frac_{LEACH}$ equals 0.3 kg N/kg synthetic fertilizer N applied and is the default value taken from [IPCC 1997, table 4-24]. The default emission factor EF_{LR} equal 0.025 kg N_2O-N/kg N leached and runoff was used for calculation of N_2O-N emissions produced from leaching and runoff of N [IPCC 2000, table 4.18].

Table 6.21. Nitrogen losses through leaching and runoff from fertilizers, animal manure and sewage sludge applied to soils

Year	N losses [Gg N/yr]	Year	N losses [Gg N/yr]
1988	720.338	2001	482.732
1989	782.143	2002	480.067
1990	694.193	2003	466.611
1991	517.595	2004	474.201
1992	467.018	2005	479.926
1993	459.857	2006	517.436
1994	482.787	2007	535.360
1995	501.343	2008	550.664
1996	493.695	2009	528.673
1997	508.065	2010	509.568
1998	513.996	2011	524.263
1999	495.364	2012	515.775
2000	478.121		

Total indirect emission in 2012 was about 24 Gg N_2O and the trend since 1992 is rather stable after significant drop in 1988−1992 (significant drop in mineral fertilisers used and animal population).

6.4.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 6.2.3.

6.4.4. Source-specific QA/QC and verification

Activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Central Statistical Office. Overall final estimation of cereals and potatoes output was verified by means of simulative calculation of crops quantity according to the distribution of output between: sale, sowing/planting, fodder and self consumption. Final estimation of sugar beets, rape and turnip rape, and some species of industrial crops were verified with procurement data for these crops. Estimation of fodder crops output in private farms, conducted by local experts of CSO, was additionally verified by the calculation of fodder crops according to the directions of their use. Total area of fodder crops comprises the area of meadows, pastures and field crops for fodder. This area does not include the area of cereals, potatoes, and other agricultural crops, a part of which was directly or indirectly used for fodder.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.4.5. Source-specific recalculations

- Amendment of AD on sewage sludge applied in agriculture in 1988-2002 and related trend of N2O emissions;
- Correction of animal manure used in indirect emissions calculations.

Table 6.22. Changes in N_2O emissions from agricultural soils resulting from recalculations.

Change	1988	1989	1990	1991	1992
Gg	14.09	14.32	13.80	13.32	12.69
%	18.49	17.38	18.73	24.14	25.67
Change	**1993**	**1994**	**1995**	**1996**	**1997**
Gg	11.50	11.61	11.43	10.88	11.03
%	22.90	22.51	21.24	20.35	20.21
Change	**1998**	**1999**	**2000**	**2001**	**2002**
Gg	11.24	10.84	10.11	9.92	10.32
%	20.39	20.37	19.50	18.91	20.03
Change	**2003**	**2004**	**2005**	**2006**	**2007**
Gg	10.04	9.53	9.80	10.15	10.11
%	20.00	18.37	18.88	18.40	17.61
Change	**2008**	**2009**	**2010**	**2011**	
Gg	9.58	9.19	9.24	9.03	
%	16.17	15.97	16.72	15.83	

6.4.6. Source-specific planned improvements

Presently no improvements are planned.

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

6.5.1. Source category description

Greenhouse gas emissions in 2012 from field burning of agricultural residues amounted for 0.88 Gg CH_4 and 0.04 Gg N_2O and were slightly higher than in 2010-2011. The share of GHG emissions from field burning of agricultural residues in total agricultural emissions is 0.1%. The trend of GHG emissions within this category is presented on figure 6.8 and fluctuates following the annual crop production.

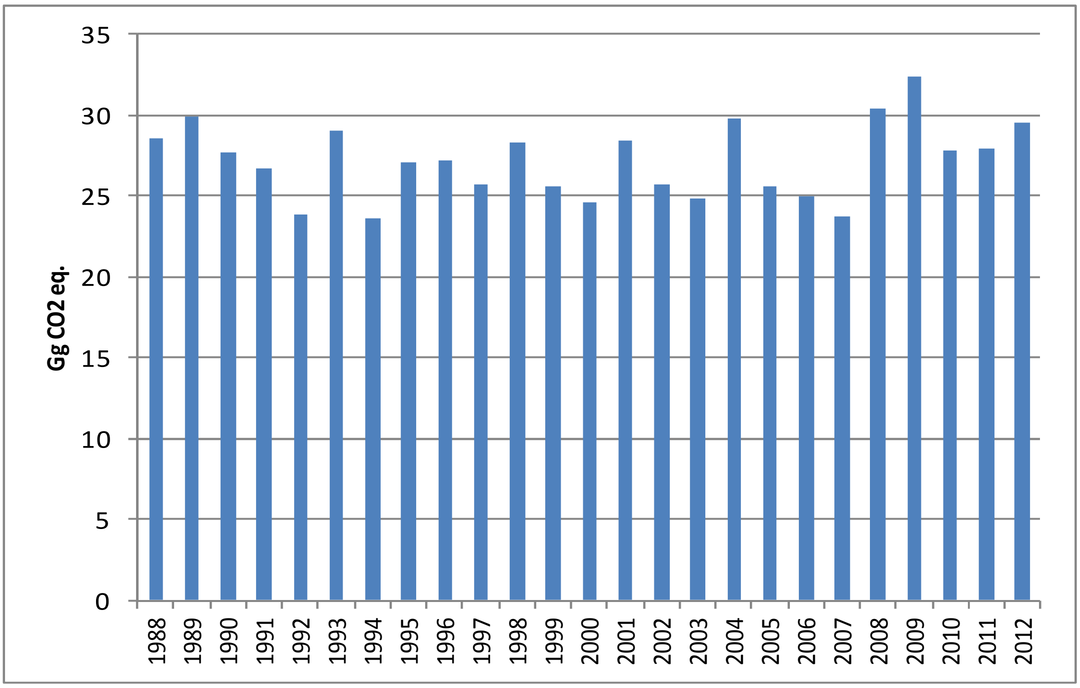

Figure 6.8 CH_4 and N_2O emissions from field burning of agricultural residues presented as CO_2 equivalent

6.5.2. Methodological issues

While estimating GHG emissions in this subcategory only methane and nitrous oxide are taken into account assuming that carbon dioxide released during burning of crop residues is reabsorbed during the next growing season.

Estimation of CH_4 and N_2O emissions from burning of agricultural residues in fields is based on methodology described in [IPCC 1997]. For domestic purposes 43 crops were selected for which residues can potentially be burned [Łoboda *at al* 1994]. Within this group certain plants were excluded for which residues can be composted or used as forage. So finally there were selected 38 crops which were than aggregated into 32 groups containing cereals. pulses. tuber and root. oil-bearing plants. vegetables and fruits potentially could be burned on fields.

Activity data on crop production comes from public statistics [GUS R3 2013]. Factors applied for emissions calculation were taken from country studies [Łoboda 1994, IUNG 2012] where experimental and literature data as well as default emission factors were used. These values for selected crops are presented in the table 6.23.

Table 6.23. Selected crop residue statistics employed in GHG estimation from field burning of agriculture residues (4.F) and direct soil emissions related to N fixing crops (4.D.1.3) and crop residues returned to soils (4.D.1.4)

Crops	Residue to crop ratio	Dry matter fraction	Fraction burned in fields	Fraction oxidized	Carbon fraction of residue	Nitrogen fraction of residue
winter wheat	0.90	0.85	0.005	0.90	0.4853	0.0068
spring wheat	0.85	0.85	0.005	0.90	0.4853	0.0068
rye	1.40	0.86	0.005	0.90	0.4800	0.0053
spring barley	0.80	0.86	0.005	0.90	0.4567	0.0069
oats	1.10	0.86	0.004	0.90	0.4700	0.0075
triticale	1.10	0.86	0.005	0.90	0.4853	0.0063
cereal mixed	0.90	0.86	0.004	0.90	0.4730	0.0071
buckwheat & millet	1.70	0.86	0.002	0.90	0.4500	0.0090
maize	1.30	0.52	0.002	0.90	0.4709	0.0094
edible pulses	0.90	0.86	0.001	0.90	0.4500	0.0180
feed pulses	1.30	0.85	0.001	0.90	0.4500	0.0203
potatoes	0.10	0.25	0.100	0.85	0.4226	0.0203
rape	1.20	0.87	0.030	0.90	0.4500	0.0068
other oil-bearing crops	3.50	0.87	0.030	0.90	0.4500	0.0068
flax straw	0.25	0.86	0.001	0.90	0.4500	0.0072
tobacco	1.25	0.50	0.002	0.85	0.4500	0.0180
hop	4.00	0.25	0.020	0.90	0.4500	0.0158
hay from greenland	0.05	0.23	0.001	0.90	0.4500	0.0198
hay from pulses	0.05	0.23	0.001	0.90	0.4500	0.0203
hay from clover and lucerne	0.05	0.23	0.001	0.90	0.4500	0.0275
tomatoes	0.60	0.15	0.050	0.85	0.4500	0.0225
other ground vegetables	0.35	0.15	0.010	0.90	0.4500	0.0248
vegetables under cover	0.40	0.35	0.010	0.90	0.4500	0.0270
apples	1.50	0.35	0.050	0.90	0.4500	0.0275
pears and other fruits	1.50	0.35	0.070	0.90	0.4500	0.0149
plums	1.50	0.35	0.100	0.90	0.4500	0.0149
cherries	1.50	0.35	0.100	0.90	0.4500	0.0149
sweet cherries	1.50	0.35	0.100	0.90	0.4500	0.0149
strawberries	0.50	0.18	0.010	0.90	0.4500	0.0149
raspberries	1.20	0.30	0.250	0.90	0.4500	0.0248
currants	1.20	0.30	0.250	0.90	0.4500	0.0149
gooseberries and other berries	1.20	0.30	0.250	0.90	0.4500	0.0149

6.5.3. Uncertainties and time-series consistency

Description of uncertainties is given in Chapter 6.2.3.

6.5.4. Source-specific QA/QC and verification

Activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Central Statistical Office. Overall final estimation of cereals and potatoes output was verified by means of simulative calculation of crops quantity according to the distribution of output between: sale. sowing/planting. fodder and self consumption. Final estimation of sugar beets. rape and turnip rape. and some species of industrial crops were verified with procurement data for these crops. Estimation of fodder crops output in private farms. conducted by local experts of CSO. was additionally verified by the calculation of fodder crops according to the directions of their use. Total area of fodder crops comprises the area of meadows. pastures and field crops for fodder. This area does not include the area of cereals. potatoes. and other agricultural crops. a part of which was directly or indirectly used for fodder.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas. units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 5.

6.5.5. Source-specific recalculations

No recalculations were made.

6.5.6. Source-specific planned improvements

No improvements are planned presently.

7. LAND USE, LAND USE CHANGE AND FORESTRY (SECTOR 5)

7.1. Overview of sector

Emissions and removals balance estimations for the LULUCF sector are associated with the estimations patterns contained in the GPG for LULUCF. It should be noted that a number of factors used in the estimations of GHG's assumes default values (recommended by the IPCC). Those factors are considered to be modified on the basis of in-country analysis.

Data included in this inventory is based on statistical data presented in statistical journals published by the Central Statistical Office. The data relating to the land area by the type of usage (in accordance with the methodology recommended by IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry) is based on:

- generalized results of land use and sown area survey conducted in June on private farms, data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land, introduced in the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454).

The consecutive regulations, classifications of land were changed inter alia due to adoption of international standards. Beginning with data for 1997 on, the registers of land were prepared by the Chief Office of Geodesy and Cartography as well as voivodship branches of geodesy and land management. The data are presented, taking into consideration geodesic area.

7.1.1. The greenhouse gas inventory overview of the Land Use, Land-Use Change and Forestry (LULUCF) sector

The greenhouse gas inventory of LULUCF sector comprises emissions and removals of CO2 due to overall carbon gains or losses in the relevant carbon pools of the predefined six land-use categories. The liming of agricultural lands is included in the LULUCF sector, as well. The non-CO2 emissions from biomass burning and disturbance associated with land-use conversion to cropland are also to be reported here. These activities altogether resulted in 34 614 Gg net removal of CO2 equivalent in 2012.

Table 7.1.1 Total GHG emissions and removals from LULUCF sector in 2012

Greenhouse gas source and sink categories	2012		
	Net CO_2 emissions/removals	CH_4	N_2O
	(Gg)		
5. Total Land-Use Categories	-34 672.39	108.21	1.76
5.A. forest Land	-39 573.27	1.49	1.06
5.A. 1. forest land remaining forest land	-36 889.02	1.39	1.06
5.A.2. land converted to forest land	-2 684.25	0.10	0.00
5.B. Cropland	1 307.56	NO	0.67
5.B.1. cropland remaining cropland	1 203.75	NO	NO
5.B.2. land converted to cropland	103.81	NO	0.67
5.C. Grassland	377.82	0.07	0.00
5.C. 1. grassland remaining grassland	392.69	0.07	0.00
5.C.2. land converted to grassland	-14.88	NO	NO
5.D. Wetlands	3 102.17	106.65	0.02
5.D. 1. wetlands remaining wetlands	2 909.33	NO	NO
5.D. 2. land converted to wetlands	192.83	106.65	0.02
5.E. Settlements	113.34	NO	NO
5.E. 1. settlements remaining settlements	-88.77	NO	NO
5.E. 2. land converted to settlements	202.11	NO	NO
5.F. Other Land	NO	NO	NO
5.F. 1. other Land remaining other Land	NO	NO	NO
5.F. 2. land converted to other Land	NO	NO	NO
5G. Other	NO	NO	NO

IE – included elsewhere, NO – not occurring

The most important sub-category recognised as the main source of removals is the subcategory *5.A forest land*. This situation is, to some extent, related to the recorded growth of timber resources. It shall be noted that the recorded growth, is the result of timber harvest carried out in accordance with the forest sustainability principle and persistent enlargement of the forest area.

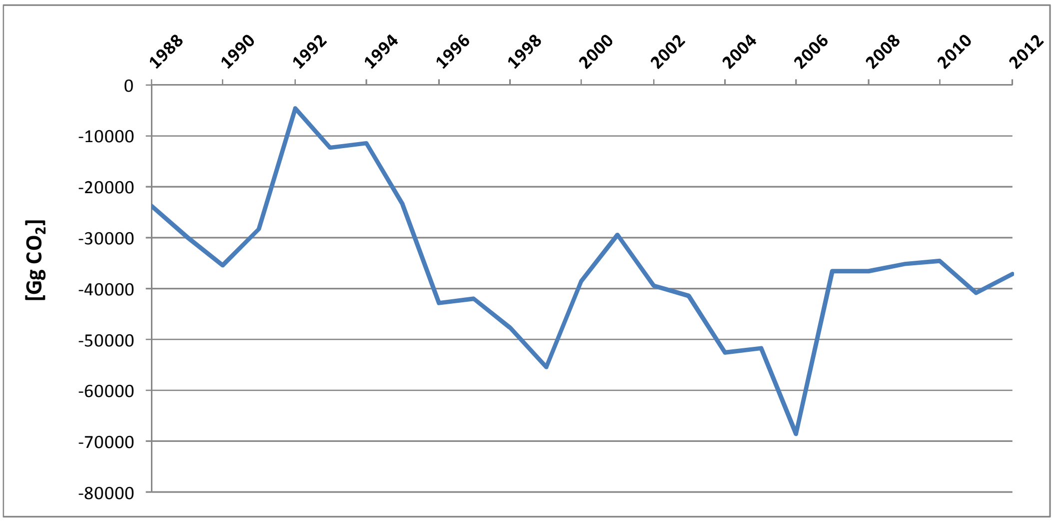

Figure 7.1. GHG's balance in LULUCF sector for years 1988-2012.

7.1.2. Country area balance in 2012

Table 7.1.2 Country area balance in 2012

Year	2012
Greenhouse gas source and sink categories	Area [ha]
5. Total land-use categories	
5.A. forest land	9 353 731
5.A.1. forest land remaining forest land	8 707 101
5.A.2. land converted to forest land	646 630
total organic soils on forest land, of which	251 460
on forest land remaining forest land	234 076
on land converted to forest land	17 383
5.B. cropland	
total cropland area	14 138 129
5.B.1. cropland remaining cropland	14 109 274
5.B.2. land converted to cropland	28 855
total organic soils on cropland, of which	534 440
on cropland remaining cropland	534 346
on land converted to cropland	1 092
5.C. grassland	
total grassland area	4 169 575
5.C.1. grassland remaining grassland	4 130 106
5.C.2. land converted to grassland	39 469
total organic soils on grassland, of which	157 910
on grassland remaining grassland	156 415
on land converted to grassland	1 494
5.D. wetlands	
total wetlands area	1 368 784
5.D.1. wetlands remaining wetlands	1 324 958
5.D.2. land converted to wetlands	43 826
total organic soils on wetland, of which	278 850
on wetlands remaining wetlands	269 921
on land converted to wetlands	8 928
5.E. settlements	
total settlements area	2 145 620
5.E.1. settlements remaining settlements	2 066 875
5.E.2. land converted to settlements	78 745
5.F. other Land	92 128
Country area balance	**31 267 967**

7.1.3. Land uses classification for representing LULUCF areas

With regard to the fact that for the reporting purposes to the United Nations Framework Convention on Climate Change and the Kyoto Protocol it is essential to match national land-use categories (as specified in the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings *(Journal of Laws 2013 pos. 1551))* to the appropriate categories of land use consistently to the IPCC guidelines (Chapter 3.2.1. GPG for LULUCF). To fulfil previously mentioned requirements following combination was prepared on the basis of the combination presented in table 7.1.3.

Table 7.1.3 Combination of land use classification systems.

IPCC category	National Land Identification System
5A forest land	forest land
5B cropland	arable land, orchards,
5C grassland	permanent meadows and pastures; woody and bushy land
5D wetland	land under waters (marine internal, surface stands); land under ponds; land under ditches;
5.E settlements	agricultural build-up areas; build-up and urbanized areas; ecological arable land; wasteland
5F Other land	miscellaneous land

7.1.4. Key categories

Key category assessment for LULUCF category is included in annex 1.

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

7.2.1. Source category description

Estimations for this subcategory were based on IPCC methodology described in the chapter 3.2.GPG LULUCF. GHG balance in this category is a net sink. In 2012 net CO_2 sink, estimated for this category was equal to 39 515 Gg CO_2.

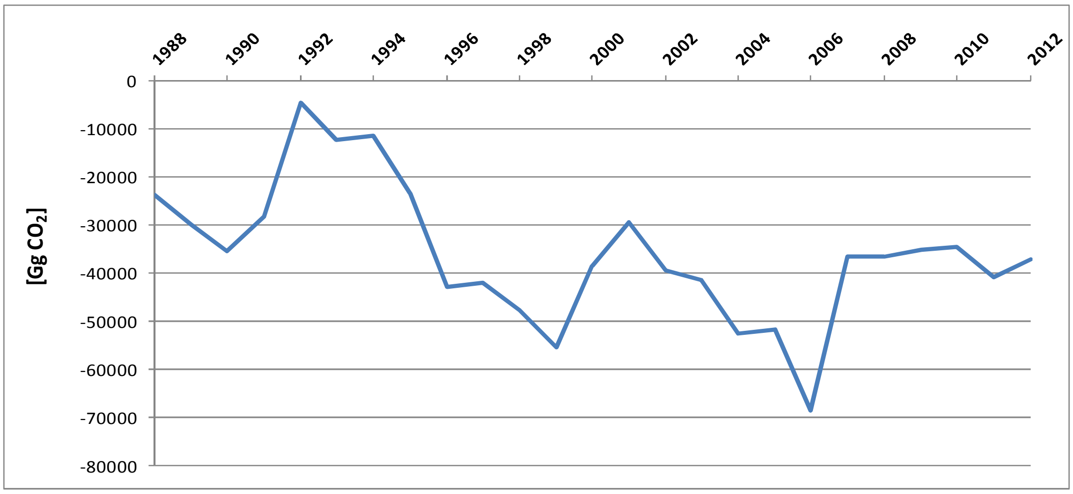

Figure 7.2 GHG's balance for the subcategory *5.A.forest land* for years 1988-2012.

7.2.1.1. Area of forest land in Poland in year 2011

Forest land reported under subcategory 5.A. is classified as a "forest" consistent to Art. 3 of *Act on Forests of 28 Sep 1991 (Journal of Law of 1991 No 101 item 444, as amended).* This assessment is consistent with internationally adopted standard which takes into account the forest land associated with forest management. Forest land area in Poland, as of 1 January 2013, was equal to 9 353 731 h*a (GUS Environmental protection 2013)*.

Table 7.2.1Forest land area by provinces as of the end of inventory year.

No	Voivodship	Unit	2008	2009	2010	2011	2012
	Total	[ha]	9 251 404	9 275 786	9 304 762	9 329 174	9353731
1.	**Dolnośląskie**	[ha]	606 104	607 327	608 387	609 279	610583
2.	**Kujawsko-pomorskie**	[ha]	425 207	426 170	427 147	427 843	428254
3.	**Lubelskie**	[ha]	568 601	572 620	576 420	579 237	581002
4.	**Lubuskie**	[ha]	706 788	707 583	708 201	709 002	709881
5.	**Łódzkie**	[ha]	386 172	387 711	388 597	389 350	390358
6.	**Małopolskie**	[ha]	439 126	438 280	439 765	440 114	440432
7.	**Mazowieckie**	[ha]	802 158	804 912	808 810	812 973	817869
8.	**Opolskie**	[ha]	257 858	258 170	258 246	258 399	258570
9.	**Podkarpackie**	[ha]	671 363	674 450	677 953	680 166	683371
10.	**Podlaskie**	[ha]	621 718	624 856	626 532	627 235	628678
11.	**Pomorskie**	[ha]	676 165	677 673	678 226	679 898	681014
12.	**Śląskie**	[ha]	400 709	399 592	399 954	401 747	402014
13.	**Świętokrzyskie**	[ha]	331 492	332 089	332 487	332 980	402364
14.	**Warmińsko-mazurskie**	[ha]	752 146	755 050	760 064	763 567	334385
15.	**Wielkopolskie**	[ha]	778 863	780 795	783 340	784 649	785648
16.	**Zachodniopomorskie**	[ha]	826 934	828 508	830 633	832 735	834009

7.2.1.2. Habitat structure

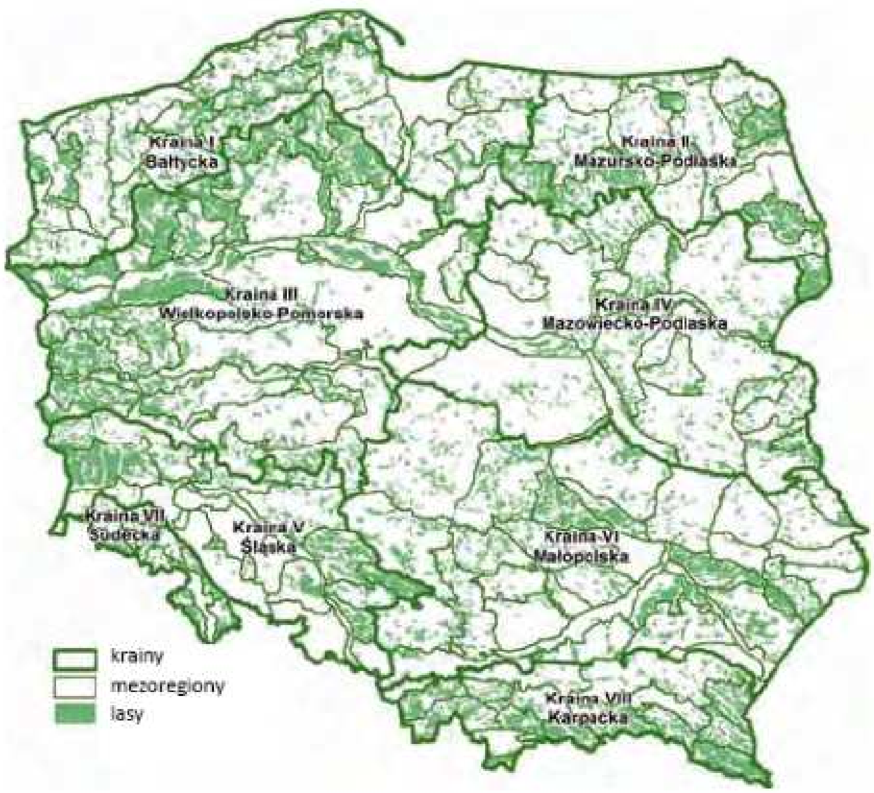

Figure 7.3 Regionalization of natural-forest habitats in Poland

The diversity of growing conditions for forests in Poland is linked to the natural-forest habitats allocations as presented on Fig. 7.3

Poland has mainly retained forests on the poorest soils, which is reflected in the structure of forest habitat types. Coniferous habitats prevail, accounting for 51.7% of the total forest area, while broadleaved habitats cover 48.3% . In both groups, a further distinction is made between upland habitats which occupy 5.7% of the forest area and mountain habitats which occupy 8.6%.

7.2.1.3. Species composition

The geographical distribution of habitats is, to a great extent, reflected in the spatial structure of dominant tree species. Apart from the mountain regions where spruce (west) and spruce and beech (east) are the main species in stand composition, and a few other locations where stands have diversified species structure, in most of the country stands with pine as the dominant species prevail.

Coniferous species dominate in Polish forests, accounting for 70.3% of the total forest area. Poland offers optimal climatic and site conditions for pine within its Euro-Asiatic natural range, which resulted in development of a number of important ecotypes (e.g. the Taborska pine or the Augustowska pine). Pine accounts for 59.9% of the area of forests in all ownership categories, for 61.7% in the State Forests and for 56.6% in the privately-owned forests.

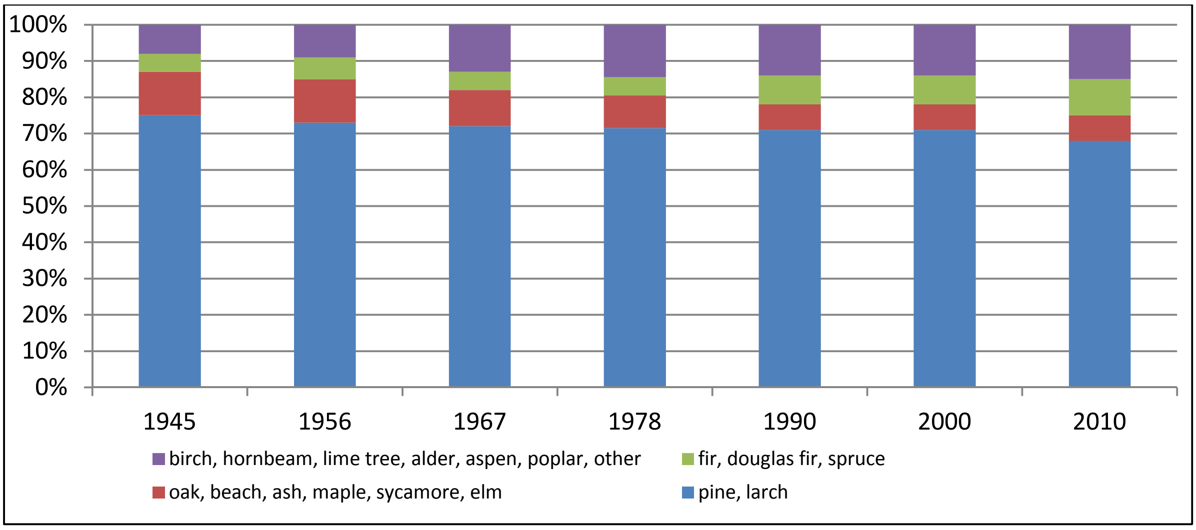

Fig. 7.4 Spatial structure of dominant tree species

Since 1945 forest species structure has undergone significant changes, expressed, inter alia, by increased share of stands for deciduous trees. Considering state forests, where it possible to trace this phenomenon on the basis of annual updates of forest land area and timber resources, total area of deciduous stands increased from 13 to 23.2%. Despite the increase in the surface of deciduous forests, their share is still below potential, arising from the structure of forest habitats.

7.2.1.4. Age structure

Stands aged 41–80 years, representing age classes III and IV prevail in the age structure of forests and cover 26.4% and 18.7% of the forest area respectively. Moreover, stands aged 41–80 years are dominating the forests of all ownership forms and private forests, with their share equal to nearly 40%. Stands older than 100 years, including stands in the restocking class (KO), stands in the class for restocking (KDO) and stands with selection structure (BP), account for 11.7% of the forest area managed by the State Forest. The share of non-afforested land accounts for 2.3%.

7.2.1.5. Structure of timber resources by volume

According to the Large-Scale Forest Inventory, estimated timber resources as of the end of 2012 amounted to 2 404 977 m^3 of gross merchantable timber, including 1 908 366 m^3 in the state forests and 379 473 m^3 in private forests.

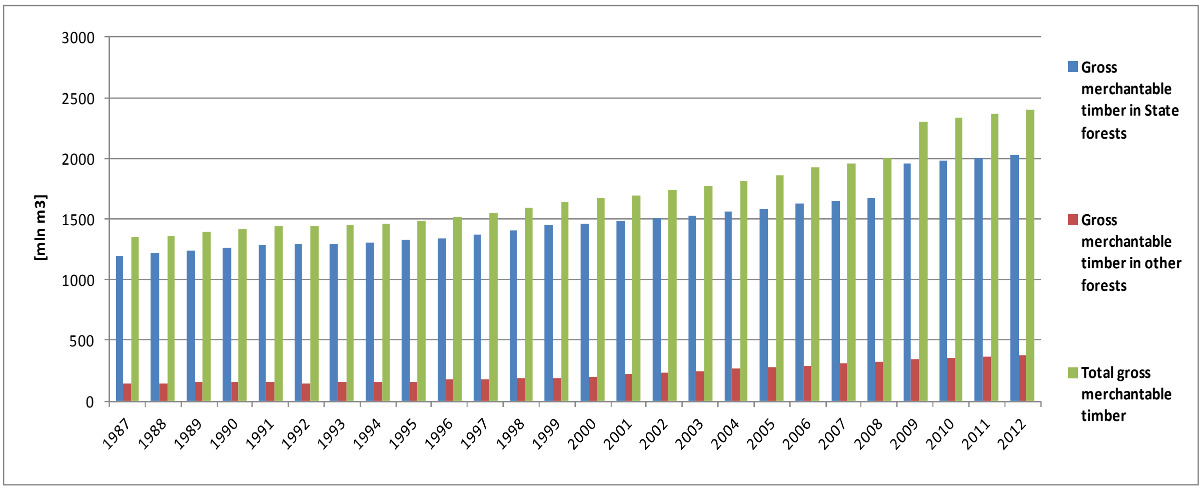

Figure 7.5 Gross timber resources in the Polish forests in years 1987-2012.

7.2.2. Information on approaches used for representing land area and on land-use databases used for the inventory preparation

According to the description given in chapter 3.2.1.1.1.3 of the GPG for LULUCF [IPCC 2003] managed forest land areas associated with the forestry activities in Poland is identified using Tier 3. Geographic boundaries encompassing units of land subject to multiple activities are indentified based on data *on the condition and changes in the registered intended use of land* developed on the basis of annual reports on land.

7.2.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

With regard to the regulations of art. 3 of the Act on Forests of September 28th 1991 *(Journal of Law of 1991 No 101 item 444, as amended)*, forest land is the area:

1) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
    a. designated for forest production, or
    b. constituting a Nature Reserve or integral part of a National Park, or
    c. entered on the Register of Monuments;
2) of contiguous area greater than or equal to 0.10 ha, associated with forest management.

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

- minimum area: 0.1 hectare,
- minimum width of forest land area: 10 m
- minimum tree crown cover: 10% with trees having a potential to reach a minimum height of 2 metres at maturity in situ. Young stands and all plantations that have yet to reach a crown density of 10 percent or a tree height of 2 metres are included under forest. Areas normally forming part of the forest area that are temporarily un-stocked as a result of human intervention, such as harvesting or natural causes such as wind-throw, but which are expected to revert to forest are also included.

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

GHG balance in this category is a net sink. In 2012 net CO_2 sink was about 36 834 Gg CO_2. For the methodologies used, see following chapters

7.2.4.1 Methodological issues

Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis.

7.2.4.2 Subcategory area

Land use matrix is presented in the annex 6

Considering the provisions of the decision 9/CP.2 `Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration` where it is decided that the four Parties that have invoked Article 4.6 of the Convention, which requested in their first communications for flexibility to use base years other than 1990, Poland has chosen the year 1988 as a starting point for the transitional period according to the IPCC 2003 guidelines).

To fulfil the reporting requirements to the United Nations Framework Convention on Climate Change as well as to the Kyoto Protocol, the following differences were considered:

- under the KP, an area of land covered by forest management activities [5(KP - I). B.1 (Art. 3.4 KP)], was assigned to the area of forest land reported in the reference year (1999), taking into account subsequent changes resulting from the exclusions of forest land for non-agricultural and non-forestry purposes (deforestation);
- under UNFCCC, an area of land considered to the subject to the category 5.A.1 *forest land remaining forest land* [Sector CRF 5.A.1]] was assigned to the area of forest land reported in the base year (according to the decision 9/CP.2), taking into account subsequent changes resulting from the exclusions of forest land for non-agricultural and non-forestry purpose as well as the results of transitional periods implementations.

7.2.4.3. Living biomass

<u>Carbon stock changes</u>

Annual change in carbon stocks in living biomass reservoir was estimated considering the changes in forest resources on forest land all forms of ownership, using the information contained in the statistical yearbooks "Forestry". Estimations were based on the equation 3.2.3 contained in the guidelines "Good Practice Guidance for Land Use, Land Use Change and Forestry", Chapter 3.2.1.1.1.1. Data sources contains tables describing forest resources by areas and age classes.

Carbon stock change method has been applied in the recent national greenhouse gas inventory . Previously, carbon stock changes had been calculated, following the early advice of the IPCC 1996 Guidelines, using the “IPCC default method” (or gain-loss method) where data on changes due to growth, harvests and disturbances was used. However, as it was noted several times in earlier NIRs, relatively high uncertainties are inherent in these data due to different reasons, therefore, we changed for the stock-change method (which is also consistent with what the IPCC 2006 Guidelines, suggested in section 4.2.1.1. of Volume 4).

As mentioned above, the general methodology to estimate emissions and removals in the forestry sector is based on the IPCC methodology (GPG for LULUCF, IPCC 2003). However, wherever it was possible, country specific data was used (Tier 2), and IPCC default values (Tier 1) were only used in a few cases.Changes in carbon stocks in the biomass pool are accounted annually on the basis of the Polish forestry statistics which provides relevant information, describing aboveground volume of all forests at the country level, available annually for the each inventory year. Moreover gross merchantable volume stock used in the above mentioned calculations is estimated on the basis of data obtained from the most recent 5-year cycle of large-scale inventory, published in the form of official statistics by the Central Statistical Office.

Fortunately, the State Forest Holding’s data base also contains aggregate annual statistics on total growing stocks by species and age classes. These statistics are produced by a bottom-up approach, i.e. growing stocks of stands are aggregated by species and age classes. There are uncertainties around these statistics, however, they are regarded smaller than those associated with a gain-loss method and systematic errors. We noted that since growing stocks and their changes incorporate the effects of all processes mentioned above, no particular inferences on emissions and removals can be made separately for any of these processes.

The forest inventory is conducted by the Forest Management and Geodesy Bureau and its branches. The inventory data is stored by stand in a computerized database, i.e. the National Forest Database

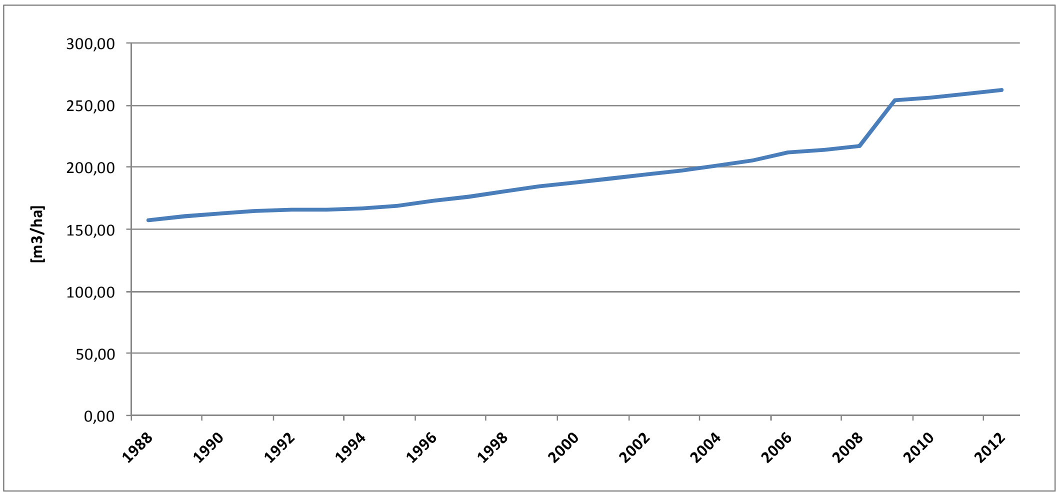

Figure 7.6 Average volume stock of merchantable timber in Polish forests .

During the continuous survey of the forest inventory, the main stand measures (such as height, diameter, basal area, and density) are estimated by various measurement methods. The survey also includes mapping of the forest area. The survey methods applied in individual stands depend on species, age and site. Since the recent forest inventory scheme is based on survey's considering measurements of individual sample plots, more accurate results were obtained from the year 2009.

For carbon stock changes in biomass, the system of calculations allows for the use of even simpler sensitivity analysis than before. This is especially true if only the major sources of CO_2 emissions and removals are considered, which represent the bulk of all emissions and removals. The reason for this is that the equation inherent in the calculation is simple: only volume stock changes, wood density, root-to-shoot ratio, and carbon fraction factors are involved. With respect to accuracy and precision, the reported estimated values are generally accurate and precise as far as practicable. Where uncertainty seems to be high, and for non-quantifiable factors, the principle of conservativeness is always applied. With regard to carbon stock change estimation, it can be concluded that many sources of error were removed by switching from the process-based method to the stock-change method. Thus, it is expected that current estimates better reflect emissions and removals associated with forest land than previous estimates.

7.2.4.4. Basic wood density

Basic wood density was calculated based as the weighted mean of wood density by wood species. To calculate the basic air-dry wood density values, the specific gravity of dry wood and shrinkage of the total volume were used for each species. Scheme for weighted mean wood density calculation is presented in table below:

Table 7.2.1. Scheme for weighted mean wood density calculation by wood species.

Species	Air-dry wood density [t/m³]	Volume of thick [thous. m³]	Share of each species in weighted mean wood density [t/m³]
	A	B	E=A*B
Pine	0.43	1270734.4	0.29810
Spruce	0.38	102573.4	0.02288
Fir	0.36	52472.4	0.01049
Beech	0.57	105113.9	0.03410
Oak	0.57	126329.0	0.03869
Hornbeam	0.63	4578.9	0.00172
Birch	0.52	76151.0	0.02201
Alder	0.43	71437.8	0.01711
Poplar	0.35	1053.4	0.00034
Aspen	0.36	4204.1	0.00082
Total	-	1814649.0	-
Weighted mean wood density			**0.44637**

In order to maintain data integrity, estimations were based on data available for the State Forests *(Annual update of forest area and woody biomass in State Forests at 1 January (Forest Management and Geodesy Bureau. Warszawa. 1969-2012))* and extrapolated for other forests.

7.2.4.5. Biomass expansion factor

Biomass expansion factors was adjusted based on weighted average default values proposed to be used by the IPCC in the framework of the "Good Practice Guidance for Land Use, Land Use Change and Forestry", table 3.A.1.10.

Table 7.2.2. Scheme for calculation of BEF 2 .

BEF_2 – coniferous species	A	BEF_2 default	1.30
BEF_2 – deciduous species	B	BEF_2 default	1.40
Gross merchantable timber – coniferous species	C	[tys. m³]	1425780
Gross merchantable timber – deciduous species	D	[tys. m³]	388868
Gross merchantable timber – total	E	[tys. m³]	1814649
BEF_2 – weighted mean	F=((A*C)+(B*D))/E		**1.3214**

In order to maintain data integrity, estimations were based on data available for the State Forests *(Annual update of forest area and woody biomass in State Forests at 1 January (Forest Management and Geodesy Bureau. Warszawa. 1969-2012))* and extrapolated for other forests.

7.2.4.6. Root-to-shoot ratio

Root-to-shoot ratio was adjusted based on weighted average default values proposed to be used by the IPCC in the framework of the "Good Practice Guidance for Land Use, Land Use Change and Forestry", table 3.A.1.8

Table 7.2.3. Scheme of R factor calculation

R – coniferous species	A	R (default)	0.23
R– deciduous species	B	R (default)	0.24
Gross merchantable timber – coniferous species	C	m³	1425780
Gross merchantable timber – deciduous species	D	m³	388868
Gross merchantable timber – total	E	m³	1814649
R- weighted mean	F=((A*C)+(B*D))/E		0.2321

In order to maintain data integrity, estimations were based on data available for the State Forests *(Annual update of forest area and woody biomass in State Forests at 1 January (Forest Management and Geodesy Bureau. Warszawa. 1969-2012)* and extrapolated for other forests.

7.2.4.7. Carbon fraction

Estimations are based on the following default factor:

- fraction of carbon in the dry matter: 0.5 [IPCC 2003];

7.2.4.8. Dead organic matter

Annual change in carbon stocks in dead wood reservoir was estimated considering the changes in dead wood resources on forest land all forms of ownership, using the information contained in the statistical yearbooks "Forestry". Estimations are based on the equation 3.2.12 contained in the guidelines "Good Practice Guidance for Land Use, Land Use Change and Forestry", Chapter 3.2.1.12.1.1.

Dead wood thickness used in the above mentioned equation is estimated on the basis of data from the most recent 5-year cycle of large-scale inventory and is published in the form of official statistics by the Central Statistical Office.

Due to the lack of relevant data for the period 1988-2007, method of "Tier 1" was used, assuming that the annual net change in carbon stocks in dead wood reservoir is equal to zero (Section 3.2.1.2.1.1 GPG for LULUCF). Accordingly, relevant reference tables of the common reporting format for the period 1988-2007, were complemented by the notation key "NO" (not occurring).

7.2.4.9. Litter

Annual change in carbon stocks in the litter reservoir was estimated with the equation 3.2.13 contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry ", section 3.2.12.1.1. For the needs of equation application, default reference values of LT_{ref} were considered to be used linked with the dominant tree species area.

Carbon stock changes in litter were estimated based ion following references contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry" [IPCC, 2003]:

- LT_{ref} deciduous species - 28 [tC / ha]
- LT_{ref} coniferous species - 27 [tC / ha]
- transitional period - 20 years
- $f_{man\ intensity}$ - 1.0
- $f_{dist\ regime}$ - 1.0

Due to the lack of relevant data for the period 1988-2007, method of "Tier 1" was used, assuming that the annual net change in carbon stocks in dead wood reservoir is equal to zero (Section 3.2.1.2.1.1 GPG for LULUCF). Accordingly, relevant reference tables of the common reporting format for the period 1988-2007, were complemented by the notation key "NO" (not occurring).

7.2.4.10. Mineral soils

Annual change in carbon stocks in the litter reservoir was estimated using equation 3.2.14 contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry ", section 3.2.1.3.1. For the needs of equation application, default reference values of SOC_{ref} were considered to be used linked with the dominant tree habitats.

Table 7.2.4 Forest habitant types in Poland with the SOC_{ref} assignment

SOC_{ref}	Forest habitat types
high active SOC ref (50 [MgC/ha])	Fresh mixed forest, moist mixed forest, mixed upland forest, mountain mixed forest, fresh broadleaved forest, moist broadleaved forest upland forest, mountain forest
low active SOC ref (33[MgC/ha])	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 SOC ref (34 [MgC/ha])	Dry coniferous forest, fresh coniferous forest 0,5* fresh mixed coniferous forest
wetland SOC ref (87 [MgC/ha])	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 7.2.5 Percentage share of soil types by land use system (for time t and t–20)

Habitats	**2012 (t)**	**1992 (t-20)**
high activity	45.5	33.3
low activity	18.0	19.3
sandy	32.0	43.5
wetland	4.5	3.9
Sum	100.0	100.0

Carbon stock changes in mineral soils were estimated based ion following references contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry" [IPCC, 2003]:

- transitional period - 20 years
- $f_{man\ intensity}$ - 1.0
- $f_{dist\ regime}$ - 1.0
- $f_{forest\ type}$ - 1.0

Results of the analysis determining the direction and rate of change in SOC content indicate that the C stock in the 1m layer of mineral soils derived from sand under the coniferous forests is with the range 65 -90 Mg C/ha, comparable results are obtained for the deciduous. The C stock in the 1m layer of mineral soils derived from soil under the deciduous forests with the range 65-115 Mg C/ha. Average C stock in the 1m layer of mineral soils derived from soils under the deciduous forests with high activity clay are with the range 140-250 Mg C/ha. Presented results were obtained from the country study ”The balance of carbon in the biomass of the main forest-forming species in Poland” Poznań, Kórnik, Warszawa, Kraków, Sękocin 2011. However, the results will be the subject of further analysis and testing.

7.2.4.11. Organic soils

The area of cultivated histosols in Poland was estimated as a case study for the purposes at national inventory [Oświecimska–Piasko 2008]. Based on information collected from Computer database on peatlands in Poland “TORF” as well as from system of Spatial Information on Wetlands in Poland the area of histosols was assessed for mid–1970s and mid–1990s. The area from which N_2O emissions were calculated covers histosols as agricultural lands cultivated and/or irrigated. So the area of such area was 882.6 thousand ha in mid–1970–ties and 769 thousand ha in mid–1990–ties. The area of histosols was then interpolated for 1976−1994.

Additionally the area of cultivated histosols was assessed for 2015 for the purpose of GHG emission projections which amounts to 680 thousand ha [PLNC6 2013]. Similarly to the previous period interpolation of histosols areas was applied between 1995 and 2015. Since 1970-ties area of histosols occupied by forest and scrub communities is increasing. In 1970-ties it was equal 170 800 ha. in

1990-ties – 214 400 ha. Also proportion of and scrub communities at organic soils are increasing from 12% at the beginning of 1970-ties to 16.5 % in 1990-ties.

Total organic soils area in 2012 was estimated for ha with the following split for subcategories: forest land remaining forest land – 234 076 ha land converted to forest land – 17 383 ha. Emissions from organic soils on forest land were estimated with the default EF contained in the table 3.2.3 p. 3.42 in GPG for LULUCF

Table 7.2.6 CO_2 emission factor as contained in the table 3.2.3 p. 3.42 in GPG for LULUCF.

Name	Volume	Unit
$EF_{drainag}$	0.68	[tC/ha/rok]

7.2.4.12. Biomass burning

According to the article 30 of *Act on forests of 28th September, 1991 (Journal of Law of 1991 No 101 item 444, as amended)* the burning of surface soil layers or remnants of vegetation is forbidden. In relation to this record it is considered that controlled biomass burning does not occur on forests. To keep correctness in CRF tables notation keys NO (not occurring) were used in the table NIR 1 and connected tables for all indicated activities for wildfires on forest land.

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

Table 7.2.7. Emissions ratios for calculation CH_4, N_2O, CO and NO_x emissions from forests fires [tab. 3.A.1.16.GPG LULUCF, IPCC 2003]

Compound	Ratio [g/kg d.m]		
CH_4	7.1	default	[IPCC 2003]
CO	112.0	default	[IPCC 2003]
N_2O	0.11	default	[IPCC 2003]
NO_x	0.6	default	[IPCC 2003]

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

GHG balance in this category is a net sink. In 2011 net CO_2 sink was approximately 2 681 Gg CO_2. For the methodologies used, see following chapters.

7.2.5.1 Methodological issues

Due to the intensive forest monitoring as described above, all forest stands are continuously accounted for. This also means that all changes in the biomass carbon stocks of the forests due to any causes from growth through harvests, natural disturbances and deforestation are captured by the forestry statistics of each stand at least on a decade scale, and those of the whole forest area even on an annual basis.

7.2.5.2. Subcategory area

Land use matrix is presented in the annex 6

Considering the provisions of the decision 9/CP.2 `Communications from Parties included in Annex I to the Convention: guidelines, schedule and process for consideration` where it is decided that the four Parties that have invoked Article 4.6 of the Convention, which requested in their first communications for flexibility to use base years other than 1990, Poland has chosen the year 1988 as a starting point for the transitional period according to the IPCC 2003 guidelines).

To fulfil the reporting requirements to the United Nations Framework Convention on Climate Change as well as to the Kyoto Protocol, the following differences were considered:

- under the KP, an area of land covered by afforestation/ reforestation activities [5(KP - I). A.1.1 (Art. 3.3 KP)], was assigned to the area of land converted to forest land reported since the reference year (1990), taking into account subsequent changes resulting from the exclusions of forest land for non-agricultural and non-forestry purposes (deforestation);
- under the UNFCCC, an area of land considered to the subject to the category 5.A.2 *land converted to forest land* [Sector CRF 5.A.2]] was assigned to the area of land conversions to forest land reported in the base year (according to the decision 9/CP.2), taking into account subsequent changes resulting from the exclusions of forest land for non-agricultural and non-forestry purpose as well as the results of transitional periods implementations.

7.2.5.3. Living biomass

Annual change in carbon stocks in living biomass reservoir was estimated considering the annual gains and losses with the equation 3.2.23 (section 3.2.2.1.1.1 of GPG for LULUCF). For the needs of equation application, default reference values of biomass increment were considered to be used.

Table 7.2.8. Default biomass increment.

Name	Value	Unit
G_{ext} (coniferous)	3	[m^3/ha/year]
G_{ext} (deciduous)	4	[m^3/ha/year]

7.2.6. Uncertainties and time-series consistency

Detailed information contain chapter 7.6.5

7.2.7. Category-specific QA/QC and verification

Detailed information contain chapter 7.6.6

7.2.8. Recalculations

Detailed information contain chapter 7.6.7

7.2.9. Planned improvements

Detailed information contain chapter 7.6.8

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

7.3.1. Source category description

Estimations for category 5.D. were based on IPCC methodology described in the chapter 3.3. of the GPG LULUCF.

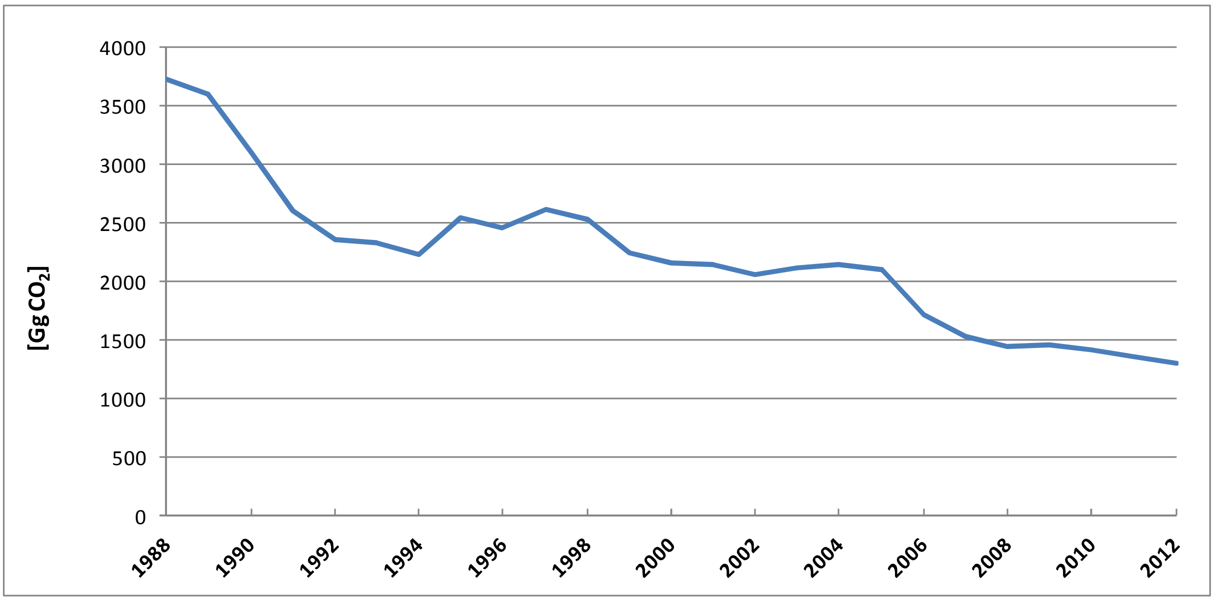

Figure 7.7. GHG's balance in subcategory 5B for years 1988-2012.

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

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 1 203 GgCO_2.

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

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 103 GgCO_2

7.3.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.3.1.1.1.3. IPCC "Good Practice Guidance for Land use, land use change and forestry - LULUCF GPG, 2003" Poland has selected Approach 2, considering the set of information's available in the register of land and buildings

7.3.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551),agricultural land considered as cropland consists of:

- arable land includes land which is cultivated, i.e. sowed and fallow land. Arable land should be maintained in good agricultural condition. Cultivated arable land is understood as land sowed or planted with agricultural or horticultural products, willow and hops plantations, area of greenhouses, area under cover and area of less than 10 a, planted with fruit trees and bushes, as well as green manure,

- fallow land includes arable land which are not used for production purposes but are maintained in good agricultural condition.
- orchards include land with the area of at least 10 a, planted with fruit trees and bushes.

7.3.4. Methodological issues

7.3.4.1. Subcategory area

Land use matrix is provided in the annex 6

7.3.4.2. Living organic matter

Annual carbon stock change in living biomass was calculated based on cropland area covered by perennial woody biomass (orchards). Annual growth rate for perennial woody biomass was calculated using equation 3.3.1.1.1.1. IPCC 2003. For calculations there were used default factors as below:

- biomass accumulation rate – 2.1 [tC/ha] table 3.3.2 GPG LULUCF page 3.71,
- harvest/maturity cycle – 30 [year] table 3.3.2 GPG LULUCF page 3.71,
- biomass carbon loss – 63 [t/ha*yr] table 3.3.2 GPG LULUCF page 3.71.

7.3.4.3. Mineral soil

Agricultural land valuation classes with the assignment to IPCC soils types.

- high activity soils - soils having appreciable contents of high activity clays (eg. 2:1 expandable clays such as montmorillonite) which promote long-term stabilization of organic matter, particularly in many carbon-rich temperate soils.
- low activity soils - soils with low-activity clays (eg., 1:1 non-expandable clays such as kaolinite and hydropus oxide clays of iron and aluminum) which have a much lower ability to stabilize organic matter and consequently respond more rapdly to changes in the soil's carbon balance; among these are highly-weathered acid soils of subtropical and tropical regions.
- sandy soil - soils with less than 8% clay and more than 70% sand, which generally have low structural stability and low capacity to stabilize carbon.
- wetland - mineral soils which have developed in poorly-drained, wet environments; they have reduced decomposition rates and high organic matter contents; if drained for agriculture they are subject to large losses of carbon.

Estimation of area of different soil types (high activity soils, low activity soils, sandy and wetland) were based on area of soil valuation classes. The percentage fraction of all soil types in croplands was calculated based on available data sets.

Table 7.3.1. Area of soil valuation classes

Valuation classes	1976	1979	1985	1990	2000
	thous. ha				
agriculture land					
Total	**19349,4**	**19200,5**	**18945**	**18804,8**	**18536,9**
I	71	70.7	70	68.7	67.8
II	547.6	551.1	550.3	544.1	536.4
III	4153.2	4152.1	4199.1	4201.6	4201.9
IV	7627.5	7611.8	7545.6	7493.4	7402.9
V	4522	4441	4310.3	4267.2	4197.2
VI	2428.1	2373.8	2269.7	2229.8	2114.9
land not classified	0	0	0	0	15,8
arable land and orchard					
Total	**15173.7**	**15073.4**	**14818**	**14682.8**	**14451.1**
I	69	68.5	67.4	66.5	65
II	480	483.8	485	482.2	479.6
III	3621.5	3618.9	3643.7	3650.7	3664.6
IV	5961	5924.2	5807.6	5743.4	5640.2
V	3151.8	3114.5	3018.3	2976.2	2908.3
VI	1890.4	1863.5	1796.1	1763.8	1682.6
Land not classified					10.8

Due to limited data availability, linear interpolation was applied between the subsequent years. Since 2000, estimations are based on the latest available data sets from the year 2000.

Table 7.3.2 Valuation classes of agricultural land with the SOC_{ref} assignment.

Soil type	Soil valuation classes
high activity	I, II, III
low activity	IV
sandy	V
wetland	other

Valuation classes of agricultural land describe the quality of land in terms of value to agricultural production. Class I corresponds to the highest agricultural value and class VI to the lowest. Valuation classes of agricultural land are presented in table 7.3.1.

Table. 7.3.3. Soil organic carbon by land use system and soil types

Land-use/ management system	Soil by IPCC	Carbon in soils [Mg C/ha]
		default IPCC
agricultural crops	high activity soils	50
	low activity soils	33
	sandy	34
	wetland	87

For calculations there were used default factors as below:

- stock change factor for land use or land-use change type in the beginning of inventory year - F_{LU}(0-T) = 0.82. [IPCC 2003 tab. 3.3.4. page 3.77].
- stock change factor for management regime in the beginning of inventory year – F_{MG}(0-T)=1.09 [IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for input of organic matter in the beginning of inventory year – F_{I}(0-T)=1.00 [IPCC 2003 tab. 3.3.4. page. 3.77].
- Stock change factor for land use or land-use change type in current inventory year – F_{LU}(0)= 0.82[IPCC 2003 tab. 3.3.4. page 3.77].

- Stock change factor for management regime in current inventory year $–F_{MG}(0)=1.09$. [IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for input of organic matter in current inventory year – $F_I(0) = 1.00$ [IPCC 2003 tab. 3.3.4. page 3.77].

7.3.4.4. Organic soils

The area of cultivated histosols in Poland was estimated as a case study for the purposes at national inventory [Oświecimska–Piasko 2008]. Based on information collected from Computer database on peatlands in Poland "TORF" as well as from system of Spatial Information on Wetlands in Poland the area of histosols was assessed for mid–1970s and mid–1990s. The area from which N_2O emissions were calculated covers histosols as agricultural lands cultivated and/or irrigated. So the area of such area was 882.6 thousand ha in mid–1970–ties and 769 thousand ha in mid–1990–ties. The area of histosols was then interpolated for 1976–1994. Additionally the area of cultivated histosols was assessed for 2015 for the purpose of GHG emission projections which amounts to 680 thousand ha [PL NC6 2013]. Similarly to the previous period interpolation of histosols areas was applied between 1995 and 2015.

N_2O emission from cultivation of histosols was estimated based on default emission factor for Mid-Latitude Organic Soils from [IPCC 2000]: 8 kg N_2O-N /ha. N_2O emission is reported in sector 4. Agriculture in subcategory 4.D.1.5.

To estimate CO_2 emission from cultivated organic soils were used default emission factor for cold temperate climate – 1.0 tC/ha*year [tab. 3.3.5 page 3.79 IPCC 2003] and equation 3.3.5 page 3.79 (IPCC 2003).

7.3.4.4.Carbon emissions from agricultural lime application

The reported annual carbon emission from agricultural lime application is calculated as:

$$C = M_{limestone} * EF_{limestone} + M_{dolomite} * EF_{dolomite}$$

where:

$M_{limestone}$ – annual amount of sold limestone ($CaCO_3$) [Mg/yr]
$M_{dolomite}$ – annual amount of sold dolomite ($CaCO_3$) [Mg/yr]
$EF_{limestone}$ – emission factor for limestone – 0.120 [Mg C/ Mg limestone]
$EF_{dolomite}$ – emission factor for dolomite – 0.130 [Mg C/ Mg dolomite]

Domestic statistic publications contain only data of use of lime fertilizers in pure nutrient (CaO), that it was necessary to convert these data into actual use of fertilizers [Radwański 2006b]. It was assumed that lime – magnesium fertilizers ($CaMg(CO_3)_2$) contains 89.1% of $CaCO_3$ and 10.9% of $MgCO_3$. Carbon (C) is converted to carbon-dioxide (CO_2) by the conversion factor 44/12.
Annual CO_2 emission in 2011 from agricultural lime application was 387 Gg CO_2. Emission from agricultural lime application is reported together with lime application in Grassland.

7.3.4.5. CH_4, N_2O, CO and NO_x emissions

CH_4, N_2O, CO and NO_x emissions from wildfires fires on croplands are reported in subcategory 5.C.1.

7.3.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.6.5

7.3.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.2.6

7.3.7. Recalculations

Detailed information contain chapter 7.6.7

7.3.8. Planned improvements

Detailed information contain chapter 7.2.8

7.4. Grassland (CRF sector 5.C.)

7.4.1. Source category description

Calculation for category 5.C. based on IPCC methodology described in the chapter 3.4. GPG LULUCF.

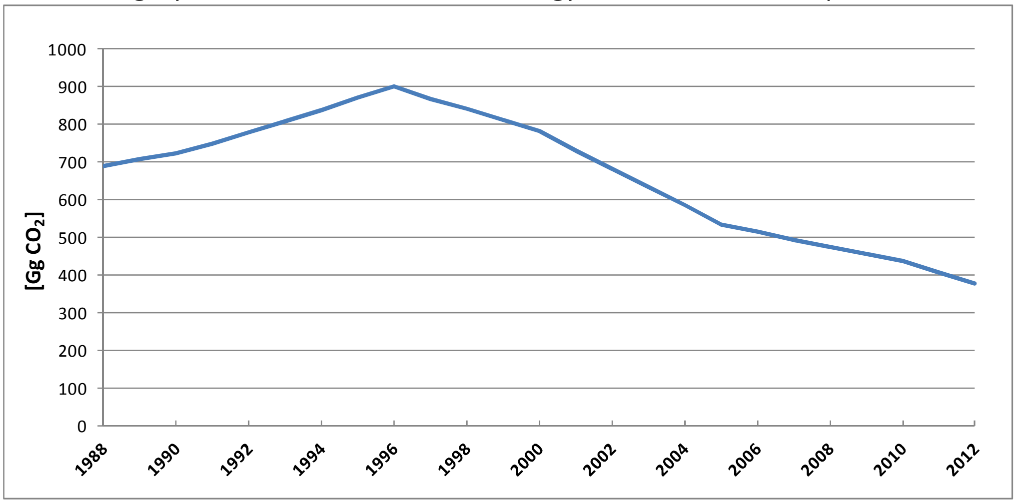

Figure 7.8 GHG's balance in subcategory 5C for years 1988-2012.

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

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 392 GgCO_2.

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

GHG balance in this was identified as a net CO_2 sink. Net CO_2 balance was equal to -14 GgCO_2.

7.4.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.4.1.1.1.3. IPCC "Good Practice Guidance for Land use, land use change and forestry - LULUCF GPG, 2003" Poland has selected Approach 2, considering the set of information's available in the register of land and buildings

7.4.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551),agricultural land considered as grassland consists of:

1. permanent meadows and pastures include land permanently covered with grass, but it does not include arable land sown with grass as part of crop rotation; permanent meadows are understood as the land permanently covered with grass and mown in principle and in mountain area also the area of mown mountain pastures and meadows.
2. permanent pastures are understood as the land permanently covered with grass not mown but grazed in principle and in mountain area – also the area of grazed pastures and meadows; permanent meadows and pastures classified to this category must be maintained in good agricultural condition.

7.4.4. Methodological issues

7.4.4.1. Subcategory area

Land use matrix is provided in the annex 6

7.4.4.2. Living organic matter

Emissions/removals from this subcategory were not estimated because in Poland there is no perennial woody biomass (conservative approach).

7.4.4.3. Mineral soil

Estimation of area of different soil types (high activity soils, low activity soils, sandy and wetland) is based on area of soil valuation classes. The percentage fraction of all soil types in grassland was calculated based on available data sets.

Table 7.4.1. Area of soil valuation classes

Valuation classes	1976	1979	1985	1990	2000
	thous. ha				
grassland					
Total	**4175.7**	**4127.1**	**4126.9**	**4122**	**4085.8**
I	2	2.2	2.6	2.2	2.8
II	67.6	67.3	65.3	61.9	56.8
III	531.7	533.2	555.4	550.9	537.3
IV	1666.5	1687.6	1738	1750	1762.7
V	1370.2	1326.5	1292	1291	1288.9
VI	537.7	510.3	473.6	466	432.3
land not classified					5

Due to limited data availability, linear interpolation was applied between the subsequent years. Since 2000,estimations are based on the latest available data sets from the year 2000.

Table 7.4.2 Valuation classes of agricultural land with the SOC_{ref} assignment.

soil type	soil valuation classes
high activity	I, II, III
low activity	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.

Table. 7.4.3. 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
Permanent meadows and pastures	sigh activity	50
	low activity	33
	sandy	34
	wetland	87

For calculations there were used default factors as below:

- stock change factor for land use or land-use change type in the beginning of inventory year - F_{LU}(0-T) = 0.82. [IPCC 2003 tab. 3.3.4. page 3.77].
- stock change factor for management regime in the beginning of inventory year – F_{MG}(0-T)=1.09 [IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for input of organic matter in the beginning of inventory year – F_I(0-T)=1.00 [IPCC 2003 tab. 3.3.4. page. 3.77].
- Stock change factor for land use or land-use change type in current inventory year – F_{LU}(0)= 0.82[IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for management regime in current inventory year –F_{MG}(0)=1.09. [IPCC 2003 tab. 3.3.4. page 3.77].
- Stock change factor for input of organic matter in current inventory year – F_I(0) = 1.00 [IPCC 2003 tab. 3.3.4. page 3.77].

7.4.4.4. 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.

7.4.4.5. Carbon emission from lime application

Carbon emission from lime application on grassland and land converted to grassland is reported together with cropland lime application in subcategory 5.B.1.

7.4.4.6. Biomass burning

CH_4, N_2O, CO and NO_x emissions from fires were calculated using following equation (IPCC 2003, page 3.49. equation 3.2.20). This subcategory is covering the non-CO_2 emission from crop area, meadows and stubbles fires.

7.4.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.6.5

7.4.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.6.6

7.4.7. Recalculations

Detailed information contain chapter 7.6.7

7.4.8. Planned improvements

Detailed information contain chapter 7.6.8

7.5. Wetlands (CRF sector 5.D.)

7.5.1. Source category description

Calculation for category 5.D. is based on IPCC methodology described in the chapter 3.5. of the GPG LULUCF.

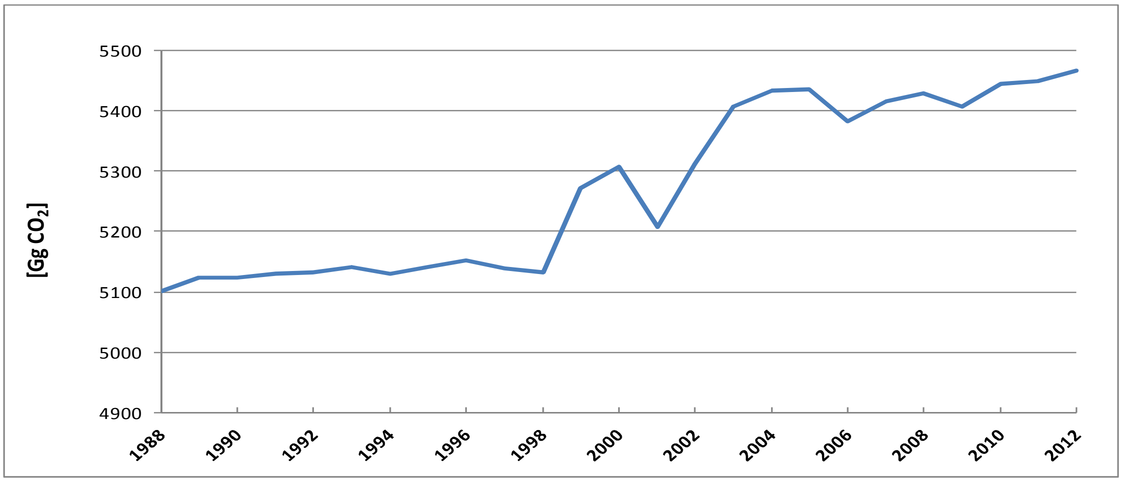

Figure 7.9 GHG's balance in subcategory 5D for years 1988-2012.

7.5.1.1. Wetlands remaining wetlands

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 2 903 GgCO_2.

7.5.1.2. Lands converted to Wetlands

GHG balance in this was identified as a net CO_2 source. Net CO_2 balance was equal to 242 GgCO_2.

7.5.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.5.1.1.1.3. IPCC "Good Practice Guidance for Land use, land use change and forestry - GPG for LULUCF, IPCC 2003" Poland has selected Approach 1, considering the set of information's available in the register of land and buildings.

7.5.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551),agricultural land considered as wetland consists of:

1. land under waters
    - marine internal;
    - surface flowing waters, which covers land under waters flowing in rivers, mountain streams, channels, and other water courses, permanently or seasonally and their sources as well as land under lakes and artificial water reservoirs. from or to which the water course flow;

- land under surface lentic water which covers land under water in lakes and reservoirs other than those described above,

2. land under ponds including water reservoirs (excluding lakes and dam reservoirs for water level adjustment) including ditches and areas adjacent and related to ponds;
3. land under ditches including open ditches acting as land improvement facilities for land used

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 2012 was 3 341 ha and area of flooded land was 852 992 ha.

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 due to the data relevant data gaps, for years 2000-2008 value from year 1999 was taken. Since 1999 national statistics contain data on area of organic soils managed for peat extraction It need to be highlighted that data from national statistics are consistent with the previously estimated values of organic soils managed for peat extraction.

Table 7.32. Area of organic soils managed for peat extraction in period 1999-2011

Year		1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Area of organic soils managed for peat extraction:, in this:	[ha]	4680.0	5178.0	2912.0	5138.0	5141.0	5508.0	5107.0	3429.0	3433.0	3410.0	3311.0	3314.0	3312.0	3312.0
Rich organic soli	[ha]	4009.7	4436.4	2494.9	4402.1	4404.7	4719.1	4375.6	2937.9	2941.3	2921.6	2836.8	2839.4	2838.0	2838.0
Poor organic soli	[ha]	670.3	741.6	417.1	735.9	736.3	788.9	731.4	491.1	491.7	488.4	474.2	474.6	474.6	474.6

Source: Central Statistical Office - Environmental Protection 2000-2011

7.5.4. Methodological issues

7.5.4.1. Wetlands remaining wetlands

Emission calculations are based on equation 3.5.5. page 3.138 IPCC 2003. For calculations there were used default emission factors for cold climate as below:

Table7.5.3. Emission factors for the subcategory wetland remaining wetland

Symbol	Unit	Emission factor	Source
$EF_{peatNrich}$	[t C/ha*year]	1.1	table 3.A.3.2. page 3.280 IPCC 2003
$EF_{peatNpoor}$	[t C/ha*year]]	0.2	

Symbol	Unit	Emission factor	Source
$EF_{peatNrich}$	[kgN_2O/ha*year]	1.8	table 3.A.3.4. page 3.284 IPCC 2003
$EF_{peatNpoor}$	[kgN_2O/ha*year]	0.1	

CO_2 emission calculations are based on equation 3.A.3.8. page 3. 287, IPCC 2003. For calculations default emission factors for cold climate were used as presented below:

Table7.5.4 Emission factors for the subcategory wetland remaining wetland

Symbol	Unit	Emission factor	Source
$E(CO_2)diff$	[kg CO_2/ha*day]	9.3	table 3.A.3.5. page 3.290 IPCC 2003
$E(CO_2)diff$	[Gg CO_2/ha*day]	0.0000093	

CH_4 emission calculations are based on equation 3.A.3.9. page 3. 287. IPCC 2003. For calculations there were used default emission factors for cold climate as below:

Table7.5.5 Emission factors contained ineq. 3.A.3.9

Symbol	Unit	Emission factor	Source
$E(CH_4)diff$	[kg CH_4/ha*day]	0.2	table 3.A.3.5. page 3.290 IPCC 2003
$E(CH_4)diff$	[Gg CH_4/ha*day]	0.0000002	
$E(CH_4)diff$	[kg CH_4/ha*day]	0.14	table 3.A.3.5. page 3.290 IPCC 2003
$E(CH_4)diff$	[Gg CH_4/ha*day]	0.00000014	

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

For calculations default emission factors were used as presented below:

- carbon fraction of dry matter CF = 0.5 [IPCC 2003. page 3.140],
- Living biomass in land immediately before conversion to flooded land B_{Before} = 2.4 t dm/ha [GPG LULUCF table 3.4.2., page 3.109],
- Living biomass immediately following conversion to flooded land B_{After} = 0 t dm/ha [IPCC 2003. page 3.140].

Table7.5.6 Emission factors contained in eq. 3.A.3.10

Emission factor	**unit**	**value**	**Source**
$EF_{peatNrich}$	[t C/ha*yr]	1.1	table 3.A.3.2. p. 3.280 IPCC 2003

7.5.5. Uncertainties and time-series consistency

Detailed information contain chapter 7.6.5

7.5.6. Category-specific QA/QC and verification

Detailed information contain chapter 7.5.6

7.5.7. Recalculations

Detailed information contain chapter 7.6.7

7.5.8. Planned improvements

Detailed information contain chapter 7.6.8

7.6. Settlements (CRF sector 5.E.)

7.6.1. Source category description

Calculation for category 5.D. is based on IPCC methodology described in the chapter 3.6. of the GPG for LULUCF.

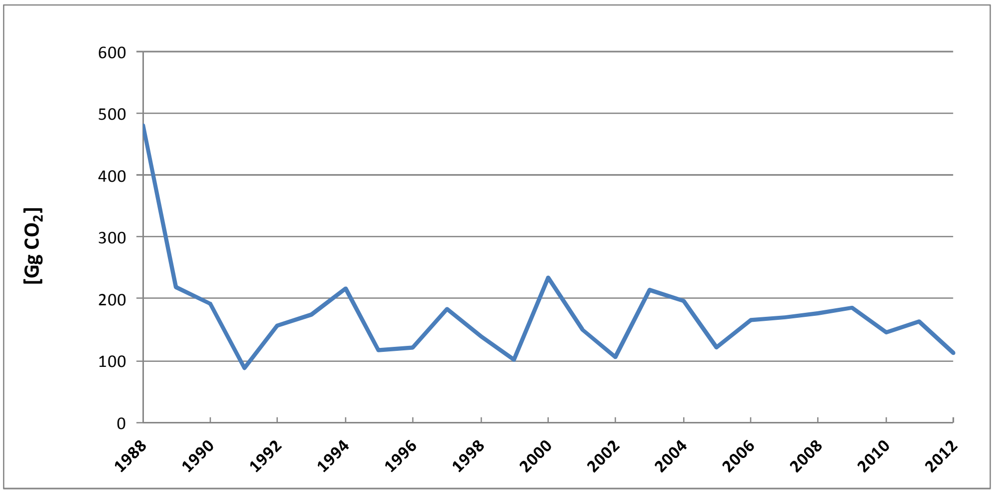

Figure 7.10 GHG's balance in subcategory 5C for years 1988-2012.

GHG balance for this subcategory was identified as a net CO_2 Source. Net CO_2 balance was equal to 113 $GgCO_2$

7.6.2. Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Pursuant to the provisions specified in section 3.6.1. IPCC "Good Practice Guidance for Land use, land use change and forestry - GPG for LULUCF, IPCC 2003" Poland has selected Approach 1, considering the set of information's available in the register of land and buildings.

7.6.3. Land-use definitions and classification system used and their correspondence to the LULUCF categories

According to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551),agricultural land considered as settlements consists of:

- residential areas include land not used for agricultural and forest production, put under dwelling buildings, devices functionally related to dwelling buildings (yards, drives, passages, playgrounds adjacent to houses), as well as gardens adjacent to houses;
- industrial areas include land put under buildings and devices serving the purpose of industrial production;
- other built-up areas include land put under buildings and devices related to administration. not listed under residential and industrial areas;
- undeveloped urbanised areas include land that is not built over, allocated in spatial management plans to building development and excluded from agricultural and forest production;
- recreational and resting areas comprise the following types of land not put under buildings;

- areas of recreational centres,. children playgrounds, beaches, arranged parks, squares, lawns (outside street lanes);
- areas of historical significance: ruins of castles, strongholds, etc.;
- sport grounds: stadiums, football fields, ski-jumping take-offs, toboggan-run, sports rifle-ranges, public baths etc.;
- area for entertainment purposes: amusement, grounds, funfairs etc.;
- zoological and botanical gardens;
- areas of non-arranged greenery, not listed under woodlands or land planted with trees or shrubbery;
- transport areas including land put under:
  - roads: national roads; voivodship roads; poviat roads; communal roads; roads within housing estates; access roads to agricultural land and woodlands and to facilities of public utility; stopping and manoeuvring yards next to railway stations, bus stations and airports, maritime and river ports and other ports, as well as universal accesses to unloading platforms and storage yards;
  - railway grounds;
  - other transport grounds.

7.6.4. Methodological issues

7.6.4.1. Settlements remaining Settlements

Living biomass

Calculations for carbon stock changes in living biomass were based on crown cower area method (urban green area – GUS 2012 Environmental Protection). Carbon stock changes in living biomass were calculated based on equation 3.a.4.1. page 3.295 [IPCC 2003.]. For calculations were used default accumulation rate C_{RF}=1.8 t C/ha were used [IPCC 2003, page 3.297].

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

Net emissions in this subcategory are equal to 202.12 Gg CO_2. The fundamental equation for estimating change in carbon stocks associated with land-use conversions has been explained in other sections of this chapterwith regard to land converted from forest land, cropland and grassland, respectively. The same decision tree and the same basic method were applied to estimate change in carbon stocks in forest land converted to settlements.

Area

Deforestation areas are those that have been clear cut and removed from areas under forest management in order that the area can be used for non-forestry purposes (i.e., for road building and other land use).

An area enters the deforestation category right away, i.e. in the year, of the clear cut which is made in order that the area can be used for non-forestry purpose.

It is noted here that, just like with AR, D areas only include the area of stands, which in the case of deforestation have been deforested, and exclude areas outside of the stands, like roads, see section 11.2.2. The demonstration that regenerated areas under FM are not accounted for as D can be found in section 11.4.2.

Table7.6.1 Area of forest land exclusions to non forestry and non agriculture purposes.[1]

Forest land exclusions			1988	1989	1990	1991	1992	1993	1994	1995	1996
UNFCCC	5.E.2.1	annually	1319,00	683,00	613,00	359,00	530,00	571,00	674,00	401,60	416,80
UNFCCC	5.E.2.1	cumulative	1319,00	2002,00	2615,00	2974,00	3504,00	4075,00	4749,00	5150,60	5567,40
KP	D	annually	NA	NA	613,00	359,00	530,00	571,00	674,00	401,60	416,80
KP	D	cumulative	NA	NA	613,00	972,00	1502,00	2073,00	2747,00	3148,60	3565,40
Forest land exclusions			**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
UNFCCC	5.E.2.1	annually	579,80	485,20	400,90	718,00	525,05	416,22	689,27	652,45	471,60
UNFCCC	5.E.2.1	cumulative	6147,20	6632,40	7033,30	7751,30	8276,35	8692,57	9381,84	10034,29	10505,89
KP	D	annually	579,80	485,20	400,90	718,00	525,05	416,22	689,27	652,45	471,60
KP	D	cumulative	4145,20	4630,40	5031,30	5749,30	6274,35	6690,57	7379,84	8032,29	8503,89
Forest land exclusions			**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**		
UNFCCC	5.E.2.1	annually	587,46	596,81	621,28	642,46	551,09	604,00	493,83		
UNFCCC	5.E.2.1	cumulative	11093,35	11690,16	10992,44	10951,90	10889,99	11134,99	11098,82		
KP	D	annually	587,46	596,81	621,28	642,46	551,09	604,00	493,83		
KP	D	cumulative	9091,35	9688,16	10309,44	10951,90	11502,99	12106,99	12600,82		

Living biomass

Annual change in carbon stocks in living biomass reservoir was estimated considering the changes in carbon stocks between biomass in the forest prior to conversion (C_{Before}) and that in the settlements after conversion (C_{After}). Estimations are based on the equation 3.2.3 contained in the guidelines "Good Practice Guidance for Land Use, Land Use Change and Forestry", Chapter 3.2.1.1.1.1

Average gross merchantable volume used in the above mentioned equation is estimated on the basis of data from the most recent 5-year cycle of large-scale inventory and is published in the form of official statistics by the Central Statistical Office

This method follows the approach in the IPCC Guidelines (Section 5.2.3, Forest and Grassland Conversion) where the amount of living aboveground biomass that is cleared for expanding settlements is estimated by multiplying the forest area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (C_{Before}) and that in the settlements after conversion (C_{After}) which is equal to zero.

Dead organic matter

Annual change in carbon stocks in dead wood reservoir was estimated considering the changes in dead wood resources on forest land all forms of ownership, using the information contained in the statistical yearbooks "Forestry". Estimations are based on the equation 3.2.12 contained in the guidelines "Good Practice Guidance for Land Use, Land Use Change and Forestry", Chapter 3.2.1.12.1.1.

Dead wood thickness used in the above mentioned equation is estimated on the basis of data from the most recent 5-year cycle of large-scale inventory and is published in the form of official statistics by the Central Statistical Office.

This method follows the approach in the IPCC Guidelines (Section 5.2.3, Forest and Grassland Conversion) where the amount of living aboveground biomass that is cleared for expanding settlements

[1] Data for the subcategory 5.E.2.1 FL converted to SL, includes changes resulting from the application of the transitional period

is estimated by multiplying the forest area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (C_{Before}) and that in the settlements after conversion (C_{After}) which is equal to zero.

Litter

Annual change in carbon stocks in the litter reservoir was estimated using equation 3.2.13 contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry ", section 3.2.12.1.1. For the needs of equation application, default reference values of LT_{ref} were considered to be used linked with the dominant tree species.

Carbon stock changes in litter were estimated based ion following references contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry" [IPCC, 2003]:

- LT_{ref} deciduous species - 28 [tC / ha]
- LT_{ref} coniferous species - 27 [tC / ha]
- transitional period - 20 years
- $f_{man\ intensity}$ - 1.0
- $f_{dist\ regime}$ - 1.0

This method follows the approach in the IPCC Guidelines (Section 5.2.3, Forest and Grassland Conversion) where the amount of living aboveground biomass that is cleared for expanding settlements is estimated by multiplying the forest area converted annually to settlements by the difference in carbon stocks between biomass in the forest prior to conversion (C_{Before}) and that in the settlements after conversion (C_{After}) which is equal to zero.

Soils

Annual change in carbon stocks in the litter reservoir was estimated using equation 3.2.14 contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry ", section 3.2.1.3.1. For the needs of equation application, default reference values of SOC_{ref} were considered to be used linked with the dominant tree habitats.

Table 7.2.4 Forest habitant types in Poland with the SOC_{ref} assignment

SOC_{ref}	Forest habitat types
high active SOC ref (50 [MgC/ha])	Fresh mixed forest, moist mixed forest, mixed upland forest, mountain mixed forest, fresh broadleaved forest, moist broadleaved forest upland forest, mountain forest
low active SOC ref (33[MgC/ha])	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 SOC ref (34 [MgC/ha])	Dry coniferous forest, fresh coniferous forest 0,5* fresh mixed coniferous forest
wetland SOC ref (87 [MgC/ha])	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

Carbon stock changes in mineral soils were estimated based ion following references contained in the Good Practice Guidance for Land Use, Land Use Change and Forestry" [IPCC, 2003]:

- transitional period – 1 year
- $f_{man\ intensity}$ – 1.0
- $f_{dist\ regime}$ – 1.0
- $f_{forest\ type}$ – 1.0

7.6.5. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2012 for IPCC sector *5.Land-Use Change and Forestry* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. This year uncertainty assumptions were applied directly to on activities and emission factors, instead of emission as in previous years. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 6. Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

Table 7.20. Results of the sectoral uncertainty analysis in 2012

2012	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	**-34672.39**	**108.21**	**1.76**	23.6%	79.0%	78.7%
A. Forest Land	-39573.27	1.49	1.06	20.6%	80.2%	80.2%
B. Cropland	1307.56			20.6%		
C. Grassland	377.82	0.07	0.00	20.6%	80.2%	80.2%
D. Wetlands	3102.17	106.65	0.02	20.6%	80.2%	80.2%
E. Settlements	113.34			20.6%		
F. Other Land						

7.6.6. Category-specific QA/QC and verification

Basing on the current recommendations from the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories, following elements of quality assurance and control were defined for the inventory of national activities in this area:

- performing an inventory of institutions. is responsible for coordinating QA / QC
- general procedures for quality control inventory QA / QC (using Tier 1).
- a detailed set for the category of sources. quality control procedures (using Tier 2)

Most of the input data used in the inventory process comes from official national statistics in the statistical studies of Central Statistical Office, reports of Forest Management and Geodesy Bureau. In case of deviations from the trend, more detailed checks are carried out concerning data input. This situation has occurred in the year 2009 for the studies presented in the official statistical volume of forest resources as a result of changes in methodology for their estimation. Presented data as a result of using National of State Forest Inventory of all forms of ownership become an official source of national statistics. In addition, for the annually calculated emissions are compared with the corresponding values from the previous years (trend of emissions), and in the event of any unexpected changes they are examined in more detail. For the detailed information see chapter QA/QC.

7.6.7. Recalculations

Main reasons leading to recalculations in the LULUCF sector for the whole time-series are as follows:

- an adjustment related to the calculation of carbon stocks in forest lands has been introducted;
- emissions from mineral soils in 5.B Cropland, 5.C Grassland and 5.E Settlements category were recalculated to take into account the new country-specific soil organic carbon stocks;
- revision of soil classification also resulted in minor changes in the emissions from mineral soils;
- revision of biomass increments on land subjest to afforestation as well as on lan considered in subcategory 5.A.2 *land converted to forests,* also resulted in minor changes in emissions/removals from mineral soils.

Net effect of recalculations on CO2 emissions/removals is shown in Table 7.61 and 7.6.2

Table 7.6.1 Recalculations implemented in the KP LULUCF activities

Activity	Year / Difference	2008	2009	2010	2011
AR	[GgCO2]	2 819	3 095	3 550	3 550,49
	[%]	-54%	-56%	-56%	-57%
D	[Gg CO2]	92	107	93	117
	[%]	35%	40%	40%	49%
FM	[Gg CO2]	-9 095	-6 951	-6 383	-15 484
	[%]	33%	24%	22%	61%

Table 7.6.2 Recalculations implemented in the LULUCF categories.

Category	Recalculation	1988	1989	1990	1991	1992	1993	1994	1995
5	[Gg CO2]	-7 719.61	-10 482.65	-9 489.53	-1 955.40	14 694.92	5 660.35	3 889.31	-8 965.21
	[%]	99.01	89.39	51.18	9.78	-138.25	-49.86	-43.60	114.13
5A	[Gg CO2]	-6 082.00	-9 689.24	-9 147.20	-2 080.94	14 378.72	5 341.41	3 752.84	-9 150.99
	[%]	35.30	48.51	35.40	7.92	-86.80	-30.84	-24.96	64.31
5B	[Gg CO2]	-1 694.45	-854.68	-404.63	60.61	251.06	235.58	33.86	80.31
	[%]	-31.26	-19.19	-11.52	2.38	11.92	11.23	1.54	3.26
5C	[Gg CO2]	64.75	65.38	65.98	67.09	68.32	86.79	106.65	107.88
	[%]	8.93	8.84	8.75	8.60	8.43	10.61	12.94	11.96

Category	Recalculation	1996	1997	1998	1999	2000	2001	2002	2003
5	[Gg CO2]	-27 175.91	-26 901.89	-32 461.56	-38 893.77	-22 619.39	-10 968.92	-20 190.17	-21 071.97
	[%]	301.03	308.91	342.02	362.07	214.99	81.07	140.99	141.16
5A	[Gg CO2]	-27 264.57	-27 122.85	-32 818.24	-39 110.21	-22 909.32	-11 156.18	-20 226.62	-20 676.71
	[%]	177.43	179.30	210.70	234.69	140.07	57.77	100.54	98.24
5B	[Gg CO2]	-17.92	116.09	199.54	58.93	134.63	32.06	-125.82	-2 343.53
	[%]	-0.72	4.63	8.54	2.69	6.65	1.52	-5.74	-99.13
5C	[Gg CO2]	109.08	108.35	160.06	159.92	159.61	158.36	164.77	183.83
	[%]	13.14	13.22	22.99	22.68	25.32	27.08	29.88	36.15

Category	Recalculation	2004	2005	2006	2007	2008	2009	2010	2011
5	[Gg CO2]	-29 631.87	-23 775.54	-37 471.81	-9 557.85	-7 107.00	-5 072.04	-4 662.04	-14 225.84
	[%]	159.19	99.59	137.36	39.72	26.78	18.55	17.10	58.86
5A	[Gg CO2]	-29 295.49	-23 321.05	-37 019.55	-8 955.86	-6 190.95	-3 730.48	-3 010.61	-12 404.75
	[%]	117.45	77.32	111.28	29.91	18.94	11.02	8.85	39.99
5B	[Gg CO2]	-515.33	-633.58	-629.91	-778.81	-1 093.31	-1 494.34	-1 790.98	-1 955.92
	[%]	-19.40	-23.17	-26.89	-33.64	-43.07	-50.48	-55.71	-58.98
5C	[Gg CO2]	182.87	181.93	181.17	180.40	187.15	186.36	185.49	186.13
	[%]	42.55	48.04	43.47	59.01	56.02	70.04	73.82	84.27

7.6.8. Planned improvements

With the connection to the first cycle of National Forest Inventory of all ownership forms, executed in a 5-year cycles but updated annually, a continuous analysis of the conventional statistics and indicators is being performed on the basis of the collected material and the use of the collected data to estimate emissions and removals from the forestry sector with regard to actions under Article. 3.3 and 3.4 of the Kyoto Protocol. It should be added that the results of NFI are a valuable source of reliable information on forest resources (i.e. dead wood on forest land. which are used in the National Inventory of greenhouse gases). In addition, research projects will be able to allow a precise determination of changes in carbon content in forest litter, and also allows verification of the conventional factors used to determine changes in carbon content in forest soils. Moreover Party is considering the revision of in-country specific SOC factors. Such an eventuality is dictated by many factors and processes that are determining the direction and rate of change in SOC content when vegetation and soil management practices are changed. Ones that may be important for increasing SOC storage include (1) increasing the input rates of organic matter, (2) changing the decomposition of organic matter inputs that increase LF-OC in particular, (3) placing organic matter deeper in the soil either directly by increasing belowground inputs or indirectly by enhancing surface mixing by soil organisms, and (4) enhancing physical protection through either intra-aggregate or organo-mineral complexes. At the moment considering the ongoing in-country research, there is not enough data currently available to precisely describe factors defined above and to determine the amount of carbon accumulating in any large region or even some particular plot of land. Subsequent analysis will be possible at the end, the ongoing national studies concerning SOC in forest soils. Party is considering described factor as necessary for further improvements.

7.7. Other land

Emissions/removals from this subcategory were not estimated. It is included to match overall consistency of country land area.

8. WASTE

8.1. Overview of sector

The GHG emission sources in waste sector involve: CH_4 emission from solid waste disposal on land, CH_4 and N_2O emissions from wastewater handling and CO_2 and N_2O emissions from waste incineration.

Following category from sector 6 have been identified as key source (excluding LULUCF):

6.A - Solid Waste Disposal on Land (CH_4 emission), share in total GHG emission	2.1%
6.B - Wastewater Handling (CH_4 emission), share in total GHG emission	1.3%

Total emission of GHG as carbon dioxide equivalent amounted to 15244.95 Gg in 2012 and increased since 1988 by 19.36% (Figure 8.1). The biggest changes in emissions occurred in 1999-2000. This is due to change of emission factors in Domestic and Commercial Wastewater subsector in 2000. The change was caused by new researches, although, those new emission factors are not suitable for previous years.

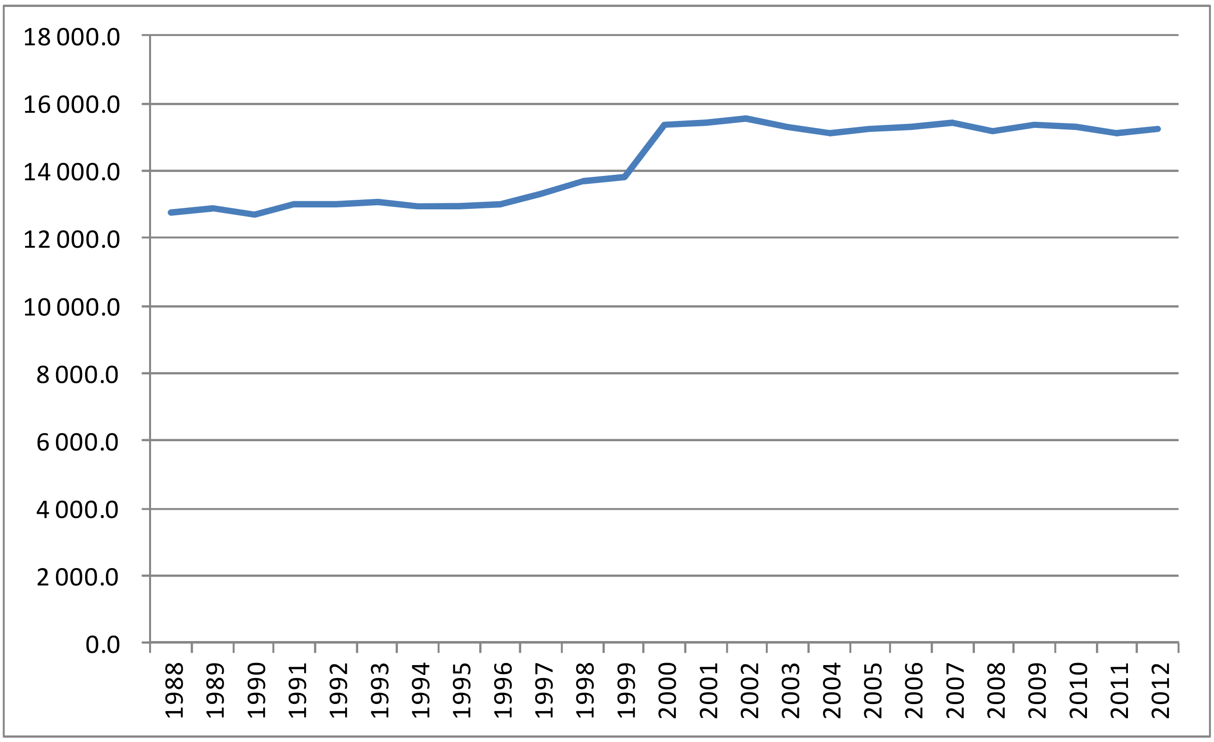

Figure 8.1. GHG emissions from waste sector in 1988-2012

Between years 1988 and 2012 decrease of GHG emissions appeared in subcategory 6.A (by 4.9 %) and 6.C (by 49.7 %). Only subcategory 6.B increased since 1988 (by 100.8 %) what the main reason of increase of emissions from the whole sector 6. *Waste*. The biggest contributor of GHG emissions is subsector 6.A *Solid Waste Disposal on Land* (Figure 8.2).

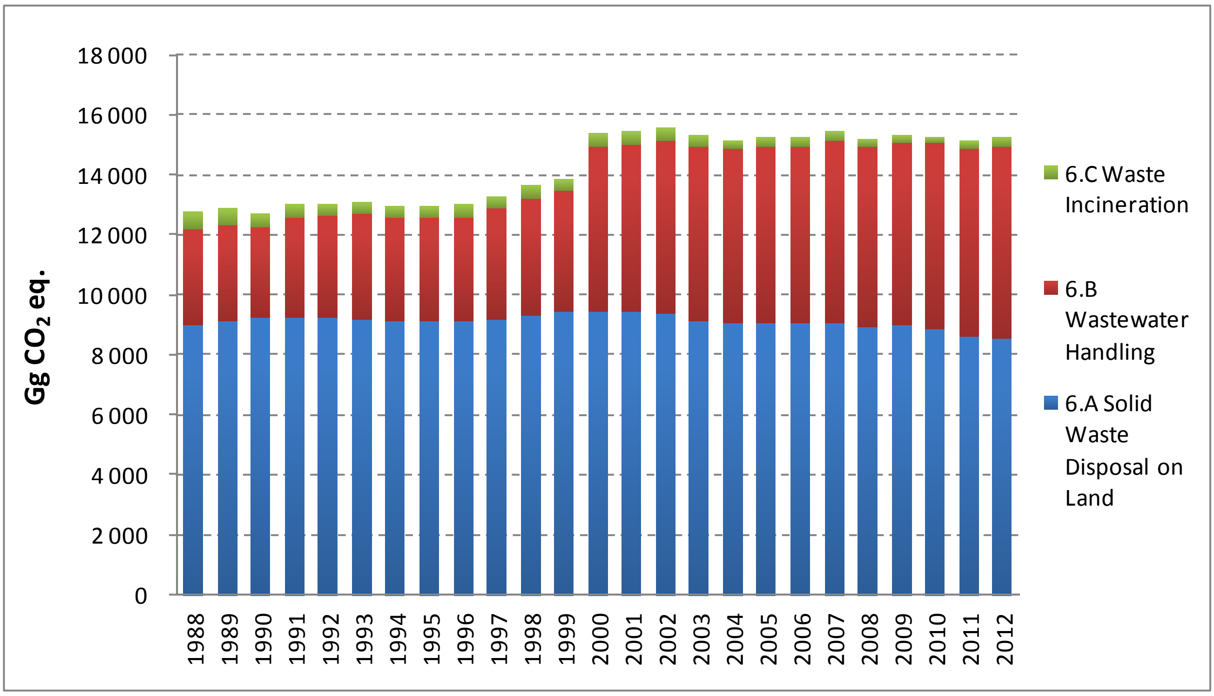

Figure 8.2. GHG emissions from waste sector divided to subsectors

8.2. Solid Waste Disposal on Land (CRF sector 6.A)

8.2.1. Source category description

The 6.A *Solid Waste Disposal on Land* subcategory share in total waste sector is 56.2% and it involves methane emissions from Managed Waste Disposal on Land (37.9% share of 6.A), Unmanaged Waste Disposal on Land deep (38.3% share of 6.A), Uncategorized MSW Disposal on Land (14.2% share of 6.A.), Industrial Waste Disposal on Land (8.6% share of 6.A) and composting of waste (1.0% share of 6.A). This sector includes emission from disposal of sewage sludge on land which is mentioned in chapter 8.2.2.

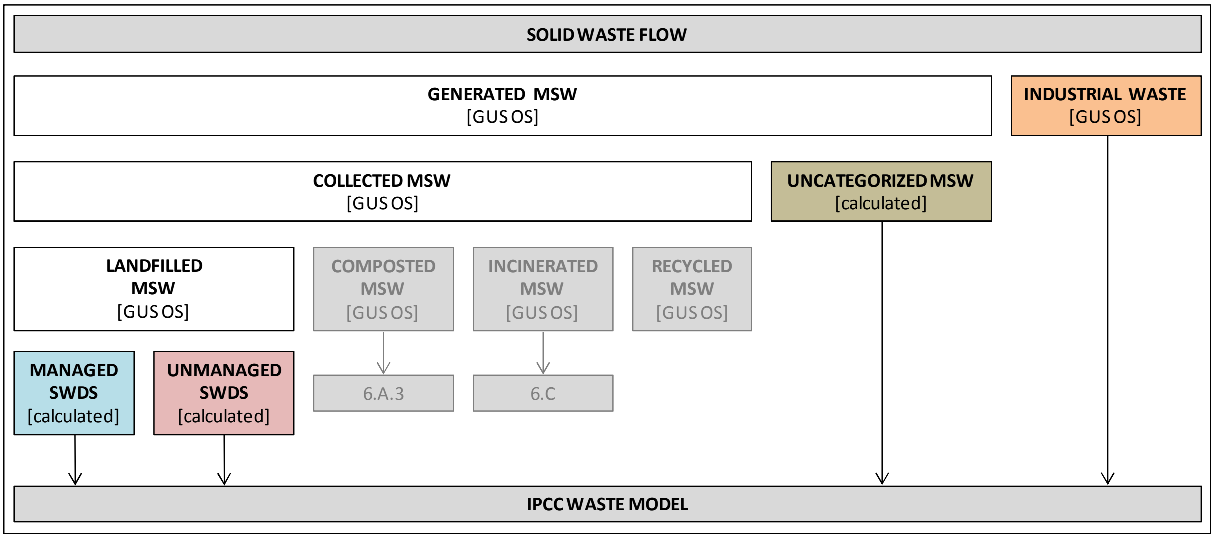

Figure 8.3. Solid waste flow scheme

The trend of emissions from sector 6.A is mostly conditioned by activity data: amount of waste generated and collected, that was biggest in the year 2000 due to development of the Poland's economy as well as the waste collection system.

The biggest change in trend emissions was in years 2000-2001 (figure 8.4). Since 2001 the trend of methane emission is decreasing, mostly due to further development of collection, segregation and landfilling system (which are the result of implementing recommendations of Landfill Directive 1999/31/EC among others). During this period recycling of waste was popularized and developed (what resulted in decrease of landfilled municipal waste), new technologies on SWDSs were introduced and amount of generated municipal waste decreased.

Another local maximum in the trend is located around the year 1991 when simultaneously occurred increase of amount of landfilled municipal waste and decrease in amount of landfilled industrial waste.

The basic legal regulatory for waste management in Poland is the Act on waste (Dz.U. z 2010 nr 185 poz. 1243) describing the ways of waste treatment leading to human and environmental protection.

Poland is importing solid waste but according to information from Chief Inspectorate of Environmental Protection those are mostly hazardous waste (no municipal waste is imported) for incineration and it's amount is included in data on incinerated waste used by Party for estimates from subsector 6.C.

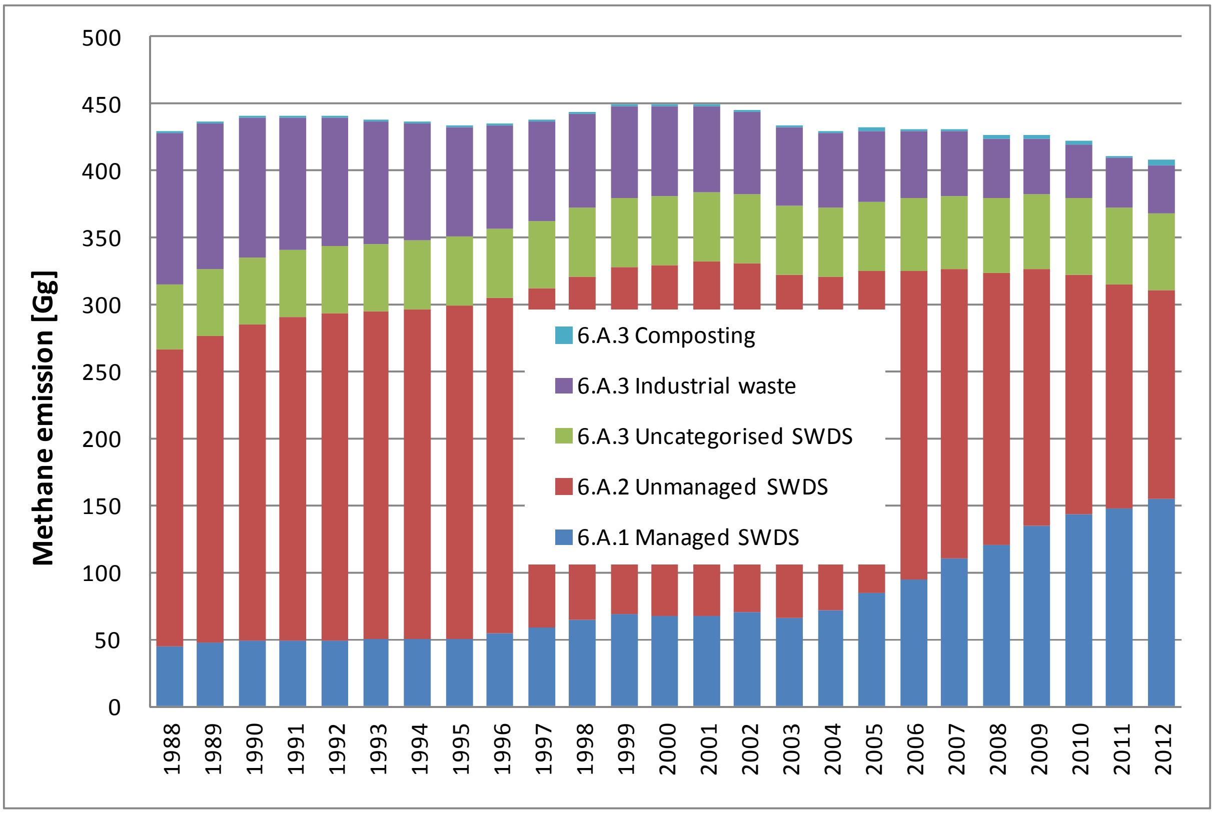

Figure 8.4. Methane emission from 6.A subsector divided to subcategories

8.2.2. Methodological issues

8.2.2.1 Managed Waste Disposal on Land and Unmanaged Waste Disposal on Land deep

The methane emission estimates from waste landfilling were calculated using IPCC 2006 *Tier 2* method. The choice of the method was supported by good quality country-specific historical and current activity data on waste disposal at SWDSs from National Statistical Office and the Ministry of Environment.

The methane emissions from solid waste disposals were calculated using the IPCC Waste Model published in [IPCC 2006]. The model establishes multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH_4 is diminished by recapturing of this gas for energy purposes. The data on recovered methane are based on responses to questionnaires of Central Statistical Office on energy combustion.

The following indicators were used for estimation of CH_4 emissions:

- DOC – degradable organic carbon in the year of deposition (table 8.1, default value [IPCC 2006])
- DOC_f – fraction of DOC that can decompose (fraction) (table 8.1, default value [IPCC 2006])
- MCF – CH_4 correction factor for aerobic decomposition in the year of deposition (table 8.2, default value [IPCC 2006])
- OX – Oxidation Factor reflecting the amount of CH_4 from solid waste disposal sites that is oxidized in the soil or other material covering the waste (table 8.3, default value [IPCC 2006])
- k – reaction constant [IPCC 2006] (table 8.3)
- F – fraction of CH_4 by volume, in generated landfill gas (fraction) [IPCC 2006] (table 8.3)
- R – methane recovery was taken from [GUS OZE 2012].

Table 8.1. DOC and DOC_f indicators

DOC (Degradable Organic Carbon)	Range	Default	Adopted Value
Food waste	0.08-0.20	0.15	0.15
Garden	0.18-0.22	0.2	0.2
Paper	0.36-0.45	0.4	0.4
Wood and straw	0.39-0.46	0.43	0.43
Textiles	0.20-0.40	0.24	0.24
DOC_f		0.5	0.5

Table 8.2. MCF indicators of organic carbon in disposed waste

Unmanaged, shallow	Unmanaged, deep	Managed	Managed, semiaerobic	Uncategorised
0.4	0.8	1	0.5	0.6

Table 8.3. Indicators k, F and OX assumed for calculations

Methane generation rate constant (k)	Range	Default	Value
Food waste	0.1–0.2	0.185	0.185
Garden	0.06–0.1	0.1	0.1
Paper	0.05–0.07	0.06	0.06
Wood and straw	0.02–0.04	0.03	0.03
Textiles	0.05–0.07	0.06	0.06
Delay time (months)		6	6
Fraction of methane (F) in developed gas		0.5	0.5
Oxidation factor (OX)		0	0-0.1*

* since 2001 managed SWDSs fulfill requirements of [IPCC 2006] to be treated as "well-managed" SWDSs for which the 0.1 value of oxidation factor is default

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

- Population – number of population was taken from [GUS],
- Collected Municipal Solid Wastes (MSW) was taken from National Statistics. Because of lack of data for years 1971-1973 data were interpolated on a basis of data from 1970 and 1974. The same method was used for 1976. In domestic statistics data were given in dam^3. To recalculate data into Gg a conversion factor was used. According to GUS this conversion factor is 0.26 Mg/m^3,
- Generated municipal solid waste – for the years 1970 – 2004 data was extrapolated according to amount of collected MSW [GUS OS],
- Municipal solid waste on landfills fulfilling requirements of Landfill Directive 1999/31/EC – data from Waste Management Department of Ministry of Environment,
- Waste treated biologically [GUS OS].

In 2012, according to statistical data [GUS 2013d], collected municipal solid wastes go to four different pathways, which shares are shown in table 8.4.

Table 8.4. Shares of waste treatment methods

Incineration	Biological treatment	Landfills	Recycling
0.5%	9.7%	74.7%	15.1%

Table 8.5. Data sources for amount of municipal waste

Years	Generated MSW [Gg]	Data source	Collected MSW [Gg]	Data source
1970	6496.65	extrapolation	4113.98	[GUS 1987]
1971	7007.31	extrapolation	4624.65	interpolation
1972	7517.98	extrapolation	5135.31	interpolation
1973	8028.64	extrapolation	5645.98	interpolation
1974	8539.31	extrapolation	6156.64	[GUS 1974d]
1975	9171.63	extrapolation	6788.96	[GUS 1986d]
1976	9780.66	extrapolation	7397.99	interpolation
1977	10389.69	extrapolation	8007.03	[GUS 1981d]
1978	11085.50	extrapolation	8702.83	[GUS 1981d]
1979	11435.29	extrapolation	9052.63	[GUS 1981d]
1980	12251.38	extrapolation	9868.72	[GUS 1986d]
1981	12397.09	extrapolation	10014.42	[GUS 1986d]
1982	12711.74	extrapolation	10329.07	[GUS 1986d]
1983	12924.57	extrapolation	10541.91	[GUS 1986d]
1984	13247.21	extrapolation	10864.54	[GUS 1986d]
1985	13469.61	extrapolation	11086.95	[GUS 1986d]
1986	13929.53	extrapolation	11546.86	[GUS 1987]
1987	14260.12	extrapolation	11877.45	[GUS 1989d]
1988	14466.84	extrapolation	12084.18	[GUS 1989d]
1989	14383.62	extrapolation	12000.95	[GUS 1990d]
1990	13480.95	extrapolation	11098.28	[GUS 1996]
1991	13020.64	extrapolation	10637.98	[GUS 1996]
1992	13003.67	extrapolation	10621.00	[GUS 1996]
1993	13027.33	extrapolation	10644.66	[GUS 1996]
1994	13397.31	extrapolation	11014.64	[GUS 1996]
1995	13367.67	extrapolation	10985.00	[GUS 2005d]
1996	14003.89	extrapolation	11621.22	[GUS 1997d]
1997	14566.11	extrapolation	12183.44	[GUS 1998d]
1998	14658.44	extrapolation	12275.77	[GUS 1999d]
1999	14699.57	extrapolation	12316.90	[GUS 2000d]
2000	14608.67	extrapolation	12226.00	[GUS 2005d]

Years	Generated MSW [Gg]	Data source	Collected MSW [Gg]	Data source
2001	13491.67	extrapolation	11109.00	[GUS 2005d]
2002	12891.37	extrapolation	10508.70	[GUS 2005d]
2003	12307.67	extrapolation	9925.00	[GUS 2005d]
2004	12141.67	extrapolation	9759.00	[GUS 2005d]
2005	12169.00	[GUS 2012d]	9352.00	[GUS 2006d]
2006	12235.00	[GUS 2009d]	9877.00	[GUS 2007d]
2007	12264.00	[GUS 2010d]	10083.00	[GUS 2011d]
2008	12194.00	[GUS 2011d]	10036.00	[GUS 2011d]
2009	12053.00	[GUS 2012d]	9265.00	[GUS 2012d]
2010	12038.00	[GUS 2012d]	10044.00	[GUS 2012d]
2011	12128.80	[GUS 2012d]	9827.60	[GUS 2012d]
2012	12085.00	[GUS 2013d]	9581.00	[GUS 2013d]

Distribution of solid waste disposal sites for managed and unmanaged ones until year 2001 was made in accordance to elaboration [Gworek 2003]. According to this publication 14% of disposal sites are managed, 86% are unmanaged.

Since 2001 Poland was implementing the Landfill Directive (1999/31/EC) and, as a result, the share of unmanaged SWDSs started to decrease (landfills fulfilling requirements of the Directive are considered to be "managed"). In accordance to data from Waste Management Department of Ministry of Environment about amount of MSW landfilled on landfills fulfilling requirements of the Directive the share of MSW on managed and unmanaged SWDSs was updated. Since 2012 all SWDSs in Poland fulfill the Directive and can be considered as „managed".

Tabela 8.6. Amount of waste collected and landfilled on managed SWDS

Year	Collected MSW [Gg]	MSW landfilled on managed SWDS [Gg]	Share
2001	data unavailable	data unavailable	20%*
2002	data unavailable	data unavailable	26%*
2003	10753.0	3414.0	32%
2004	9029.3	5207.5	58%
2005	8623.1	5210.0	60%
2006	7824.4	5903.3	75%
2007	9227.8	7411.4	80%
2008	8947.2	7584.8	85%
2009	8543.6	7379.9	86%
2010	8577.6	7885.3	92%
2011	7649.8	6979.1	91%
2012	-	-	100%

* extrapolated data

Composition of waste was made on the basis of publication [Rosik-Dulewska Cz. 2000] and on the basis of publication by [Rzeczyński B. 1996]. From the first publication composition of waste in 1985 was taken:

food	30%
garden	3%
paper	14%
wood	5%
textile	2%
plastics, other inert	46%

From the second publication, information on change in composition of metals and plastics during 20 years was taken (11.8% decrease from 1992 to 1972), and interpolation for the years until 2000 was made (table 8.6). Data for 2001-2003 are based on National Waste Management Plan 2003 [KPGO 2003], for 2004-2008 on [KPGO 2010], and for 2008-2012 on [KPGO 2014].

Table 8.7. Composition of municipal solid waste

Year	Food	Garden	Paper	Wood	Textile	Plastics, and other inert
1970	32%	5%	16%	6%	4%	39%
1971	32%	5%	16%	6%	4%	39%
1972	32%	5%	16%	6%	4%	39%
1973	31%	5%	15%	6%	3%	39%
1974	31%	4%	15%	6%	3%	40%
1975	31%	4%	15%	6%	3%	41%
1976	31%	4%	15%	6%	3%	41%
1977	31%	4%	15%	6%	3%	42%
1978	31%	4%	15%	6%	3%	42%
1979	31%	4%	15%	5%	3%	43%
1980	31%	4%	15%	5%	3%	43%
1981	30%	4%	14%	5%	2%	44%
1982	30%	4%	14%	5%	2%	44%
1983	30%	3%	14%	5%	2%	45%
1984	30%	3%	14%	5%	2%	45%
1985	30%	3%	14%	5%	2%	46%
1986	29%	3%	14%	5%	2%	47%
1987	29%	3%	14%	5%	2%	47%
1988	28%	3%	14%	4%	2%	48%
1989	27%	3%	15%	4%	2%	49%
1990	26%	3%	15%	4%	2%	49%
1991	26%	3%	15%	4%	2%	50%
1992	25%	3%	15%	4%	2%	51%
1993	24%	3%	15%	4%	2%	52%
1994	24%	3%	15%	4%	2%	52%
1995	23%	3%	15%	4%	2%	53%
1996	22%	3%	16%	4%	2%	54%
1997	21%	2%	16%	4%	2%	54%
1998	21%	2%	16%	3%	3%	55%
1999	20%	2%	16%	3%	3%	56%
2000	19%	2%	16%	3%	3%	56%
2001	18%	2%	16%	3%	3%	57%
2002	18%	2%	16%	3%	3%	57%
2003	18%	2%	16%	3%	3%	57%
2004	24%	2%	20%	2%	2%	50%
2005	24%	2%	20%	2%	2%	50%
2006	24%	2%	20%	2%	2%	50%
2007	24%	2%	20%	2%	2%	50%
2008	33%	3%	14%	1%	3%	46%
2009	33%	3%	14%	1%	3%	46%
2010	33%	3%	14%	1%	3%	46%
2011	33%	3%	14%	1%	3%	46%
2012	33%	3%	14%	1%	3%	46%

Abovementioned composition of municipal solid waste is used in IPCC Waste Model to calculate amounts of each fraction of waste deposited at SWDSs, and finally - amounts of CH_4 generated by each fraction.

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

Following the ERT 2009 recommendations emission from sewage sludge sent to landfills was assumed for years 1995-2011. Emission from sewage sludge was estimated on the basis of [IPCC 2006] methodology, using IPCC Waste Model. Emission factors were default [IPCC 2006] (table 8.8).

Table 8.8. Sewage sludge emission factors

DOC	Reaction constant (k)
0.05	0.185

Other parameters were assumed as for municipal solid waste.

The activity data was taken from Central Statistical Office annuals – Environment Protection (in 2011 from [GUS 2013d], for years 1998, 1999 and 2001 there was a lack of data and interpolation had to be done).

Table 8.9. Sewage sludge activity data

Year	Amount of sewage sludge disposed on landfills [Gg]
1995	1 471
1996	1 419
1997	2 184
1998	1 983
1999	1 783
2000	1 582
2001	1 573
2002	1 565
2003	1 510
2004	1 511
2005	1 330
2006	1 271
2007	991
2008	696
2009	605
2010	553
2011	534
2012	559

Extrapolating the amounts of sewage sludge disposed on landfills prior to 1995 is not possible due to lack of distinct trend.

8.2.2.2 Industrial Waste

Methodology is based on 2006 IPCC Guidelines [IPCC 2006]. Estimations were made using the IPCC Waste Model in MS Excel. Because the model originally doesn’t calculate the emission from industrial waste for each type of waste (there is only possibility to put total amount of waste), so the emission from industrial waste was calculated in the same way as municipal waste (according to IPCC Guidelines it is correct). So the waste model was used separately to calculate emissions from municipal and industrial waste. The choice of the method was supported by good quality country-specific historical and current activity data on industrial waste disposal at SWDSs.

According to IPCC Guidelines there is CH_4 emission only from few types of industrial waste:

- paper and cardboard,
- textiles,
- food,
- wood,
- tobacco,
- rubber and leather (only synthetic).

In national inventory activity data were taken from Central Statistical Office annuals – Environment Protection. Time series is 1975-2012. Before year 1975 there were no data on industrial waste. Waste from manufacturing of furniture is not included in the inventory due to lack of information on content of wood, plastic, metal and other materials in disposed furniture.

Table 8.10. Composition of industrial waste [Gg]

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert	Total	Source of activity data
1975	2 671.2	226.1	78.0	67.2	0.0	0.0	3 042.5	[GUS 1975d]
1976	3 390.7	173.6	79.5	51.5	0.0	0.0	3 695.3	[GUS 1976d]
1977	4 226.3	216.6	107.3	110.3	0.0	0.0	4 660.5	[GUS 1977d]
1978	4 841.5	163.1	87.2	201.0	0.0	0.0	5 292.8	[GUS 1978d]
1979	4 551.0	164.9	94.9	87.6	0.0	0.0	4 898.4	[GUS 1979d]
1980	3 727.0	198.4	88.1	93.2	0.0	0.0	4 106.7	[GUS 1981d]
1981	4 337.8	161.4	47.9	79.2	0.0	0.0	4 626.3	[GUS 1982d]
1982	3 741.9	273.5	47.7	82.4	0.0	0.0	4 145.5	[GUS 1983d]
1983	3 519.6	380.0	60.7	66.4	0.0	0.0	4 026.7	[GUS 1984d]
1984	3 373.1	319.2	50.7	78.8	0.0	0.0	3 821.8	[GUS 1985d]
1985	3 483.9	295.9	61.5	81.5	0.0	0.0	3 922.8	[GUS 1986d]
1986	1 273.3	347.2	102.2	144.9	0.0	0.0	1 867.6	[GUS 1987d]
1987	1 258.9	381.4	123.6	87.5	0.0	0.0	1 851.4	[GUS 1988d]
1988	1 498.3	409.2	106.0	137.8	0.0	0.0	2 151.3	[GUS 1989d]
1989	1 235.3	492.9	108.5	70.2	0.0	0.0	1 906.9	[GUS 1990d]
1990	1 211.5	408.2	90.9	42.2	0.0	0.0	1 752.8	[GUS 1991d]
1991	1 385.1	407.0	65.6	40.1	0.0	0.0	1 897.8	[GUS 1992d]
1992	938.9	363.2	23.9	53.4	81.4	11.5	1 472.3	[GUS 1993d]
1993	1 058.9	339.0	17.6	34.0	36.1	13.1	1 498.7	[GUS 1994d]
1994	855.3	277.1	19.1	21.6	21.2	10.4	1 204.7	[GUS 1995d]
1995	705.3	240.3	35.2	25.9	19.2	17.5	1 043.4	[GUS 1996d]
1996	791.0	266.9	30.9	29.2	19.5	12.1	1 149.6	[GUS 1997d]
1997	624.3	258.2	23.0	24.7	17.5	13.3	961.0	[GUS 1998d]
1998	612.3	464.5	20.9	21.3	8.2	27.9	1 155.1	[GUS 1999d]
1999	467.5	729.1	24.5	12.5	5.2	30.1	1 268.9	[GUS 2000d]
2000	430.6	446.3	21.7	6.9	3.3	31.7	940.5	[GUS 2001d]
2001	330.9	363.0	13.5	2.8	2.8	23.4	736.4	[GUS 2002d]
2002	295.7	356.5	15.3	1.7	0.9	16.3	686.4	[GUS 2003d]
2003	275.6	275.2	13.6	1.2	0.6	18.2	584.4	[GUS 2004d]
2004	294.3	186.2	10.1	1.9	0.7	0.7	493.9	[GUS 2005d]
2005	314.4	144.5	7.6	4.5	0.7	0.6	472.3	[GUS 2006d]
2006	244.1	119.4	3.9	2.0	0.3	1.9	371.6	[GUS 2007d]
2007	219.6	105.5	3.5	0.3	0.1	1.8	330.8	[GUS 2008d]
2008	151.6	72.1	3.1	0.3	0.0	1.5	228.6	[GUS 2009d]
2009	88.3	100.3	2.0	0.0	0.0	1.6	192.2	[GUS 2010d]
2010	85.2	175.0	1.4	0.0	0.0	2.2	263.8	[GUS 2011d]
2011	61.1	125.9	1.5	0.0	0.1	2.4	191.0	[GUS 2012d]
2012	53.1	111.5	1.4	0.0	0.0	1.8	167.8	[GUS 2013d]

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.

On the basis of waste amount from each industry sector the composition of waste was calculated.

Table 8.11. Composition of industrial waste

Year	Food	Paper	Wood	Textile	Rubber	Plastics, other inert
1975	87.8%	0.0%	7.4%	2.6%	2.2%	0.0%
1976	91.8%	0.0%	4.7%	2.2%	1.4%	0.0%
1977	90.7%	0.0%	4.6%	2.3%	2.4%	0.0%
1978	91.5%	0.0%	3.1%	1.6%	3.8%	0.0%
1979	92.9%	0.0%	3.4%	1.9%	1.8%	0.0%
1980	90.8%	0.0%	4.8%	2.1%	2.3%	0.0%
1981	93.8%	0.0%	3.5%	1.0%	1.7%	0.0%
1982	90.3%	0.0%	6.6%	1.2%	2.0%	0.0%
1983	87.4%	0.0%	9.4%	1.5%	1.6%	0.0%
1984	88.3%	0.0%	8.4%	1.3%	2.1%	0.0%
1985	88.8%	0.0%	7.5%	1.6%	2.1%	0.0%
1986	68.2%	0.0%	18.6%	5.5%	7.8%	0.0%
1987	68.0%	0.0%	20.6%	6.7%	4.7%	0.0%
1988	69.6%	0.0%	19.0%	4.9%	6.4%	0.0%
1989	64.8%	0.0%	25.8%	5.7%	3.7%	0.0%
1990	69.1%	0.0%	23.3%	5.2%	2.4%	0.0%
1991	73.0%	0.0%	21.4%	3.5%	2.1%	0.0%
1992	63.8%	0.0%	24.7%	1.6%	3.6%	5.5%
1993	70.7%	0.0%	22.6%	1.2%	2.3%	2.4%
1994	71.0%	0.0%	23.0%	1.6%	1.8%	1.8%
1995	67.6%	0.0%	23.0%	3.4%	2.5%	1.8%
1996	68.8%	0.0%	23.2%	2.7%	2.5%	1.7%
1997	65.0%	0.0%	26.9%	2.4%	2.6%	1.8%
1998	53.0%	0.0%	40.2%	1.8%	1.8%	0.7%
1999	36.8%	0.0%	57.5%	1.9%	1.0%	0.4%
2000	45.8%	0.0%	47.5%	2.3%	0.7%	0.4%
2001	44.9%	0.0%	49.3%	1.8%	0.4%	0.4%
2002	43.1%	0.0%	51.9%	2.2%	0.2%	0.1%
2003	47.2%	0.0%	47.1%	2.3%	0.2%	0.1%
2004	59.6%	0.0%	37.7%	2.0%	0.4%	0.1%
2005	66.6%	0.0%	30.6%	1.6%	1.0%	0.1%
2006	65.7%	0.0%	32.1%	1.0%	0.5%	0.1%
2007	66.4%	0.0%	31.9%	1.1%	0.1%	0.0%
2008	66.4%	0.0%	31.5%	1.4%	0.1%	0.0%
2009	45.9%	0.0%	52.2%	1.0%	0.0%	0.0%
2010	32.3%	0.0%	66.3%	0.5%	0.0%	0.0%
2011	32.0%	0.0%	65.9%	0.8%	0.0%	0.1%
2012	31.6%	0.0%	66.4%	0.8%	0.0%	0.0%

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

Abovementioned composition of municipal solid waste is used in IPCC Waste Model to calculate amounts of each fraction of waste deposited at SWDSs, and finally - amounts of CH_4 generated by each fraction.

Table 8.12. DOC and DOC_f indicators

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

Table 8.13. 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 8.14. Indicators k, F and OX assumed for calculations

Methane generation rate constant (k)	Range	Default	Value
Food waste	0.1–0.2	0.185	0.185
Paper	0.05–0.07	0.06	0.06
Wood and straw	0.02–0.04	0.03	0.03
Textiles	0.05–0.07	0.06	0.06
Rubber	0.02–0.04	0.03	0.03
Delay time (months)		6	6
Fraction of methane (F) in developed gas		0.5	0.5
Oxidation factor (OX)		0	0

8.2.2.3. Biological treatment of solid waste

Following the ERT 2013 recommendation estimation of methane emissions from biological treatment of solid waste was added to inventory of GHG in subsector 6.A. Calculations are based on IPCC 2006 Guidelines [IPCC 2006] methodology, *Tier 1*, choice of which justifies lack of country-specific method of estimation GHG emission.

Emission factor applied by Party is 4 g CH_4/kg treated waste (composting, wet weight basis).

Data on amount of waste treated biologically in years 1993 – 2012 (apart from 1997 where interpolation was applied) were taken from [GUS 2012d] yearbook. For the years 1988 – 1992 activity data were achieved by extrapolation.

Table 8.15. Amounts of biologically treated waste and data sources

Year	Waste treated biologicaly [Gg]	Data source
1988	32.0	extrapolation
1989	39.6	extrapolation
1990	48.9	extrapolation
1991	60.5	extrapolation
1992	74.7	extrapolation
1993	92.4	[GUS 1994d]
1994	114.2	[GUS 1997d]
1995	200.6	[GUS 1997d]
1996	218.6	[GUS 1998d]
1997	220.2	interpolation
1998	304.3	[GUS 2002d]
1999	322.0	[GUS 2003d]
2000	322.0	[GUS 2003d]
2001	395.1	[GUS 2004d]
2002	297.6	[GUS 2004d]
2003	244.2	[GUS 2004d]
2004	392.2	[GUS 2007d]
2005	537.5	[GUS 2007d]
2006	478.7	[GUS 2009d]
2007	502.0	[GUS 2010d]
2008	488.3	[GUS 2011d]
2009	683.7	[GUS 2012d]
2010	782.0	[GUS 2012d]
2011	484.5	[GUS 2012d]
2012	1064.3	[GUS 2013d]

8.2.3. Uncertainties and time-series consistency

Uncertainty analysis for the revised year 2012 for IPCC sector *6.Waste* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 8.
Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

Table 8.16. Uncertainty analysis results in sector 6 in 2012

2012	CO_2 [Gg]	CH_4 [Gg]	N_2O [Gg]	CO_2 Emission uncertainty [%]	CH_4 Emission uncertainty [%]	N_2O Emission uncertainty [%]
6. Waste	**278.74**	**658.83**	**3.63**	51.0%	65.4%	49.3%
A. Solid Waste Disposal on Land		407.64			85.8%	
B. Wastewater Handling		251.20	3.58		100.4%	50.0%
C. Waste Incineration	278.74		0.05	51.0%		21.2%

8.2.4. Source-specific QA/QC and verification

Activity data concerning solid waste disposals and sewage sludge come from Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data. In some cases of solid waste comparison is made between national statistical data and National Waste Management Plan. Activity data on waste incineration is based on external expert's research involving questionnaires from individual entities. Country specific emission factors involved in estimation of GHG emissions from waste water treatment are based on external expert's analysis of questionnaires from individual entities.

The attempt has been undertaken to ensure internal consistency between different treatment pathways of waste and sewage sludge. Calculations in waste sector were examined with focus on formulas, units and trends consistency. Generally QC procedures follow QA/QC plan presented in Annex 7.

8.2.5. Source-specific recalculations

- correction of methodology of estimation methane content in landfill gas,
- added estimates of emissions from biological treatment of solid waste,
- complemented estimates of emissions from industrial waste disposal on land with amount of waste disposed in tailing ponds.

Table 8.17. Change in methane emissions in result of recalculations

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gg CH_4	98.4	92.3	86.0	80.5	77.0	71.4	67.5	63.2	58.5	55.1	51.6	48.9
%	30%	27%	24%	22%	21%	20%	18%	17%	16%	14%	13%	12%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gg CH_4	42.2	54.8	53.0	50.1	46.9	45.5	45.9	45.5	53.5	53.2	57.3	63.7
%	10%	14%	14%	13%	12%	12%	12%	12%	14%	14%	16%	18%

8.2.6. Source-specific planned improvements

No further improvements are currently planned for sector 6.A.

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

8.3.1. Source category description

The 6.B subcategory share in total waste sector is 41.9% and it involves methane emission from industrial wastewater (3% share of 6.B), methane emission from domestic and commercial wastewater (79% share of 6.B) and N_2O emission from human sewage (17% share of 6.B).

The main driver of emission change in sector 6.B is the *Domestic and Commercial Wastewater* subsector. The biggest change of emission trend occurred in the years 1999-2000, which was caused by the change of emission factors in year 2000, which resulted from new researches. New emission factors are not suitable for previous years. The trend of emissions from this sector is growing, mostly because of increase of population of cities and villages connected to wastewater treatment plants resulting from building new facilities and development of infrastructure.

Emission of methane from 6.B.1 *Industrial wastewater* subsector is constantly decreasing due to reduction of wastewater production by industries.

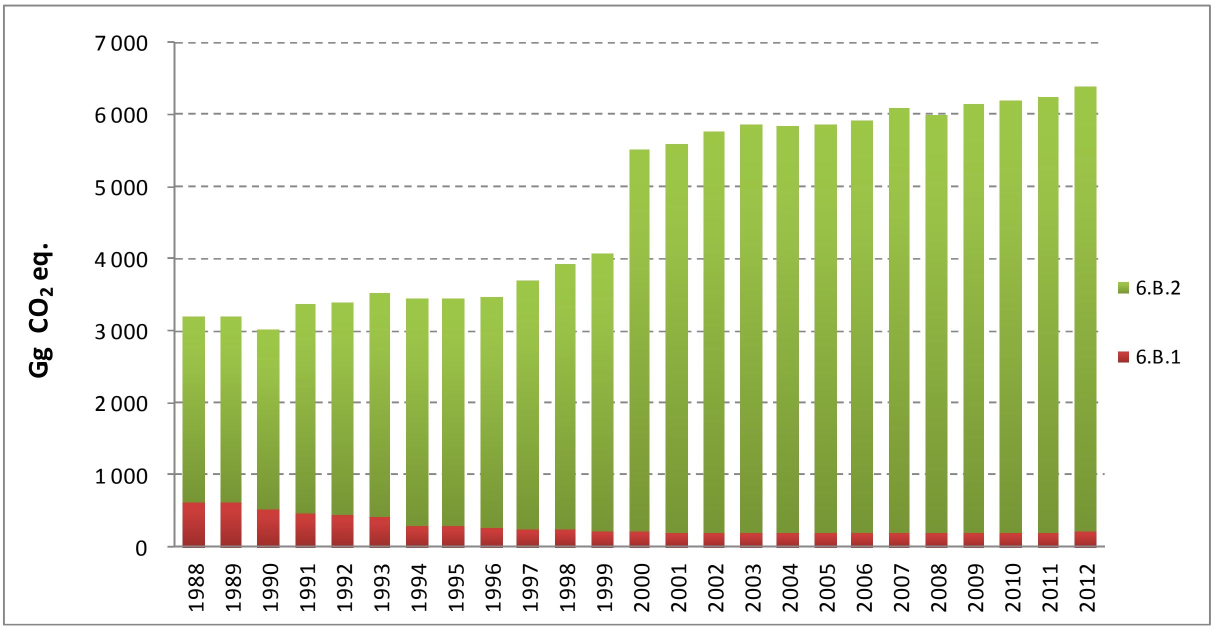

Figure 8.5. GHG emission from 6.B subsector

8.3.2. Methodological issues

8.3.2.1. Industrial wastewater (CRF sector 6.B.1)

Data on amount of industrial wastewater from separate branches and on biological treatment of organic wastewater were taken from national statistics [GUS 2013d]. Data on employment and production from some branches were taken from national statistics [GUS 1989-2013].

Table 8.18. Emission factors on wastewater and sludge

Industry sector	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/m^3		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

Total organic product is derived from amount of wastewater from each industry, COD concentration in organic wastewater and wastewater produced per unit product by industry.

Table 8.19. Amount of industrial wastewater by industry [million m^3]

Rok	Mining and quarrying	Iron and steel	Non-iron metals	Synthetic fertilizers	Food products: Meat & Poultry	Food products: Fish Processing	Food products: Vegetables & Fruits	Food products: Vegetable Oils	Food products: Dairy Products	Food products: Sugar	Food products: Soft Drinks	Food products: Beer & Malt	Food products: Other	Textiles	Leathers	Wood and Paper	Petroleum Refineries	Organic Chemicals	Plastics & Resins	Other non-metallic	Manufacturing of Machinery and Transport Equipment	Other
1988	548.0	94.2	48.7	123.0	3.3	1.6	14.2	3.7	19.5	23.7	4.1	4.0	2.7	14.2	6.3	195.0	43.2	126.0	17.4	58.2	53.6	90.9
1989	426.5	119.6	86.1	118.3	3.0	1.5	12.0	2.5	20.6	21.0	4.2	4.0	5.7	13.9	5.7	199.1	43.4	224.1	0.0	59.6	54.6	91.3
1990	519.0	99.8	39.7	92.5	2.7	1.3	10.0	1.5	19.7	20.4	4.3	4.3	3.7	11.1	4.7	184.0	38.7	107.0	17.6	53.3	50.3	95.2
1991	470.0	73.1	67.8	58.4	3.2	1.2	8.5	1.0	17.7	13.9	5.0	4.0	2.6	8.2	4.2	168.0	40.0	120.0	15.8	43.9	42.1	89.8
1992	453.0	51.4	66.2	53.5	5.4	1.1	7.4	0.5	16.2	10.0	5.8	4.0	0.6	9.0	3.0	146.0	36.6	108.0	15.7	31.0	32.6	79.8
1993	392.0	47.0	59.7	48.5	4.6	0.9	8.0	2.1	15.3	11.0	2.3	3.6	1.5	7.8	2.6	132.0	33.6	97.7	15.1	28.0	30.7	82.7
1994	382.0	45.8	128.0	51.3	3.9	0.8	7.4	1.2	14.2	7.9	2.6	2.7	1.6	7.3	1.7	129.0	32.6	101.0	14.6	29.6	29.5	104.0
1995	378.0	44.4	134.0	41.5	4.0	0.3	8.3	1.0	13.2	7.7	2.4	2.1	1.5	6.4	1.6	121.0	33.2	98.6	12.6	29.3	27.0	94.5
1996	362.0	43.0	142.0	48.5	4.2	0.4	7.8	3.6	12.5	6.5	2.6	1.7	0.9	5.7	1.3	117.0	28.1	94.3	6.7	28.8	25.9	115.0
1997	340.0	43.9	172.0	51.9	4.2	0.2	7.7	4.8	12.2	5.7	2.9	1.7	1.1	5.2	1.1	114.0	25.1	81.5	9.2	32.9	26.5	110.0
1998	336.0	25.3	188.0	52.3	3.9	0.1	9.4	2.5	12.3	6.1	2.7	1.6	2.5	4.7	0.7	106.0	24.3	63.1	10.3	27.9	25.1	161.0
1999	362.3	13.2	184.8	52.6	4.0	0.1	7.5	3.2	11.4	4.9	2.6	1.4	0.5	3.1	0.7	90.3	20.3	55.9	8.4	29.8	22.0	116.7
2000	350.0	14.2	184.0	51.7	3.6	0.1	7.5	2.4	11.3	4.0	2.5	1.3	0.8	2.6	1.1	81.7	17.8	47.7	7.8	32.3	12.0	121.0
2001	332.0	14.8	187.0	49.7	3.4	0.1	7.2	0.7	11.7	2.9	2.1	1.3	0.7	2.1	1.2	76.9	18.1	42.4	4.7	34.2	10.4	130.0
2002	293.0	13.3	184.0	50.3	3.4	0.1	6.4	0.3	11.3	2.7	2.2	1.4	0.7	1.7	0.9	77.1	16.8	42.0	2.7	38.0	9.1	126.0
2003	272.0	9.6	155.0	46.0	3.5	0.1	7.8	0.2	11.5	2.7	3.1	1.2	0.8	1.6	0.8	71.5	17.4	38.3	2.5	31.9	8.1	120.0
2004	261.0	8.2	135.0	49.4	4.1	0.1	6.8	0.3	13.0	2.2	2.0	1.2	3.3	1.5	0.6	70.9	19.6	36.0	2.5	37.4	6.8	129.0
2005	267.0	6.5	132.0	48.6	4.3	0.0	6.6	0.3	13.5	1.8	2.1	1.3	2.8	1.6	0.7	68.9	19.3	38.4	2.4	36.3	7.0	128.0
2006	272.0	7.4	132.0	50.7	4.6	0.0	7.0	0.4	13.8	1.4	2.1	1.7	2.3	1.3	0.6	69.7	20.7	38.6	2.2	43.2	4.4	128.0
2007	271.0	10.8	133.0	52.6	4.8	0.0	6.8	0.4	14.4	1.9	1.9	1.4	2.4	0.7	0.6	67.6	23.0	39.1	2.3	39.4	4.2	148.0
2008	242.6	8.3	130.8	176.3	5.0	0.0	6.0	0.6	14.2	2.7	1.6	1.4	2.6	0.6	0.4	64.7	20.9	35.5	1.9	46.1	3.7	141.7
2009	252.9	12.8	128.4	121.3	5.8	0.0	6.1	0.8	14.2	3.2	1.8	1.1	2.1	0.4	0.5	66.8	21.3	29.4	1.8	39.9	2.1	168.4
2010	283.2	16.5	147.3	49.8	6.6	0.0	5.8	0.7	14.5	2.6	1.6	2.4	36.1	0.3	0.4	64.2	23.1	35.6	2.1	46.8	2.8	183.2
2011	286.2	13.2	166.4	48.1	6.5	0.0	5.8	0.6	13.8	3.1	2.2	10.3	35.3	0.0	0.3	66.3	23.1	38.0	2.4	48.0	2.7	164.9
2012	286.0	12.4	133.5	53.8	6.6	0.0	7.1	0.7	13.9	3.6	3.1	1.3	39.2	0.0	0.2	69.4	23.8	35.4	2.2	40.2	2.2	136.1

Data on share of aerobic and anaerobic wastewater treatment method and recovery of methane in industrial wastewater treatment was taken from expert opinion [Przewłocki, 2007].

Methodology is consistent with Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Workbook [IPCC 1997] and publication [Przewłocki, 2007], and based on COD default emission factors. For some branches, were the COD EF was not available country specific data were used [Rueffer, 1998].

N_2O emission estimates are not provided in the inventory because of lack of sufficient data to calculate it and no obligation of the estimation in applied 1996 IPCC methodology.

8.3.2.2. Domestic and Commercial Wastewater (CRF sector 6.B.2)

CH_4 emission from domestic and commercial wastewater was based on methodology [IPCC 1997]. Amounts of degradable organic components for wastewater and for sludge were estimated basing on the data on population connected to sewage treatment plants and on the rate of the each type of sewage treatment plants in municipal wastewater treatment. These data were taken from [GUS 2009d]. Activity data are presented in table 8.20. Default value of organic load in biochemical oxygen demand per person, which is equal to 60 g BOD/person/day [IPCC 2000], was taken for the calculations. Fraction of BOD that readily settles and is removed as sludge was estimated basing on the report [Bernacka 2005] (the country specific value – BOD = 369 g O_2/m^3).

Methane emission factors calculated according to abovementioned report [Bernacka 2005] are:

- wastewater – 0.030 kg CH_4 / kg BOD_5,
- sludge – 0.488 kg CH_4 / kg BOD_5.

The default value (0.6 kg CH_4/kg BOD) of maximum methane producing capacity was applied for estimation of sludge and wastewater emission factors. Fractions of wastewater and sludge anaerobically treated with and without methane recovery are estimated according to [Bernacka 2005]. These values are as follows: percentage of wastewater anaerobically treated – 5%, fractions of sludge anaerobically degraded – 81.3% of which with methane recovery – 83.5%.

Total organic product is derived from amount of population using wastewater plants, organic load in biochemical oxygen demand per person and fraction of BOD.

Table 8.20. Activity data for domestic and commercial wastewater

Year	Municipal waste discharged into collection system [mln m^3]	% treated wastewater
1988	2 478.1	52.75
1989	2 443.5	54.79
1990	2 313.9	60.11
1991	2 166.1	62.91
1992	2 075.3	64.08
1993	1 981.4	64.68
1994	1 999.2	63.81
1995	1 852.4	67.89
1996	1 751.8	71.04
1997	1 691.9	75.32
1998	1 655.5	79.21
1999	1 589.9	81.31
2000	1 494.0	83.23
2001	1 425.3	86.12

Year	Municipal waste discharged into collection system [mln m^3]	% treated wastewater
2002	1 353.1	88.01
2003	1 323.7	87.56
2004	1 293.6	89.07
2005	1 273.6	89.51
2006	1 265.2	91.33
2007	1 265.5	92.78
2008	1 254.4	93.22
2009	1224.7	96.43
2010	1297.8	95.73
2011	1258.8	95.58
2012	1248.8	97.76

N_2O emission from humane sewage was calculated according to default method [IPCC 1997]. Country population was taken from [GUS 2011] and value of protein consumption per capita per year was taken from FAO database. For years 2010-2011 protein consumption was assumed on the level of 2009 data (lack of data in FAO database after 2009). Default values were used for fraction of nitrogen in protein and for N_2O emission factor [IPCC 2000].

Following the ERT 2013 recommendation Party changed source of methane recovery data from based on [Bernacka 2005] calculated values to data from National Statistical Office. As a result emissions from the sector rose up to 500%, the trend of emissions changed from decreasing to growing, and the category 6.B became the key source.

8.3.3. Uncertainties and time-series consistency

See chapter 8.2.3.

8.3.4. Source-specific QA/QC and verification

See chapter 8.2.4.

8.3.5. Source-specific recalculations

Table 8.21. Change in emissions in result of recalculations

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gg CO_2 eq.	0.0	0.0	-81.9	-39.6	-47.9	-12.9	-53.1	-90.2	-122.3	-120.8	-143.5	-152.5
%	0%	0%	-3%	-1%	-1%	0%	-2%	-3%	-3%	-3%	-4%	-4%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gg CO_2 eq.	-164.2	-194.4	-151.0	-186.7	-270.2	-330.4	-375.6	-375.4	-517.9	-506.0	-552.5	-569.4
%	-3%	-3%	-3%	-3%	-4%	-5%	-6%	-6%	-8%	-8%	-8%	-8%

- methane recovery from wastewater treatment plants was added to calculations.

8.3.6. Source-specific planned improvements

- further improvement of methodology of estimating emissions from domestic and industrial wastewater.

8.4. Waste Incineration (CRF sector 6.C)

8.4.1. Source category description

The 6.C subcategory share in total waste sector is 1.9% and it involves CO_2 and N_2O emissions from incineration of municipal, industrial and medical waste and sewage sludge. According to IPCC Guidelines biogenic emission of CO_2 is not included in total emission. In 2012 it amounts to 99.2 Gg.

Methane emissions from subsector 6.C were not estimated because of lack of sufficient source data. Additionally, according to the IPCC 2006 Guidelines there is no need in estimating these emissions because of the low concentrations and high uncertainties (it is a good practice to apply an emission factor of zero).

8.4.2. Methodological issues

Waste incineration was estimated based on IPCC methodology [IPCC 2000] and domestic case study [Wielgosiński G. 2003]. Emission factors for CO_2 from incineration of municipal waste were taken from other country's experience [Background Papers, IPCC]. The rest of emission factors as default were taken from [IPCC 2000]. Biogenic and non-biogenic content of waste for municipal waste was assumed on a basis of national case study [Wielgosiński G. 2003]. For industrial, medical waste and sewage sludge this content was taken from [IPCC 2000]. The activity data for municipal, industrial waste and sewage sludge were calculated using data for 2009 from [Wielgosiński G. 2003] and statistical data [GUS 2013d] on incinerated municipal and industrial waste for 2012. Activity data on incinerated medical waste were calculated on the basis of data for 2009 from [Wielgosiński G. 2011] and on the basis of number of hospital beds and average use of hospital bed in 2012 from national statistics [GUS 2013d].

Data on incinerated sewage sludge were taken from [GUS 2013d].

Table 8.22. Activity data in 2012 [Gg]

Type of waste	Amount of waste incinerated
municipal	50.70
industrial	143.76
medical	34.16
sewage sludge	101.10

Table 8.23. Biogenic and non-biogenic content of waste

Non-biogenic waste	
municipal	0.7
industrial	0.9
medical	0.4
Biogenic waste (1-nonbiogenic)	
municipal	0.3
industrial	0.1
medical	0.6
sewage sludge	1

Table 8.24. Emission factors

Incineration of municipal waste	CO_2 [Gg CO_2/Gg of waste]	1
	N_2O [kg N_2O/Gg]	8
Incineration of industrial waste CO_2 [Gg CO_2/Gg of waste]	C content of waste	0.5
	Efficiency of combustion	0.995
	N_2O [kg N_2O/Gg]	210
Incineration of medical waste CO_2 [Gg CO_2/Gg of waste]	C content of waste	0.6
	Efficiency of combustion	0.95
Incineration of sewage sludge CO_2 [Gg CO_2/Gg of waste]	C content of waste	0.3
	Efficiency of combustion	0.95
	N_2O [kg N_2O/Gg]	800

Table 8.25. Composition of incinerated waste [Gg]

Year	Municipal		Medical		Industrial (incl. hazardous)		Sewage sludge
	nonbiogenic	biogenic	nonbiogenic	biogenic	nonbiogenic	biogenic	biogenic
1988	0.0	0.0	22.6	33.9	291.7	32.4	0.0
1989	0.0	0.0	22.1	33.1	268.2	29.8	0.0
1990	0.0	0.0	22.4	33.6	225.8	25.1	0.0
1991	0.0	0.0	22.0	33.1	201.4	22.4	0.0
1992	0.0	0.0	21.4	32.1	191.2	21.2	0.0
1993	0.0	0.0	21.7	32.5	189.1	21.0	0.0
1994	0.0	0.0	21.8	32.7	189.7	21.1	0.0
1995	0.0	0.0	21.4	32.2	192.5	21.4	0.0
1996	0.0	0.0	21.3	32.0	195.5	21.7	0.0
1997	0.0	0.0	20.9	31.3	195.3	21.7	0.0
1998	0.0	0.0	20.7	31.1	208.9	23.2	41.4
1999	0.0	0.0	19.9	29.9	172.6	19.2	31.9
2000	2.0	0.9	20.4	30.6	222.2	24.7	34.1
2001	18.2	7.8	10.8	16.1	214.1	23.8	46.6
2002	25.2	10.8	7.3	10.9	223.3	24.8	31.5
2003	29.1	12.5	8.2	12.3	177.3	19.7	47.0
2004	30.1	12.9	10.7	16.1	131.4	14.6	39.9
2005	31.1	13.3	11.8	17.7	144.0	16.0	37.4
2006	28.9	12.4	8.8	13.3	143.6	16.0	39.3
2007	30.7	13.1	10.1	15.2	142.4	15.8	33.7
2008	28.6	12.2	9.8	14.7	111.4	12.4	44.5
2009	28.2	12.1	11.4	17.2	107.5	11.9	50.4
2010	28.6	12.3	11.1	16.6	102.7	11.4	66.4
2011	27.6	11.8	13.3	20.0	103.9	11.5	85.2
2012	35.5	15.2	13.7	20.5	129.4	14.4	101.1

The table 8.25 presents composition of incinerated waste. Before the year 2000 no municipal waste was incinerated in Poland. Data on incineration of sewage sludge before 1998 are not available and lack of distinguishable trend indisposes extrapolation.

Following the ERT 2009 recommendation all activity data were recalculated to dry matter basis (except AD used to calculate CO_2 emission from incineration of industrial waste).

Waste combusted for energy purposes are included in Energy sector and treated as a fuel. Information on used EFs is included in NIR report under the Annex 2.

8.4.3. Uncertainties and time-series consistency

See chapter 8.2.3.

8.4.4. Source-specific QA/QC and verification

See chapter 8.2.4.

8.4.5. Source-specific recalculations

- new data on amounts of incinerated sewage sludge from national statistics [GUS 213d] were used in calculations.

Table 8.26. Change in GHG emissions in result of recalculations

Change	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gg CO_2 eq.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Change	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gg CO_2 eq.	0.0	-3.0	-4.1	-3.0	-3.9	-2.8	-2.7	-2.9	2.7	1.8	2.4	4.0
%	0%	-1%	-1%	-1%	-1%	-1%	-1%	-1%	1%	1%	1%	2%

8.4.6. Source-specific planned improvements

- research on usage of activity data from Central Waste System for emissions estimation.

9. OTHER (CRF SECTOR 7)

No other sectors were identified in the Polish GHG inventory.

10. RECALCULATIONS AND IMPROVEMENTS

10.1. Explanations and justifications for recalculations

10.1.1. GHG inventory

Interannual inventory recalculations are usually caused by continuous improvement of methodology and corrections of time series consistency. Also activity data elaborated by the Central Statistical Office (which is the main source of data), Eurostat and Energy Market Agency undergoes regular correction of historical trends. Recalculations are made also in response to the international review of GHG inventory performed on a regular basis.

Specific information on recalculation within CRF sectors are given in sectoral chapters 3-8 and in CRF table 8. The percentage change caused by recalculation with respect to the previous submission, has been calculated as follows:

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

where:

LS = Latest Submission (for 1988−2011 inventory submitted in NIR 2014)
PS = Previous Submission (for 1988−2011 inventory submitted in NIR 2013)

10.1.2. KP-LULUCF inventory

Main reasons leading to recalculations in the LULUCF sector for the whole time-series are as follows:

- an adjustment related to the calculation of carbon stocks in forest lands has been introduced;
- revision of biomass increments on land subject to afforestation as well as on land considered in subcategory 5.A.2 *Land converted to forests,* also resulted in minor changes in emissions/removals from mineral soils.

Net effect of recalculations on CO_2 emissions/removals is shown in Table 7.6.1.

10.2. Implications for emission levels and trends

10.2.1. GHG inventory

Recalculations of CO_2 emissions revealed decrease in almost entire period (Fig. 10.1), what was caused mostly by change in net carbon balance in LULUCF sector. Here the verification of data used for estimation of carbon stock change in live biomass in subcategory 5.A.1 forestland remaining forestland was made. Additionally recalculation of process CO_2 emissions were performed in 2.C.1 subsector: Iron and ore sinter production (for 1988-2011), pig iron (1990-2011), basic oxygen furnace steel production (1988-2011), electric furnace steel production (2005-2011). The purpose of these recalculations was need for methodological consistency (between 1998-2004 and 2005-2011, for which EU-ETS verified reports were available) as well as improvement of data in entire trend.

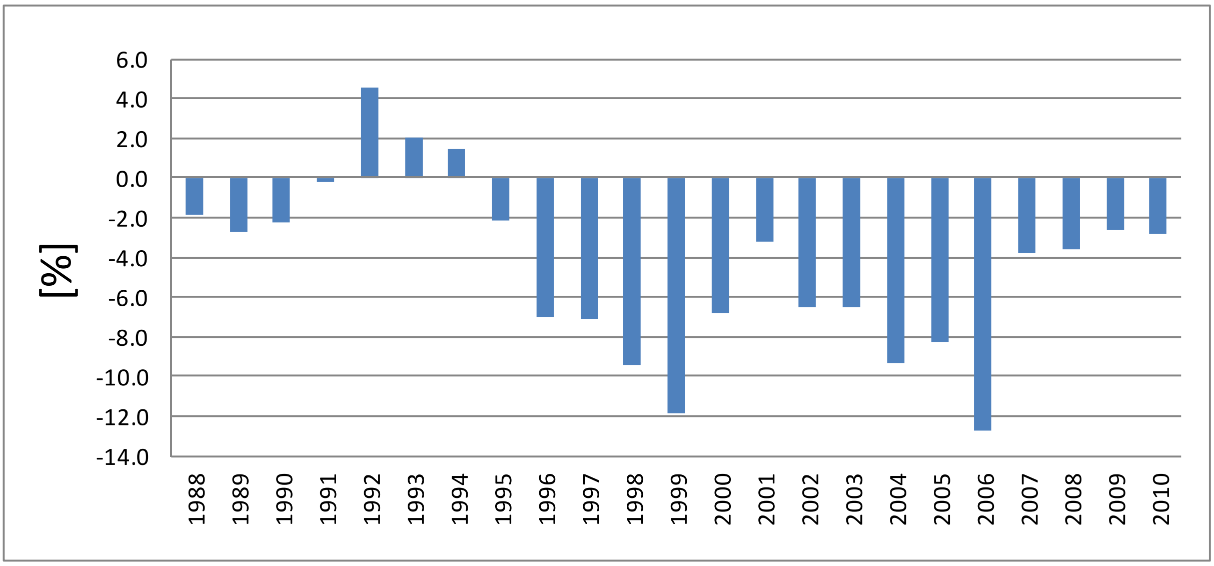

Figure 10.1. Recalculation of CO_2 for entire time series made in CRF 2014 comparing to CRF 2013

In the case of CH_4 the main reason for recalculations (Fig. 10.2) was the correction of activity data related to population of non-dairy cattle (age subcategories) in accordance with trend since 1998 what caused increase in CH_4 emissions from enteric fermentation and manure management. The same factor influenced N_2O emissions increase in 1988-1997.

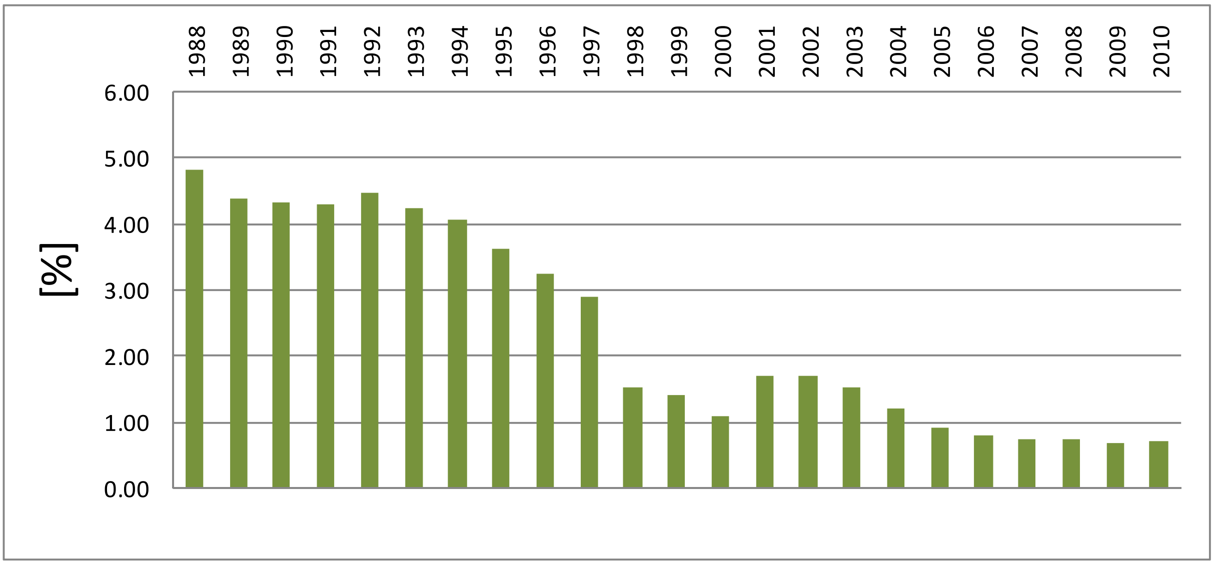

Figure 10.2. Recalculation of CH_4 for entire time series made in CRF 2014 comparing to CRF 2013

Whereas increase in N_2O emissions in entire period (Fig. 10.3) was triggered mostly by correction of manure used for estimation of indirect emissions as well as by amendment of trend of activity data related to application of sewage sludge in agriculture for 1988-2002.

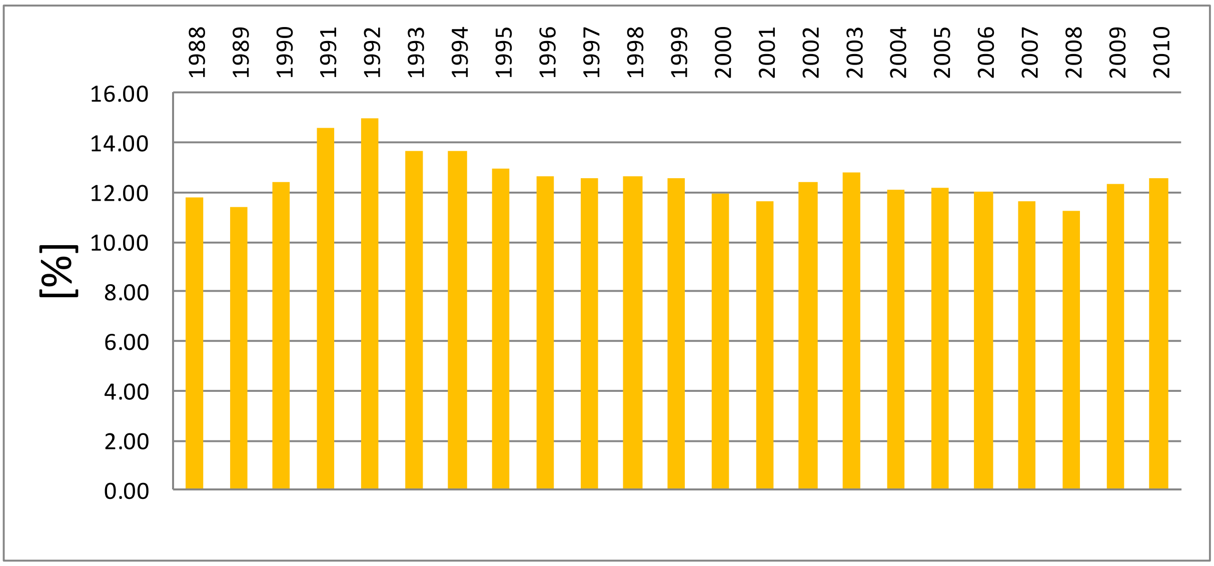

Figure 10.3. Recalculation of N_2O for entire time series made in CRF 2014 comparing to CRF 2013

10.2.2. KP-LULUCF inventory

As a result of recalculations for KP−LULUCF sector decrease in net emissions for 2008−2011 was observed. The main reason for recalculations was the application of carbon stock change method related to the calculation of carbon stocks in forest lands. Net emissions of CO_2 related to more detailed estimations resulted in emissions decrease by 50.5% comparing to Submission 2012. Data on emissions of non-CO_2 gases did not change.

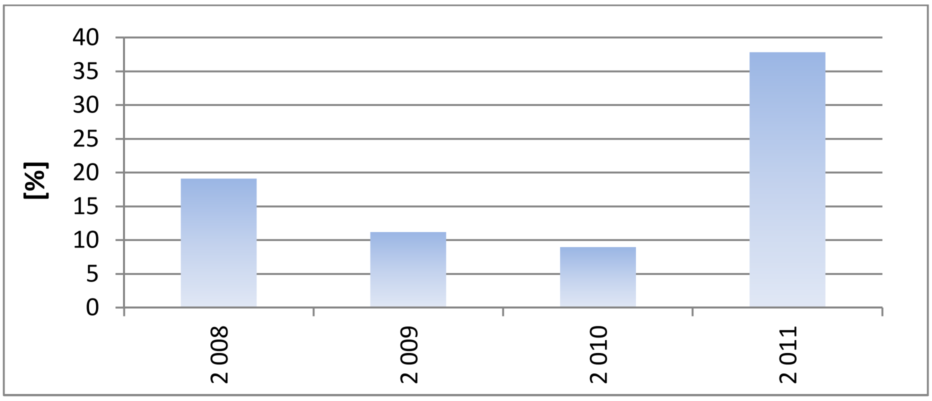

Fig. 10.4. Recalculation of CO_2 for 2008−2011 for KP-LULUCF activities made in CRF 2014 comparing to CRF 2013

10.3. Implications for emission trends

10.3.1. GHG inventory

Recalculations made in 2014 did not influenced the change in GHG emission trend in 1988−2011 as they are made in consistent manner as relates to activity data and methods used ensuring comparability of results in entire series. Changes for particular years fluctuate from -0.3 up to 1.8% (Fig. 10.4).

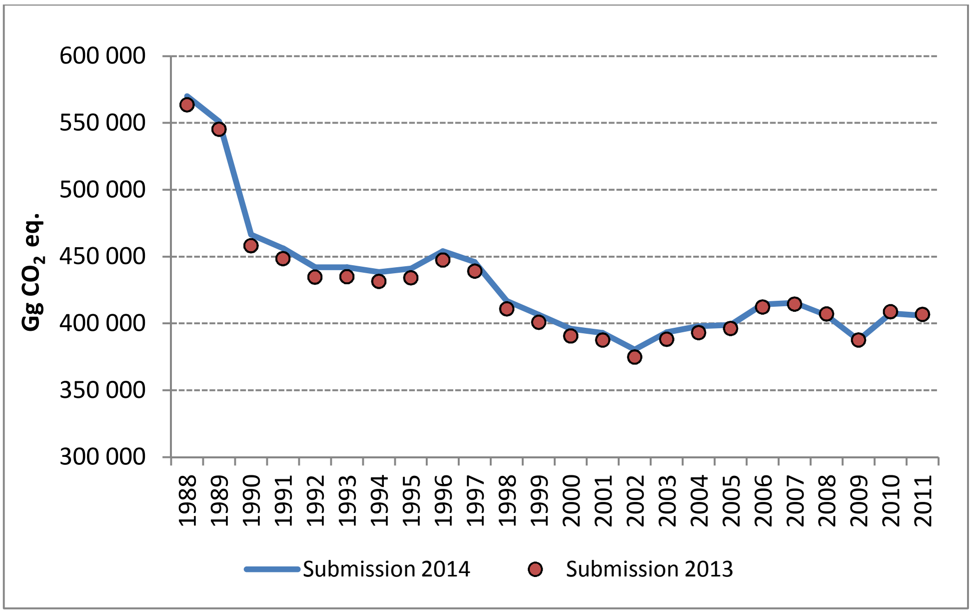

Figure 10.4. GHG emission trends according to Submissions made in 2014 and 2013

10.3.2. KP-LULUCF inventory

Net CO_2 emissions/removals related to elaborating the calculations in more detail, decreased in by 50.5% comparing to Submission 2013. Net emissions of other gases did not change.

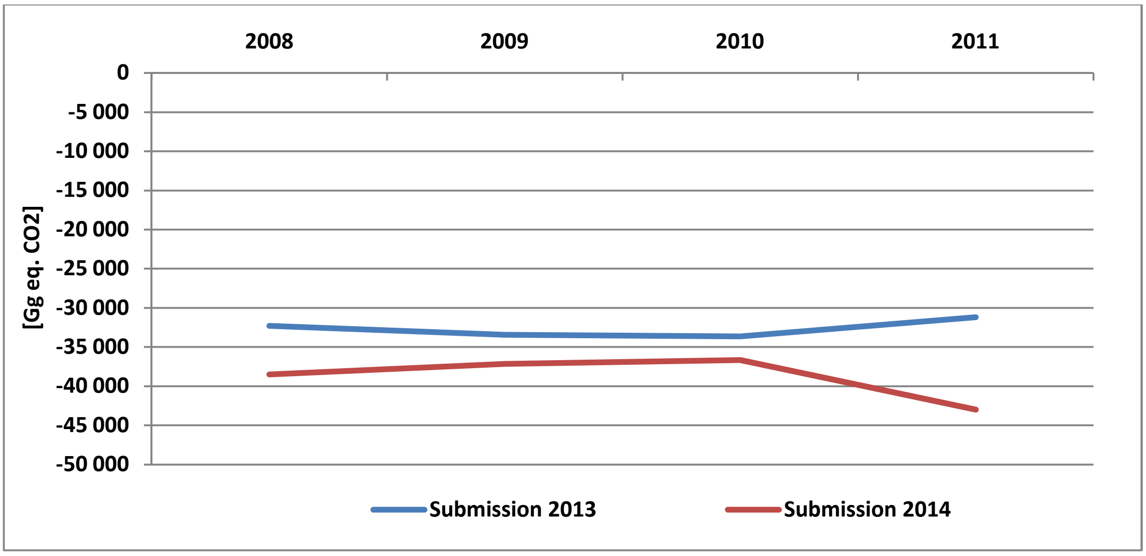

Figure 10.5. KP LULUCF GHG emission trends according to Submissions made in 2014 and 2013

10.4. Recalculations, including in response to the review process, and planned improvements to the inventory

10.4.1. GHG inventory

Table 10.1. The list of recommendations resulting from previous ERTs and its implementation status

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
general	ARR/2012/POL Para 10, 16	The ERT noted that table 7 of the NIR with a key category analysis has not been provided for the base year (1988) as planned according to the previous review report. The ERT recommends that the Party provide the key category analysis for the base year in its next annual submission.	Key category analysis for 1988 is given.	Annex 1
general	ARR/2012/POL Para 11	The ERT encourages the Party to update the structure of the NIR to be in line with the annotated outline of the NIR, including reporting elements under the Kyoto Protocol, in order to improve completeness of reporting.	NIR outline has been extended with the elements of KP-LULUCF reporting.	ES.2.2 ES.3.2
general	ARR/2012/POL Para 15	The ERT reiterates the encouragement of the previous review reports to consider performing a tier 2 key category analysis for the next annual submission in order to incorporate the impact of uncertainties into the analysis.	Tier 2 key category analysis is under elaboration.	
general	ARR/2012/POL Para 17	Poland reported the use of the key category analysis including LULUCF for determining whether the associated activity under the Kyoto Protocol should be considered as key. On this basis, Poland has identified afforestation and reforestation, and forest management as key categories. As has been noted by the previous review report, Poland does not report the use of a qualitative assessment as suggested by the IPCC good practice guidance for LULUCF (para. 5.4.4). The ERT encourages the Party to include such an assessment in the next annual submission.	The issue is under consideration.	
general	ARR/2012/POL Para 19	Other planned improvements regarding uncertainties, reported for several submissions, have still not been implemented, such as: the collection of new data needed to finalize the analysis based on the Monte Carlo simulation method; changing the description of assumptions and procedures of the uncertainty analysis to cover more details than in previous reports; deeper investigation of data for industrial gases; and the collection of data and setting up of a model for Kyoto Protocol, Article 3, paragraphs 3 and 4, uncertainty estimates. In response to a question raised by the ERT during the review, Poland stated that a new uncertainty evaluation model has already been elaborated and is being finalized, so an updated analysis using the Monte Carlo methodology will be performed for the 2013 annual submission.	Uncertainty analysis based on Monte Carlo simulation has been delayed. Nevertheless higher priority was given to project extending uncertainty analysis to include level assessment for the base year and in second stage – assessment of uncertainty introduced into the trend in total national emissions. Description of uncertainty analysis was improved and new information on trend uncertainty was introduced to the section.	

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
general	ARR/2012/POL Para 26	The ERT reiterates the previous recommendation that Poland disaggregate the information on recalculations, uncertainties, QA/QC activities and planned improvements at category-specific level, and include the information regarding KP-LULUCF reporting in the NIR, as set out in the annotated outline of the NIR, including reporting elements under the Kyoto Protocol.	NIR outline has been presented in more detail.	
general	ARR/2012/POL Para 30	Moreover, Poland has not provided a table with a compilation of previous review recommendations and planned and performed actions in response to these recommendations, as was encouraged by the previous ERT. During the review week, Poland stated that it will include such a table in the next annual submission. The ERT welcomes this information, as it will increase the transparency of the Party’s actions in response to the review process.	It has been included.	10
general	ARR/2012/POL Para 146	The ERT noted that in the previous review report, Poland was advised that the commitment period reserve calculation should be reported based on data in the most recent inventory submission and recommends that Poland include consistent information on its commitment period reserve in its next annual submission.	CPR based on the most recent GHG inventory is calculated and presented in chapter 1.1.3.	1.1.3
general	ARR/2012/POL Para 149	Report any changes in the information provided under Article 3.14.	The chapter has been revised.	15
1A	ARR/2012/POL Para 37	The ERT recommends that Poland report in the next submission where the emissions from military use of fuel are allocated.	There is no official information on data concerning use of fuels on military purposes. This data are confidential.	
1A	ARR/2012/POL Para 38, 50	The current ERT reiterates the recommendation of the previous review report that Poland improves the transparency of the energy chapter of the NIR by describing and interpreting the significant fluctuations in the emission trends of the key categories and by providing the underlying assumptions, including references, for the use of country-specific EFs and other data in the next annual submission.	Source data for elaboration of equation that connect NCV of fuels with C content, they are presented for every request of the ERT. This data are individual data from enterprises and should be recognized as confidential.	
1A	ARR/2012/POL Para 39	The NIR still does not provide an explanation for the large drop in fuel consumption between 1989 and 1990; it is not clear whether this is a result of differences in data collection and processing methodology between IEA and Eurostat or a real drop in sectoral activities. The ERT reiterates the recommendations of the previous review reports that Poland, in the next NIR, describe in further detail how time-series consistency is ensured in the energy sector when using the three data sets.	Emission data for years 1988-1989 was recalculated based on updated data from IEA database.	Chapters: 3.2.6.5, 3.2.7.5, 3.2.9.5 and Annex 2
1A	ARR/2012/POL Para 41	The ERT recommends that Poland improve the reporting of details on the annual QA/QC	Comparison of statistical data on fuel consumption and data concerning fuel	3.2.6.4

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
		measures implemented in the sector and provide information in the next annual submission on the cross-checks made between the national statistics data, Eurostat data and the EU ETS data, as well as information on any validations of EFs by comparison with the EU ETS data.	use from EU ETS reports for particular sub-sector is difficult i.e. due to aggregation method. In statistical data fuels are split according to use of them for production of commercial and non-commercial heat while in the EU ETS installations provided data on total fuel use without any split. NCVs for particular fuels are also often different in statistical data and in EU ETS reports, what made more difficult the comparison analysis. Any doubts related to energy balances are explained with Agency responsible for collecting this data.	
1A	ARR/2012/POL Para 49	The ERT recommends that Poland consider the EU ETS data as a possible source for developing country-specific EFs or at least to report the use of the data for verification purposes.	Analyses of the possibility of country specific EF elaboration for the significant fuels in Polish fuel structure are planned.	3.2
1A	ARR/2012/POL Para 51	The ERT reiterates the recommendation of the previous review report that AD and emissions from industrial and municipal waste (non-biogenic) be reported under other fuels. It further reiterates the recommendation that Poland, in the next annual submission, ensure consistent reporting between iron and steel under the manufacturing industries and construction category in the energy sector and iron and steel production under the metal production category in the industrial processes sector across the entire time series.	Industrial and municipal waste (non-biogenic fraction) is reported, according to ERT recommendation, under other fuels. The change was made for entire period. Emission estimation for the years 2005-2011 were methodologically harmonised with the emission calculation for the years 1988-2004 both in 1.A.2.a subcategory, and in 2.C.1 subsector.	3.1 Annex 2 3.2.7.5, 4.4.2 4.4.5
	ARR/2012/POL Para 52	The ERT recommends that Poland include clarification about the calculation and reporting of recovered CH_4 processing under the energy and waste sections in the next NIR.	In *Energy* sector there are included wastes that are used as fuels. Biogas (i.a. from landfills), which is consumed for heat or energy production is included in energy statistic as well. Detailed information on consumption of these fuels is presented in Annex 2 of the NIR.	3.2 Annex 2
1A RA/SA	ARR/2012/POL Para 43	The ERT recommends that Poland gives explanations regarding the factors contributing to a difference greater than 2.0 per cent.	More detail explanations on differences is given.	3.2.1
1A RA/SA	ARR/2012/POL Para 44	The ERT encourages Poland, with a view to improving comparability and transparency of the reported information, to report all relevant data in CRF table 1.A(b) in the available mass/volume units and provide the energy conversion factors used.	All relevant data in CRF table 1.A(b) are given in mass unit (where it was possible).	CRF table 1.A(b)
1A RA/SA	ARR/2012/POL Para 36, 45	The ERT recommends that consistency between the IEA data used for 1988 and 1989 and the Eurostat data used for 1990–2010 is ensured in the next annual submission.	As the emissions for the base year 1988 were approved in 2007 for the AAU purposes this data was not updated since that time. For 1988-1989 only IEA data are available so still data sources will not be coherent. Agency responsible for elaborating energy balances for PL confirmed that data before 1990 will not be updated.	CRF table 1.A(b)

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
		For 2010 an omission for jet kerosene for international bunkers is noted for the reference approach. The ERT recommends that this error be corrected in the next annual submission.	IEA data for years 1988, 1989 has been updated. Jet kerosene for bunker has been amended.	
1A	ARR/2012/POL Para 46	The ERT encourages Poland to collect information on scheduled flights from the national aviation authorities and verify with the information from the European Organization for the Safety of Air Navigation or other relevant international organizations, in order to develop an accurate method to split domestic fuel use and international aviation bunker fuels.	Cooperation has been already initiated with ULC (The Civil Aviation Authority of the Republic of Poland) to collect relevant data to develop method to split domestic/international aviation. Analysis is under way. According to the initial estimations based on EUROCONTROL data on fuel use share of jet kerosene used for domestic aviation in Poland amounts to the value assumed by PL (5%).	3.2.8.2.1
1A, 2G	ARR/2012/POL Para 48, 76	Report emissions from lubricants and paraffin waxes consistently across energy and industrial processes sectors.	It has been corrected.	CRF table 1.A(d) and 2(I)
1A3b	ARR/2012/POL Para 53	Ensure that the entire time series for road transportation is calculated using fuel sold with consistent CO_2 EFs. Regarding the CO_2 EFs used for road transportation, previous review reports recommended that Poland clarify how the EF for gasoline is derived for each year of the time series (the methodology used to determine the carbon content) and report in the NIR of its next annual submission on the types of gasoline and the amounts sold. The previous review report further recommended that Poland revise the entire time series using consistent EFs for diesel oil or explain the differences in the value of the IEFs in the NIR of its next annual submission.	Poland uses AD based on fuel sold for whole time series. More detail explanations is given.	3.2.8.2
2.A.1	ARR/2012/POL Para 64	The ERT reiterates the recommendation of the previous review reports that Poland provide the EU ETS data, including country-specific methodologies, EFs and other background information used in the calculation of the emissions from cement production in the NIR in the next annual submission, together with information on the data verification activities applied for the category.	CO_2 emission value is directly taken from EU ETS reports for cement installations (all installation for clinker production are covered by EU ETS). Activity data are taken from statistical yearbook. EU ETS is still developed and additional, detailed information on clinker production are still collected. Analysis based on longer trend will be more comprehensive, such case studies are carried on.	4.2.2.1
2.A.2	ARR/2012/POL Para 65	The ERT notes that Poland used the method and default EFs provided in the IPCC good practice guidance. However, given that lime production is a key category for Poland, the ERT recommends that the Party use the country-specific quicklime (CaO) content of high-calcium lime, the dolomitic 'quick' lime (CaO.MgO) content of dolomitic lime and the proportion of lime types (CaO/CaO.MgO ratio) in its calculations. The ERT recommends that in the next annual submission Poland describe and clearly document the method and equations used.	The detailed data on lime production is still under analysis as far as new data will be collected in EUETS submissions and in national database on emissions.	
2.B.1	ARR/2012/POL	Given that ammonia production is a key	Analysis of the possibility of country	4.3.6

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
	Para 66	category for Poland, the ERT reiterates the recommendation of the previous review report that, in accordance with the IPCC good practice guidance, plant- or country-specific carbon content for the natural gas and coke oven gas used in ammonia production should be developed.	specific EF elaboration for the significant fuels in the Polish fuel structure is planned.	
2.B.1	ARR/2012/POL Para 67	The ERT reiterates the recommendation in the previous review reports that Poland explains the trend of ammonia production and variability of the EF in the next annual submission.	This fluctuation is the result of economy market situation as well as product demand	
2.B.1	ARR/2012/POL Para 68	Noting the confidentiality of the part of the information for the category, the ERT recommends that Poland improve transparency of the NIR by providing additional information on the methodology and equations used, the number of nitric acid plants and the types of N_2O abatement technology used, as well as an explanation for any unusual trend in the IEF and emissions.	Description was extended	4.3.2.2
2.C.1	ARR/2012/POL Para 69	The NIR is not clear on how the emissions from iron and steel production are estimated using the EU ETS data and how time-series consistency is maintained. The ERT reiterates the recommendations in the previous review reports that Poland include this information in its next annual submission.	Emissions for category 2.C.1 (iron ore sinter production, pig iron production and steel production) were recalculated and appropriate descriptions were modified.	4.4
2.C.1	ARR/2012/POL Para 70	Poland indicated that in 2010 fuel from sintering plants (specifically coke and anthracite) were not subtracted from iron and steel (energy) and that it will amend section 4.4.2.1 to include this information. The ERT strongly recommends that Poland address this issue as it would lead to overestimation of CO_2 emissions.	Process emission from iron ore sintering plants was recalculated.	4.4.2.1
2.C.1	ARR/2012/POL Para 71	Poland still lists the reallocation of CO_2 emissions from fuel used in sinter, steel and pig iron production from the energy to the industrial processes sector for the period 1988 to 2004 among its planned improvements. The ERT recommends that the Party resolve the time-series consistency issue in the next annual submission.	Emissions for category 2.C.1 (iron ore sinter production, pig iron production and steel production) were recalculated.	4.4
2.G	ARR/2012/POL Para 77	The previous review report recommended that the CO_2 process emission and flaring emission from refinery be reallocated under the category fugitive emissions from oil, natural gas and other sources under the energy sector. The ERT reiterates this recommendation.	CO_2 process emission and flaring emission from refineries were removed from 2.G. category into 1.B IPCC category.	3.3.2
2.G	ARR/2011/POL page 20	The ERT recommends that Poland reallocates the CO_2 emissions from processes in refinery plants reported under the category other to the category fugitive emissions from oil, natural gas and other sources under the energy sector in its reporting of CO_2 emissions in its next annual submission.	Relocation has been done and data are removed to 1.B.2.C.2.	3.9.
4	ARR/2012/POL Para 81	The ERT recommends that Poland include information about performed recalculations	Explanations on recalculations are given according to subcategories.	6.2.5, 6.3.5,

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
		within each subcategory of the NIR in the next annual submission.		6.4.5, 6.5.5
4	ARR/2012/POL Para 82	it was recommended that Poland improve the structure of the agriculture chapter in the NIR in line with the UNFCCC reporting guidelines, and report the uncertainty estimates, QA/QC activities and improvements planned by category in the NIR.	Structure of the NIR is made for all sectors in more detail breakdown, also for Agriculture.	6.2.4, 6.3.4, 6.4.4, 6.5.4
4	ARR/2012/POL Para 83	The ERT reiterates the recommendation made in previous review reports that Poland provide clear explanatory information on country-specific EFs, AD and methodologies used for the emissions estimation for the key categories in the next annual submission	More information of AD and methodologies is given in chapters ”Methodological issues”.	6.2.2, 6.3.2, 6.4.2, 6.5.2
4.A	ARR/2012/POL Para 86	Poland provided additional information describing inter-annual changes. The ERT recommends that Poland include an analysis of the inter-annual changes of population size in the next annual submission.	Information is included.	6.1, 6.2.2
4.A	ARR/2012/POL Para 87	For non-dairy cattle ... additional information on the types of cattle included under non-dairy cattle, including animal numbers as well as the CH_4 EFs by type would need to be included for replication of the estimates.	Information is included.	6.2.2
4.A	ARR/2011/POL Para 79	Poland used data from GUS and from the National Research Institute of Animal Production to harmonize the time series, but inconsistencies, especially for young cattle, still occurred even in this reference database, mostly between data for the years 1988-1997 and data for the years 1998-2008. In the previous review report, Poland was recommended to explain in further detail the inconsistencies in the time series caused by the incorporation of the AD from the National Research Institute of Animal Production in its next NIR. However, this issue was not addressed in the 2011 submission wherefore the ERT reiterates this recommendation.	To obtain consistent time series for non-dairy cattle population the amendment for 1988-1997 years has been made.	6.2.2
4.A	ARR/2011/POL Para 77	In its estimation of CH_4 emissions from enteric fermentation of goats, horses, swine and poultry, Poland reports average CH_4 conversion rates (Ym) as .NE. instead of .NA. Considering that the emissions are estimated using the IPCC default EFs, the ERT encourages Poland to correct the notation key in its next annual submission.	Notation keys are corrected.	CRF table 4.A
4.B	ARR/2012/POL para 90	The ERT reiterates the recommendations in previous review reports that Poland document the country-specific data used for estimating the emissions of significant animal categories and provide a more detailed description of its AWMS, and further recommends that the Party include information on the livestock population, nitrogen (N) excretion rates and AWMS for the entire time series in the next annual submission.	Extended information is given.	6.3.2

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
4.B	ARR/2012/POL para 91	The ERT noted some mistakes/inconsistencies in the reporting of N excretion per AWMS in CRF table 4.B(b) for sheep (for 2000 and 2004) and non-dairy cattle (for 2006 and 2007). In response to a question raised by the ERT during the review week, Poland provided corrected calculations with revised allocation of N excretion per AWMS. The ERT recommends that Poland include the corrections in the next annual submission in order to improve the accuracy of its reporting.	Data has been corrected.	CRF Table 4.B(b)
4.B	ARR/2012/POL para 92	The ERT noted that Poland has reported an incorrect AWMS allocation percentage in CRF table 4.B(a) for the entire time series. In response to a question raised by the ERT during the review week, Poland explained that the incorrect reporting is due to a technical problem with the CRF Reporter and the Party provided the ERT with the correct values of the AWMS allocation. The ERT encourages Poland to solve the problem and include the correct allocation percentages in the next annual submission.	There is a technical issue related to introducing data into CRF. Percentage numbers are put in, as the output big numbers appear. For instance liquid system for dairy cattle for 2011 amounts to 10,576...% but in CRF this number looks like: 10 576 724 447 928 500.	
4.D	ARR/2012/POL para 93	The ERT recommends that Poland include in the NIR of its next annual submission a justification of the use of FracGRAZ for the entire time series in order to ensure transparency.	Table with FracGRAZ trend is given (6.14) with additional information above table.	6.4.2.1
4.D.1.3	ARR/2012/POL Para 94	The ERT notes, as pointed out in the previous review report, that the description in the NIR of how these estimates have been calculated is not transparent and complete, because it does not include sufficient background data on the country-specific values for the AD (crops cultivated) and parameters (N content and fraction of crop biomass removed from the fields) used for the estimation of N_2O emissions from crop residues and N-fixing crops. The ERT recommends that Poland include this information in its next annual submission. The ERT also encourages Poland to disaggregate N-fixing crops to specific species (peas, beans, soybean) as the basis for its emission estimates and to include a description of the weighted mean values of FracNCRO and FracNCRBF in its next NIR.	Crop production is given in table 6.12. N content is given in table 6.20. FracR is presented for individual crops in table 6.15 and weighted mean for all crops for entire series in table 6.16. This subcategory has not been disaggregated into individual N-fixing crops as it was recommended by ERT due to lack of detail activity data in public statistics for pulses edible. For pulses for forage there are activity data published in division for: alfalfa, clover, serradilla. Nevertheless country specific indicators like: Residue/crop ratio, Dry matter fraction, FracNCRBF, FracNCRO are available only for entire groups "forage pulses" and "edible pulses". If new data or case studies will be available more detail calculations will be made. N_2O emissions from N-fixing crops (4.D.1.3) constitute about 1% of N_2O emissions from 4.D. Agricultural soils and are not qualified as the key source within finer granulation of the Polish GHG inventory.	6.4.2.3, 6.4.2.4

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
4.D	ARR/2012/POL Para 95	The ERT recommends that Poland include in the N_2O emission calculation the correct FracR for the entire time series and include appropriate documentation on the changes in the NIR of the next annual submission.	More data is presented in NIR 2013 (tables 6.17 and 6.18) for FracR for individual crops as well as weighted mean for entire series.	6.4.2.4 CRF table 4.Ds2
5	ARR/2012/POL Para 101	The ERT reiterates the recommendation that Poland provide more detailed information on carbon stock changes in land converted to forest land in its next annual submission.	More detailed information is given in the section 7.2.5.	7.2.5
5	ARR/2012/POL Para 102	The ERT reiterated the recommendation in the previous review reports that Poland continues its efforts to improve its land area identification system in order to provide consistent time series on land use and land-use change.	More detail information is given in the section 7.1.4.	7.1.4
5	ARR/2012/POL Para 103	The ERT strongly recommends that Poland address this issue by setting a single transition period and separate estimations for each land remaining in the category longer than the transition period and land converted to the category within the transition period.	Party set 20-years default transition period which has been applied to all land use categories.	7.2; 7.3; 7.4; 7.5; 7.6;
5	ARR/2012/POL Para108	The ERT commends this effort made by Poland to improve the transparency and accuracy of reporting of ne carbon stock change and reiterates the recommendation made in the previous review reports that the Party provide in its next annual submission the sources of AD and justification for the country-specific value for the carbon stock change in soils, as well as a rationale for the increase in the value.	Party applied default SOC_{ref} factors for estimation CSC in subcategories linked to forest land.	7.2; 7.6;
5	ARR/2012/POL Para 109	The ERT commends Poland for the improvement of DOM carbon stock changes and recommends that the Party improve the time-series consistency for the next annual submission.	More detailed information is given in the section 7.2.5.	7.2.
5	ARR/2011/POL Para 86	The ERT reiterates the recommendations in the previous review reports that Poland provides these explanations in its next annual submission in order to increase the transparency of its recalculations.	More detail information is given in the section 7.2.	7.2
5	ARR/2011/POL Para 87	The ERT reiterates the recommendation in the previous review report that Poland continues its efforts to improve its land area identification system in order to provide a consistent time series on land use and land-use change, including a consistent time series on land-use change.	More detail information is given in the section 7.2.	7.2
5	ARR/2011/POL Para 89	The ERT recommends that Poland include this information together with more detailed explanations of the calculation of the country specific soil organic carbon change rates in its next annual submission.	Party applied default SOC_{ref} factors for estimation CSC in subcategories linked to forest land.	7.2; 7.6;
6	ARR/2012/POL Para 114	The trends are not explained transparently in the NIR. The ERT reiterates the recommendation in the previous report that Poland provides this information in the NIR of its next annual submission.	The explanation of trends is given in NIR.	8.1
6.A	ARR/2012/POL	The ERT reiterates the recommendation	The information on QA/QC and	8.1

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
	Para 117	made in the previous review reports that Poland increase the transparency of the NIR by providing in the NIR of the next annual submission explanatory information to justify the choices of the national EFs and the methodologies used for the estimation of emissions within the sector, and include the information on QA/QC and verification, recalculations, planned improvements and uncertainties (currently not included in the waste chapter) at the category level in line with the UNFCCC reporting guidelines. The ERT also recommends that Poland provide a detailed description of waste flows, describe in its NIR the legislative and regulatory measures for waste management and clearly report the CH_4 recovered that is used for energy purposes.	verification, recalculations, planned improvements and uncertainties, as well as legislation and methane recovery are included in NIR.	8.2.2.1 8.2.3 8.2.4 8.2.5 8.2.6
6.A	ARR/2012/POL Para 120	The ERT noted that, although a good deal of information relating to the waste generated and its composition is provided in the NIR, it is not clear how this information is used in the estimation of CH4 emissions from SWDS. The ERT reiterates its recommendation from the previous review report that Poland provide a clear description of the steps taken in the inventory calculations in the NIR of the next annual submission.	The description of usage of composition of waste in the calculations is provided.	8.2.2.1 8.2.2.2
6.A	ARR/2012/POL Para 123	The ERT strongly recommends that the Party include the imported waste in the country's waste stream, explore the type of waste, waste composition and treatment methods and improve the transparency of its reporting when describing the allocation of emissions across different categories.	Party investigated the case – according to Chief Inspectorate of Environmental Protection imported waste is already included in Party's waste stream – imported is mostly hazardous waste (no municipal waste) for incineration – the amount of incinerated hazardous waste is included in 6.C subsector.	8.2.1
6.A	ARR/2012/POL Para 124	Poland does not estimate emissions from biodegradable waste coming from the manufacture of furniture, leather and related products. The ERT encourages the Party to further explore the composition of industrial waste, include all biodegradable waste, in the waste model and provide revised emission estimates from all biodegradable sources.	Manufacture of synthetic leather is already included in rubber section. Including of manufacture of furniture is currently impossible due to lack of information on content of wood, plastic, metal and other materials in furniture.	8.2.2.2
6.A	ARR/2012/POL Para 125	The ERT noted that in the report from the Central Statistical Office for 2010 it is indicated that waste is disposed of on plant-specific and other landfills such as dumps, slag heaps and tailing ponds. The IPCC good practice guidance provides an MCF for uncategorized SWDS and the Party is encouraged to estimate emissions from the entire amount of industrial waste and provide such information in its next annual submission. The Party is also encouraged to update the percentages of waste going to landfills rather than using the GUS 1981 allocation.	Party estimated emissions from the entire amount of industrial waste. No current data on the percentages of waste going to other landfills nor its composition are available so default parameters were used in the calculations.	8.2.2.2
6.A	ARR/2012/POL Para 127	The ERT recommends that the Party estimate emissions from sewage sludge going to	Explanation to following recommendation was given in the NIR.	8.2.2.1

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
		landfill for the entire time series and document the estimates in its next annual submission. The ERT suggests that where no AD are available (prior to 1995) Poland could use the suggested methods in the IPCC good practice guidance to estimate these AD (e.g. by extrapolating the values).		
6.B	ARR/2012/POL Para 128	The emissions from domestic and commercial wastewater dropped by 63.4 per cent in 2000. Poland explained that it has been using a new EF since 2000 only, based on newly available research. Details of the research or information on how time-series consistency has been assured have not been provided in the NIR. The ERT noted that, based on the information provided in the CRF tables, it appears that the decrease in emissions is due to changes in the volume of CH_4 recovered in wastewater handling facilities, not a change in the EF. The ERT reiterates its recommendation of the previous review report that Poland provide in the NIR more information on the study, including a more detailed explanation how time-series consistency has been ensured.	The new methodology (IPCC 2006 guidelines) is being implemented which improves emission estimation in this sector.	-
6.B	ARR/2012/POL Para 129	Poland explained that the CH_4 IEF for industrial wastewater varies because the wastewater production of the different industries varies annually. Poland also explained that the EFs as well as the data on CH_4 recovery from industrial wastewater handling are based on expert judgment. The ERT reiterates the recommendations in the previous review report and strongly recommends that Poland provide additional information on the methodologies and country-specific parameters as well as detailed information on the expert judgment used in the NIR of its next annual submission in order to improve the transparency of its reporting.	Improvement of this Chapter is still under elaboration.	-
6.C	ARR/2012/POL Para 131	The ERT encourages the Party to include information on the composition of incinerated waste and EFs in its next annual submission.	Composition of incinerated waste and EFs are provided in NIR.	8.4.2

10.4.2. KP-LULUCF inventory

Table 10.2. The list of recommendations resulting from previous ERTs and its implementation status

CRF sector	Paragraph in Review report	Recommendation	POL response	NIR chapter
KP	ARR/2012/POL Para 133	The ERT welcomed Poland's intention to improve its land identification system and reiterates the recommendation of the previous review team that Poland improve the information in the NIR on how available data are used to estimate land areas and area changes.	More detail information is given in the section 7.2. in the NIR.	7.2
KP	ARR/2012/POL Para 136	The ERT welcomes this improvement and reiterates the recommendation in the previous review report that Poland provides transparent information to justify the assumptions on the carbon stock changes in mineral soils and the emissions from organic soils.	More detail information is given in the section 7.2.4 in the NIR.	7.2.4
KP	ARR/2012/POL Para 142	The ERT strongly recommends that the Party include information to demonstrate that forest management activities under Article 3, paragraph 4, of the Kyoto Protocol are not accounted for under activities under Article 3, paragraph 3, in accordance with paragraph 9(c) of the annex to decision 15/CMP.1, in its next annual submission and improve the transparency and completeness of the reporting.	More detail information is given in the section 11.4.3 in the NIR.	11.4.3
KP	ARR/2011/POL Para 110	The ERT recommends that Poland improve the information in the NIR on how available data are used to estimate areas and area changes to comply with the requested information of decision 15/CMP.1, and that all units of land and areas of land are identifiable as requested by decision 15/CMP.1, annex, paragraph 6, and by decision 16/CMP.1, annex, paragraph 20.	More detail information is given in the section 11.4 in the NIR.	11.4

10.5. Changes in methodological description

The major changes in methodological descriptions that have been made since the last Polish submission in 2013 are presented below in aggregated form.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methodological descriptions compared to the previous year NIR	Please tick where this is also reflected in recalculations compared to the previous year CRF	If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc
Total (Net Emissions)			
1. Energy			
A. Fuel Combustion (Sectoral Approach)			
1. Energy Industries			
2. Manufacturing Industries and Construction	√	√	NIR 3.2.7.2.1 (changes in 1.A.2.a subcategory connected with changes in 2.C.1 subsector) (info on recalculation - chapter 3.2.7.5 of NIR)
3. Transport	√	√	NIR 3.2.8.5 (changes in 1A3b and 1A3d)
4. Other Sectors			
5. Other			
B. Fugitive Emissions from Fuels			
1. Solid Fuels			
2. Oil and Natural Gas			
2. Industrial Processes			
A. Mineral Products	√	√	NIR, chapter 4.2.2.3 (supplement of CO_2 emission in 2.A.3 category) and 4.2.2.4 (change of AD type for CO_2 emission estimation in 2.A.4 category)
B. Chemical Industry			
C. Metal Production	√	√	NIR, chapter 4.4.2.1 (iron ore sinter production), 4.4.2.4 (pig iron production), 4.4.2.5 (steel production in BOF) and 4.4.2.6 (steel production in EAF), harmonisation of methodology between the periods: 1988-2004 and 2005-2011
D. Other Production			
E. Production of Halocarbons and SF6			
F. Consumption of Halocarbons and SF6			
G. Other			
3. Solvent and Other Product Use			
4. Agriculture			
A. Enteric Fermentation	√	√	NIR, chapter 6.2.2 and 6.2.5, (cattle population correction), CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	DESCRIPTION OF METHODS	RECALCULATIONS	REFERENCE
	Please tick where the latest NIR includes major changes in methodological descriptions compared to the previous year NIR	**Please tick where this is also reflected in recalculations compared to the previous year CRF**	**If ticked please provide some more detailed information for example related to sub-category, gas, reference to pages in the NIR, etc**
B. Manure Management	√	√	NIR, chapter 6.3.2 and 6.3.5, (cattle population correction, AWMS update for animals), CH_4 and N_2O,
C. Rice Cultivation			
D. Agricultural Soils	√	√	NIR, chapter 6.4.2.6 and 6.4.5 (amendment of sewage sludge trend, correction of indirect emissions), N_2O
E. Prescribed Burning of Savannas			
F. Field Burning of Agricultural Residues			
G. Other			
5. Land Use, Land-Use Change and Forestry			
A. Forest Land	√	√	NIR, chapter 7.2, CO_2
B. Cropland			
C. Grassland			
D. Wetlands			
E. Settlements	√	√	NIR, chapter 7.6.4.2, CO_2
F. Other Land			
G. Other			
6. Waste			
A. Solid Waste Disposal on Land	√	√	NIR, chapter 8.2.2 and 8.2.5, (methane content in landfill gas, add composting and industrial waste from tailing ponds), CH_4
B. Waste-water Handling	√	√	NIR, chapter 8.3.2 and 8.3.5, (recovery of methane in wastewater treatment plants), CH_4
C. Waste Incineration			
D. Other			
7. Other (as specified in Summary 1.A)			

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

11. KP-LULUCF

11.1. General information

The information provided in this chapter follows the requirements set in ”Guidelines for the preparation of the information required under Article 7 of the Kyoto Protocol” (Annex to decision 15/CMP.1, FCCC/KP/CMP/2005/8/Add.2).

11.1.1. Definition of a forest and any other criteria for reporting under Articles 3.3 and 3.4 of the Kyoto Protocol

For the needs of reporting to Articles 3.3 and 3.4 of the Kyoto Protocol, Poland selected the following minimum values for the forest definition[2]:

- minimum forest land area: 0,1 hectare
- minimum width of forests land area[3]: 10 m
- minimum tree crown cover: 10% with trees having a potential to reach a minimum height of 2 meters at maturity in situ. Young stands and all plantations that have yet to reach a crown density of 10 percent of tree height of 2 meters are included under forest. Areas normally forming part of the forest area that are temporarily un-stocked as result of human intervention, such as harvesting or natural causes such as wind-throw, but which are expected to revert to forest are also included.

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

Consist with the regulations of art. 3 of the Act on Forests of September 28th, 1991 [Journal of Law of 1991 NO 101 item 444, as amended], a forest is a land

1) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
   - designated for forest production, or
   - constituting a Nature Reserve or integral part of a National Park, or
   - entered on the Register of Monuments;
2) associated with forest management, but occupied in the name thereof by buildings or building sites, melioration installations and systems, forest division lines, forest roads, land beneath power lines, forest nurseries and timber stores; or else put to use as forest car parks or tourist infrastructure.

[2] These values are not in contradiction to forest definition in the Polish law (Act *on forests of 28 Sep 1991* [Journal of Law of 1991 No 101 item 444, as amended]).
[3] Excluding small private properties, private land given to State Forest [Państwowe Gospodarstwo Leśne Lasy Państwowe] or land belonging to Agriculture Real Estate Agency [Agencja Nieruchomości Rolnych Skarbu Państwa].

11.1.2. Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

Poland selected the optional activity of Forest Management (FM) under Article 3.4 of the Kyoto Protocol to be included in the accounting for the first commitment period, but does not elect any other activities: Cropland Management, Grazing Land Management and Revegetation.

Poland intends to account for the entire commitment period for the activities under article 3.3 (Afforestation, Reforestation and Deforestation) and for Forest Management activity under Article 3.4.

11.1.3. Description of how the definitions of each activity under Article 3.3 and each elected activity under Article 3.4 have been implemented and applied consistently over time

The definitions given below refer to those caused by human activities that increase or reduce the areas of forest land.

a) Afforestation

Afforestation refers to the conversion of land not fulfilling the forest definition to forest land according to the following assumptions:

- area of the transformed land is at least equal to 0.1 ha,
- transformed land remained without cover of forest vegetation for at least 50 years, until 31.12.1989 year
- transformation is directly caused by intended human activity.

Land subject to the afforestation activity, was assigned to the area of forest land, established on the basis of legal land use conversion since 1990.

This approach was applied due to the fact that from the moment of conversion afforested land is at least subject of the protective measures listed respectively in the Act on forests of September 28th, 1991 (Journal of Laws of 1991 No. 101, item. 444, as amended) as well as in the Act on the protection of agricultural and forest land of February 3rd, 1995 (Journal of Laws of 1995 No. 16, item. 78, as amended) considered as direct human-induced activities, intended for the forest land including newly established.

b) Reforestation

Reforestation refers to the conversion of land not fulfilling the forest definition to forest land according to the following assumptions:

- area of the transformed land is at least equal to 0.1 ha,
- transformed land remained without cover of forest vegetation for less than 50 years, until 31.12.1989 year
- transformation is directly caused by intended human activity

c) Deforestation

Deforestation refers to the conversion of forest land to other categories of land use. Within the national statistical surveys that category of land use change is considered as the exclusion of forest land for non –forestry purposes. The assumptions used to determine the size of deforestation are as follows:

- transformed the area remains covered with forest vegetation on 01.01.1990,
- transformation is directly caused by intended human activity.

Deforestation is strictly limited by the national law. The main document in this regard is the Act on the protection of agricultural and forest land of February 3rd, 1995 (Journal of Laws of 1995 No. 16, item. 78, as amended). Any exclusion of forest land for non –forestry and non agricultural purposes requires:

1) for the agricultural land consisting valuation land classes I-III – the consent of the minister responsible for rural development;
2) for the forest land owned by the State – the consent of the minister responsible for the environment or the person having his authorization;
3) for the remaining forest land - the consent of the province marshal, issued considering the opinion expressed by the local Chamber of Agriculture.

d) <u>Forest Management</u>

Forest management has been defined in paragraph 1 (f) of the Annex to Decision 16/CMP.1 as a system of practices aimed as management of forests, including their ecological (including protection of biodiversity), economic and social functions conducted in a sustainable manner. Sustainable forest management as described in the *Act on Forest Forests of 28 Sep 1991*... sets out principles for the retention, protection and augmentation of forest resources, as well as for the management of forests and other elements of the environment in reference to the national economy.

Sustainable forest management practices, consistent to the provisions of this *Act on Forests*..., apply to all forests irrespectively of their form of ownership. Such activities carried out mainly by the State Forest National Forests Holding result in biomass increase leading to growth of carbon sequestration. Increasing forest area as well as activities aiming at saving forest resources in Poland support this process. The following main activities are performed within forest management by the General Direction of The State Forests:

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

All forest land in Poland is considered as managed and in addition all forest land is a subject to the Forest Management plans, as a part of sustainable forest management prepared by National State Forest Holding, as well as Simplified Forest Management plans (in cases when forests do not constitute Treasury property) are approved by the Ministry of Environment.

11.1.4. Description of precedence conditions and/or hierarchy among Article 3.4 activities, and how they have been consistently applied in determining how land was classified

Since only one activity of the listed Article 3.4 Activities was elected by Poland, no precedence conditions among Article 3.4 activities are applicable.

11.2. Land-related information

11.2.1. Spatial assessment unit used for determining the area of the units of land under Article 3.3

The spatial assessment unit for determining the area of land units under Article 3.3 is 0.1 ha, which is the same as the minimum area of forest.

According to the description given in chapter 4.2.2.2 of the GPG for LULUCF [IPCC 2003], land use areas associated with LULUCF activities in Poland are identified using Reporting Method 2. Geographical boundaries of individual activities under art 3.3 and 3.4 of the Kyoto Protocol are reflected in the country administrative divisions (provinces) and detailed information related to land use is identified on the basis of data on the status and changes in land and buildings register[4] presented at the provincial scale.

With regard to the regulations of art. 3 of the act on forests, forest land considered a subject to the forest management is the area:

3) of contiguous area greater than or equal to 0.10 ha, covered with forest vegetation (or plantation forest) – trees and shrubs and ground cover, or else in part deprived thereof, that is:
    a. designated for forest production, or
    b. constituting a Nature Reserve or integral part of a National Park, or
    c. entered on the Register of Monuments;
4) of contiguous area greater than or equal to 0.10 ha, associated with forest management.

Provisions of this act allow to standardize the definition of forest land as a part of land use scheme. Party has established a system of regulations allowing to indentify, collect, process, report and publish data of land use in the annual statistics. Annual summary reports on land use areas submitted by the Head Office of Geodesy and Cartography are prepared on the basis of regulations of *Act on geodesy and cartography* (Journal of Laws of 1989 No. 30, item. 163, as amended) constituting the basis for the statistical publications fulfilling requirements of National Land Identification System.

11.2.2. Methodology used to develop the land transition matrix

Annually updated data obtained from National Record of land and buildings directly refers to changes in land use caused by intended human intervention at the level of single cadastral unit.

Any changes in land use categories are recorded with the attribute of the area being a subject of any type of conversion and are constituting a basis for the of annual reports on land prepared by the Head Office of Geodesy and Cartography. Data on the condition and changes in the registered intended use of land were developed on the basis of annual reports on land are published as the official statistical information by the Central Statistical Office. Publications of the different categories of land use are subsequently used to determine the direction of changes in land use.

Considering the area of the country and its specific conditions, there is no applicable stratification that would justify reporting on smaller than a regional level smaller than proveniences. This is also supported by the attributes of the available activity data. However, the land-use representation and land-use change identification system developed for the KP and UNFCCC reporting purposes permit a

[4] Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551).

truly detailed spatial assessment and identification of AR and D activities at the level of the individual cadastral units.

Reporting requirements under the United Nations Framework Convention on Climate Change and the Kyoto Protocol requires to match national land-use categories (according to the Regulation of the Minister of Administration and Digitization of 29 November 2013 amending the regulation on the registration of land and buildings. (Journal of Laws 2013 pos. 1551) to the appropriate IPCC land use categories (Section 3.2.1. GPG for LULUCF).

According to the abovementioned requirements assumptions are as follows:

1) Afforestation / reforestation
   - 5 (KP-I) A.1.1. cropland converted to forest land *[arable land converted to forest land]*
   - 5 (KP-I) A.1.1. grassland converted to forest land *[permanent meadows and pasture converted to forest land]*
2) Deforestation
   - 5 (KP-I) A.2. forest land converted to settlements *[forest land designated for non-agricultural and non-forest purposes]*
3) Forest management
   - 5 (KP-I). B.1. forest land remaining forest land

To fulfil the reporting requirements to the United Nations Framework Convention on Climate Change as well as to the Kyoto Protocol, the following differences need to be considered:

- under the UNFCCC, an area of land covered by forest management activities [5(KP - I). B.1 (Art. 3.4 KP)], shall be assigned to the area of forest land reported in the reference year (1990), taking into account subsequent changes resulting from the exclusions of forest land for non-agricultural and non-forestry purposes (deforestation);
- under Kyoto Protocol, an area of land considered to the subject to the category 5.A.1 *forest land remaining forest land* [Sector CRF 5.A.1] shall be assigned to the area of forest land reported in the base year (according to the decision 9/CP.2), taking into account subsequent changes resulting from the exclusions of forest land for non-agricultural and non-forestry purpose as well as the results of transitional period implementations.

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

National Forest Inventory (in Polish: "Wielkoobszarowa inwentaryzacja stanu lasu") is carried out by the Forest Management and Geodesy Bureau, according to the assumptions contained in the *Instruction for the preparation of the large scale national forest inventory* (in Polish "Instrukcja wykonywania wielkoobszarowej inwentaryzacji stanu lasu") approved by the Minister of Environment. First cycle of inventory was based on the instruction approved by Minister of Environment on February 5th , 2005. Second cycle of inventory has been prepared on the basis of the instruction approved by Minister of Environment on 10 June 2010.

Described above instructions emphasizes the needs of carrying out the large-scale inventories of the forest according to the Art. 13a of the *Act on Forests of 28 Sep 1991 (O. J. of 2011, No 12, item* 59) requiring State Forests to prepare the periodic large-scale inventories of forests taking into account the needs for evaluation and periodical controlling of forests.

Measurements and observations are made on permanent sample plots ad are repeadted periodically. The basis to determine the surface network of sample plots is a system of permanent observation plots (ICP Forest) for damage assessment in forests, consistent with the European Union regulations (ie. the network 16x16 km).

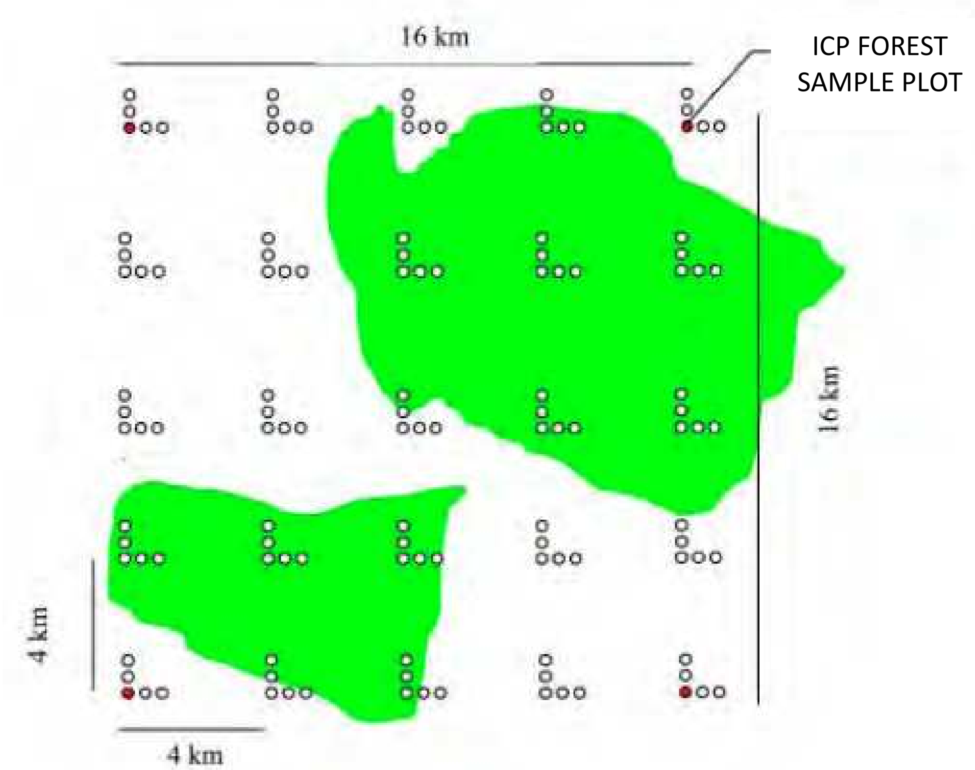

Figure 11.1. The general layout of sample plots.

The network of sample plots for large-scale inventory system was concentrated to 4x4 km, with the specification of the single plots coordinates in the system WGS 84 and PUWG 1992. The individual sample plot was assumed schematically in the system of routes deployed in the network 4x4 km, while within each line 200 meters long (shaped L with equal arms) five sample plots is located.

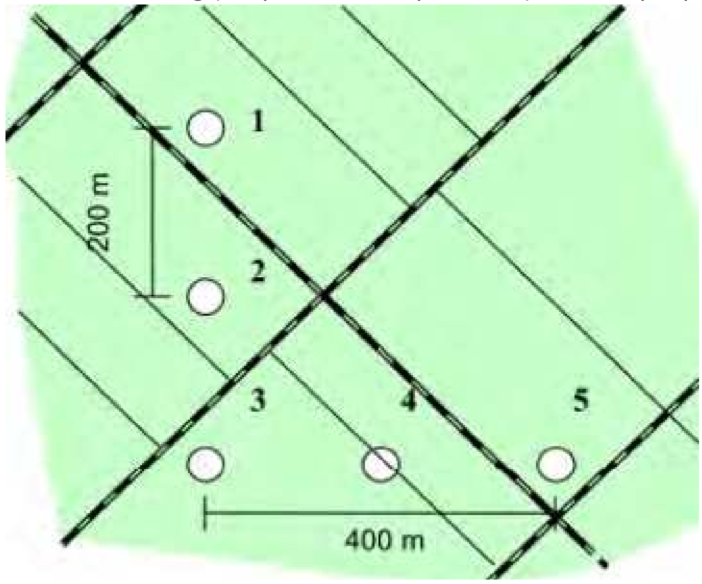

Figure 11.2. Routes system with the background of the sample plots distribution

Over 28 thous. of sample plots have been established in Polish forests during the current inventory process. Location of every single sample plots in the area was marked on the map considering the designation and identification of marker points (from the beginning determined by the location of individual sample plots). Since the long term stabilization was completed and single points were marked (by punching a metal tube about 1 inch in diameter and 30 cm into the ground and punching the nails in his neck the next three root trees), offsets to the centre of each sample plot were measured (using the azimuth and distance). Locations of sample plots were recorded mostly by GPS receivers, starting from the point of marker and navigation on the ground to the next trial area where it was possible to read the GPS coordinates with appropriate measurement parameters. This point was also marked as an intermediate point, stabilized in the same manner as marker point.

In following years the second cycle of large-scale forest inventory was implemented. Sample plots established in 2005 were again measured in accordance with the *Instruction for preparation*... (Ministry of Environment, 2010). New sample plots were established with the latest *Instruction for preparation*... (Ministry of Environment, 2010) on land where conversion from land not fulfilling the forest definition to forest land had occurred. Sample plots established on forest land excluded for non–forestry purposes were verified and removed from sample plots measurements. Verification was made possible by more detailed land use maps at the level of single cadastral units which were used for identification of sample plots.

11.3. Activity-specific information

11.3.1. Description of the methodologies and the underlying assumptions used

11.3.1.1. Description of the methodologies and the underlying assumptions used

Methods for estimating greenhouse gas emissions from forest land, land converted to forest land and forest land converted to settlements are based on available official statistics, published by the Central Statistical Office.

Data on the condition and changes in the registered intended use of land was developed on the basis of annual reports on land, introduced in the following Regulations: of the Minister of Agriculture and Municipal Management of 20 February 1969 on land register (MP No. 11, item 98), from 1997 – of the Minister of Spatial Economy and Construction and of the Minister of Agriculture and Food Economy 17 December 1996 on register of land and buildings (O. J. No. 158, item 813), and from 2002 of the Minister of Regional Development and Construction of 29 March 2001 on register of land and buildings (O. J. No. 38, item 454). The consecutive regulations, classifications of land were changed inter alia due to adoption of international standards. Beginning with data for 1997 on, the registers of land were prepared by the Chief Office of Geodesy and Cartography as well as by the voivodship branches of geodesy and land management. The data are presented, taking into consideration geodesic area.

The linkage between the *AR*, *D* and *FM* activities and the reporting based on land use categories under the Convention, generally always represent A/R as a land-use conversion from a land-use category other than forest land to the land use category of forest land. Similarly, *D* is an activity when forest land is converted to other types of land-use, as shown above. These links are retained consistently for the entire reporting period, similarly as for the adopted methodology. This ensures consistent and independent treatment of the activity data and methodologies across the Kyoto Protocol for the first commitment period, as well as for the reporting period under the Convention, i.e., since 1988.

Although the system of land-use representation and land-use identification is basically identical for both KP and Convention reporting, there are some notable differences that have implications for the reported areas of KP activities. These differences are imposed by the specific requirements for the reporting of LULUCF activities under the Kyoto protocol, namely:

i.AR activities that qualify under KP accounting are only those commenced since 1990.
ii.AR land must be traced under KP reporting, i.e., it never enters the land registered under FM activity.

Methodological principles used for estimations of carbon stock changes and greenhouse gas emissions/removals under Kyoto Protocol were the same as for estimations under UNFCCC reporting. Calculations were made in accordance with Good Practice Guidance for LULUCF (2003). More detailed description of calculations for conversion of other land uses to forest land and forest land to other land uses were made in accordance with the chapter 7.

11.3.1.2. Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

For the litter and dead wood pools on AR land, the option of paragraph 21 of decision 16/CPM.1. is selected, and it is demonstrated (see below) that these pools are not a source, thus, no accounting is made for these pools.

Carbon stock changes in dead wood on afforested and reforested areas is assumed to be equal to zero, therefore reported as 'NO'. The accumulation of dead wood was assumed to be marginal on afforested and reforested sites, during 1990-2012, and also dead wood pool can not decrease on those sites, because there is actually no dead wood there before the conversion. The dead wood starts to accumulate when natural mortality or thinnings occur that is nearly at the age of over 20 years. To keep correctness in CRF tables notation keys NO (not occurring) were used in the relevant table.

Carbon stock changes in litter on afforested and reforested areas is assumed to be equal to zero, therefore reported as 'NO'. The accumulation of litter was assumed to be marginal on afforested and reforested sites, during 1990-2012, When an area is afforested, first it is cleared of all above-ground biomass in case there was any, however, no DW and LI are usually present on these lands prior to afforestation. After afforestation, dead woody debris, litter as well as dead trees start to accumulate. In lack of representative measurements, the rate and timing of accumulation is not known, however, standard forestry experience suggests that they depend on species, site and silvicultural regime, and quickly accumulate over time. Fast growing species are usually planted so that no large amount of deadwood is produced, or thinned so that self-thinning does not ensue, but litter is continuously produced even in these stands. On the other hand, slow-growing species tend to produce dead wood and litter even at an early stage. Overall for all AR land, also considering that AR activity has been continuous since 1990 and stands on AR land are usually younger for deadwood and litter accumulation to saturate, it can safely be concluded that the carbon in the deadwood and litter pools in AR lands was increasing between 2008-2010, i.e. these pools are not a source. The above demonstration is based upon well-established principles of forest science, the every-day experiences of forestry practice, the experience and data of forest surveys, as well as sound reasoning. Because of this, although no representative measurements have been made as mentioned, the level of confidence of the demonstration is suggested to be very high. To keep correctness in CRF tables notation keys NO (not occurring) were used in the relevant table.

According to the article 30 of *Act on forests of 28th September, 1991 (Journal of Law of 1991 No 101 item 444, as amended)* the burning of surface soil layers or remnants of vegetation is forbidden. In relation to this record it is considered that controlled biomass burning does not occur on forests. To keep correctness in CRF tables notation keys NO (not occurring) were used in the table NIR 1 and connected tables for all indicated activities for wildfires on forest land.

The size of forest land with the relation to legitimacy of fertilization on forest land in a large scale causing that fertilization is limited only to the forest nurseries where use of fertilizers is a part of intensive production technology. In this situation, to prevent the possibility of double emission estimation in conjunction with the sector “Agriculture”, it is assumed that fertilization on forest land is not affected. To keep correctness in CRF tables notation keys NO (not occurring) were used in the table NIR 1 and connected tables for all indicated activities for fertilization on forest land.

11.3.1.3. Information on whether or not indirect and natural GHG emissions and removals have been factored out

The indirect and natural GHG emissions and removals were not factored out.

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

The methods used for emissions and removals estimations of greenhouse gases for the ARD AND FM activities are the same as presented in the description of the methodology contained in Chapter 7

Table 11.1 Recalculations

Activity	Year	2008	2009	2010	2011
	Difference				
AR	[Gg]	2 819	3 095	3 550	3 550,49
	[%]	-54%	-56%	-56%	-57%
D	[Gg]	92	107	93	117
	[%]	35%	40%	40%	49%
FM	[Gg]	-9 095	-6 951	-6 383	-15 484
	[%]	33%	24%	22%	61%

In category 5.A Forest Land carbon stock change in living biomass and dead organic matter are reported. A complete assessment of FF with respect to the area and carbon stock changes in 2012 was made presented in Chapter 7. Changes in carbon stocks in the biomass pools were estimated using the stock-change method. Due to the nature of the Polish forestry statistics, estimates of total aboveground volume of all forests in the country are available annually, thus, we can develop carbon stock change estimates for each inventory year.

The resulting carbon stock changes demonstrate that the biomass of the forests in Poland has been a sink for the last almost three decades. This is also consistent with the fact that the total current annual increment for the country has been estimated to be much higher than the annual harvests for all historical years. We also note that the net volume stock changes, and thus the net carbon stock changes display some variability. This is, however, a consequence of the relatively stable annual increment estimates and the rather variable harvest estimates, and can be considered to partly capture the entire variability. Other parts of the variability, which are related to the varying true increment of the stands, cannot be captured with our estimation system because it is continuous but not already available estimates.

11.3.1.5. Uncertainty estimates

Uncertainty analysis for the revised year 2012 for IPCC sector *5.Land-Use Change and Forestry* was estimated with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Simplified approach was based on the assumptions that every value is independent and probability distribution is symmetric. This year uncertainty assumptions were

applied directly to on activities and emission factors, instead of emission as in previous years. Results of the sectoral uncertainty analysis are given below. More details on uncertainty assessment of whole inventory are given in annex 8.
Recalculation of data for years 1988-2011 ensured consistency for whole time-series.

Table 11.2. The results of the analysis of uncertainty for sector 5 LULUCF under the Kyoto Protocol

2012	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	**-34672.39**	**108.21**	**1.76**	23.6%	79.0%	78.7%
A. Forest Land	-39573.27	1.49	1.06	20.6%	80.2%	80.2%

11.3.1.6. Information on other methodological issues

The method used to estimate emissions/removals from Afforestation, Deforestation and Forest Management activities are of the same as those used for the UNFCC reporting. It is important to highlight that, although we use the best methods and data that is currently available, and that often represent Tier 2 or 3, we are not able to accurately estimate carbon stock changes always using Tier 2 or 3. Therefore, a highly conservative approach is applied in all steps of the inventory whenever the application of higher Tiers is not possible. This approach is characterized by always selecting data and methods that overestimate emissions and underestimate removals.

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

Not applicable.

11.4. Article 3.3

11.4.1. Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

The annually updated cadastral information from the National Record of Lands and Buildings refers exclusively to intentional, i.e., human-induced interventions into land use. These interventions are thereby reflected in the corresponding records, including the time attribute, collected and summarized at the level of cadastral units. Summarised area of land use changes at the level of cadastral units are annually reported as a official statistical data by the Central Statistical Office

11.4.2. Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Since no remote sensing technology is directly involved in the KP LULUCF emission inventory, there is no issue related to distinguishing harvesting or forest disturbance from deforestation. Harvesting and forest disturbance always occur on Forest land, while deforestation is a cadastral change of land use from Forest Land to other categories of land use.

11.4.3. Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

The actions referred to the deforestation under Article 3.3 of the Kyoto Protocol and the provisions of Article 5 of the *Act on Agricultural and Forest Land Protection (Journal of Laws of 1995, No 16, item78 as amended*) require a formal decision to exclude individual forest plots as administrative units of forestry production. National legal considerations indicate deforestation as a process of administrative changes in land use category, while the temporary deprivation of the forest land of forest cover cannot be equated with deforestation process and should be treated as part of sustainable forest management.

Any deforestation in terms of land use change in the in-country land use scheme requires an official decision. Hence, no permanent loss of forest cover may occur prior this approval, which is reflected in cadastral land use. A temporary loss of forest cover up to an area of 2 [ha] ha may occur as part of forest management operations on Forest land (units of land subject to *FM*), which is not qualified as deforestation in terms of Art. 3.3. KP LULUCF activity. Nevertheless, forest owners (art. 13.1 of the the *Act on forests* of September 28th, 1991 *(Journal of Laws of 1991 No. 101, item. 444, as amended)* shall be obliged to ensure the permanent maintenance of forest cover, as well as continuity of utilization, and in particular:

1) to preserve forest vegetation (plantations) in forests, as well as natural marshlands and peatlands;
2) to reintroduce forest vegetation (plantations) in forest areas within five years of a stand being cleared;
3) to tend and protect forest, including against fire;
4) to convert and rebuild stands, where these are not in a condition to ensure achievement of the objectives of forest management set out in the Forest Management Plan, Simplified Forest Management Plan or Decision;
5) to make rational use of forests in a manner permanently ensuring optimal discharge of all the functions thereof, by means of:
   a) the harvesting of wood within limits not exceeding a forest's productive capabilities,
   b) the harvesting of raw materials and by-products of forest use, in a manner providing for biological renewal, and also ensuring protection of forest-floor vegetation.

Size of final felling as a area of the feelings at the country level that have lost forest cover but which is not yet classified as deforested is presented in the table below.

Table 11.3. Size of final felling.

Year	Land area [thos. ha]
2008	44.5
2009	49.3
2010	47.6
2011	48.7
2012	50,3

11.5. Article 3.4.

11.5.1. Information that demonstrates that activities under Article 3.4 have occurred since 1 January 1990 and are human-induced

Poland adopted the broad definition (FCCC/CP/2001/13/Add.1;IPCC 2003) of FM. It reads "Forest management" is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in sustainable manner". This decision implies that entire forest area in the country is subject to FM interventions, as guided by the the *Act on forests* of September 28th, 1991 (Journal of Laws of 1991 No. 101, item. 444, as amended)

11.5.2. Information relating to Forest Management.

All operations related to Forest management are conducted under strict provisions contained in the framework of the *Act on forests* of September 28th, 1991 *(Journal of Laws of 1991 No. 101, item. 444, as amended)*

11.5.2.1 That the definition of forest for this category conforms with the definition in item 11.1 above

FM land only includes managed forest areas that are included in the FL category, for which the definition of "forest" is applied as required by the the *Act on forests* of September 28th, 1991 *(Journal of Laws of 1991 No. 101, item. 444, as amended)*, as it is demonstrated above in section 11.1.

11.5.2.2 That forest management is a system of practices for stewardship and use of forest land aimed at fulfil relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner (paragraph 1(f) of the annex to decision 16/CMP.1 (land use, land-use change and forestry).

All the principles defined in paragraph 1(f) of the annex to decision 16/CMP.1 (land use, land-use change and forestry) are among the principles of forestry of Poland as set by the *Act on forests* of September 28th, 1991 *(Journal of Laws of 1991 No. 101, item. 444, as amended)*

11.5.2.3 Emissions and removals from Forest Management

The methodology is described in the chapter 7. General methodological notes, and the estimated emissions and removals are reported in the CRF tables.

11.5.3. Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year

Not applicable for Poland (notation key NA in Table NIR 1)

11.6. Other information

11.6.1. Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Possibly any deviation from the sector list for key category analysis suggested by GPG (IPCC, 2000) and GPG for LULUCF (IPCC, 2003) should be explained. Obviously, the Tier2 key category analysis can be performed only on the sector list of uncertainty analysis.

The following key categories have been identified and reported in Table NIR 3 according to Chapter 5.4 of the IPCC GPG for LULUCF:

- CO_2 removals from Forest Management

Afforestation/reforestation and deforestation activities were not considered as a key category as the total emissions from this activities are smaller than the smallest category considered key in the key category analysis under the Convention.

11.7. Information relating to Article 6

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

12. Information on accounting of Kyoto units

12.1. Background information

In order to meet Annex I Parties obligations of reporting on holdings and transactions with Kyoto Protocol Units within the Polish registry, the following chapters present relevant data on the topic.

All the information submitted in the annual report, including those relating to the transaction, CDM notifications and accounting of Kyoto units are based on data derived from the consolidated Union Registry.

12.2. Summary of information reported in the SEF tables

In accordance with paragraph 11 of the annex I.E to Decision 15/ CMP.1 SEF report on Kyoto units accounted on and transferred to and from accounts in Polish registry in year 2013 was generated via Union Registry application; it has been attached in Annex9 of this submission.

12.3. Discrepancies and notifications

In accordance with respective paragraphs of the annex I.E to Decision 15/CMP.1 additional information was provided:

a) *paragraph 12: List of discrepant transactions*
   No discrepant transactions occurred in 2013.
b) *paragraph 13 & 14: List of CDM notifications*
   No CDM notifications occurred in 2013.
c) *paragraph 15: List of non-replacements*
   No non-replacements occurred in 2013.
d) *paragraph 16: List of invalid units*
   No invalid units exist as at 31 December 2013.
e) *paragraph 17: Actions and changes to address discrepancies*
   No actions were taken or changes made to address discrepancies for the period under review.

12.4. Publicly accessible information

In accordance with section E in Part II of Annex to Decision 13 / CMP.1 the following information have been made available to the public by the National Centre for Emissions Management acting as the administrator of Polish part of the Union Registry at the indicated link http://www.kobize.pl/raporty-publiczne_EN.html :

a) *paragraph 45: Account information*
   In this report following information were provided:
   - *paragraph 45 (a): Account name: the holder of the account*
   - *paragraph 45 (b): Account type: the type of account (holding, cancellation or retirement)*
   - *paragraph 45(c): Commitment period: the commitment period with which a cancellation or retirement account is associated*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART45.pdf)

In line with the data protection requirements of Regulation (EC) No 45/2001 and Directive 95/46/EC and in accordance with Article 110 and Annex VIII of Commission Regulation (EU) No 389/2013, the information on account identifier and account representatives held in the EUTL, the Union Registry and any other KP registry (required by paragraph 45) is considered confidential.

b) *paragraph 46: Article 6 project information*
   - *paragraph 46 (a): Project name*
   - *paragraph 46 (b): Project location - the Party and town or region in which the project is located*
   - *paragraph 46 (c): Years of ERUs issuance as a result of the Article 6 project*
   - *paragraph 46 (d): Reports - downloadable electronic version of all publicly available documentation relating to the project*

These information is available in the report - *Joint Implementation (JI) project information* (reference: https://dokumenty.kobize.pl/projekty_ji/index.htm)

c) *paragraph 47: Holding and transaction information*
   - *paragraph 47 (a): The total quantity of ERUs, CERs, AAUs and RMUs at the beginning of the year*

   (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_a.pdf)

   Information on the total quantity of ERUs, CERs, AAUs and RMUs held in each account is considered to be confidential (in accordance with article 110 (1) of Commission Regulation (EU) No 389/2013 of 2 May 2013). Therefore, the report details were limited to information related to subtotals per account type only.

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

   (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_b_h_k.pdf)

   - *paragraph 47 (c): The total quantity of ERUs issued on the basis of Article 6 projects*

   (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

   - *paragraph 47 (d): The total quantity of ERUs, CERs, AAUs and RMUs acquired from other registries and the identity of the transferring registries*

   (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_d_f.pdf)

   Information on details of transactions carried out is considered to be confidential (in accordance with article 110 (1) of Commission Regulation (EU) No 389/2013 of 2 May 2013). Therefore, the transaction details were limited to transferring and/or acquiring registry ID only.

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

   (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

   - *paragraph 47 (f): The total quantity of ERUs, CERs, AAUs and RMUs transferred to other registries and the identity of the acquiring registries*

   (reference: https://dokumenty.kobize.pl/raporty/Public_ART47_d_f.pdf)

   Information on details of transactions carried out is considered to be confidential (in accordance with article 110 (1) of Commission Regulation (EU) No 389/2013 of 2 May 2013).

Therefore, the transaction details were limited to transferring and/ or acquiring registry ID only.

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

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

- *paragraph 47 (h): The total quantity of ERUs, CERs, AAUs and RMUs cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_b_h_k.pdf)

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

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

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

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_c_e_g_i_j.pdf)

- *paragraph 47 (k): The total quantity of ERUs, CERs and AAUs carried over from the previous commitment period*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_ART47_b_h_k.pdf)

- *paragraph 47 (l): Current holdings of ERUs, CERs, AAUs and RMUs in each account*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART47_l.pdf)

Information on the total quantity of ERUs, CERs, AAUs and RMUs held in each account is considered to be confidential (in accordance with article 110 (1) of Commission Regulation (EU) No 389/2013 of 2 May 2013). Therefore, the report details were limited to information related to subtotals per account type only.

d) *paragraph 48: Authorized Legal Entities Information*

(reference: https://dokumenty.kobize.pl/raporty/Public_ART48.pdf)

In line with the data protection requirements of Regulation (EC) No 45/2001 and Directive 95/46/EC and in accordance with Article 110 and Annex III of the Commission Regulation (EU) no 389/2013, the legal entity contact information (required by paragraph 48) is considered confidential.

12.5. Calculation of the commitment period reserve (CPR)

The value of commitment period reserve presented in the registry - 2 012 046 833 tons of eq. CO_2 – was calculated as 100 per cent of five times the most recently reviewed inventory, which amounts to 402 409 367 tones of eq. CO_2 emissions in 2010, and was approved during the review in 2012. The CPR value was introduced into the system on 18th of March 2013, after publication of the 2012 inventory results on UNFCCC pages (FCCC/ARR/2012/POL. 18 March 2013. UNFCCC).

5*402 409 367 tones of eq. CO_2 = 2 012 046 833 tons of eq. CO_2

13. INFORMATION ON CHANGES IN NATIONAL SYSTEM

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

14. Information on changes in national registry

The following changes to the national registry of Poland have occurred in 2013.

a) 15/CMP.1 annex II, paragraph 32.(a): Change of name or contact

No change in the name or contact information of the registry administrator occurred during the reported period.

b) *15/CMP.1 annex II, paragraph 32.(b): Change of cooperation arrangement*

No change of cooperation arrangement occurred during the reported period.

c) 15/CMP.1 annex II, paragraph 32.(c): Change to the database or the capacity of national registry

An updated diagram of the database structure is attached in Annex 9.
Iteration 5 of the national registry released in January 2013 and Iteration 6 of the national registry released in June 2013 introduces changes in the structure of the database.
Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality.
No change was required to the database and application backup plan or to the disaster recovery plan.
No change to the capacity of the national registry occurred during the reported period.

d) 15/CMP.1 annex II, paragraph 32.(d): Change of conformance to technical standards

Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality.
However, each release of the registry is subject to both regression testing and tests related to new functionality. These tests also included thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production environment (see Tests results report – releases 5.2-6.1.7.1 in Annex 9).
No other change in the registry's conformance to the technical standards occurred for the reported period.

e) 15/CMP.1 annex II, paragraph 32.(e): Change of discrepancies procedures

No change of discrepancies procedures occurred during the reported period.

f) 15/CMP.1 annex II, paragraph 32.(f): Change of Security

No change of security measures occurred during the reporting period.

g) 15/CMP.1 annex II, paragraph 32.(g): Change of list of publicly available information

No change to the list of publicly available information occurred during the reporting period.

h) 15/CMP.1 annex II, paragraph 32.(h): Change of Internet address

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

i) 15/CMP.1 annex II, paragraph 32.(i): Change of data integrity measure

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

j) 15/CMP.1 annex II, paragraph 32.(j): Change of test results

Changes introduced in release 5 and 6 of the national registry were limited and only affected EU ETS functionality.

Both regression testing and tests on the new functionality were successfully carried out prior to release of the version to Production environment. The site acceptance test was carried out by quality assurance consultants on behalf of and assisted by the European Commission; the report is attached in Annex 9 (see Tests results report – releases 5.2-6.1.7.1).

Recommendations of the SIAR assessment report Part 1 and Part 2

Following responses to recommendations made by the assessor of the Standard Independent Assessment Report for year 2012 were submitted by the Party on the consultation form.

Reference	Recommendation description	Response
P2.3.3	The assessor recommends that following major changes in the national registry, the party provides a data model which contains all DES required entities complete with descriptions in its annual NIR.	During year 2012 changes to the database and to the capacity of the national registry have occurred. In 2012, the registry has undergone a major redevelopment with a view to comply with the new requirements of Commission Regulation 920/2010 and Commission Regulation 1193/2011 in addition to implementing the Consolidated System of EU registries (CSEUR). The complete description of the consolidated registry was provided in the common readiness documentation and specific readiness documentation for the national registry of EU and all consolidating national registries. Since the successful certification of the registry on 1 June 2012, Iteration 4 of the registry, introduced in October 2012, added a limited number of new entities, none of them relating to DES entities. Additionally a data model (which was attached to PL consultation form of July 2013) shows more clearly the relevant entities "RECONCILIATIONS", "NOTIFICATIONS", "RESPONSES"," INTERNAL AUDIT LOG" and "MESSAGE LOG." As specified in the DES (Section VII. Data Logging Specifications/E. Message Archive), a copy of messages sent and received is stored in standalone files in one of two managed servers in the hosting environment. For that reason, the Message Archive is not shown in the database model. The "MESSAGE LOG" object holds the location of the entire message, for each Message_ID. Since the successful certification of the registry on 1 June 2012, there has been no change in the capacity of the registry or change of its infrastructure.
P2.3.10	The assessor strongly recommends that the Party test	The consolidated EU system of registries successfully completed a full certification procedure in June 2012.

Reference	Recommendation description	Response
	each release thoroughly against the DES as part of each major release cycle and provide the results of such tests in its annual NIR.	Notably, this procedure includes connectivity testing, connectivity reliability testing, distinctness testing and interoperability testing to demonstrate capacity and conformance to the Data Exchange Standard (DES). This included a full Annex H test. Please refer to "Tests results report – release v.4.0" in Annex 9. The October 2012 release (version 4.0) was only a minor iteration and changes were limited to EU ETS functionality (auctioning of phase 3 and aviation allowances, a new EU ETS account type - trading account and a trusted account list) and had no impact on Kyoto Protocol functions in the registry. The test script previously provided reflects this. However, each major release of the registry is subject to both regression testing and tests related to new functionality. These tests include thorough testing against the DES and were successfully carried out prior to the relevant major release of the version to Production. (Please refer to "Tests results report – release v.4.0" in Annex 9).
P1.4.1, P1.4.2, P1.4.4	The assessor identified some minor limitations regarding the publicly available information. The assessor was unable to determine whether the published information is up-to-date. The assessor recommends to add the date when the data snapshot was taken in the reports.	Poland is going to comply with assessor's recommendation and include in the future the information on the date when the data snapshot was taken in all publicly available information listed in chapter 12, paragraph 4 of the NIR.

15. Changes in information on minimization of adverse impacts in accordance with Article 3.14

According to chapter I.H of the annex to the decision 15/CMP.1 and recommendation of ERT from 2011 below Poland provides new information (since the last NIR 2012) on how it is implementing its commitment under Article 3.14 of the Kyoto Protocol related to striving to implement its commitment under Article 3.1 of the Kyoto Protocol in such a way as to minimize potential adverse social, environmental and economic impacts on developing countries.

In the frames of project *GreenEvo - Green Technology Accelerator,* run by the Ministry of Environment, aiming at increasing the efficiency of technology transfer from Poland through good identification of the developing countries' needs in this regard, the fifth application stage is under way. On the other hand in frames of programme called GEKON (Ecological Concepts Generator) aimed at developing financial support for scientific and industrial consortia related to the search and implementation of environmentally friendly technologies, the second stage of competition is under development. The areas where financial support is available cover: environmental aspects of attaining the unconventional gas, energy efficiency and energy storage, water protection and its rational use, clean sources of energy, inventive methods of getting fuel, energy and materials from waste as well as waste recycling.

In 2013 the Polish climate development support amounted to 4.9 million EUR. The activities in frames of bilateral co-operation were realised covering 1.339 million EUR. About 67% of the climate support was assigned to adaptation projects, the remaining part supported activities aimed at climate change mitigation and capacity building. These projects were realised among others in: Afghanistan Armenia, Azerbaijan, Burkina Faso, Ethiopia, Georgia, Kirgizstan, Moldova, Nigeria, Sudan, Tanzania and Palestine.

In frames of bilateral development assistance in 2013, including small grants system, activities were performed covering 2.803 million EUR. In Moldova projects supported by the Ministry of Foreign Affairs are going to serve the local communities contending with lack of fresh water. Model solutions will be implemented in relation to sewage treatment in rural areas. In total 6 projects will be performed with cost of 832 thousand EUR. On the areas of Palestine, Armenia, Tajikistan, Kirgizstan and Uzbekistan, construction of irrigation and sewage treatment systems, as well as mitigation of fresh water contamination have been supported. In Georgia and Azerbaijan the projects amounted for 225 thousand EUR covered soil protection, waste reduction and mitigation of natural disasters impact. In Ethiopia the projects have been introduced, amounted for 22.3 thousand EUR, aiming at green areas protection, education on environmental protection and limitation of deforestation. In the North Korea the plans for construction of sea walls against oil improving the state of marine environment in Chogjin have been financed with amount of 13.8 thousand EUR.

In frames of multilateral co-operation, in 2013, the Ministry of Environment has planned to support financially international organisations acting in climate change combat with 1.537 million EUR.

Republic of Poland, acting the Presidency of 19th Conference of the Parties of the UNFCCC, supported with 3.34 million EUR the participation of delegates from non−Annex I Parties attending the sessions as well as the additional contributions to the UNFCCC Secretariat.

ABBREVIATIONS

AWMS	Animal waste management system
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
CRF	Common reporting format
DOC	Degradable organic component
ERT	Expert Review Team
GHG	Greenhouse Gases
IE	Included elsewhere
KOBiZE	National Centre for Emissions Management
LULUCF	Land use, land-use change and forestry
MCF	Methane correction factor (Waste)
MCF	Methane Conversion Factor (Agriculture)
MSW	Municipal solid waste
NA	Not applicable
NE	Not estimated
NO	Not occurring
NMVOC	Non-methane volatile organic compounds
SWDS	Solid waste disposal site

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Annex 1. Key categories in 2012

The source categories in all sectors, are identified to be *key sources* on the basis of their contribution to the total level and/or trend assessment. The methodology of reporting key categories is based on IPCC Good Practice Guidance (IPCC 2000), Tier 1. Poland's key category analysis guides the inventory preparation and is used to set priorities for the development of more advanced methodologies.

From source categories which have been identify as key sources in level assessment, the most important are:
- Stationary Combustion - Solid Fuels,
- Transport Road Transportation,
- Stationary Combustion - Gaseous Fuels.

Emission from these sources made up 69.4% 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 62.3% of the total GHG emissions. Combustion of solid fuels in stationary sources alone, made up 51.7% of the total GHG emissions.

The most important source categories in trend assessment are:
- Stationary Combustion - Solid Fuels,
- Transport Road Transportation,
- Stationary Combustion - Gaseous Fuels.

Share of these sources in national total made up 60.2%.

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

Level Assessment without category 5 in year 2012

		IPCC Source Categories	Direct GHG	Emission in 2012	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary Combustion - Solid Fuels	CO2	206 453.26	0.5171	0.52
2	1.A.3.b	Transport Road Transportation	CO2	45 123.35	0.1130	0.63
3	1.A.1, 2, 4	Stationary Combustion - Gaseous Fuels	CO2	25 494.16	0.0639	0.69
4	1.A.1, 2, 4	Stationary Combustion - Liquid Fuels	CO2	16 967.35	0.0425	0.74
5	4.D.1	Direct Soil Emissions	N2O	12 420.94	0.0311	0.77
6	4.A	Enteric Fermentation	CH4	8 977.07	0.0225	0.79
7	6.A	Solid Waste Disposal on Land	CH4	8 560.37	0.0214	0.81
8	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	7 437.48	0.0186	0.83
9	4.D.3	Indirect Soil Emissions	N2O	7 423.17	0.0186	0.85
10	1.B.1.a	Coal Mining and Handling	CH4	7 369.40	0.0185	0.87
11	2.A.1	Cement Production	CO2	6 384.30	0.0160	0.88
12	6.B	Wastewater Handling	CH4	5 275.12	0.0132	0.90
13	4.B	Manure Management	N2O	4 869.94	0.0122	0.91
14	1.B.2.b	Natural Gas	CH4	4 690.83	0.0117	0.92
15	2.B.1	Ammonia Production	CO2	4 316.39	0.0108	0.93
16	1.A.1, 2, 4	Stationary Combustion - Other Fuels	CO2	3 340.81	0.0084	0.94
17	4.B	Manure Management	CH4	2 465.98	0.0062	0.95
18	1.A.1, 2, 4	Stationary Combustion - Solid Fuels	CH4	1 955.04	0.0049	0.95

Level Assessment without category 5 in year 1988

		IPCC Source Categories	Direct GHG	Emission in 1988	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	375 009.14	0.6580	0.66
2	1.A.3.b	Transport Road Transportation	CO2	20 771.21	0.0364	0.69
3	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 738.97	0.0311	0.73
4	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	0.0289	0.75
5	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	0.0288	0.78
6	4.A	Enteric Fermentation	CH4	16 242.48	0.0285	0.81
7	4.D.1	Direct Soil Emissions	N2O	16 064.04	0.0282	0.84
8	4.D.3	Indirect Soil Emissions	N2O	10 461.73	0.0184	0.86
9	6.A	Solid Waste Disposal on Land	CH4	9 000.86	0.0158	0.87
10	4.B	Manure Management	N2O	8 047.57	0.0141	0.89
11	2.C.1	Iron and Steel Production	CO2	7 334.19	0.0129	0.90
12	2.A.1	Cement Production	CO2	7 081.72	0.0124	0.91
13	2.B.2	Nitric Acid Production	N2O	4 386.47	0.0077	0.92
14	2.B.1	Ammonia Production	CO2	4 357.99	0.0076	0.93
15	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 259.58	0.0075	0.94
16	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 207.68	0.0074	0.94
17	4.B	Manure Management	CH4	3 435.68	0.0060	0.95

Level Assessment with category 5 in year 2012

		IPCC Source Categories	Direct GHG	Emission in 2012	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	206 453.26	0.4621	0.46
2	1.A.3.b	Transport Road Transportation	CO2	45 123.35	0.1010	0.56
3	5.A.1	Forest Land remaining Forest Land	CO2	-36 889.02	0.0826	0.65
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	25 494.16	0.0571	0.70
5	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	16 967.35	0.0380	0.74
6	4.D.1	Direct Soil Emissions	N2O	12 420.94	0.0278	0.77
7	4.A	Enteric Fermentation	CH4	8 977.07	0.0201	0.79
8	6.A	Solid Waste Disposal on Land	CH4	8 560.37	0.0192	0.81
9	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	7 437.48	0.0166	0.82
10	4.D.3	Indirect Soil Emissions	N2O	7 423.17	0.0166	0.84
11	1.B.1.a	Coal Mining and Handling	CH4	7 369.40	0.0165	0.86
12	2.A.1	Cement Production	CO2	6 384.30	0.0143	0.87
13	6.B	Wastewater Handling	CH4	5 275.12	0.0118	0.88
14	4.B	Manure Management	N2O	4 869.94	0.0109	0.89
15	1.B.2.b	Natural Gas	CH4	4 690.83	0.0105	0.91
16	2.B.1	Ammonia Production	CO2	4 316.39	0.0097	0.91
17	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	3 340.81	0.0075	0.92
18	5.D.1	Wetlands remaining Wetlands	CO2	2 909.33	0.0065	0.93
19	5.A.2	Land converted to Forest Land	CO2	-2 684.25	0.0060	0.93
20	4.B	Manure Management	CH4	2 465.98	0.0055	0.94
21	5.D.2	Land converted to Wetlands	CH4	2 239.73	0.0050	0.95
22	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	1 955.04	0.0044	0.95
23	1.B.1.b	Solid Fuel Transformation	CO2	1 868.03	0.0042	0.95

Level Assessment with category 5 in year 1988

		IPCC Source Categories	Direct GHG	Emission in 1988	Level Assessment	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	375 009.14	0.6212	0.62
2	5.A.1	Forest Land remaining Forest Land	CO2	-23 281.89	0.0386	0.66
3	1.A.3.b	Transport Road Transportation	CO2	20 771.21	0.0344	0.69
4	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 738.97	0.0294	0.72
5	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	0.0272	0.75
6	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	0.0272	0.78
7	4.A	Enteric Fermentation	CH4	16 242.48	0.0269	0.80
8	4.D.1	Direct Soil Emissions	N2O	16 064.04	0.0266	0.83
9	4.D.3	Indirect Soil Emissions	N2O	10 461.73	0.0173	0.85
10	6.A	Solid Waste Disposal on Land	CH4	9 000.86	0.0149	0.86
11	4.B	Manure Management	N2O	8 047.57	0.0133	0.88
12	2.C.1	Iron and Steel Production	CO2	7 334.19	0.0121	0.89
13	2.A.1	Cement Production	CO2	7 081.72	0.0117	0.90
14	2.B.2	Nitric Acid Production	N2O	4 386.47	0.0073	0.91
15	2.B.1	Ammonia Production	CO2	4 357.99	0.0072	0.92
16	1.A.1, 2, 4	Stationary combustion Other Fuels	CO2	4 259.58	0.0071	0.92
17	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 207.68	0.0070	0.93
18	5.B.1	Cropland remaining Cropland	CO2	3 725.56	0.0062	0.94
19	4.B	Manure Management	CH4	3 435.68	0.0057	0.94
20	2.A.2	Lime Production	CO2	3 395.60	0.0056	0.95
21	1.B.2.b	Natural Gas	CH4	3 357.52	0.0056	0.95

Trend Assessment without category 5 in 2012

		IPCC Source Categories	Direct GHG	Base Year Estimate	Emission in 2012	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary Combustion - Solid Fuels	CO2	375 009.14	206 453.26	0.5171	0.1618	28.12887	0.28
2	1.A.3.b	Transport Road Transportation	CO2	20 771.21	45 123.35	0.1130	0.1179	20.50032	0.49
3	1.A.1, 2, 4	Stationary Combustion - Gaseous Fuels	CO2	16 408.68	25 494.16	0.0639	0.0549	9.54734	0.58
4	6.A	Solid Waste Disposal on Land	CH4	538.34	8 560.37	0.0214	0.0309	5.37071	0.64
5	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	0.00	7 437.48	0.0186	0.0280	4.86991	0.68
6	6.B	Wastewater Handling	CH4	0.00	5 275.12	0.0132	0.0199	3.45404	0.72
7	1.A.1, 2, 4	Stationary Combustion - Liquid Fuels	CO2	17 738.97	16 967.35	0.0425	0.0195	3.38485	0.75
8	6.B	Wastewater Handling	N2O	9 000.86	1 108.31	0.0028	0.0184	3.19402	0.78
9	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	7 369.40	0.0185	0.0134	2.33538	0.81
10	2.C.1	Iron and Steel Production	CO2	7 334.19	1 692.93	0.0042	0.0120	2.08542	0.83
11	1.B.2.b	Natural Gas	CH4	3 357.52	4 690.83	0.0117	0.0093	1.60932	0.84
12	2.B.2	Nitric Acid Production	N2O	4 386.47	811.33	0.0020	0.0079	1.37899	0.86
13	4.A	Enteric Fermentation	CH4	16 242.48	8 977.07	0.0225	0.0069	1.19533	0.87
14	4.D.1	Direct Soil Emissions	N2O	16 064.04	12 420.94	0.0311	0.0065	1.13735	0.88
15	2.A.1	Cement Production	CO2	7 081.72	6 384.30	0.0160	0.0063	1.09634	0.89
16	1.B.2.d	Other	CO2	0.00	1 671.13	0.0042	0.0063	1.09422	0.90
17	1.A.3.c	Transport Railways	CO2	2 829.42	350.48	0.0009	0.0058	1.00268	0.91
18	2.B.1	Ammonia Production	CO2	4 357.99	4 316.39	0.0108	0.0053	0.92845	0.92
19	6.C	Waste Incineration	CO2	2 039.25	278.74	0.0007	0.0041	0.70555	0.93
20	2.A.3	Limestone and Dolomite Use	CO2	1 190.80	1 764.55	0.0044	0.0037	0.63682	0.94
21	2.A.2	Lime Production	CO2	3 395.60	1 378.78	0.0035	0.0033	0.57593	0.94
22	1.A.1, 2, 4	Stationary Combustion - Biomass	CH4	229.44	1 005.64	0.0025	0.0032	0.55856	0.95
23	1.A.1, 2, 4	Stationary Combustion - Solid Fuels	CH4	4 207.68	1 955.04	0.0049	0.0032	0.55225	0.95

Trend Assessment with category 5 in 2012

		IPCC Source Categories	Direct GHG	Base Year Estimate	Emission in 2012	Level Assessment	Trend Assessment	Contribution to Trend [%]	Cumulative Total
1	1.A.1, 2, 4	Stationary combustion Solid Fuels	CO2	375 009.14	206 453.26	0.4621	0.2164	36.8879	0.37
2	1.A.3.b	Transport Road Transportation	CO2	20 771.21	45 123.35	0.1010	0.0897	15.2835	0.52
3	5.A.1	Forest Land remaining Forest Land	CO2	-23 281.89	-36 889.02	0.0826	0.0592	10.0905	0.62
4	1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO2	16 408.68	25 494.16	0.0571	0.0402	6.8521	0.69
5	2.F.1	Refrigeration and Air Conditioning Equipment	HFC	0.00	7 437.48	0.0166	0.0224	3.8253	0.73
6	1.B.1.a	Coal Mining and Handling	CH4	16 443.14	7 369.40	0.0165	0.0146	2.4831	0.75
7	1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO2	17 738.97	16 967.35	0.0380	0.0115	1.9590	0.77
8	6.B	Wastewater Handling	CH4	2 039.25	5 275.12	0.0118	0.0114	1.9351	0.79
9	2.C.1	Iron and Steel Production	CO2	7 334.19	1 692.93	0.0038	0.0113	1.9274	0.81
10	4.A	Enteric Fermentation	CH4	16 242.48	8 977.07	0.0201	0.0093	1.5796	0.83
11	5.A.2	Land converted to Forest Land	CO2	-29.28	-2 684.25	0.0060	0.0080	1.3694	0.84
12	2.B.2	Nitric Acid Production	N2O	4 386.47	811.33	0.0018	0.0074	1.2562	0.85
13	1.B.2.b	Natural Gas	CH4	3 357.52	4 690.83	0.0105	0.0066	1.1317	0.87
14	6.A	Solid Waste Disposal on Land	CH4	9 000.86	8 560.37	0.0192	0.0057	0.9688	0.88
15	1.A.3.c	Transport Railways	CO2	2 829.42	350.48	0.0008	0.0053	0.8992	0.88
16	2.F.9	Potential emissions as a proxy for actual emissions	HFC	2 344.41	1.99	0.0000	0.0052	0.8934	0.89
17	1.B.2.d	Other	CO2	0.00	1 671.13	0.0037	0.0050	0.8595	0.90
18	5.B.1	Cropland remaining Cropland	CO2	3 725.56	1 203.75	0.0027	0.0047	0.8022	0.91
19	1.A.1, 2, 4	Stationary combustion Solid Fuels	CH4	4 207.68	1 955.04	0.0044	0.0035	0.5998	0.92
20	2.A.2	Lime Production	CO2	3 395.60	1 378.78	0.0031	0.0034	0.5863	0.92
21	2.G	Other	CO2	0.00	1 132.41	0.0025	0.0034	0.5824	0.93
22	2.A.1	Cement Production	CO2	7 081.72	6 384.30	0.0143	0.0034	0.5818	0.93
23	4.B	Manure Management	N2O	8 047.57	4 869.94	0.0109	0.0033	0.5655	0.94
24	2.B.1	Ammonia Production	CO2	4 357.99	4 316.39	0.0097	0.0033	0.5574	0.94
25	2.A.3	Limestone and Dolomite Use	CO2	1 190.80	1 764.55	0.0039	0.0027	0.4532	0.95
26	5.D.1	Wetlands remaining Wetlands	CO2	2 794.69	2 909.33	0.0065	0.0025	0.4301	0.95

LEVEL ASSESSMENT AND TREND ASSESSMENT WITH CATEGORY 5 IN 2012

IPCC Source Categories		Direct GHG	Level Assessment - L, Trend Assessment - T		
			2012		1988
	ENERGY				
1.A.1, 2, 4	Stationary combustion Liquid Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Solid Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary combustion Other Fuels	CO_2	L		L
1.A.1, 2, 4	Stationary combustion Liquid Fuels	CH_4			
1.A.1, 2, 4	Stationary combustion Solid Fuels	CH_4	L	T	L
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 Other Fuels	CH_4			
1.A.1, 2, 4	Stationary combustion Liquid Fuels	N_2O			
1.A.1, 2, 4	Stationary combustion Solid Fuels	N_2O			
1.A.1, 2, 4	Stationary combustion Gaseous Fuels	N_2O			
1.A.1, 2, 4	Stationary combustion Biomass	N_2O			
1.A.1, 2, 4	Stationary combustion Other Fuels	N_2O			
1.A.3.a	Transport Civil Aviation	CO_2			
1.A.3.b	Transport Road Transportation	CO_2	L	T	L
1.A.3.c	Transport Railways	CO_2		T	
1.A.3.d	Transport Navigation	CO_2			
1.A.3.e	Transport Other	CO_2			
1.A.3.a	Transport Civil Aviation	CH_4			
1.A.3.b	Transport Road Transportation	CH_4			
1.A.3.c	Transport Railways	CH_4			
1.A.3.d	Transport Navigation	CH_4			
1.A.3.e	Transport Other	CH_4			
1.A.3.a	Transport Civil Aviation	N_2O			
1.A.3.b	Transport Road Transportation	N_2O			
1.A.3.c	Transport Railways	N_2O			
1.A.3.d	Transport Navigation	N_2O			
1.A.3.e	Transport Other	N_2O			
1.A.5.b	Other Mobile	CO_2			
1.A.5.b	Other Mobile	CH_4			
1.A.5.b	Other Mobile	N_2O			
1.B.1.a	Coal Mining and Handling	CH_4	L	T	L
1.B.1.b	Solid Fuel Transformation	CO_2	L		
1.B.1.b	Solid Fuel Transformation	CH_4			
1.B.1.c	Other	CO_2			
1.B.1.c	Other	CH_4			
1.B.2.a	Oil	CO_2			
1.B.2.a	Oil	CH_4			
1.B.2.b	Natural Gas	CO_2			
1.B.2.b	Natural Gas	CH_4	L	T	L
1.B.2.c	Venting and Flaring	CO_2			
1.B.2.c	Venting and Flaring	N_2O			
1.B.2.d	Other	CO_2		T	
	INDUSTRIAL PROCESSES				
2.A.1	Cement Production	CO_2	L	T	L
2.A.2	Lime Production	CO_2		T	L
2.A.3	Limestone and Dolomite Use	CO_2		T	
2.A.4	Soda Ash (production)	CO_2			
2.A.7	Other (ETS Data; Bricks, Tiles And Ceramics Materials production)	CO_2			
2.B.1	Ammonia Production	CO_2	L	T	L
2.B.1	Ammonia Production	CH_4			
2.B.2	Nitric Acid Production	N_2O		T	L
2.B.3	Adipic Acid Production	N_2O			
2.B.4	Carbide Production (calcium carbide)	CO_2			
2.B.5	Other	CO_2			
2.B.5	Other	CH_4			
2.B.5	Other	N_2O			
2.C.1	Iron and Steel Production	CO_2		T	L
2.C.1	Iron and Steel Production	CH_4			
2.C.1	Iron and Steel Production	N_2O			
2.C.2	Ferroalloys Production	CO_2			

IPCC Source Categories		Direct GHG	Level Assessment - L, Trend Assessment - T		
			2012		1988
2.C.2	Ferroalloys Production	CO_2			
2.C.3	Aluminium Production	PFC			
2.C.3	Aluminium Production	SF_6			
2.C.4	SF6 Used in Aluminium and Magnesium Foundries	CO_2			
2.C.5	Other	CO_2			
2.D	Other Production	CO_2			
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	L	T	
2.F.2	Foam Blowing	HFC			
2.F.3	Fire Extinguishers	HFC			
2.F.3	Fire Extinguishers	PFC			
2.F.4	Aerosols/Metered Dose Inhalers	HFC			
2.F.5	Solvents	HFC			
2.F.8	Electrical Equipment	SF_6			
2.F.9	Potential emissions as a proxy for actual emissions	HFC		T	
2.G	Other	CO_2		T	
	SOLVENT AND OTHER PRODUCT USE				
3.A	Paint Application	CO_2			
3.B	Degreasing and Dry Cleaning	CO_2			
3.C	Chemical Products, Manufacture and Processing	CO_2			
3.D	Other	CO_2			
3.D	Other	N_2O			
	AGRICULTURE				
4.A	Enteric Fermentation	CH_4	L	T	L
4.B	Manure Management	CH_4	L		L
4.B	Manure Management	N_2O	L	T	L
4.D.1	Direct Soil Emissions	N_2O	L		L
4.D.2	Animal Production	N_2O			
4.D.3	Indirect Soil Emissions	N_2O	L		L
4.F	Field Burning of Agricultural Residues	CH_4			
4.F	Field Burning of Agricultural Residues	N_2O			
	LAND USE CHANGE AND FORESTRY				
5.A.1	Forest Land remaining Forest Land	CO_2	L	T	L
5.A.1	Forest Land remaining Forest Land	CH_4			
5.A.1	Forest Land remaining Forest Land	N_2O			
5.A.2	Land converted to Forest Land	CO_2	L	T	
5.A.2	Land converted to Forest Land	CH_4			
5.A.2	Land converted to Forest Land	N_2O			
5.B.1	Cropland remaining Cropland	CO_2		T	L
5.B.2	Land converted to Cropland	CO_2			
5.B.2	Land converted to Cropland	N_2O			
5.C.1	Grassland remaining Grassland	CO_2			
5.C.1	Grassland remaining Grassland	CH_4			
5.C.1	Grassland remaining Grassland	N_2O			
5.C.2	Land converted to Grassland	CO_2			
5.D.1	Wetlands remaining Wetlands	CO_2	L	T	
5.D.2	Land converted to Wetlands	CO_2			
5.D.2	Land converted to Wetlands	CH_4	L		
5.D.2	Land converted to Wetlands	N_2O			
5.E.1	Settlements remaining Settlements	CO_2			
5.E.2	Land converted to Settlements	CH_4			
5.E.2	Land converted to Settlements	N_2O			
	WASTE				
6.A	Solid Waste Disposal on Land	CH_4	L	T	L
6.B	Wastewater Handling	CH_4	L	T	
6.B	Wastewater Handling	N_2O			
6.C	Waste Incineration	CO_2			

LEVEL ASSESSMENT AND TREND ASSESSMENT WITHOUT CATEGORY 5 IN 2012

IPCC Source Categories		Direct GHG	Level Assessment - L, Trend Assessment - T		
			2012		1988
	ENERGY				
1.A.1, 2, 4	Stationary Combustion - Liquid Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary Combustion - Solid Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary Combustion - Gaseous Fuels	CO_2	L	T	L
1.A.1, 2, 4	Stationary Combustion - Other Fuels	CO_2	L		L
1.A.1, 2, 4	Stationary Combustion - Liquid Fuels	CH_4			
1.A.1, 2, 4	Stationary Combustion - Solid Fuels	CH_4	L	T	L
1.A.1, 2, 4	Stationary Combustion - Gaseous Fuels	CH_4			
1.A.1, 2, 4	Stationary Combustion - Biomass	CH_4		T	
1.A.1, 2, 4	Stationary Combustion - Other Fuels	CH_4			
1.A.1, 2, 4	Stationary Combustion - Liquid Fuels	N_2O			
1.A.1, 2, 4	Stationary Combustion - Solid Fuels	N_2O			
1.A.1, 2, 4	Stationary Combustion - Gaseous Fuels	N_2O			
1.A.1, 2, 4	Stationary Combustion - Biomass	N_2O			
1.A.1, 2, 4	Stationary Combustion - Other Fuels	N_2O			
1.A.3.a	Transport Civil Aviation	CO_2			
1.A.3.b	Transport Road Transportation	CO_2	L	T	L
1.A.3.c	Transport Railways	CO_2		T	
1.A.3.d	Transport Navigation	CO_2			
1.A.3.e	Transport Other	CO_2			
1.A.3.a	Transport Civil Aviation	CH_4			
1.A.3.b	Transport Road Transportation	CH_4			
1.A.3.c	Transport Railways	CH_4			
1.A.3.d	Transport Navigation	CH_4			
1.A.3.e	Transport Other	CH_4			
1.A.3.a	Transport Civil Aviation	N_2O			
1.A.3.b	Transport Road Transportation	N_2O			
1.A.3.c	Transport Railways	N_2O			
1.A.3.d	Transport Navigation	N_2O			
1.A.3.e	Transport Other	N_2O			
1.A.5.b	Other Mobile	CO_2			
1.A.5.b	Other Mobile	CH_4			
1.A.5.b	Other Mobile	N_2O			
1.B.1.a	Coal Mining and Handling	CH_4	L	T	L
1.B.1.b	Solid Fuel Transformation	CO_2			
1.B.1.b	Solid Fuel Transformation	CH_4			
1.B.1.c	Other	CO_2			
1.B.1.c	Other	CH_4			
1.B.2.a	Oil	CO_2			
1.B.2.a	Oil	CH_4			
1.B.2.b	Natural Gas	CO_2			
1.B.2.b	Natural Gas	CH_4	L	T	
1.B.2.c	Venting and Flaring	CO_2			
1.B.2.c	Venting and Flaring	N_2O			
1.B.2.d	Other	CO_2		T	
	INDUSTRIAL PROCESSES				
2.A.1	Cement Production	CO_2	L	T	L
2.A.2	Lime Production	CO_2		T	
2.A.3	Limestone and Dolomite Use	CO_2		T	
2.A.4	Soda Ash (production)	CO_2			
2.A.7	Other (ETS Data; Bricks, Tiles And Ceramics Materials production)	CO_2			
2.B.1	Ammonia Production	CO_2	L	T	L
2.B.1	Ammonia Production	CH_4			
2.B.2	Nitric Acid Production	N_2O		T	L
2.B.3	Adipic Acid Production	N_2O			
2.B.4	Carbide Production (calcium carbide)	CO_2			
2.B.5	Other	CO_2			
2.B.5	Other	CH_4			
2.B.5	Other	N_2O			
2.C.1	Iron and Steel Production	CO_2		T	L
2.C.1	Iron and Steel Production	CH_4			
2.C.1	Iron and Steel Production	N_2O			
2.C.2	Ferroalloys Production	CO_2			

IPCC Source Categories		Direct GHG	Level Assessment - L, Trend Assessment - T		
			2012		1988
2.C.2	Ferroalloys Production	CO_2			
2.C.3	Aluminium Production	PFC			
2.C.3	Aluminium Production	SF_6			
2.C.4	SF6 Used in Aluminium and Magnesium Foundries	CO_2			
2.C.5	Other	CO_2			
2.D	Other Production	CO_2			
2.F.1	Refrigeration and Air Conditioning Equipment	HFC	L	T	
2.F.2	Foam Blowing	HFC			
2.F.3	Fire Extinguishers	HFC			
2.F.3	Fire Extinguishers	PFC			
2.F.4	Aerosols/Metered Dose Inhalers	HFC			
2.F.5	Solvents	HFC			
2.F.8	Electrical Equipment	SF_6			
2.F.9	Potential emissions as a proxy for actual emissions	HFC			
2.G	Other	CO_2			
	SOLVENT AND OTHER PRODUCT USE				
3.A	Paint Application	CO_2			
3.B	Degreasing and Dry Cleaning	CO_2			
3.C	Chemical Products, Manufacture and Processing	CO_2			
3.D	Other	CO_2			
3.D	Other	N_2O			
	AGRICULTURE				
4.A	Enteric Fermentation	CH_4	L	T	L
4.B	Manure Management	CH_4	L		L
4.B	Manure Management	N_2O	L		L
4.D.1	Direct Soil Emissions	N_2O	L	T	L
4.D.2	Animal Production	N_2O			
4.D.3	Indirect Soil Emissions	N_2O	L		L
4.F	Field Burning of Agricultural Residues	CH_4			
4.F	Field Burning of Agricultural Residues	N_2O			
	LAND USE CHANGE AND FORESTRY				
5.A.1	Forest Land remaining Forest Land	CO_2			
5.A.1	Forest Land remaining Forest Land	CH_4			
5.A.1	Forest Land remaining Forest Land	N_2O			
5.A.2	Land converted to Forest Land	CO_2			
5.A.2	Land converted to Forest Land	CH_4			
5.A.2	Land converted to Forest Land	N_2O			
5.B.1	Cropland remaining Cropland	CO_2			
5.B.2	Land converted to Cropland	CO_2			
5.C.1	Grassland remaining Grassland	CO_2			
5.C.1	Grassland remaining Grassland	CH_4			
5.C.1	Grassland remaining Grassland	N_2O			
5.C.2	Land converted to Grassland	CO_2			
5.D.1	Wetlands remaining Wetlands	CO_2			
5.D.2	Land converted to Wetlands	CO_2			
5.D.2	Land converted to Wetlands	CH_4			
5.D.2	Land converted to Wetlands	N_2O			
5.E.1	Settlements remaining Settlements	CO_2			
5.E.2	Land converted to Settlements	CH_4			
5.E.2	Land converted to Settlements	N_2O			
	WASTE				
6.A	Solid Waste Disposal on Land	CH_4	L	T	L
6.B	Wastewater Handling	CH_4	L	T	
6.B	Wastewater Handling	N_2O		T	
6.C	Waste Incineration	CO_2		T	
6.C	Waste Incineration	N_2O			

Annex 2. Fuel consumption and GHG emission factors from selected categories of CRF sector 1.A

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1752.496	1719.899	1597.240	1574.444	1504.529	1364.716	1317.391	1205.058	1267.444	1221.134	1155.693
Lignite	568.786	575.819	555.587	561.502	548.623	550.751	539.277	529.124	533.077	530.661	535.230
Hard coal briquettes (patent fuels)	5.001	3.888	2.520	0.322	0.117	0.059	0.059	0.000	0.000	0.059	0.000
Brown coal briquettes	0.354	0.247	0.140	0.060	0.200	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.274	21.900	21.641	16.329	9.561	3.107	4.094	4.738	7.156	7.949	10.768
Fuel wood and wood waste	16.695	15.123	14.571	14.384	17.265	13.783	14.051	1.322	2.656	3.293	3.673
Biogas	0.004	0.006	0.014	0.003	0.024	0.000	0.006	0.125	0.137	0.088	0.204
Industrial wastes	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878	3.393	3.267	3.809
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	13.591	12.561	12.626	12.967	10.944	8.864	7.524	7.239	6.954	5.301	4.076
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.184
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.767	0.724	0.601	0.601	0.558	0.429	0.387	0.343	1.158	1.674	1.545
Fuel oil	73.080	70.760	65.360	61.280	56.400	55.080	55.600	25.840	27.720	27.280	17.600
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	1.287	1.188	0.990	0.742	0.644	0.842	1.238	0.050	0.000	0.000	0.000
Coke oven gas	5.568	6.565	7.125	7.555	8.863	8.144	13.147	12.828	13.975	16.450	13.697
Blast furnace gas	28.221	26.733	22.377	12.797	13.378	10.239	13.190	5.905	3.218	3.306	3.060
Gas works gas	0.659	0.579	0.167	0.129	0.335	0.085	0.037	0.021	0.004	0.002	0.000
Fuels											
Liquid fuels	75.134	72.672	66.951	62.623	57.602	56.351	57.225	26.233	28.878	29.000	19.329
Gaseous fuels	21.274	21.900	21.641	16.329	9.561	3.107	4.094	4.738	7.156	7.949	10.768
Solid fuels	2374.674	2346.290	2197.782	2169.776	2086.989	1942.858	1890.625	1760.175	1824.672	1776.913	1711.756
Other fuels	3.741	3.873	5.265	8.914	7.354	6.658	6.876	3.878	3.393	3.267	3.809
Biomass	16.699	15.129	14.585	14.387	17.289	13.783	14.057	1.447	2.793	3.381	3.877
Total	**2491.522**	**2459.864**	**2306.224**	**2272.029**	**2178.795**	**2022.757**	**1972.877**	**1796.471**	**1866.892**	**1820.510**	**1749.539**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	1125.965	1118.163	1127.286	1091.937	1144.769	1122.123	1105.919	1159.978	1145.487	1057.079	1030.534
Lignite	521.068	504.999	512.219	494.038	518.250	514.275	533.979	525.818	501.140	521.178	494.048
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	16.210	21.627	28.242	38.700	45.496	53.667	57.039	52.808	49.653	51.052	51.828
Fuel wood and wood waste	3.398	3.461	4.886	4.809	5.799	8.905	17.500	21.180	25.434	38.251	55.083
Biogas	0.349	0.443	0.563	0.615	0.843	1.293	1.820	2.021	2.305	3.038	3.123
Industrial wastes	3.082	3.273	3.369	4.629	2.964	4.038	5.219	5.205	4.783	0.936	0.846
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.384	0.368
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	2.850	1.995	1.710	1.254	0.912	0.598	0.342	0.171	0.142	0.086	0.056
Liquid petroleum gas (LPG)	0.230	0.184	0.184	0.184	0.046	0.000	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.588	1.973	2.059	2.317	2.188	1.545	1.201	1.159	0.730	0.815	0.944
Fuel oil	16.720	13.680	14.680	13.200	11.920	10.040	8.080	7.960	7.280	7.400	6.680
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	16.077	17.094	17.079	16.420	18.032	16.955	14.373	18.322	19.908	21.739	17.487
Blast furnace gas	3.286	4.317	4.976	4.783	5.715	6.665	4.146	8.323	5.965	9.766	7.443
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	18.538	15.837	16.923	15.701	14.154	11.585	9.281	9.119	8.010	8.215	7.664
Gaseous fuels	16.210	21.627	28.242	38.700	45.496	53.667	57.039	52.808	49.653	51.052	51.828
Solid fuels	1669.246	1646.568	1663.270	1608.461	1687.678	1660.616	1658.759	1712.612	1672.642	1609.848	1549.568
Other fuels	3.082	3.273	3.369	4.629	2.964	4.038	5.219	5.205	4.783	1.320	1.214
Biomass	3.747	3.904	5.449	5.424	6.642	10.198	19.320	23.201	27.739	41.289	58.206
Total	**1710.823**	**1691.209**	**1717.253**	**1672.915**	**1756.934**	**1740.104**	**1749.618**	**1802.945**	**1762.827**	**1711.724**	**1668.480**

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

Fuels	2010	2011	2012
Hard coal	1092.598	1058.955	992.678
Lignite	477.467	517.018	527.314
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	52.230	58.669	63.579
Fuel wood and wood waste	66.119	79.252	106.026
Biogas	3.653	2.817	3.680
Industrial wastes	1.114	1.150	0.916
Municipal waste - non-biogenic fraction	0.367	0.403	0.371
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.080	0.040	0.080
Petroleum coke	0.000	0.000	0.000
Coke	0.057	0.028	0.028
Liquid petroleum gas (LPG)	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	0.858	1.030	0.830
Fuel oil	7.400	7.000	6.320
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	23.685	22.168	21.333
Blast furnace gas	9.793	10.998	11.174
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	8.338	8.070	7.230
Gaseous fuels	52.230	58.669	63.579
Solid fuels	1603.600	1609.167	1552.527
Other fuels	1.481	1.553	1.287
Biomass	69.772	82.069	109.706
Total	**1735.421**	**1759.528**	**1734.329**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	0.114	0.113	0.046	0.090	0.069	0.245	0.068	1.302	1.451	1.349	0.629
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163	0.438
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.520	1.080	0.880
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.028	0.028	0.000	0.028	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.092
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.043	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.043	0.043	0.000	0.086	0.086	0.172	0.172	0.214	0.343
Fuel oil	14.800	13.800	11.440	10.560	15.760	12.800	11.960	32.400	40.520	32.200	39.840
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	8.860	9.306	7.474	7.623	8.514	9.256	10.444	12.028	8.960	10.197	6.286
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.081
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	23.660	23.106	18.957	18.226	24.274	22.185	22.490	44.643	50.172	43.737	47.441
Gaseous fuels	2.395	2.396	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244
Solid fuels	0.142	0.140	0.046	0.118	0.069	0.245	0.068	1.302	1.451	1.349	0.710
Other fuels	7.724	7.487	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163	0.438
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**33.921**	**33.129**	**25.896**	**20.155**	**26.533**	**24.040**	**24.408**	**49.426**	**53.722**	**47.778**	**56.833**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	0.586	0.208	0.070	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	10.832	12.110	11.354	10.124	12.770	15.454	14.482	14.900	20.816	18.816	17.381
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.310	0.219	0.095	0.253	0.176	0.221	0.285	0.224	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	1.720	0.000	0.040	0.040	0.040	0.360	0.320	0.440	0.360	0.840	1.480
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.184	0.276	0.000	0.046	0.092	0.000	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.090	0.135	0.000	0.000	0.135	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.000	0.000	0.000
Diesel oil	0.086	1.373	0.386	0.858	0.343	0.987	0.300	0.729	0.172	0.429	0.214
Fuel oil	35.080	36.160	42.280	42.560	43.520	42.880	42.560	41.720	44.080	43.560	44.160
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	6.386	9.058	10.444	10.048	10.048	11.632	10.692	12.969	16.582	17.424	15.246
Coke oven gas	0.051	0.069	0.070	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	43.546	47.002	53.150	53.552	54.178	55.859	53.915	55.858	61.194	62.253	61.100
Gaseous fuels	10.832	12.110	11.354	10.124	12.770	15.454	14.482	14.900	20.816	18.816	17.381
Solid fuels	0.637	0.277	0.140	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.023
Other fuels	0.310	0.219	0.095	0.253	0.176	0.221	0.285	0.224	0.000	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**55.325**	**59.608**	**64.739**	**63.952**	**67.124**	**71.534**	**68.682**	**70.982**	**82.010**	**81.069**	**78.504**

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

Fuels	2010	2011	2012
Hard coal	0.023	0.023	0.023
Lignite	0.000	0.050	0.022
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	19.232	26.893	29.020
Fuel wood and wood waste	0.000	0.000	0.000
Biogas	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.600	0.800	1.640
Petroleum coke	0.000	0.000	0.000
Coke	0.000	0.000	0.000
Liquid petroleum gas (LPG)	0.000	0.092	0.092
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	0.129	0.172	0.087
Fuel oil	46.560	39.280	31.400
Feedstocks	0.000	0.000	0.000
Refinery gas	22.869	21.532	28.215
Coke oven gas	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	70.158	61.876	61.434
Gaseous fuels	19.232	26.893	29.020
Solid fuels	0.023	0.073	0.045
Other fuels	0.000	0.000	0.000
Biomass	0.000	0.000	0.000
Total	**89.413**	**88.842**	**90.499**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	12.314	10.347	10.425	7.912	6.205	23.487	57.593	58.698	59.891	56.159	53.263
Lignite	0.416	0.057	0.078	0.132	0.073	0.322	0.303	0.336	0.370	0.333	0.296
Hard coal briquettes (patent fuels)	0.023	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.035	0.018	0.020	0.020	0.000	0.040	0.020	0.020	0.040	0.040	0.020
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.082	0.083
Natural gas	13.736	15.364	12.371	12.432	14.665	12.354	17.401	14.850	23.269	21.155	17.779
Fuel wood and wood waste	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.003	0.003	0.003	0.003
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.011	0.028	0.023
Industrial wastes	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.151
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.080	0.040
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.173	0.522	0.619	0.538	0.284	0.513	1.226	0.884	0.598	0.142	0.086
Liquid petroleum gas (LPG)	0.092	0.092	0.092	0.092	0.092	0.046	0.046	0.046	0.046	0.000	0.046
Motor gasoline	0.088	0.088	0.090	0.090	0.090	0.180	0.314	0.269	0.090	0.090	0.045
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.043	0.043	0.043	0.043	0.043	0.043	0.000	0.000	0.043
Diesel oil	2.130	1.960	1.845	2.145	2.274	4.418	3.560	3.775	3.260	2.832	2.231
Fuel oil	0.240	0.040	0.040	0.040	0.080	0.360	0.280	0.160	0.160	0.080	0.520
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	50.866	50.938	43.557	38.488	39.121	34.604	40.489	37.038	35.105	37.000	33.709
Blast furnace gas	5.632	4.440	3.961	1.995	1.430	2.123	2.488	1.954	1.582	1.893	1.695
Gas works gas	0.005	0.008	0.005	0.180	0.010	0.120	0.000	0.006	0.061	0.019	0.017
Fuels											
Liquid fuels	2.550	2.180	2.110	2.410	2.579	5.047	4.243	4.293	3.716	3.164	3.008
Gaseous fuels	13.736	15.364	12.371	12.432	14.665	12.354	17.401	14.850	23.269	21.155	17.779
Solid fuels	70.465	66.330	58.694	49.265	47.123	61.209	102.119	98.936	97.647	95.586	89.086
Other fuels	0.046	0.001	0.000	0.000	0.000	0.311	0.235	0.184	0.158	0.138	0.151
Biomass	0.018	0.001	0.006	0.000	0.004	0.008	0.011	0.004	0.014	0.031	0.026
Total	**86.815**	**83.875**	**73.181**	**64.107**	**64.371**	**78.929**	**124.009**	**118.267**	**124.804**	**120.074**	**110.050**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	44.994	34.648	32.658	16.819	19.618	13.900	12.331	9.542	17.495	12.424	7.456
Lignite	0.286	0.420	0.307	1.000	0.625	0.542	0.175	0.204	1.380	1.766	0.908
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.020	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.083	0.041	0.000	0.041	0.128	0.126	0.000	0.000	0.000	0.000	0.000
Natural gas	19.458	19.491	12.986	12.515	9.741	11.190	10.106	10.363	9.680	9.239	8.858
Fuel wood and wood waste	0.005	0.006	0.039	0.029	0.008	0.004	0.002	0.011	0.057	0.020	0.134
Biogas	0.022	0.027	0.012	0.018	0.018	0.016	0.012	0.015	0.028	0.017	0.003
Industrial wastes	0.155	0.010	0.008	0.005	0.013	0.000	0.000	0.029	0.042	0.051	0.015
Municipal waste - non-biogenic fraction	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.080	0.080	0.000	0.040	0.040	0.040	0.080	0.040	0.040	0.040	0.040
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.028	0.171	0.028	0.000	0.114	0.057	0.028	0.000	0.028	0.656	0.000
Liquid petroleum gas (LPG)	0.046	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.046	0.000	0.046
Motor gasoline	0.045	0.045	0.045	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.802	1.802	1.587	1.244	1.244	1.115	1.330	1.287	1.244	1.373	1.502
Fuel oil	0.160	0.240	0.080	0.360	0.240	0.160	0.280	0.040	0.160	0.040	0.040
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	29.871	32.634	33.111	32.027	36.094	36.410	32.796	36.409	39.839	39.605	28.051
Blast furnace gas	0.847	0.840	0.149	0.086	0.021	0.030	0.042	0.045	0.037	0.000	0.000
Gas works gas	0.013	0.004	0.004	0.004	0.004	0.004	0.003	0.004	0.005	0.006	0.012
Fuels											
Liquid fuels	2.259	2.208	1.712	1.730	1.652	1.441	1.690	1.413	1.490	1.453	1.628
Gaseous fuels	19.458	19.491	12.986	12.515	9.741	11.190	10.106	10.363	9.680	9.239	8.858
Solid fuels	76.059	68.737	66.257	49.936	56.476	50.943	45.375	46.204	58.784	54.457	36.427
Other fuels	0.155	0.014	0.008	0.005	0.013	0.000	0.000	0.029	0.042	0.051	0.015
Biomass	0.027	0.037	0.052	0.047	0.026	0.020	0.014	0.026	0.085	0.037	0.137
Total	**97.958**	**90.487**	**81.015**	**64.233**	**67.908**	**63.594**	**57.185**	**58.035**	**70.081**	**65.237**	**47.065**

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

Fuels	2010	2011	2012
Hard coal	2.061	2.666	0.665
Lignite	1.442	1.666	0.728
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	10.321	9.949	11.414
Fuel wood and wood waste	0.349	0.162	0.160
Biogas	0.000	0.000	0.000
Industrial wastes	0.016	0.022	0.010
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.040	0.080	0.040
Petroleum coke	0.000	0.000	0.000
Coke	0.000	0.057	0.000
Liquid petroleum gas (LPG)	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	1.630	2.059	1.485
Fuel oil	0.080	0.040	0.040
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	38.485	35.626	33.457
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.012	0.009	0.012
Fuels			
Liquid fuels	1.750	2.179	1.565
Gaseous fuels	10.321	9.949	11.414
Solid fuels	42.000	40.024	34.862
Other fuels	0.016	0.022	0.010
Biomass	0.349	0.162	0.160
Total	**54.436**	**52.336**	**48.011**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	2.367	1.278	1.138	1.243	1.494	9.159	8.513	25.320	28.922	23.636	21.085
Lignite	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.009	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941	0.498	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	12.258	7.268	10.599	22.303	28.082	28.938	33.055	26.589	24.442	28.763	23.702
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.043	0.645	0.043
Diesel oil	0.128	0.128	0.172	0.129	0.172	0.343	0.558	0.772	0.901	0.558	0.300
Fuel oil	18.120	15.400	11.000	7.800	5.280	4.280	2.960	2.040	0.960	4.720	1.600
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	32.570	30.997	26.038	22.090	22.568	21.604	25.480	27.686	24.404	24.257	24.742
Blast furnace gas	43.812	40.192	36.484	27.903	25.909	25.676	28.350	37.610	34.205	36.120	29.520
Gas works gas	4.316	3.219	2.174	1.462	0.718	0.613	0.067	0.068	0.080	0.058	0.007
Fuels											
Liquid fuels	18.248	15.528	11.172	7.929	5.452	4.623	3.518	2.855	1.904	5.969	1.943
Gaseous fuels	73.507	63.332	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993
Solid fuels	95.323	82.955	76.433	75.020	78.771	85.990	95.465	117.273	112.053	112.843	99.056
Other fuels	3.158	3.344	4.079	6.756	6.497	4.272	3.757	2.941	0.498	0.000	0.000
Biomass	0.000	0.000	0.000	0.000	0.000	0.016	0.014	0.005	0.006	0.004	0.006
Total	**190.236**	**165.159**	**144.535**	**123.679**	**117.288**	**120.463**	**128.241**	**147.313**	**140.359**	**147.094**	**124.998**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	19.074	18.262	14.701	12.424	12.593	17.281	11.379	9.636	12.268	4.360	5.482
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.029	0.029	0.029	0.000	0.000	0.029	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	21.440	22.024	18.328	15.463	14.827	19.969	20.460	21.008	22.724	20.401	16.597
Fuel wood and wood waste	0.004	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.008	0.000	0.277	0.706	1.195	1.654	0.965	1.015	1.313	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	22.410	26.040	21.559	21.660	23.042	23.462	15.852	12.973	5.455	6.112	3.565
Liquid petroleum gas (LPG)	0.046	0.184	0.184	0.230	0.184	0.138	0.000	0.000	0.000	0.046	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.343	0.515	0.172	0.129	0.129	0.129	0.086	0.129	0.086	0.086	0.085
Fuel oil	1.800	1.040	0.640	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	15.875	17.574	16.994	15.122	16.132	15.368	12.643	12.770	13.885	10.059	5.396
Blast furnace gas	24.034	31.874	26.768	23.876	25.282	27.109	19.239	20.580	28.624	18.785	10.160
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	2.189	1.825	0.996	0.359	0.313	0.267	0.086	0.129	0.086	0.132	0.131
Gaseous fuels	21.440	22.024	18.328	15.463	14.827	19.969	20.460	21.008	22.724	20.401	16.597
Solid fuels	81.393	93.750	80.051	73.111	77.078	83.220	59.113	55.988	60.232	39.316	24.603
Other fuels	0.008	0.000	0.277	0.706	1.195	1.654	0.965	1.015	1.313	0.000	0.000
Biomass	0.004	0.003	0.006	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001
Total	**105.034**	**117.602**	**99.658**	**89.642**	**93.417**	**105.114**	**80.626**	**78.141**	**84.356**	**59.850**	**41.332**

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

Fuels	2010	2011	2012
Hard coal	4.003	5.189	8.481
Lignite	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.029
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	16.922	17.209	16.906
Fuel wood and wood waste	0.000	0.000	0.000
Biogas	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	5.209	9.193	10.300
Liquid petroleum gas (LPG)	0.046	0.046	0.092
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	0.085	0.085	0.043
Fuel oil	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	8.488	8.420	8.087
Blast furnace gas	12.220	11.261	11.507
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	0.131	0.131	0.135
Gaseous fuels	16.922	17.209	16.906
Solid fuels	29.920	34.063	38.404
Other fuels	0.000	0.000	0.000
Biomass	0.000	0.000	0.000
Total	**46.973**	**51.403**	**55.445**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1.411	1.323	0.455	0.565	0.850	1.916	1.771	4.172	4.285	3.907	3.331
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.638
Fuel wood and wood waste	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361	2.164
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	9.754	8.730	6.014	5.216	2.280	2.793	6.412	6.327	6.612	6.584	6.384
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.043	0.000
Diesel oil	0.043	0.043	0.043	0.043	0.129	0.086	0.129	0.172	0.214	0.214	0.257
Fuel oil	0.640	0.760	0.760	0.800	0.800	0.760	0.800	0.720	0.680	0.640	0.520
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.461	0.437	0.397	0.178	0.186	0.043	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.375	0.341	0.042	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	0.683	0.803	0.803	0.843	0.929	0.846	0.929	0.892	0.940	0.897	0.777
Gaseous fuels	5.638	5.470	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.638
Solid fuels	12.001	10.832	6.908	5.965	3.316	4.752	8.183	10.499	10.897	10.491	9.715
Other fuels	0.870	0.719	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361	2.164
Biomass	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.149	0.042	0.026
Total	**19.191**	**17.823**	**12.749**	**11.924**	**5.972**	**8.073**	**15.257**	**18.988**	**19.505**	**19.215**	**18.320**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	3.117	3.108	3.790	2.560	2.115	1.092	0.024	0.024	0.589	0.000	0.000
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	5.660	5.814	5.700	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.852
Fuel wood and wood waste	0.010	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	2.070	2.268	2.551	2.739	2.539	1.800	1.003	1.004	0.982	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	5.928	6.070	6.156	6.156	5.928	5.956	5.814	6.042	6.441	6.640	6.270
Liquid petroleum gas (LPG)	0.000	0.046	0.092	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.172	0.257	0.172	0.172	0.129	0.172	0.172	0.172	0.172	0.172	0.172
Fuel oil	0.560	0.560	0.520	0.400	0.320	0.400	0.400	0.400	0.160	0.160	0.160
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	0.732	0.863	0.784	0.618	0.495	0.658	0.618	0.618	0.378	0.378	0.378
Gaseous fuels	5.660	5.814	5.700	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.852
Solid fuels	9.045	9.178	9.946	8.716	8.043	7.048	5.838	6.066	7.030	6.640	6.270
Other fuels	2.070	2.268	2.551	2.739	2.539	1.800	1.003	1.004	0.982	0.000	0.000
Biomass	0.010	0.011	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total	**17.517**	**18.134**	**18.986**	**17.663**	**16.945**	**15.911**	**13.927**	**14.572**	**15.133**	**13.560**	**12.500**

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

Fuels	2010	2011	2012
Hard coal	0.000	0.250	0.114
Lignite	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	6.048	6.670	6.890
Fuel wood and wood waste	0.000	0.000	0.000
Biogas	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	6.042	6.213	6.384
Liquid petroleum gas (LPG)	0.046	0.046	0.000
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	0.214	0.172	0.175
Fuel oil	0.120	0.120	0.120
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	0.000	0.039	0.043
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	0.380	0.338	0.295
Gaseous fuels	6.048	6.670	6.890
Solid fuels	6.042	6.502	6.541
Other fuels	0.000	0.000	0.000
Biomass	0.000	0.000	0.000
Total	**12.470**	**13.510**	**13.726**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	9.197	9.059	7.216	6.623	4.550	13.125	7.945	70.221	71.191	63.913	54.992
Lignite	0.056	0.038	0.039	0.038	0.027	0.047	0.029	0.428	0.460	0.389	0.429
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408
Fuel wood and wood waste	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.000
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Industrial wastes	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	9.593
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.600	2.880	3.440
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.763	4.530	2.679	1.966	1.852	1.881	1.938	3.477	2.964	1.454	1.539
Liquid petroleum gas (LPG)	3.726	4.554	0.000	0.000	0.000	0.046	0.000	0.000	0.000	0.000	0.000
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.258	0.344	0.172	0.086
Diesel oil	1.406	1.363	0.987	0.858	0.772	0.729	0.729	0.944	1.072	1.072	1.416
Fuel oil	6.080	6.120	2.720	1.880	2.760	2.480	3.600	8.160	9.320	9.360	17.560
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	3.614	1.930	0.396	3.465	5.445	4.455	0.198	1.584	6.584	9.652	18.513
Coke oven gas	1.053	0.993	0.701	0.522	0.440	1.548	0.276	0.729	0.784	0.140	0.174
Blast furnace gas	0.148	0.136	0.047	0.010	0.006	0.011	0.014	0.023	0.004	0.013	0.004
Gas works gas	0.190	0.230	0.214	0.192	0.133	0.126	0.110	0.070	0.052	0.000	0.000
Fuels											
Liquid fuels	14.825	13.968	4.103	6.203	8.977	7.753	4.527	10.946	19.920	23.136	41.015
Gaseous fuels	6.409	6.244	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408
Solid fuels	12.407	14.986	10.896	9.351	7.008	16.738	10.312	74.948	75.455	65.909	57.138
Other fuels	12.255	14.915	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	9.593
Biomass	0.345	0.390	0.118	0.039	0.010	0.003	0.035	0.007	0.000	0.000	0.001
Total	**46.241**	**50.503**	**37.118**	**38.519**	**37.466**	**52.572**	**41.972**	**113.803**	**118.940**	**114.425**	**117.155**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	50.522	50.115	48.485	45.458	27.959	28.709	30.107	27.683	28.785	46.079	44.061
Lignite	0.138	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	9.041	9.464	8.481	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762
Fuel wood and wood waste	0.000	0.000	0.000	0.001	0.153	0.102	0.165	0.000	0.121	0.000	0.058
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	9.808	10.332	10.968	10.093	9.914	8.749	6.901	7.851	6.875	7.233	8.575
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	2.520	0.480	0.480	0.280	0.240	0.000	0.040	0.040	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.624	1.596	1.710	1.738	1.568	1.881	1.454	2.964	1.938	1.168	0.884
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.092
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.090
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.043	0.000	0.043	0.043	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	1.330	1.030	4.762	4.247	4.333	3.904	3.775	4.076	3.732	3.689	4.547
Fuel oil	15.680	13.520	7.360	7.640	7.080	7.320	3.920	3.920	3.600	0.640	1.120
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	19.602	23.314	20.542	20.740	21.830	22.424	18.266	21.334	22.473	19.156	20.889
Coke oven gas	0.130	0.050	0.150	0.285	0.634	0.606	0.608	0.547	0.658	0.654	0.483
Blast furnace gas	0.007	0.011	0.008	0.004	0.013	0.019	0.006	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	39.175	38.344	33.187	32.950	33.483	33.648	26.001	29.370	29.805	23.485	26.738
Gaseous fuels	9.041	9.464	8.481	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762
Solid fuels	52.421	51.772	50.353	47.485	30.174	31.215	32.175	31.194	31.381	47.901	45.428
Other fuels	9.808	10.332	10.968	10.093	9.914	8.749	6.901	7.851	6.875	7.233	8.575
Biomass	0.000	0.000	0.000	0.001	0.153	0.102	0.165	0.000	0.121	0.000	0.058
Total	**110.445**	**109.912**	**102.989**	**97.728**	**80.181**	**81.212**	**73.346**	**77.468**	**76.953**	**86.656**	**90.561**

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

Fuels	2010	2011	2012
Hard coal	49.706	43.998	43.743
Lignite	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	12.043	13.755	13.568
Fuel wood and wood waste	0.058	0.053	0.131
Biogas	0.000	0.000	0.000
Industrial wastes	8.137	7.259	7.748
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	0.826	1.340	3.164
Liquid petroleum gas (LPG)	0.138	0.138	0.138
Motor gasoline	0.000	0.045	0.045
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	4.161	3.604	3.188
Fuel oil	0.640	0.720	0.560
Feedstocks	0.000	0.000	0.000
Refinery gas	17.176	15.890	12.524
Coke oven gas	0.627	0.616	0.595
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	22.115	20.397	16.455
Gaseous fuels	12.043	13.755	13.568
Solid fuels	51.159	45.954	47.502
Other fuels	8.137	7.259	7.748
Biomass	0.058	0.053	0.131
Total	**93.512**	**87.418**	**85.404**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1.639	1.940	1.548	1.741	1.379	4.524	3.836	22.318	22.233	23.979	18.936
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563
Fuel wood and wood waste	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.331	0.247	0.256	0.285	0.256	0.314	0.285	0.285	0.256	0.142	0.086
Liquid petroleum gas (LPG)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.092	0.184
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.043	0.000	0.086	0.000	0.000	0.000
Diesel oil	0.085	0.085	0.043	0.086	0.043	0.043	0.086	0.129	0.601	0.987	1.115
Fuel oil	1.240	1.160	1.280	1.200	1.320	1.560	1.400	2.360	1.040	1.040	1.320
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.004	0.003	0.003	0.003	0.002	0.003	0.002	0.002	0.001	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.003	0.003	0.003	0.014	0.002	0.000	0.000	0.000	0.004	0.000	0.000
Fuels											
Liquid fuels	1.371	1.291	1.369	1.332	1.409	1.692	1.532	2.621	1.687	2.119	2.619
Gaseous fuels	0.103	0.162	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563
Solid fuels	1.976	2.192	1.810	2.043	1.639	4.841	4.123	22.605	22.494	24.121	19.022
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.352	0.205	0.001	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476
Total	**3.803**	**3.850**	**3.281**	**3.436**	**3.074**	**8.179**	**7.515**	**40.895**	**40.879**	**43.808**	**38.680**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	17.528	15.696	15.564	14.317	14.050	13.797	13.430	11.592	9.452	7.850	8.515
Lignite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.007	1.210	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.834
Fuel wood and wood waste	15.545	15.938	15.138	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.171
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018
Industrial wastes	0.000	0.000	0.011	0.106	0.109	0.150	0.125	0.123	0.118	0.137	0.155
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.040	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	0.000	0.028	0.028	0.028	0.057	0.028	0.028	0.028	0.028	0.028	0.000
Liquid petroleum gas (LPG)	0.092	0.138	0.092	0.046	0.046	0.092	0.046	0.092	0.184	0.046	0.092
Motor gasoline	0.000	0.000	0.000	0.000	0.090	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.815	0.601	0.472	0.429	0.472	0.472	0.343	0.386	0.429	0.300	0.300
Fuel oil	1.320	1.360	1.480	1.560	1.600	1.680	1.600	1.600	1.720	1.640	1.600
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	2.227	2.185	2.044	2.035	2.208	2.244	2.029	2.118	2.333	1.986	1.992
Gaseous fuels	1.007	1.210	1.445	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.834
Solid fuels	17.528	15.724	15.592	14.345	14.107	13.825	13.458	11.620	9.480	7.878	8.515
Other fuels	0.000	0.000	0.011	0.106	0.109	0.150	0.125	0.123	0.118	0.137	0.155
Biomass	15.545	15.938	15.138	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.189
Total	**36.307**	**35.057**	**34.230**	**34.569**	**36.468**	**37.833**	**36.511**	**36.216**	**34.662**	**34.552**	**34.685**

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

Fuels	2010	2011	2012
Hard coal	9.950	11.096	10.643
Lignite	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	5.030	4.587	5.535
Fuel wood and wood waste	19.117	18.689	19.090
Biogas	0.049	0.069	0.082
Industrial wastes	0.158	0.169	0.153
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	0.028	0.000	0.000
Liquid petroleum gas (LPG)	0.092	0.092	0.092
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	0.257	0.214	0.175
Fuel oil	1.640	1.680	1.520
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	1.989	1.986	1.787
Gaseous fuels	5.030	4.587	5.535
Solid fuels	9.978	11.096	10.643
Other fuels	0.158	0.169	0.153
Biomass	19.166	18.758	19.172
Total	**36.321**	**36.596**	**37.290**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	25.200	31.694	31.914	35.940	32.724	55.643	53.801	73.024	88.777	78.207	64.659
Lignite	0.085	0.104	0.058	0.019	0.018	0.369	0.195	0.265	0.380	0.250	0.317
Hard coal briquettes (patent fuels)	0.023	0.023	0.000	0.000	0.000	0.205	0.205	0.059	0.029	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	1.965	1.910	1.970	1.984	2.339	3.171	7.180	3.839	15.051	12.927	10.694
Fuel wood and wood waste	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.101
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
Industrial wastes	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.080	0.040
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	3.609	3.569	3.334	2.936	2.650	3.249	2.708	2.565	3.192	2.850	2.080
Liquid petroleum gas (LPG)	0.046	0.046	0.046	0.046	0.046	0.046	0.092	0.138	0.184	0.184	0.276
Motor gasoline	0.440	0.264	0.135	0.090	0.135	0.180	0.135	0.180	0.180	0.045	0.090
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086	0.000	0.000	0.000
Diesel oil	2.087	1.534	1.244	1.030	0.901	1.201	1.072	0.901	5.448	5.191	6.821
Fuel oil	1.840	1.640	1.640	1.480	1.320	3.280	3.920	6.120	2.720	2.400	2.680
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.336	0.120	0.111	0.125	0.124	0.102	0.003	0.025	0.004	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.027	0.032	0.051	0.014	0.001	0.001	0.000	0.000	0.003	0.000	0.000
Fuels											
Liquid fuels	4.413	3.484	3.065	2.646	2.402	4.707	5.219	7.425	8.612	7.900	9.907
Gaseous fuels	1.965	1.910	1.970	1.984	2.339	3.171	7.180	3.839	15.051	12.927	10.694
Solid fuels	29.280	35.542	35.468	39.034	35.517	59.569	56.912	75.938	92.385	81.307	67.056
Other fuels	0.003	0.002	0.000	0.000	0.031	0.003	0.003	0.000	0.000	0.000	0.000
Biomass	0.114	0.105	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.104
Total	**35.775**	**41.043**	**40.594**	**43.758**	**40.361**	**67.601**	**69.370**	**87.284**	**116.142**	**102.209**	**87.761**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	46.327	43.417	40.020	41.803	39.030	36.095	35.894	30.864	31.182	26.778	25.814
Lignite	0.237	0.191	0.149	0.192	0.175	0.129	0.092	0.074	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950
Fuel wood and wood waste	0.069	0.049	0.062	0.060	0.323	0.373	0.214	0.239	0.164	0.365	0.192
Biogas	0.020	0.063	0.042	0.037	0.063	0.074	0.068	0.072	0.084	0.094	0.109
Industrial wastes	0.000	0.001	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.710	1.624	1.368	1.539	1.340	1.226	0.969	0.855	0.912	0.656	0.656
Liquid petroleum gas (LPG)	0.460	0.690	0.874	1.426	1.380	1.564	1.426	1.196	0.920	1.012	0.966
Motor gasoline	0.045	0.135	0.045	0.090	0.090	0.000	0.045	0.045	0.045	0.045	0.045
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	7.465	7.336	7.250	6.864	6.864	6.178	5.405	4.504	4.076	4.504	3.132
Fuel oil	2.280	2.520	2.720	2.960	3.040	3.280	3.160	2.920	2.760	2.000	1.440
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	10.250	10.681	10.889	11.340	11.374	11.022	10.036	8.665	7.801	7.561	5.583
Gaseous fuels	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950
Solid fuels	48.274	45.232	41.557	43.534	40.545	37.450	36.955	31.793	32.094	27.434	26.470
Other fuels	0.000	0.001	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.089	0.112	0.104	0.097	0.386	0.447	0.282	0.311	0.248	0.459	0.301
Total	**67.868**	**66.520**	**63.927**	**67.461**	**67.380**	**65.083**	**64.729**	**59.392**	**60.757**	**56.179**	**53.304**

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

Fuels	2010	2011	2012
Hard coal	25.907	25.614	26.149
Lignite	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	21.610	22.128	23.704
Fuel wood and wood waste	0.441	0.534	0.443
Biogas	0.101	0.145	0.208
Industrial wastes	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	0.627	0.542	0.314
Liquid petroleum gas (LPG)	0.828	0.782	0.690
Motor gasoline	0.045	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	2.874	2.360	3.319
Fuel oil	1.240	1.360	1.360
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	4.987	4.502	5.369
Gaseous fuels	21.610	22.128	23.704
Solid fuels	26.534	26.156	26.463
Other fuels	0.000	0.000	0.000
Biomass	0.542	0.679	0.651
Total	**53.673**	**53.465**	**56.187**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	158.688	147.564	111.152	109.155	98.584	157.660	157.182	160.662	192.053	169.694	131.898
Lignite	1.052	0.841	0.331	0.714	0.274	0.815	0.392	0.783	0.749	0.574	0.470
Hard coal briquettes (patent fuels)	0.233	0.139	0.088	0.029	0.000	0.000	0.000	0.000	0.030	0.000	0.000
Brown coal briquettes	0.123	0.089	0.060	0.060	0.040	0.040	0.040	0.040	0.040	0.040	0.040
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	52.767	50.455	40.219	34.461	36.058	39.907	38.844	40.694	40.860	41.717	44.738
Fuel wood and wood waste	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.978	6.529	8.199	8.237
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.001	0.002
Industrial wastes	0.464	0.504	0.090	0.035	0.401	0.548	1.738	2.491	2.819	1.180	2.300
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.120	1.840	1.720
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	39.594	37.281	26.734	21.346	22.117	21.118	18.041	15.732	16.758	12.625	12.112
Liquid petroleum gas (LPG)	0.184	0.138	0.138	0.092	0.092	0.092	0.230	0.184	0.184	0.506	0.690
Motor gasoline	1.716	1.584	1.122	1.302	0.898	0.942	0.538	1.032	0.628	2.335	0.763
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.043	0.172	0.215	0.172	0.559	0.258	0.301	0.258
Diesel oil	15.549	14.186	11.368	9.609	8.065	8.495	8.108	9.609	20.335	18.361	15.230
Fuel oil	9.720	9.960	6.320	4.640	5.960	7.280	8.040	11.120	6.960	7.400	10.440
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	5.183	4.599	3.774	2.805	2.075	1.709	0.537	0.935	0.531	0.363	0.999
Blast furnace gas	0.140	0.118	0.101	0.106	0.079	0.108	0.120	0.053	0.053	0.036	0.010
Gas works gas	5.382	4.817	4.002	3.593	2.918	2.414	2.152	1.804	1.034	0.503	0.331
Fuels											
Liquid fuels	27.169	25.868	18.948	15.686	15.187	17.024	17.088	22.504	28.485	30.743	29.101
Gaseous fuels	52.767	50.455	40.219	34.461	36.058	39.907	38.844	40.694	40.860	41.717	44.738
Solid fuels	210.395	195.448	146.242	137.808	126.087	183.864	178.464	180.009	211.248	183.835	145.860
Other fuels	0.464	0.504	0.090	0.035	0.401	0.548	1.738	2.491	2.819	1.180	2.300
Biomass	10.113	9.468	6.981	5.973	5.077	5.028	3.414	4.980	6.530	8.200	8.239
Total	**300.909**	**281.743**	**212.480**	**193.963**	**182.810**	**246.371**	**239.548**	**250.678**	**289.942**	**265.675**	**230.238**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	109.930	94.010	73.101	60.843	55.377	54.257	51.254	49.569	60.409	51.066	37.444
Lignite	0.316	0.267	0.158	0.125	0.055	0.009	0.009	0.019	0.000	0.072	0.163
Hard coal briquettes (patent fuels)	0.000	0.059	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.040	0.040	0.020	0.020	0.040	0.040	0.040	0.040	0.060	0.120	0.100
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	40.269	46.523	50.178	52.506	56.740	60.829	62.287	65.056	66.426	66.574	64.617
Fuel wood and wood waste	8.606	10.111	10.991	12.592	11.999	12.445	12.028	11.167	13.030	13.999	14.035
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.003
Industrial wastes	2.045	2.624	2.337	2.595	3.984	3.491	4.413	8.840	6.906	8.560	9.108
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.003	0.013	0.717	1.620	1.777	0.378	4.419
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.001	0.029
Other petroleum products	0.760	0.240	0.040	0.080	0.080	0.120	0.080	0.120	0.080	0.080	0.040
Petroleum coke	0.000	0.000	0.000	0.000	4.416	3.232	7.072	3.584	1.568	1.152	2.752
Coke	10.888	9.150	7.211	6.328	6.640	5.786	3.220	3.905	5.330	3.364	2.735
Liquid petroleum gas (LPG)	1.104	1.978	1.840	2.714	2.622	2.990	2.208	1.610	1.472	1.564	1.426
Motor gasoline	0.359	0.314	0.179	0.134	0.224	0.180	0.179	0.224	0.135	0.090	0.179
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.215	0.129	0.129	0.086	0.043	0.043	0.086	0.129	0.086	0.043	0.043
Diesel oil	13.170	12.397	11.840	11.926	12.440	12.397	12.656	12.955	11.797	11.326	10.983
Fuel oil	9.480	7.480	7.400	7.440	7.240	7.360	7.000	5.520	3.600	3.680	3.240
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.811	0.417	0.917	0.783	0.863	1.940	1.480	1.528	1.673	1.570	1.266
Blast furnace gas	0.005	0.011	0.003	0.003	0.000	0.013	0.013	0.000	0.000	0.000	0.007
Gas works gas	0.304	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	25.088	22.538	21.428	22.380	27.065	26.322	29.281	24.142	18.738	17.935	18.663
Gaseous fuels	40.269	46.523	50.178	52.506	56.740	60.829	62.287	65.056	66.426	66.574	64.617
Solid fuels	122.294	103.954	81.410	68.102	62.975	62.045	56.016	55.061	67.472	56.192	41.715
Other fuels	2.045	2.624	2.337	2.595	3.987	3.504	5.130	10.460	8.683	8.938	13.527
Biomass	8.606	10.111	10.991	12.592	11.999	12.445	12.028	11.169	13.036	14.001	14.067
Total	**198.302**	**185.750**	**166.344**	**158.175**	**162.766**	**165.145**	**164.742**	**165.888**	**174.355**	**163.640**	**152.589**

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

Fuels	2010	2011	2012
Hard coal	39.398	44.498	34.384
Lignite	0.313	0.646	0.817
Hard coal briquettes (patent fuels)	0.000	0.029	0.000
Brown coal briquettes	0.080	0.200	0.100
Crude oil	0.000	0.000	0.000
Natural gas	68.129	68.590	65.556
Fuel wood and wood waste	17.759	20.449	22.080
Biogas	0.000	0.000	0.000
Industrial wastes	10.539	11.799	12.239
Municipal waste - non-biogenic fraction	4.512	5.017	3.913
Municipal waste – biogenic fraction	0.123	1.338	1.360
Other petroleum products	0.120	0.120	0.120
Petroleum coke	1.792	0.064	0.000
Coke	2.908	2.906	2.678
Liquid petroleum gas (LPG)	1.564	1.564	1.196
Motor gasoline	0.269	0.135	0.089
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.043	0.043	0.000
Diesel oil	10.555	11.325	9.039
Fuel oil	3.320	3.120	2.360
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	1.634	1.891	1.697
Blast furnace gas	0.009	0.012	0.004
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	17.663	16.371	12.804
Gaseous fuels	68.129	68.590	65.556
Solid fuels	44.342	50.182	39.680
Other fuels	15.051	16.816	16.152
Biomass	17.882	21.787	23.440
Total	**163.067**	**173.746**	**157.632**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	207.335	163.251	54.547	62.166	54.214	50.334	34.666	34.267	25.608	18.696	16.200
Lignite	0.540	0.390	0.000	0.000	0.000	0.017	0.091	0.025	0.026	0.009	0.009
Hard coal briquettes (patent fuels)	5.749	1.581	0.000	0.000	0.000	0.000	0.000	0.322	0.000	0.000	0.000
Brown coal briquettes	0.548	0.476	0.420	0.000	0.000	1.780	1.820	1.940	0.240	0.540	0.120
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769
Fuel wood and wood waste	0.000	0.000	4.501	2.945	0.000	12.312	11.719	11.560	10.046	9.028	8.437
Biogas	0.084	0.123	0.379	0.187	0.206	0.062	0.249	0.423	0.579	0.599	0.648
Industrial wastes	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	80.500	77.450	34.712	28.264	40.068	33.402	27.332	25.878	26.220	28.642	13.480
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	1.334	0.782	0.782	1.748	1.564
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.473	0.559	1.763	2.064
Diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.987	4.290	6.220
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	1.417	1.135	1.224	1.088	0.877	0.428	0.123	0.053	0.034	0.127	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.937	0.330	0.312	0.554	0.576	0.091	0.014	0.014	0.014	0.072	0.040
Fuels											
Liquid fuels	0.000	0.000	0.000	0.000	0.000	0.000	1.334	1.255	2.328	7.881	9.848
Gaseous fuels	13.079	12.601	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769
Solid fuels	297.025	244.614	91.215	92.072	95.735	86.052	64.046	62.499	52.142	48.086	29.849
Other fuels	2.135	0.144	0.504	0.081	0.011	0.352	0.089	0.000	0.124	0.000	0.003
Biomass	0.084	0.123	4.880	3.132	0.206	12.374	11.968	11.983	10.625	9.627	9.085
Total	**312.322**	**257.481**	**110.386**	**106.262**	**107.142**	**110.326**	**87.010**	**88.997**	**83.990**	**89.850**	**81.554**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	15.104	13.354	13.460	21.677	21.539	22.502	25.405	29.320	25.291	28.763	31.393
Lignite	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.520	0.380	0.000	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	37.696	38.567	49.971	61.001	67.057	69.570	68.410	63.517	65.488	71.250	75.746
Fuel wood and wood waste	8.553	8.514	5.736	5.747	5.752	6.028	6.171	4.580	5.482	5.012	7.098
Biogas	0.663	0.678	0.860	0.683	0.700	0.558	0.343	0.505	0.291	0.876	0.848
Industrial wastes	0.004	0.004	0.091	0.092	0.060	0.002	0.022	0.000	0.000	0.000	0.092
Municipal waste - non-biogenic fraction	0.000	0.020	0.000	0.009	0.011	0.000	0.000	0.000	0.000	0.037	0.031
Municipal waste – biogenic fraction	0.000	0.019	0.000	0.010	0.014	0.013	0.030	0.028	0.029	0.008	0.000
Other petroleum products	0.640	0.880	3.000	0.360	1.720	2.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	12.226	8.265	3.819	8.122	8.180	5.928	2.679	2.878	2.594	2.080	2.138
Liquid petroleum gas (LPG)	2.070	2.300	3.266	3.358	5.520	5.014	4.600	5.244	4.922	4.462	3.772
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	1.892	1.763	0.645	0.387	0.258	0.000	0.000	0.000	0.000	0.043	0.086
Diesel oil	7.636	13.342	15.015	19.090	16.774	14.286	13.213	23.252	22.866	22.866	21.707
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.005	0.005	0.004	0.003	0.004	0.003	0.003	0.003	0.014	0.018	0.017
Fuels											
Liquid fuels	12.238	18.285	21.926	23.195	24.272	21.300	17.813	28.496	27.788	27.371	25.565
Gaseous fuels	37.696	38.567	49.971	61.001	67.057	69.570	68.410	63.517	65.488	71.250	75.746
Solid fuels	27.864	22.004	17.283	29.822	29.723	28.433	28.087	32.202	27.900	30.862	33.550
Other fuels	0.004	0.024	0.091	0.101	0.071	0.002	0.022	0.000	0.000	0.037	0.123
Biomass	9.216	9.211	6.596	6.440	6.466	6.599	6.544	5.113	5.802	5.896	7.946
Total	**87.018**	**88.091**	**95.867**	**120.559**	**127.589**	**125.904**	**120.876**	**129.328**	**126.978**	**135.416**	**142.930**

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

Fuels	2010	2011	2012
Hard coal	36.517	31.197	32.690
Lignite	1.475	0.702	0.531
Hard coal briquettes (patent fuels)	0.000	0.000	0.146
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	83.433	78.134	77.360
Fuel wood and wood waste	7.929	7.818	6.834
Biogas	0.994	2.430	2.663
Industrial wastes	0.019	0.011	0.008
Municipal waste - non-biogenic fraction	0.005	0.035	0.028
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.080	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	2.109	1.824	0.513
Liquid petroleum gas (LPG)	3.404	3.312	4.048
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.043	0.043	0.043
Diesel oil	27.156	25.397	18.603
Fuel oil	0.080	0.040	0.000
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	0.001	0.001	0.001
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.017	0.018	0.014
Fuels			
Liquid fuels	30.763	28.792	22.694
Gaseous fuels	83.433	78.134	77.360
Solid fuels	40.119	33.742	33.895
Other fuels	0.024	0.046	0.036
Biomass	8.923	10.248	9.497
Total	**163.262**	**150.962**	**143.482**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	543.559	489.774	272.689	358.521	351.542	372.347	309.920	305.701	326.681	271.980	213.584
Lignite	2.911	1.180	0.526	0.042	0.000	2.956	4.403	4.279	3.420	2.626	1.772
Hard coal briquettes (patent fuels)	17.200	4.742	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	1.627	1.427	1.240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268
Fuel wood and wood waste	33.615	32.351	34.335	27.721	33.969	106.000	104.715	105.000	101.000	100.000	100.700
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	31.927	30.721	14.866	12.110	26.732	30.752	27.788	27.502	28.044	32.775	19.950
Liquid petroleum gas (LPG)	6.762	7.452	1.702	1.012	1.840	6.072	8.970	12.834	16.100	18.400	18.400
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.145	6.435	8.580
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	15.996	15.134	15.155	13.706	11.334	6.779	3.560	1.723	0.226	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	4.655	3.697	3.088	1.307	0.739	0.431	0.418	0.258	0.222	0.181	0.164
Fuels											
Liquid fuels	6.762	7.452	1.702	1.012	1.840	6.072	8.970	12.834	18.245	24.835	26.980
Gaseous fuels	102.581	107.619	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268
Solid fuels	617.874	546.675	307.564	385.686	390.347	413.265	346.089	339.463	358.593	307.562	235.470
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	33.615	32.351	34.335	27.721	33.969	106.000	104.715	105.000	101.000	100.000	100.700
Total	**760.831**	**694.097**	**465.805**	**548.093**	**567.368**	**666.927**	**611.445**	**616.856**	**620.895**	**582.419**	**501.418**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	223.330	166.012	184.730	171.709	164.455	175.723	203.593	236.664	216.419	234.225	233.649
Lignite	1.286	1.169	1.373	1.482	1.605	1.919	2.006	2.168	1.972	2.565	2.219
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	135.995	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857
Fuel wood and wood waste	95.000	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	18.525	11.685	11.970	8.550	8.550	7.125	2.992	3.278	1.425	1.140	5.928
Liquid petroleum gas (LPG)	19.320	20.240	20.700	21.390	25.300	23.920	23.000	23.000	23.920	24.380	25.254
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	9.781	17.160	21.450	22.952	22.952	21.450	19.305	19.305	15.444	11.583	7.936
Fuel oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.163	0.158	0.151	0.134	0.128	0.113	0.095	0.099	0.081	0.071	0.069
Fuels											
Liquid fuels	29.101	37.400	42.150	44.342	48.252	45.370	42.305	42.305	39.364	35.963	33.190
Gaseous fuels	135.995	127.611	133.737	127.093	127.629	126.376	135.111	138.686	132.622	131.450	134.857
Solid fuels	243.304	179.024	198.224	181.875	174.738	184.880	208.686	242.209	219.897	238.001	241.865
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	95.000	95.000	104.500	104.500	103.075	103.360	100.700	104.500	102.000	102.500	102.500
Total	**503.400**	**439.035**	**478.611**	**457.810**	**453.694**	**459.986**	**486.802**	**527.700**	**493.883**	**507.914**	**512.412**

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

Fuels	2010	2011	2012
Hard coal	284.655	230.777	243.699
Lignite	4.035	3.593	3.619
Hard coal briquettes (patent fuels)	0.000	0.000	0.000
Brown coal briquettes	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000
Natural gas	148.427	135.471	141.397
Fuel wood and wood waste	112.746	115.000	116.850
Biogas	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	6.526	5.700	5.415
Liquid petroleum gas (LPG)	24.840	23.000	23.000
Motor gasoline	0.000	0.000	0.000
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	4.504	4.719	3.799
Fuel oil	0.000	0.000	0.000
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.067	0.059	0.040
Fuels			
Liquid fuels	29.344	27.719	26.799
Gaseous fuels	148.427	135.471	141.397
Solid fuels	295.283	240.129	252.773
Other fuels	0.000	0.000	0.000
Biomass	112.746	115.000	116.850
Total	**585.800**	**518.319**	**537.819**

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

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	38.608	38.489	36.365	57.356	62.959	62.501	60.542	58.583	62.611	52.483	46.050
Lignite	1.581	1.139	0.844	1.018	0.911	0.814	1.642	1.698	1.299	1.292	1.419
Hard coal briquettes (patent fuels)	0.598	0.527	0.645	0.146	0.088	0.059	0.059	0.000	0.000	0.000	0.000
Brown coal briquettes	0.106	0.106	0.040	0.020	0.020	0.000	0.000	0.000	0.000	0.000	0.000
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.868
Fuel wood and wood waste	0.039	0.113	0.039	0.278	0.583	20.057	18.367	18.500	17.567	17.000	17.100
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	1.786	1.754	1.568	1.168	0.684	0.570	4.018	4.018	4.104	5.130	5.700
Liquid petroleum gas (LPG)	0.000	0.000	0.000	0.000	0.000	0.000	0.460	0.690	1.150	1.380	1.380
Motor gasoline	0.000	0.000	0.000	0.000	0.000	0.674	1.122	1.122	1.122	1.212	1.122
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	53.967	51.972	53.968	51.995	60.661	74.989	81.381	85.457	94.380	109.481	99.099
Fuel oil	10.264	9.469	9.231	8.179	7.133	18.066	22.052	13.957	8.242	10.974	8.862
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.012	0.010	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.001	0.002	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001
Fuels											
Liquid fuels	64.230	61.441	63.199	60.174	67.794	93.729	105.015	101.226	104.894	123.047	110.463
Gaseous fuels	0.507	0.445	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.868
Solid fuels	42.691	42.026	39.465	59.710	64.662	63.946	66.261	64.299	68.014	58.905	53.170
Other fuels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	0.039	0.113	0.039	0.278	0.583	20.057	18.367	18.500	17.567	17.000	17.100
Total	**107.467**	**104.025**	**103.151**	**120.437**	**133.094**	**177.864**	**189.855**	**184.268**	**190.903**	**199.523**	**181.601**

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

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hard coal	49.162	33.231	36.975	30.820	29.693	31.728	35.673	42.074	37.748	41.640	41.538
Lignite	1.097	0.939	1.236	1.395	1.528	2.086	2.188	2.489	2.125	2.770	2.485
Hard coal briquettes (patent fuels)	0.000	0.000	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.059	0.029
Brown coal briquettes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.040	0.040
Crude oil	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Natural gas	0.476	0.536	0.777	0.914	1.197	1.182	1.084	1.492	1.840	1.900	1.577
Fuel wood and wood waste	17.100	17.100	19.043	19.010	19.017	19.878	19.038	19.977	19.060	19.024	19.030
Biogas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Industrial wastes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.006	0.012	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.006	0.013	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke	5.130	3.420	3.705	2.850	2.850	1.995	1.140	1.425	0.855	0.826	0.855
Liquid petroleum gas (LPG)	1.610	1.840	2.300	2.760	3.220	3.220	3.220	2.300	2.300	2.346	2.070
Motor gasoline	1.347	1.392	0.943	0.269	0.314	0.224	0.269	0.314	0.224	0.224	0.224
Aviation gasoline	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Diesel oil	101.458	111.969	104.590	104.247	105.105	107.207	109.395	81.510	75.075	75.075	72.930
Fuel oil	8.674	8.428	8.221	6.805	8.195	8.606	9.455	3.846	3.397	3.474	4.342
Feedstocks	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fuels											
Liquid fuels	113.089	123.629	116.054	114.081	116.834	119.257	122.339	87.970	80.996	81.119	79.566
Gaseous fuels	0.476	0.536	0.777	0.914	1.197	1.182	1.084	1.492	1.840	1.900	1.577
Solid fuels	55.389	37.590	41.916	35.065	34.071	35.838	39.001	46.028	40.728	45.335	44.947
Other fuels	0.006	0.012	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biomass	17.106	17.113	19.053	19.010	19.017	19.878	19.038	19.977	19.060	19.024	19.030
Total	**186.066**	**178.880**	**177.811**	**169.070**	**171.119**	**176.155**	**181.462**	**155.467**	**142.624**	**147.378**	**145.120**

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

Fuels	2010	2011	2012
Hard coal	50.605	41.488	43.707
Lignite	1.667	1.337	1.327
Hard coal briquettes (patent fuels)	0.029	0.059	0.059
Brown coal briquettes	0.000	0.000	0.020
Crude oil	0.000	0.000	0.000
Natural gas	1.486	1.531	1.796
Fuel wood and wood waste	21.088	23.931	20.948
Biogas	0.000	0.271	0.400
Industrial wastes	0.000	0.000	0.000
Municipal waste - non-biogenic fraction	0.000	0.000	0.000
Municipal waste – biogenic fraction	0.000	0.000	0.000
Other petroleum products	0.000	0.000	0.000
Petroleum coke	0.000	0.000	0.000
Coke	0.940	0.998	0.285
Liquid petroleum gas (LPG)	2.300	2.346	2.300
Motor gasoline	0.045	0.045	0.045
Aviation gasoline	0.000	0.000	0.000
Jet kerosene	0.000	0.000	0.000
Diesel oil	72.801	73.445	75.329
Fuel oil	3.516	3.953	4.066
Feedstocks	0.000	0.000	0.000
Refinery gas	0.000	0.000	0.000
Coke oven gas	0.000	0.000	0.000
Blast furnace gas	0.000	0.000	0.000
Gas works gas	0.000	0.000	0.000
Fuels			
Liquid fuels	78.662	79.789	81.740
Gaseous fuels	1.486	1.531	1.796
Solid fuels	53.241	43.882	45.398
Other fuels	0.000	0.000	0.000
Biomass	21.088	24.202	21.348
Total	**154.477**	**149.404**	**150.282**

Table 13. CO2 EFs [kg/GJ] for coal and lignite in 1.A.1.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	95.58	95.57	95.25	95.11	94.97	94.97	94.95	94.98	94.96	94.95	94.91	94.92
Lignite	111.47	110.88	109.87	109.76	109.28	109.90	110.03	108.95	109.04	108.90	108.41	108.31
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.97	94.97	94.94	94.93	94.98	94.95	94.92	94.97	94.98	94.90	94.97	95.01
Lignite	108.72	108.21	108.64	108.56	108.84	107.83	107.88	107.54	107.20	107.52	108.62	109.56
	2012											
Hard coal	94.99											
Lignite	109.76											

Table 14. CO2 EFs [kg/GJ] for coal and lignite in 1.A.1.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.64	94.76	94.64	94.81	94.72	94.86	94.64	94.59	94.58	94.55
Lignite												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.64							94.64	94.64	94.64
Lignite												109.53
	2012											
Hard coal	94.64											
Lignite	109.74											

Table 15. CO2 EFs [kg/GJ] for coal and lignite in 1.A.1.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	95.30	95.37	94.70	94.73	94.65	94.81	94.71	94.86	94.60	94.55	94.55	94.51
Lignite	111.39	110.71	103.84	105.02	106.21	104.86	103.76	108.93	109.01	105.71	108.39	103.45
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.59	94.54	94.51	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.67	94.69
Lignite	104.58	105.50	104.33	105.94	105.96	105.87	105.62	106.15	106.87	106.39	108.60	109.53
	2012											
Hard coal	94.66											
Lignite	109.74											

Table 16. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.54
Lignite				104.75						106.72		
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.46	94.68	94.55	94.37	94.15
Lignite												
	2012											
Hard coal	93.92											
Lignite												

Table 17. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.52	94.37	94.49	94.53	94.59	94.43	94.43	93.51				94.71
Lignite												
	2012											
Hard coal	94.69											
Lignite												

Table 18. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite	105.16	104.93	103.84	104.75	106.72	105.13	104.14	108.93	109.01	105.66	108.39	103.47
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.56	94.55	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.68	94.70
Lignite												
	2012											
Hard coal	94.70											
Lignite												

Table 19. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.d category .

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.59	94.58	94.55
Lignite												
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.45	94.70	94.75	94.68	94.70
Lignite												
	2012											
Hard coal	94.70											
Lignite												

Table 20. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.e category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.55
Lignite	105.14	104.92	104.14	104.75	106.72	104.90	103.84	108.93	109.01	105.67	108.39	103.40
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.44	94.69	94.75	94.67	94.70
Lignite	104.57	105.47	104.38	105.87	105.85	105.91	105.71					
	2012											
Hard coal	94.70											
Lignite												

Table 21. CO2 EFs [kg/GJ] for coal and lignite in 1.A.2.f category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.68	94.70	94.73	94.65	94.81	94.71	94.86	94.63	94.58	94.58	94.55
Lignite	105.15	104.92	103.89	105.15	106.18	104.84	103.66	108.93	103.02	105.68	108.39	103.40
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.62	94.57	94.55	94.53	94.59	94.34	94.52	94.45	94.69	94.75	94.68	94.70
Lignite	104.62	105.54	104.33	106.04	106.72	106.72	104.75	0.00	106.72	106.49	108.60	109.53
	2012											
Hard coal	94.70											
Lignite	109.74											

Table 22. CO2 EFs [kg/GJ] for coal and lignite in 1.A.4.a category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.71	94.64	94.80
Lignite	111.07	110.71				108.93	110.02	109.72	108.16	106.72	106.72	106.72
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.84	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.61	94.06
Lignite											109.72	109.61
	2012											
Hard coal	93.96											
Lignite	111.17											

Table 23. CO2 EFs [kg/GJ] for coal and lignite in 1.A.4.b category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.72	94.65	94.80
Lignite	111.07	110.71	109.64	109.40	0.00	108.61	109.92	108.97	108.20	108.42	108.46	108.59
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.85	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.61	94.06
Lignite	108.78	108.55	107.94	108.96	109.67	108.09	108.14	108.93	107.15	107.25	109.70	109.61
	2012											
Hard coal	93.96											
Lignite	111.19											

Table 24. CO2 EFs [kg/GJ] for coal and lignite in 1.A.4.c category

Fuels	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Hard coal	94.70	94.76	94.76	94.76	94.57	94.75	94.82	94.89	94.44	94.71	94.65	94.80
Lignite	111.07	110.71	109.61	109.01	108.12	108.61	109.92	108.97	108.19	108.41	108.47	108.60
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Hard coal	94.84	94.94	94.87	94.68	94.34	94.14	93.99	94.20	94.04	94.05	93.61	94.06
Lignite	108.76	108.54	107.93	108.98	109.67	108.09	108.14	108.93	107.15	107.25	109.71	109.61
	2012											
Hard coal	93.96											
Lignite	111.19											

Table 25. CO_2 EFs [kg/GJ] applied for other fuels in the years 1988-2012 for stationary sources in 1.A.1, 1.A.2 and 1.A.4 categories [IPCC 1997, IPCC 2006]

Fuels	EF
Hard coal briquettes (patent fuels)	92.71
Brown coal briquettes	92.71
Crude oil	72.60
Natural gasl	55.82
Fuel wood and wood waste	*109.76*
Biogas	*54.33*
Industrial wastes	*140.14*
Municipal waste - non-biogenic fraction	*89.87*
Municipal waste – biogenic fraction	*98.00*
Other petroleum products	72.60
Petroleum coke	99.83
Coke	106.00
Liquid petroleum gas (LPG)	62.44
Motor gasoline	68.61
Aviation gasoline	*69.30*
Jet kerosene	70.79
Diesel oil	73.33
Fuel oil	76.59
Feedstocks	72.60
Refinery gas	66.07
Coke oven gas	47.43
Blast furnace gas	240.79
Gas works gas	*44.18*

EF from [IPCC 2006] are marked in italics.

Table 26. CH_4 EFs [kg/GJ] applied for the years 1988-2012 for stationary sources [IPCC 2006, IPCC 1997]

Fuels	1.A.1	1.A.2	1.A.4.a	1.A.4.b-c
Hard coal	0.0010	0.0100	0.0100	0.3000
Lignite	0.0010	0.0100	0.0100	0.3000
Hard coal briquettes (patent fuels)	0.0010	0.0100	0.0100	0.3000
Brown coal briquettes	0.0010	0.0100	0.0100	0.3000
Crude oil	0.0030	0.0030	0.0100	0.0100
Natural gasl	0.0010	0.0050	0.0050	0.0050
Fuel wood and wood waste	0.0300	0.0300	0.3000	0.3000
Biogas	0.0010	0.0010	0.0050	0.0050
Industrial wastes	0.0300	0.0300	0.3000	0.3000
Municipal waste - non-biogenic fraction	0.0300	0.0300	0.3000	0.3000
Municipal waste – biogenic fraction	0.0300	0.0300	0.3000	0.3000
Other petroleum products	0.0030	0.0030	0.0100	0.0100
Petroleum coke	0.0030	0.0030	0.0100	0.0100
Coke	0.0010	0.0100	0.0100	0.3000
Liquid petroleum gas (LPG)	0.0010	0.0010	0.0050	0.0050
Motor gasoline	0.0030	0.0030	0.0100	0.0100
Aviation gasoline	0.0030	0.0030	0.0100	0.0100
Jet kerosene	0.0030	0.0030	0.0100	0.0100
Diesel oil	0.0030	0.0030	0.0100	0.0100
Fuel oil	0.0030	0.0030	0.0100	0.0100
Feedstocks	0.0030	0.0030	0.0100	0.0100
Refinery gas	0.0010	0.0010	0.0050	0.0050
Coke oven gas	0.0010	0.0010	0.0050	0.0050
Blast furnace gas	0.0010	0.0010	0.0050	0.0050
Gas works gas	0.0010	0.0010	0.0050	0.0050

Table 27. N_2O EFs [kg/GJ] applied for the years 1988-2012 for stationary sources in 1.A.1, 1.A.2 and 1.A.4 categories [IPCC 2006]

Fuels	EF
Hard coal	0.0015
Lignite	0.0015
Hard coal briquettes (patent fuels)	0.0015
Brown coal briquettes	0.0015
Crude oil	0.0006
Natural gasl	0.0001
Fuel wood and wood waste	0.0040
Biogas	0.0001
Industrial wastes	0.0040
Municipal waste - non-biogenic fraction	0.0040
Municipal waste – biogenic fraction	0.0040
Other petroleum products	0.0006
Petroleum coke	0.0006
Coke	0.0015
Liquid petroleum gas (LPG)	0.0001
Motor gasoline	0.0006
Aviation gasoline	0.0006
Jet kerosene	0.0006
Diesel oil	0.0006
Fuel oil	0.0006
Feedstocks	0.0006
Refinery gas	0.0001
Coke oven gas	0.0001
Blast furnace gas	0.0001
Gas works gas	0.0001

Annex 3.1. Calculation of CO_2 emission from 2.A.3 subcategory: *Limestone and dolomite use*

Table 1. Estimation of CO_2 emission from dolomite use in production of dead burned dolomite and calcined dolomite for the years 1988-2012 (all values in the table are expressed in gigagrams [Gg])

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Dead burned dolomite and calcined dolomite production	436	403	264	267	249	198	218	233	201	198	158	148	174	161	153	114	152
Dolomite use in dead burned dolomite and calcined dolomite	836	773	506	511	477	380	418	446	385	380	302	283	334	308	293	219	290
CO2 emission from dolomite decomposition	**400**	**370**	**242**	**244**	**228**	**182**	**200**	**213**	**184**	**182**	**145**	**135**	**160**	**147**	**140**	**105**	**139**

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Dead burned dolomite and calcined dolomite production	128	140	129	127	84	94	85	67
Dolomite use in dead burned dolomite and calcined dolomite	245	269	247	244	162	179	162	129
CO2 emission from dolomite decomposition	**117**	**129**	**118**	**117**	**77**	**86**	**78**	**62**

Table 2. Estimation of CO_2 emission from dolomite use in glass production for the years 1988-2012 (all values in the table are expressed in gigagrams [Gg])

	1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Glass container production	436	403	264	267	249	198	218	233	201	874	918	928	976	993	970	968	1108
Float glass production	672	670	577	592	565	624	712	777	811	245	352	332	341	296	406	506	540
Production of glass -flat drown	-	-	-	-	-	-	-	65	133	115	106	86	84	87	89	73	81
Dolomite use for glass container production	430	452	345	323	308	295	266	189	121	70	73	74	78	79	78	77	89
Dolomite use for float glass production	54	54	46	47	45	50	57	62	65	44	63	60	61	53	73	91	97
Dolomite use for production of glass - flat drown	0	0	0	0	0	0	0	12	24	10	10	8	8	8	8	7	7
Sum of dolomite use in glass production	39	41	31	29	28	27	24	17	11	124	146	142	147	141	159	175	193
CO2 emission from dolomite decomposition	**92**	**94**	**77**	**76**	**73**	**76**	**81**	**91**	**100**	**59**	**70**	**68**	**70**	**67**	**76**	**84**	**92**

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Glass container production	1083	1116	1210	1270	1202	1281	1305	1422
Float glass production	540	651	644	720	718	820	903	957
Production of glass -flat drown	47	47	47	28	0	0	43	35
Dolomite use for glass container production	87	89	97	102	96	102	104	114
Dolomite use for float glass production	97	117	116	130	129	148	163	172
Dolomite use for production of glass - flat drown	4	4	4	3	0	0	4	3
Sum of dolomite use in glass production	188	211	217	234	225	250	271	289
CO2 emission from dolomite decomposition	**90**	**101**	**104**	**112**	**108**	**120**	**130**	**138**

Table 3. Estimation of CO_2 emission from limestone use in glass production for the years 1988-2012 (all values in the table are expressed in gigagrams [Gg])

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Glass container production	672	670	577	592	565	624	712	777	811	874	918	928	976	993	970	968	1108
Float glass producton	-	-	-	-	-	-	-	65	133	245	352	332	341	296	406	506	540
Production of glass -flat drown	430	452	345	323	308	295	266	189	121	115	106	86	84	87	89	73	81
Domestic glassware production	70	70	62	58	53	48	54	64	67	70	74	79	79	81	83	89	98
Technical glass production	95	95	74	50	40	44	46	48	52	52	65	64	68	54	53	53	69
Limestone consumption for glass container production	94	94	81	83	79	87	100	109	114	122	129	130	137	139	136	136	155
Limestone consumption for float glass producton	0	0	0	0	0	0	0	3	7	12	18	17	17	15	20	25	27
Limestone consumption for production of glass -flat drown	52	54	41	39	37	35	32	23	15	14	13	10	10	10	11	9	10
Limestone consumption for production of domestic glassware and technical glass	8	8	7	5	5	5	5	6	6	6	7	7	7	7	7	7	8
Sum of limestone use in glass production	154	156	129	127	121	127	137	140	141	155	166	164	171	171	174	177	200
CO2 emission from limestone decomposition	**68**	**69**	**57**	**56**	**53**	**56**	**60**	**62**	**62**	**68**	**73**	**72**	**75**	**75**	**76**	**78**	**88**

	2005	2006	2007	2008	2009	2010	2011	2012
Glass container production	1083	1116	1210	1270	1202	1281	1305	1422
Float glass producton	540	651	644	720	718	820	903	957
Production of glass -flat drown	47	47	47	28	0	0	43	35
Domestic glassware production	97	102	115	107	63	72	79	72
Technical glass production	65	70	70	68	59	60	60	66
Limestone consumption for glass container production	152	156	169	178	168	179	183	199
Limestone consumption for float glass producton	27	33	32	36	36	41	45	48
Limestone consumption for production of glass -flat drown	6	6	6	3	0	0	5	4
Limestone consumption for production of domestic glassware and technical glass	8	9	9	9	6	7	7	7
Sum of limestone use in glass production	192	203	216	226	210	227	240	258
CO2 emission from limestone decomposition	**85**	**89**	**95**	**99**	**93**	**100**	**106**	**114**

Table 4. Estimation of CO_2 emission from calcite use as limestone sorbents to desulfurize the off-gases by wet method (lime WFGD) in the years 1988-2012 (all values in the table are expressed in gigagrams [Gg])

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Desulphurization plaster production in lime wet FGD	0	0	0	0	0	0	0	175	474	583	674	860	1140	1134	1038	1109	1250
Consumption of limestone sorbents to desulfurize the off-gases by wet method (lime WFGD)	0	0	0	0	0	0	0	104	282	346	400	511	677	673	617	659	742
Limestone consumption in lime WFGD	0	0	0	0	0	0	0	99	268	329	380	485	643	640	586	626	705
CO2 emission from decomposition of calcium carbonate in WFGD	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**43**	**118**	**145**	**167**	**214**	**283**	**281**	**258**	**275**	**310**

	2005	2006	2007	2008	2009	2010	2011	2012
Desulphurization plaster production in lime wet FGD	1177	1240	1338	1596	2076	2389	2561	2742
Consumption of limestone sorbents to desulfurize the off-gases by wet method (lime WFGD)	699	736	795	948	1233	1418	1521	1628
Limestone consumption in lime WFGD	664	700	755	900	1171	1347	1445	1547
CO2 emission from decomposition of calcium carbonate in WFGD	**292**	**308**	**332**	**396**	**515**	**593**	**636**	**680**

Table 5. Estimation of CO_2 emission from decomposition of calcite use to desulfurize the off-gases in fluid bad boilers (FGD in FBB) and in other method of flue gas desulfurization (FGD other than lime WFGD) in the years 1988-2012 (all values in the table are expressed in gigagrams [Gg])

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
SO2 emission captured by FGD in power plants and autoproducers CHP	916	924	766	786	857	900	990	1048	1178	1321	1379	1426	1620	1630	1699	1881	1939
SO2 captured with use of lime wet FGD method	0	0	0	0	0	0	0	65	176	217	251	320	424	422	386	413	465
SO2 captured with use of other FGD method	916	924	766	786	857	900	990	983	1002	1104	1128	1106	1196	1208	1313	1468	1474
Consumption of limestone sorbents to desulfurize the off-gases in FBB and in FGD other than lime wet FGD	1574	1588	1317	1351	1473	1547	1702	1689	1721	1898	1939	1901	2055	2076	2256	2524	2533
Limestone consumption in FGD in FBB and in FGD other than lime wet FGD	1543	1556	1290	1324	1444	1516	1668	1656	1687	1860	1900	1863	2014	2035	2211	2473	2482
CO2 emission from calcium carbonate in FGD in FBB and in FGD other than lime WFGD	**679**	**685**	**568**	**583**	**635**	**667**	**734**	**728**	**742**	**818**	**836**	**820**	**886**	**895**	**973**	**1088**	**1092**

	2005	2006	2007	2008	2009	2010	2011	2012
SO2 emission captured by FGD in power plants and autoproducers CHP	1967	2075	2091	2178	2136	2299	2524	2297
SO2 captured with use of lime wet FGD method	438	461	498	594	773	889	953	1020
SO2 captured with use of other FGD method	1529	1614	1593	1584	1363	1410	1571	1277
Consumption of limestone sorbents to desulfurize the off-gases in FBB and in FGD other than lime wet FGD	2628	2773	2738	2723	2343	2424	2700	2195
Limestone consumption in FGD in FBB and in FGD other than lime wet FGD	2575	2718	2683	2668	2297	2375	2646	2151
CO2 emission from calcium carbonate in FGD in FBB and in FGD other than lime WFGD	**1133**	**1196**	**1181**	**1174**	**1010**	**1045**	**1164**	**946**

Table 6. Estimation of total CO_2 emission values from limestone and dolomite use in 2.A.3 subcategory for the years 1988-2012 (all values in the table are expressed in gigagrams [Gg])

	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Sum of CO2 emissions from limestone and dolomite use presented in the tables 1-5	1191	1168	904	919	951	941	1032	1090	1154	1272	1291	1308	1475	1466	1523	1630	1722
CO2 emission from limestone and dolomite use in glass production, already included in GHG inventory in 2.A.7 subcategory	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO2 emission from limestone and dolomite use in 2.A.3 subcategory	**1191**	**1168**	**904**	**919**	**951**	**941**	**1032**	**1090**	**1154**	**1272**	**1291**	**1308**	**1475**	**1466**	**1523**	**1630**	**1722**

	2005	2006	2007	2008	2009	2010	2011	2012
Sum of CO2 emissions from limestone and dolomite use presented in the tables 1-5	1717	1822	1830	1898	1804	1943	2113	1940
CO2 emission from limestone and dolomite use in glass production, already included in GHG inventory in 2.A.7 subcategory	157	176	181	158	125	139	183	176
CO2 emission from limestone and dolomite use in 2.A.3 subcategory	**1560**	**1647**	**1649**	**1740**	**1678**	**1805**	**1930**	**1765**

Annex 3.2. Calculation of CO_2 process emission from ammonia production (2.B.1)

Table 1. Calculation of CO_2 process emission from ammonia production

		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Activity data	**Unit**												
natural gas	[10^3 m3]	2 184 552	2 230 523	1 447 064	1 447 326	1 337 619	1 401 804	1 688 887	1 942 704	1 907 689	1 937 127	1 789 006	1 587 228
natural gas	TJ	76 413	77 862	50 625	50 911	47 044	49 522	60 161	69 070	67 919	69 049	64 163	56 105
coke oven gas	[10^3 m3]	183 960	113 672	30 560									
coke oven gas	TJ	3 204	1 970	537									
CO_2 emission from natural gas use	Gg	4 205	4 294	2 786	2 786	2 575	2 698	3 251	3 740	3 672	3 729	3 444	3 055
CO_2 emission from coke oven gas use	Gg	153	94	26									
Total CO2 emission	Gg	4 358	4 388	2 811	2 786	2 575	2 698	3 251	3 740	3 672	3 729	3 444	3 055
Ammonia production	Gg	2389.353	2433.726	1531.552	1560.883	1480.798	1630.946	1945.470	2248.317	2185.188	2251.616	2047.948	1784.726
Implied EF of CO_2 process emission	[MgCO2/ Mg NH3]	1.82	1.80	1.84	1.78	1.74	1.65	1.67	1.66	1.68	1.66	1.68	1.71

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Activity data	**Unit**												
natural gas	[10^3 m3]	1 965 162	1 873 685	1 455 329	2 122 465	2 177 127	2 310 818	2 197 622	2 186 299	2 221 406	1 814 589	1 881 957	2 061 524
natural gas	TJ	70 483	68 096	52 144	76 053	77 817	82 219	78 591	78 072	79 351	63 478	67 234	73 798
coke oven gas	[10^3 m3]												
coke oven gas	TJ												
CO_2 emission from natural gas use	Gg	3783	3607	2802	4086	4191	4448	4230	4209	4276	3493	3623	3 968
CO_2 emission from coke oven gas use	Gg												
Total CO2 emission	Gg	3783	3607	2802	4086	4191	4448	4230	4209	4276	3493	3623	3 968
Ammonia production	Gg	2243.108	2103.805	1594.797	2246.505	2451.557	2523.790	2326.621	2417.543	2485.148	2010.891	2059.437	2321.849
Implied EF of CO_2 process emission	[MgCO2/ Mg NH3]	1.69	1.71	1.76	1.82	1.71	1.76	1.82	1.74	1.72	1.74	1.76	1.71

		2012
Activity data	**Unit**	
natural gas	[10^3 m3]	2 242 281
natural gas	TJ	81 150
coke oven gas	[10^3 m3]	
coke oven gas	TJ	
CO_2 emission from natural gas use	Gg	4 316
CO_2 emission from coke oven gas use	Gg	
Total CO2 emission	Gg	4 316
Ammonia production	Gg	2467.458
Implied EF of CO_2 process emission	[MgCO2/ Mg NH3]	1.75

Annex 4. Energy balance data for main fuels in 2012

Energy balances in 2012 for several main fuels: lignite, natural gas, coke oven gas and blast furnace gas are given below. Similar balance data for hard coal are presented in Chapter 1.4.

Lignite consumption

National fuel balance	Lignite - Eurostat	
	10^3 Mg	TJ
In	64 427	534 388
From national sources	64 280	533 136
1) Indigenous production	64 280	533 136
2) Transformation output or return	0	0
3) Stock decrease	0	0
Import	147	1 252
Out	64 427	534 388
National consumption	64 155	534 147
1) Transformation input	63 334	527 305
a) input for secondary fuel production	0	0
b) fuel combustion	63 334	527 305
2) Direct consumption	822	6 842
Non-energy use	1	7
Combusted directly	821	6 835
Combusted in Poland	64 155	534 141
Stock increase	138	1 146
Export	134	1 108
Losses and statistical differences	0	-2 012

Net calorific value	MJ/kg	8.33

Natural gas consumption

National fuel balance	Natural gas - Eurostat
	TJ
In	580 746
From national sources	160 250
1) Indigenous production	160 250
2) Transformation output or return	0
3) Stock decrease	0
Import	420 496
Out	580 746
National consumption	568 390
1) Transformation input	80 622
a) input for secondary fuel production	0
b) fuel combustion	80 622
2) Direct consumption	487 768
Non-energy use	83 816
Combusted directly	403 952
Combusted in Poland	484 573
Stock increase	11 192
Export	107
Losses and statistical differences	1 057

Coke oven gas consumption

National fuel balance	Coke Oven Gas - Eurostat
	TJ
In	65 321
From national sources	65 321
1) Indigenous production	0
2) Transformation output or return	65 321
3) Stock decrease	0
Import	0
Out	65 321
National consumption	65 211
1) Transformation input	21 332
a) input for secondary fuel production	0
b) fuel combustion	21 332
2) Direct consumption	43 879
Non-energy use	0
Combusted directly	43 879
Combusted in Poland	65 211
Stock increase	0
Export	0
Losses and statistical differences	110

Blast furnace gas consumption

National fuel balance	Blast furnace gas - Eurostat
	TJ
In	22 684
From national sources	22 684
1) Indigenous production	0
2) Transformation output or return	22 684
3) Stock decrease	0
Import	0
Out	22 684
National consumption	22 684
1) Transformation input	11 173
a) input for secondary fuel production	0
b) fuel combustion	11 173
2) Direct consumption	11 510
Non-energy use	0
Combusted directly	11 510
Combusted in Poland	22 684
Stock increase	0
Export	0
Losses and statistical differences	0

Annex 5.
Methodological notes related to elaboration of representative research on livestock animals performed by Central Statistical office
[GUS R1 (2013)]

METHODICAL NOTES

I. SOURCES OF DATA

The data in this publication were compiled on the basis of:

- generalized results of sample surveys[a/] on cattle, sheep, poultry and pigs, as well as, the animal output in private farms,
- statistical reports in the scope of livestock in state and cooperative farms and companies with public and private property share,
- statistical reports from slaughter houses of farm animals,
- statistical reports from poultry hatcheries,
- information on the livestock of poultry from voivodship experts,
- own estimates.

Surveys on cattle, sheep, poultry and animal output were conducted in approx. of the sample of private farms breeding the above-listed species of animals; this sample amounted to 30 thousand farms.

Surveys on pigs and production of pigs for slaughter were carried out in a sample of private farms breeding pigs; this sample amounted to 30 thousand farms.

The results of the survey of farm animal stocks and animal output were compiled by voivodship according to the residence of the land user, i.e. for private farms – according to the official residence (place of residence) of the land user, while for state owned farms, cooperative farms and companies – according to the official residence of the enterprise (farm).

II. MAJOR DEFINITIONS, TERMS AND ENUMERATION RULES

An agricultural farm is understood as an organised economic and technical unit with separate management (a user or a manager), conducting agricultural activity.

An agricultural activity shall include activity related to cultivation of plants and rearing and breeding of animals, which covers: all field crops (including mushrooms), vegetable gardening and horticulture, nurseries, cultivation and seed production of agricultural and horticultural crops as well as activity related to rearing and breeding of animals (cattle, sheep, goats, horses, pigs, poultry, rabbits, fur-covered animals, game kept

a/ The surveys on cattle, sheep and poultry stock are conducted twice a year, i.e. in June and in December, while the survey on pigs – three times a year, i.e. in April, August and December.

for slaughter), bees as well as activity consisting in maintaining the land no longer used for production purposes in accordance with cultivation principles with respect for environment protection requirements (according to the norms).

A natural person is holding (private farm) is understood as a farm owned or used by a natural person of the area of at least 1.0 ha and more of agricultural land or a farm of the area of less than 1.0 ha, excluding agricultural land, which meets at least one of the thresholds mentioned below:

- 0,5 ha of fruit-bearing trees plantation,
- 0,5 ha of fruit-bearing shrubs plantation,
- 0,3 ha of fruit and ornamental nurseries,
- 0,5 ha of soil-grown vegetables,
- 0,5 ha of soil-grown strawberries,
- 0,1 ha of vegetables under cover,
- 0,1 ha of strawberries under cover,
- 0,1 ha of flowers and ornamental plants under cover,
- 0,5 ha of hop,
- 0,1 ha of tobacco,
- 25 m^2 of edible mushrooms,
- 10 head of cattle in total,
- 5 head of cows in total,
- 50 head of pigs in total,
- 10 head of sows,
- 20 head of sheep in total,
- 20 head of goats in total,
- 100 head of poultry for slaughter in total,
- 80 head of poultry for laying in total,
- 5 head of horses in total,
- 50 head of female rabbits,
- 80 beehives.

A legal person's or organizational unit without legal status is understood as farm run by a legal person or an organization unit without legal personality, the basic activity of which is rated, according to the Polish Classification of Activities, to Section A, division 01, group:

- growing of non perennial,

- 01.2 – growing of perennial plants,
- 01.3 – plant propagation,
- 01.4 – livestock production and breeding,
- 01.5 – cultivation of plants combined with rearing and breeding of animals (mixed agricultural activity),
- 01.6, class 01.61 – service activities supporting plant production (maintaining the lands in accordance with cultivation principles with respect for environment protection requirements), and also, irrespective of the basic activity classification, when the area of agricultural land per the lands used by an individual is 1 ha and more or when livestock is reared and bred.

A holder is understood as a natural person or a legal person or an organisational unit without legal personality, actually using the land, regardless of whether as owners or leaseholders, or using the land in any other respect, regardless of whether this land is situated in one or in several gminas.

Livestock

The survey covered the livestock staying in the farm during the survey period, as well as animals sent to herding, grazing and shepherd’s huts. All animals were registered, i.e. the ones owned by an agriculture holding user or members of his household, as well as animals temporarily or permanently kept in the farm, i.e. taken for raising, fattening, etc., irrespective of the fact whether they were taken from private farms, state-owned farms, cooperative entities, or companies.

Dairy cows are understood as cows which, due to their breed, species or particular qualities, are kept in a farm exclusively or mainly for production of milk to be consumed or to be processed into dairy products. Dairy cows rejected from breeding, kept in a farm for the period regarded as pre-slaughter pasturing, after which they are sent to slaughter, are also included in this group.

Suckling cows are understood as cows which, due to their breed (beef breed cows and cows born from a cross-breed with beef breeds) or particular qualities, are kept in a farm exclusively or mainly for calves for slaughter, and whose milk is used to feed calves or other animals. Suckling cows rejected from breeding, kept in a farm for the period regarded as pre-slaughter pasturing, after which they are sent to slaughter, are also included in this group.

In the case of farms engaged in production of poultry on a large scale (such as a large-scale farm producing broilers or hen eggs), in which no poultry has been recorded on the survey day due to the current technological break in production, whenever such break does not exceed 8 weeks, the poultry stocks from the period before emptying the rooms (poultry houses) have been adopted.

Information on the number of cattle, sheep and poultry contained in this publication referes to the stocs in June and December 20112, while the data of pigs to the stocs in March, July and November 2012.

III. MAJOR GROUPS AND THE SCOPE OF PUBLISHED DATA

The data regarding the farm animals stocks as well as the elements of cattle and pigs turnover were classified according to ownership forms, i.e. for the private sector, as well as the public one.

The **private sector** includes: entities of state domestic ownership (private farms, cooperative farms and private domestic companies), foreign ownership and mixed ownership.

The **public sector** includes state owned farms (of the State Treasury and state legal persons), farms owned by self-governments (gminas) and entities of mixed ownership (companies with a predominance of public property).

As regards the private sector the data in this publication are presented for the following farms:

- of state domestic ownership, including:
    - private farms,
    - agricultural production cooperatives,
- of foreign ownership,
- of mixed ownership.

As regards the public sector the data were compiled for farms:

- of state ownership (state owned farms), including farms of the State Treasury ownership,
- farms owned by self-governments.

The percentages are presented with one decimal point and due to the electronic technique of rounding may not sum up into 100%. These figures are substantially correct.

IV. SAMPLING SCHEME

Survey on cattle, sheep and poultry stock

1. Introductory notes

The purpose of the surveys conducted by the Central Statistical Office twice a year (i.e. in June and in December) is to obtain detailed information on the number of cattle and poultry, both by voivodships and for Poland, and on the number of sheep for Poland only. The surveyed population consists of private agricultural farms which, according to the results of the Agricultural Census 2010, were keeping cattle, or poultry, or sheep, and farms with the area of agricultural land of 15 ha or more, which did not keep the above mentioned species of animals. The surveyed population in 2012 consisted of 909, 523 farms, of which approx. 854 thousand farms keeping cattle, poultry, or sheep. It was decided that the sample for the survey would consist of approx. 30 thousand private farms.

2. Sampling frame

The results of the Agricultural Census 2010 were used for establishing the sampling frame. An individual agricultural farm constituted a sampling unit. The following information was recorded for each farm:

- voivodship code,
- farm number (Nr_gos),
- total farm area,
- agricultural land in the farm ,
- number of cattle,
- number of poultry,
- number of sheep.

3. Sampling scheme

Before sampling, the population of farms was divided into three parts. **The first part** included farms fulfilling at least one of the following criteria, i.e. farms with at least one head of cattle or farms with more than 50 head of poultry and without any sheep. This part of population included 574, 901 farms. **The second part** consisted of farms with no cattle or sheep, and with no more than 50 head of poultry. Furthermore, the farms which did not keep the above mentioned animals at all, but having the area of agricultural land of 15 ha or more were also included in this group. The second part amounted to 323, 335 farms. Finally, **the third part** included farms keeping sheep, and It amounted to 11, 287 farms.

Sample drawing was done with a stratified and optimal sampling scheme. The number of cattle and poultry was used in the first part of the population as the criteria for stratification and allocation of the sample between the strata. In the second part, the strata were established on the basis of the agricultural land, whereas in the third part – on the basis of the number of head of sheep. There were created 12 strata in each voivodship, of which 7 related to farms from the first part, and 5 related to farms from the second part. In the third part, 6 national strata were established, i.e. strata that covered farms from all voivodships.

It was decided that a sample consisting of approx. 21 thousand farms be drawn from **the first part** farms.

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

(1) the size of **n** sample is established for the population of farms in Poland, and not for individual voivodships, where n consists of approx. 21,000 farms,

(2) the sample is drawn in individual voivodships according to the stratified and optimal sampling scheme, with the use of the Neyman method,

(3) the population in each voivodship is first divided into 7 strata (h = 1, 2, …., 7), and the sample is then allocated between these strata,

(4) stratum no. 7 (i.e. h = 7) in each voivodship consists of such sampling units for which the value of variables adopted as the stratification basis is above the specified threshold. The stratum created in this way, so called the upper stratum, includes the units which are not drawn, but which are all included in the sample,

(5) it has been assumed that the expected accuracy of the survey results, measured with the variation coefficient of the livestock of cattle or poultry, will be identical for each voivodship and will be approximately equal to 1.0%.

The above problem was solved with the use of the numerical optimization method[1]. The population was divided into strata whose (upper) boundaries expressed in the number of cattle and poultry were presented in Table 1.

Table 1. Boundaries of strata by voivodship in the survey on cattle, sheep, and poultry stocks in 2012.

WOJ.	B – cattle D - poultry	b_1	b_2	b_3	b_4	b_5	b_6
02	B	5	12	23	40	65	111
	D	413	452	527	942	1,598	17,998
04	B	9	19	32	50	76	133
	D	213	264	279	407	513	7,393
06	B	4	10	20	34	55	93
	D	101	122	127	170	217	3,029
08	B	8	18	30	48	75	116
	D	1,185	1,445	2,165	4,995	16,525	41,995
10	B	5	12	22	35	55	122
	D	164	211	357	429	519	9,919
12	B	2	5	10	17	30	53
	D	101	123	123	173	174	3,049
14	B	9	18	32	58	92	144
	D	187	217	233	386	530	10,199
16	B	8	17	29	46	72	116
	D	350	373	660	807	1,532	29,998
18	B	1	2	4	9	20	27
	D	42	82	101	102	135	453
20	B	9	21	29	32	52	144
	D	66	78	79	104	109	1,002
22	B	7	15	27	42	64	102
	D	413	427	507	673	892	16,998
24	B	5	11	21	37	60	101
	D	455	510	572	1,032	3,198	19,998
26	B	2	3	5	6	14	48
	D	39	64	73	119	163	316
28	B	13	27	43	69	107	175
	D	430	567	795	992	5,998	18,998
30	B	10	21	36	58	91	153
	D	417	525	594	1,084	1,699	21,099
32	B	7	16	29	45	69	115
	D	322	432	437	747	773	13,998

[1] The description of the solution to this problem was published in the article written by B. Lednicki and R. Wieczorkowski “Optimal Stratification and Sample Allocation Between Subpopulation and Strata”, Statistics in Transition”, book 10, 2003, Warsaw

The boundaries of stratum 6, i.e. b_6, presented in Table 1, constitute also a **threshold** above which the farms are included in stratum 7, which means that they are not subject to sampling, but are all included in the sample. For other strata, i.e. h = 1, 2, … , 6, the Neyman optimal allocation method was applied for establishing the values of n_{wh}, i.e. size of the samples drawn from the h-stratum in w-voivodship.

After that, 20, 807 farms were drawn to the sample, based on the assumed allocation, including 3,861 farms from stratum no. 7.

Before sampling, 5 strata were established in each voivodship in **the second part** (h = 8, 9,…., 12). These strata were created in respect of agricultural land, i.e.: h = 8: farms of less than 1 ha, h = 9: farms of 1 ha to 4.99, h = 10: farms of 5 ha to 14.99 ha, h = 11: farms of 15 ha to 49.99 ha, h = 12: farms of 50 ha or more. Identical accuracy of the number of poultry in this part of the population was adopted as the criterion for allocation of the sample between voivodships, while within voivodships the sample was allocated by means of the Neyman optimal method. From this part of the population 6,938 farms were drawn.

In **the third part**, in which 6 national strata were established (h = 13, 14, ..., 18), 2,255 farms were drawn for the sample. **All farms from stratum 18 were included in the sample.** These were farms keeping sheep and simultaneously 50 or more head of cattle, or at least 400 head of poultry. The boundaries of other strata, and the assumed number of the sample allocated between these strata, were established with the above mentioned numerical optimisation method. The upper stratum (h = 17) was also established, from which no farms were drawn. This stratum included farms which had not been previously included in stratum 18, and which kept more than 75 head of sheep. The upper boundaries of the remaining strata were the following: $b_{13} = 2$, $b_{14} = 6$, $b_{15} = 13$, $b_{16} = 24$. The aim of establishing this category of farms as a separate one, as well as optimising the division into strata, was to accurately estimate the data on the livestock of sheep in country terms, with no regional breakdown.

Eventually, the entire sample for the survey on cattle, poultry, and sheep consisted of 30000 farms.

4. Results generalization and the accuracy assessment method

The sum of X variable value, such as cattle stock in total, is the basic parameter estimated in the survey of livestock of cattle, sheep and poultry.

This parameter for w-voivodship is calculated according to the formula:

(1) $\hat{x}_w = \sum_h \sum_i W1_{whi} * x_{whi},$ (i = 1, 2, ... , n_{wh}; h = 1, 2, ... , 9)

where:

x_{whi} – the value of X variable in i-farm (sampling unit) drawn from h-stratum in w-voivodship,

$W1_{whi}$ – the weight assigned to i-farm drawn from h-stratum of w-voivodship,whereas this weight is calculated according to this formula:

(2) $$W1_{whi} = \frac{N_{wh}}{n_{wh}},$$

N_{wh} – the number of sampling units in h-stratum of w-voivodship,

n_{wh} – the number of sampling units drawn for the sample from h-stratum of w-voivodship.

The $W1_{whi}$ weight might be used to estimate the survey results only if the survey is completed. This weight must be corrected if some of the sampled farms refuse to participate in the survey. For this purpose, the drawn sample is divided into 4 groups based on information on the survey performance:

(1) the surveyed farms,
(2) farms that refused to participate in the survey,
(3) closed down farms etc.,
(4) farms with which the contact was not established during the survey performance.

For each stratum separately in each voivodship, the size of the above groups, namely $n1_{wh}$, $n2_{wh}$, $n3_{wh}$ and $n4_{wh}$ is established, and then the likelihood function of surveyed and not surveyed among the farms with a determined status is established, that is:

(3) $$c_{wh} = \frac{n1_{wh} + n2_{wh}}{n_{wh} - n4_{wh}},$$

Then the number of the n_{awh} active farms in h-stratum of w-voivodship is calculated for the drawn sample:

(4) $$n_{awh} = n1_{wh} + n2_{wh} + c_{wh} * n4_{wh}$$

On this basis, the R_{wh} correction factor is calculated for a given stratum:

(5) $$R_{wh} = \frac{n_{awh}}{n1_{wh}},$$

The purpose of this factor is to correct the $W1_{whi:}$ weight in order to obtain final $W_{hi:}$ weight:

(6) $$W_{whi} = R_{wh} * W1_{whi},$$

The sum of X variable value for Poland is the sum of values obtained for particular voivodships, i.e.:

(7) $\hat{x} = \sum_{w} \hat{x}_w,$ (w = 1, 2, ... , 16)

Original weights resulting from sampling are corrected not only due to incompleteness of the survey but also due to the occurrence of so called outliers, that is unusual farms. This pertains to farms with high assigned weight (drawn with a high likelihood function) and, at the same time, with relatively high values for some of the analysed variables. In this case, the weight correction is to prevent significant overestimation of the value of the surveyed variable.

For the selected major assessments of the parameters, their variation coefficients were calculated as the accuracy measures. For an estimator expressed by formula (1) i.e. for w-voivodship, its variation coefficient estimation is expressed in the following formula:

(8) $v\left(x_w\right) = \frac{\sqrt{d^2\left(\hat{x}_w\right)}}{\hat{x}_w} * 100,$

while:

(9) $d^2\left(\hat{x}_w\right) = \sum_{h} n_{awh}\left(1 - \frac{n_{wh}}{N_{wh}}\right) * s_{wh}^2,$

where:

(10) $s_{wh}^2 = \frac{1}{n_{awh} - 1} \sum_{i} \left(y_{whi} - \frac{1}{n_{awh}} * \hat{y}_{wh}\right)^2,$

while:

(11) $y_{whi} = W_{whi} * x_{whi},$

and:

(12) $\hat{y}_{wh} = \sum_{i} y_{whi},$

For Poland the variation coefficient of the sum X estimated with the formula (7) is expressed by the following formula:

(13) $v\left(\hat{x}\right) = \frac{\sqrt{d^2\left(\hat{x}\right)}}{\hat{x}},$

whereas:

$$(14)\quad d^2(\hat{x}) = \sum_w d^2(\hat{x}_w),$$

Survey on pigs

1. Introductory notes

The purpose of the surveys on pigs stocks, conducted by the Central Statistical Office three times a year (i.e. in April, in August and in December), is to obtain detailed information on the number of pigs by voivodships and for Poland. The surveyed population consists of individual farms which, according to the data of the Agricultural Census 2010, were keeping pigs, as well as farms with the area of agricultural land of 15 ha or more, but with no pigs. The surveyed population consisted of 499,284 farms, of which approx. 359.3 thousand of farms keeping pigs. It was decided that the sample for the survey would consist of approx. 30 thousand farms.

2. Sampling frame

Individual results of the Agricultural Census 2010 were employed in establishing the sampling frame. An individual agricultural farm constituted a sampling unit. The following information was recorded for each farm:

- voivodship code,
- farm number (Nr_gos),
- total farm area,
- agricultural land,
- number of pigs.

3. Sampling scheme

In order to draw sample, a stratified sampling and optimal scheme was used with respect to farms which, according to the sampling frame, reared pigs. In contrast, the stratified and proportional sampling was applied in each voivodship with respect to the population of farms which did not keep pigs. 2.0% of farms with the area of agricultural land of 15.00 – 49.99 ha, and 5.0% of farms with the area of agricultural land of 50.00 ha or more were drawn for the sample. In total, a sample consisting of 2,770 farms was drawn from this part of the population.

It was decided that a sample consisting of approx. 27 thousand farms be drawn from all farms breeding and rearing pigs.

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

(1) the size of **n** sample is established for the population of farms in Poland, and not for individual voivodships, where n consists of approx. 27 thousand farms,

(2) the sample is drawn in individual voivodships according to the stratified and optimal sampling scheme, by means of the Neyman method,

(3) the population in each voivodship is first divided into 7 strata (h = 1, 2, …. , 7), and then the sample is allocated between these strata,

(4) stratum no. 7 (i.e. h = 7) in each voivodship consists of such sampling units, for which the value of at least one of the variables adopted as the stratification basis is above the specified threshold. The stratum created this way, regarded as the upper stratum, includes the units which are not drawn, but which are all included in the sample,

(5) it has been assumed that the expected accuracy of the survey results, measured with the variation coefficient of the livestock of pigs, will be identical for each voivodship and will be equal approximately to 0.3%.

The above problem was solved with the use of the numerical optimization method[2]. The population was divided into strata whose (upper) boundaries expressed in the number of pigs were presented in Table 2 below.

Table 2. Boundaries of strata by voivodship in the survey on pigs stock in 2012.

VOIV.	b_1	b_2	b_3	b_4	b_5	b_6
02	4	9	17	27	45	68
04	16	33	59	95	153	269
06	4	8	16	28	51	106
08	5	13	24	37	53	76
10	6	16	28	47	85	174
12	3	7	14	24	37	63
14	6	15	29	54	104	203
16	12	29	48	76	115	175
18	-	-	8	16	27	50
20	4	9	17	30	58	110
22	9	19	37	57	93	146
24	6	15	25	40	64	97
26	4	9	17	28	47	80
28	7	20	38	68	113	180
30	16	38	67	113	191	371
32	7	18	37	69	146	1,286

[2] The description of the solution to this problem was published in the article written by B. Lednicki and R. Wieczorkowski “Optimal Stratification and Sample Allocation Between Subpopulation and Strata”, Statistics in Transition, book 10, 2003, Warsaw

The boundary of stratum 6, i.e. $\mathbf{b_6}$, presented in Table 2, also constitutes a **threshold, above which** the sampling units are included in stratum 7, which means they are not subject to sampling, but are all included in the sample. For other strata, i.e. h = 1, 2, … , 6, the Neyman optimal allocation method was employed for establishing the values of $n_{wh,}$ i.e. size of the samples drawn from the h-stratum in w-voivodship. In the case of one voivodship ("18"), as a result of applying numerical optimization procedures, the lower strata obtained were numerically too small, which caused strata 1 and 2 to be necessarily combined in one stratum no. 3. After that, 27, 230 farms were drawn to the sample, based on the assumed allocation, including 10,246 farms from stratum no. 7. Together with farms not keeping pigs (according to the sampling frame) fron stratum no. 8 (i.e. farms of the area of 15.00 ha to 49.99 ha of agricultural land) and stratum no. 9 farms (i.e. farms of 50 ha or more), the sample consisted of 30,000 farms.

4. Results generalization and the accuracy assessment method

The sum of X variable value, such as pigs stock in total, is the basic parameter estimated during the survey on the livestock of pigs.

This parameter for w-voivodship is calculated according to the formula:

(1) $\hat{x}_w = \sum_h \sum_i W1_{whi} * x_{whi},$ (i = 1, 2, ... , n_{wh}; h = 1, 2, ... , 9)

where:

x_{whi} – the value of X variable in i-farm (sampling unit) drawn from h-stratum in w-voivodship,

$W1_{whi}$ – weight assigned to i-farm drawn from h-stratum in w-voivodship, calculated on the basis of the following formula:

(2) $W1_{whi} = \frac{N_{wh}}{n_{wh}},$

N_{wh} – the number of sampling units in h-stratum of w-voivodship,

n_{wh} – the number of sampling units drawn from h-stratum of w-voivodship.

Weight $W1_{whi}$ can be used for the estimation of survey results only when the survey is complete. The weight must be adjusted when a part of farms drawn for the survey refuse to participate in the survey. For this purpose, the drawn sample is divided into 4 groups on the basis of information on carrying out the survey:

(1) the surveyed farms,

(2) farms which refused to participate in the survey,

(3) closed down farms etc.

(4) farms with which there was no contact during carrying out the survey.

For each stratum, separately for each voivodship, the size of the above groups, i.e. $n1_{wh}$, $n2_{wh}$, $n3_{wh}$ and $n4_{wh}$ is established, then the likelihood function of surveyed and not surveyed among the farms with a determined status is established, i.e.:

(3) $$c_{wh} = \frac{n1_{wh} + n2_{wh}}{n_{wh} - n4_{wh}},$$

Next, the number of the n_{awh} active farms in h-stratum of w-voivodship is calculated for the drawn sample:

(4) $$n_{awh} = n1_{wh} + n2_{wh} + c_{wh} * n4_{wh}$$

On the basis of this, the R_{wh} correction factor is calculated for a given stratum:

(5) $$R_{wh} = \frac{n_{awh}}{n1_{wh}},$$

The function of this factor is the correction of the $W1_{whi}$ weight in order to achieve final weight $W_{hi:}$

(6) $$W_{whi} = R_{wh} * W1_{whi},$$

The evaluation of the sum of X variable value for Poland is the sum of values obtained for particular voivodships, i.e.:

(7) $$\hat{x} = \sum_{w} \hat{x}_w, \qquad (w = 1, 2, \ldots , 16)$$

Primary weights resulting from sample drawing are corrected not only due to the incompleteness of the survey but also due to the occurrence of the so called outlier farms. This pertains to farms with high assigned weight (drawn with a high likelihood function) and, at the same time, with relatively high values for some of the analysed variables. Weight correction is aimed at preventing substantial overestimation of the value of the analysed variable.

For the selected major assessments of the parameters, their variation coefficients were estimated as the accuracy measures. For an estimator expressed by formula (1), i.e. for w-voivodship, its variation coefficient is estimated with the following formula:

(8) $$v\left(x_w\right) = \frac{\sqrt{d^2\left(\hat{x}_w\right)}}{\hat{x}_w} * 100,$$

while:

(9) $$d^2(\hat{x}_w) = \sum_h n_{awh}\left(1 - \frac{n_{wh}}{N_{wh}}\right) * s_{wh}^2,$$

where:

(10) $$s_{wh}^2 = \frac{1}{n_{awh}-1}\sum_i\left(y_{whi} - \frac{1}{n_{awh}} * \hat{y}_{wh}\right)^2,$$

while:

(11) $$y_{whi} = W_{whi} * x_{whi},$$

and:

(12) $$\hat{y}_{wh} = \sum_i y_{whi},$$

For Poland the variation coefficient of the sum X estimated with the formula (7) is expressed by the following formula:

(13) $$v(\hat{x}) = \frac{\sqrt{d^2(\hat{x})}}{\hat{x}},$$

whereas:

(14) $$d^2(\hat{x}) = \sum_w d^2(\hat{x}_w),$$

The values of the relative standard error of selected attributes for Poland – based on the results of a sample survey of the livestock of cattle, sheep and poultry as well as the results of a survey of pigs – conducted in December 2012.

No. of the attribute	Name of the attribute	Relative standard error
1.	Cattle total	0.74
2.	Cows	0.83
3.	Pigs total	0.67
4.	Sows total	0.69
5.	Hens	0.41
6.	Laying hens	0.76

Annex 6. Land use matrix

Table 1.Land use area for the period 1987-2012

Category	IPCC	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
		[ha]												
Arable land, orchards, permanent pastures and meadows (total)	5B	18857200	18834700	18804700	18783841	18759564	18740884	18712799	18689685	18663821	18632581	18607762	18592096	18557635
Arable land	5B	14480000	14464000	14414000	14342464	14323890	14306699	14287576	14268943	14248221	14224743	14205069	14179626	14152315
Orchards	5B	259000	238000	265000	321665	321170	320695	320478	319858	319918	319429	317996	316413	315029
Permanent meadows and pastures (total)	5C	4118200	4132700	4125700	4119712	4114504	4113490	4104745	4100884	4095682	4088409	4084697	4096057	4090291
Pastures	5C	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	2387639	2383437
Permanent meadows	5C	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	1708418	1706854
Agricultural built-up areas	5E	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Lands under ponds	5E	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Lands under ditches	5E	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Forest land as well as woody and bushy land	5A	8858000	8864500	8876000	8883692	8893709	8905569	8917160	8936738	8958359	8996177	9028914	9087164	9103593
Forests	5A	8660500	8667000	8678500	8693900	8706300	8718200	8715024	8724217	8741530	8778706	8809429	8861245	8877142
Woody and bushy land	5A	197500	197500	197500	189792	187409	187369	202136	212521	216829	217471	219485	225919	226451
Lands under waters	5D	821900	823300	825000	825728	826548	828069	829746	829665	831330	833298	832763	832869	833395
a) marine internal	5D	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	74984	75778
b) surface flowing	5D	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	456203	456644
c) surface standing	5D	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	140980	141127
d) ditches	5D	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	160702	159846
Built-up and urbanised areas	5E	1948100	1959500	1972400	1983021	1995064	2007360	2023244	2034536	2036820	2036100	2034472	2040413	2048902
Residential areas	5E	923600	932400	944000	820213	829082	837802	849670	858123	866181	874879	883060	733999	738966
Industrial areas	5E	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	86432	91200
Other built-up areas	5E	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	76112	71975
Urbanised un-built areas	5E	IE	IE	IE	70395	71260	70810	69232	70436	72042	73313	74827	71543	79627
Recreational areas	5E	IE	IE	IE	61612	61250	62077	63803	65205	65166	66027	66759	67809	69229
Transport areas	5E	982600	985600	987500	IE	IE	IE	IE	IE	IE	IE	IE	964614	959817
a) roads	5E	IE	IE	IE	866271	869400	872318	875504	877202	871277	860443	849493	845325	841773
b)rail areas	5E	IE	IE	IE	122927	121963	121691	121748	121101	121121	120312	120017	107527	105318
c) other	5E	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	11762	12726
Minerals	5E	41900	41500	40900	41603	42109	42662	43287	42469	41033	41126	40316	39904	38088
Ecological arable land	5D	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	4476	9456
Wasteland	5D	500200	500200	503500	504265	505872	505319	505219	505289	506303	506340	505489	501730	499783
Other	5F	251100	251100	255000	256124	256810	249945	248882	241036	239891	234005	231440	209754	215738
Miscellaneous land	5F	31800	35000	32200	31659	30935	31356	31452	31553	31978	30001	27662	NO	NO
Total	$\sum$	31268300	31268300	31268800	31268330	31268502	31268502	31268502	31268502	31268502	31268502	31268502	31268502	31268502

Table 1.Land use area for the period 1987-2012 cont.

Category	IPCC	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
								[ha]						
Arable land, orchards, permanent pastures and meadows (total)	5B	18523732	19161882	19184894	19207214	19148218	19098822	19069399	19024975	18980740	18930981	18869891	18825006	18770139
Arable land	5B	14129284	14095216	14058687	14090607	14074424	14059171	14036936	14027060	14002026	13969108	13921466	13890560	13850930
Orchards	5B	313376	310253	310098	307033	296542	289817	292414	289494	293031	292376	294836	292362	287199
Permanent meadows and pastures (total)	5C	4081071	4056350	4058656	4063487	4047433	4026446	4003150	3970770	3947905	3931092	3914003	3902606	3889487
Pastures	5C	2377429	2363326	2362929	2363360	2352841	2342935	2332943	2315293	2302422	2292770	2286565	2280351	2273889
Permanent meadows	5C	1703642	1693024	1695727	1700127	1694592	1683511	1670207	1655477	1645483	1638322	1627438	1622255	1615598
Agricultural built-up areas	5E	IE	508930	569384	552264	527235	518749	530493	530379	530671	530212	531895	530361	532829
Lands under ponds	5E	IE	33610	30917	38112	50445	55605	59383	61600	64733	70351	72326	74707	76267
Lands under ditches	5E	IE	157523	157152	155712	152140	149033	147022	145672	142373	137843	135365	134409	133427
Forest land as well as woody and bushy land	5A	9130719	9146564	9199286	9264017	9338464	9388544	9400680	9463453	9496122	9531015	9569734	9599599	9633820
Forests	5A	8903555	8915629	8968157	9031089	9106365	9152905	9164084	9224110	9251403	9275784	9304761	9329175	9353731
Woody and bushy land	5A	227164	230936	231129	232928	232099	235639	236597	239343	244719	255231	264973	270424	280088
Lands under waters	5D	833992	640414	645379	645427	636191	636653	636292	638244	640467	639833	645301	645543	647378
a) marine internal	5D	75780	77551	77808	78358	78152	79381	79129	79380	79222	79231	79232	79232	79245
b) surface flowing	5D	457056	457936	460281	466527	470627	475194	482481	486076	490095	494976	503891	505538	507588
c) surface standing	5D	141891	104927	107289	100542	87412	82079	74682	72788	71150	65625	62177	60774	60545
d) ditches	5D	159265	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Built-up and urbanised areas	5E	2056718	1522599	1453066	1458022	1475783	1490957	1494362	1510649	1529364	1550228	1572402	1589873	1612791
Residential areas	5E	737646	235992	187406	212506	233558	245247	248741	256578	268510	278479	287014	296600	306463
Industrial areas	5E	93405	93285	94257	96788	100487	104253	105971	108177	110041	112113	113005	113906	115591
Other built-up areas	5E	74443	72349	72107	80538	90328	99413	104949	111262	116820	122490	127660	132749	138214
Urbanised un-built areas	5E	87748	79796	68751	55293	57206	54547	52851	52265	51240	51406	54279	54021	53715
Recreational areas	5E	69747	65483	64241	63736	64690	64528	64906	65130	65209	65466	65403	64824	64853
Transport areas	5E	955429	939169	930376	914630	896865	891766	885651	886929	887571	891187	896217	899198	905393
a) roads	5E	837720	820280	810826	794588	780773	775959	770505	771268	773204	776163	780593	784096	790264
b)rail areas	5E	105029	105939	106557	106509	103985	103748	103466	103518	102678	102981	102799	102412	101933
c) other	5E	12680	12950	12993	13533	12107	12059	11680	12143	11689	12043	12825	12690	13196
Minerals	5E	38300	36526	35928	34530	32649	31202	31294	30308	29974	29087	28823	28575	28562
Ecological arable land	5D	11778	15670	17692	20064	25141	28240	30161	32830	33890	34372	34747	35338	35565
Wasteland	5D	499761	495079	493015	498613	497900	492773	488458	486761	485470	481737	479957	478800	476147
Other	5F	211792	286295	275171	175145	146805	132325	148586	111025	101885	99801	95936	93809	92128
Miscellaneous land	5F	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	∑	31268502	31268502	31268502	31268502	31268502	31268315	31267938	31267938	31267938	31267967	31267967	31267967	31267967

Annex 7. Quality Assurance and Quality Control Plan

Here are presented the basic elements of QA/QC plan which are to be implemented and co-ordinated by the National Centre for Emission Balancing and Management (KOBiZE), the unit responsible for Polish GHG inventory preparation. It follows the *IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories* (2000) recommendations. The main procedures for QA/QC activities are described in chapter 5 of the *National programme for Quality Assurance and Quality Control of Polish GHG inventory* [QA-QC 2012] and the detail check procedures are contained below as the examples of QC procedures performed by KOBiZE experts.

General timeframes of annual inventory preparation (including checking procedures), approval and submission are presented in the table 1. The dates for particular stages are established based on country specific availability of statistical data as well as national (legal) and international obligations.

Table 1. Timetable for inventory preparation and check for the year n-2 (n – submission year).

Timing	Activity
June -15 December (year n–1)	→ Data and emission factors collection (estimation) → Check for consistency data → Initial calculations and checks of GHG emissions considering ERT recommendations → Submission to the Ministry of Environment for acceptance
15 January (year n–2)	→ Submission of PL GHG inventory for the year n-2 and elements of NIR to the European Commission (required by dec. 280/2004//EC Article 3.1)
15 December – 15 February (year n–2)	→ Elaboration of final inventory, additional checks and final corrections to the inventory, preparation of NIR and CRF tables → Submission to the Ministry of Environment for acceptance
15 March (year n–2)	→ Submission of complete National Inventory Report and CRF tables to the European Commission (required by dec. 280/2004//EC Article 3.1)
15 April* (year n–2)	→ Submission of PL GHG inventory for the year n-2 to the UNFCCC Secretariat (CRF and NIR) (required by dec. 18/CP.8)

** National GHG Inventory should be submitted to the UNFCCC Secretariat 6 weeks after 15 April at the latest, which is 27 May, to comply with the reporting obligations*

Each IPCC sector undergoes detail QC procedure which is carried out by performer for given category/subcategory. Check for correctness of data, emission factors and calculation results are performed several times during the following stages of inventory elaboration: during its preparation, after completing the calculations, after CRF tables generation and after NIR report completing. Additionally part of the data, especially for Energy sector, are checked by other KOBiZE experts than those making inventory who are responsible for other sectors. As a part of QA activity the inventory team cooperates with specialists from different institutes, associations and individual experts who are involved in verification of data and assumptions to the inventory (see table 3). Additionally full National Inventory Report with CRF tables jest verified by the Ministry of Environment and cooperating agencies before official approval and submission it to the European Commission and UNFCCC Secretariat.

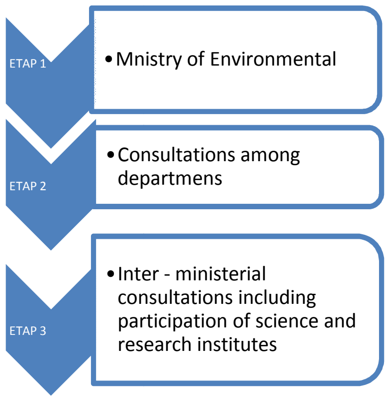
Depending on methodology used for emission estimation within categories Tier 1 or Tier 2 check procedures are carried out. The extended QC procedure for checking the correctness of emissions estimations is used for these categories where country specific emission factors are established. This concerns the key categories especially for such sectors like: fuel combustion (1.A), transport (1.A.3), cement production (2.A.1), enteric fermentation (4.A), manure management (4.B), agricultural soils (4.D) and others. For GHG emission sources for which Tier 1 method is used for emission calculation also Tier 1 method is applied for inventory checks. The categorisation of IPCC inventory sectors for Tier 1 and Tier 2 quality control procedures is shown in table 2.

For the purposes of documentation of data and calculations QC the files are archived in electronic and hardcopy forms.

Table 2. Categorisation of IPCC sectors for Quality Control Tier 1 and Tier 2 procedures.

Categories checked following the Tier 1 procedure (according to table 4)	**Categories checked following the Tier 2 procedure (according to table 5)**
1.A.1,2,4,5.a stationary combustion (solid, liquid and gaseous fuels) (CH_4, N_2O) **1.A.3** transport (except 1.A.3.b) (CO_2, CH_4, N_2O) **1.A.3.b** road transport (CH_4, N_2O)	**1.A.1, 1.A.2., 1.A.4, 1.A.5.a** stationary combustion (solid, liquid and gaseous fuels) (CO_2) **1.A.3.b** road transport (CO_2)
1.B.1.c other (except 1.B.1.a) **1.B.2** oil and natural gas (except of 1.B.2.b) (CO_2, CH_4)	**1.B.1.a** coal mining and handling (CH_4) **1.B.2.b** natural gas (CH_4)
2.A.4 soda ash prod. (CO_2) **2.B.4** carbide prod. (CO_2) **2.B.5** other (CO_2, CH_4, N_2O) **2.C** Metal production (except 2.C.1) (CO_2, CH_4) **2.E+2.F** production and consumption of halocarbons and SF_6	**2.A.1** cement production (CO_2) **2.A.2** lime production (CO_2). **2.B.1** ammonia production (CO_2) **2.B.2** nitric acid production (N_2O) **2.C.1** iron and steel production (CO_2)
3. Solvent and other product use	
4.B manure management (N_2O) **4.D.2** pasture, range and paddock manure (N_2O) **4.D.3** indirect soil emissions (N_2O) **4.F** field burning of agricultural residues (CH4, N_2O)	**4.A** enteric fermentation (CH_4) **4.B** manure management (CH_4) **4.D.1** direct soil emissions (N_2O)
5. LULUCF (except of 5.A) (CO_2, CH_4, N_2O)	**5.A** forest land (CO_2)
6.B wastewater handling (CH4, N_2O) **6.C** waste incineration (CO2, N_2O)	**6.A** solid waste disposal on land (CH_4)

Table 3. General plan for QC (KOBiZE) with QA (external review) activities within Polish GHG inventory.

<table>
<tr><th colspan="2">Action within inventory frames
for specific categories</th><th>internal QC (KOBiZE)</th><th>External check
(outside of KOBiZE)</th></tr>
<tr><td rowspan="6">Activity data:
Collection
Introduction
Reference description
Emission factors:
Choice
Calculation
Verification
Emission calculation</td><td>1. Energy</td><td>experts on energy and industrial processes
expert on energy and industrial processes for LRTAP
expert on transport
expert on waste</td><td rowspan="12">
</td></tr>
<tr><td>2. Industrial processes</td><td>expert on energy and industrial processes</td></tr>
<tr><td>3. Solvent and other product use</td><td>expert on waste</td></tr>
<tr><td>4. Agriculture</td><td>expert on agriculture</td></tr>
<tr><td>5. LULUCF</td><td>expert on LULUCF</td></tr>
<tr><td>6. Waste</td><td>expert on waste</td></tr>
<tr><td colspan="2">Elaboration of key categories</td><td>expert on waste</td></tr>
<tr><td colspan="2">Elaboration of uncertainties</td><td>expert on database</td></tr>
<tr><td colspan="2">Inserting data into CRF Reporter and data generation</td><td>expert on database</td></tr>
<tr><td colspan="2">Check of data processed by CRF Reporter against calculated data</td><td>expert for given category</td></tr>
<tr><td colspan="2">NIR preparation
in Polish and English (including automatization)</td><td>experts on energy and industrial processes
expert on agriculture
expert on transport
expert on waste
expert on database
expert on register</td></tr>
<tr><td colspan="2">Documentation & archiving of documentation</td><td>expert on database</td></tr>
</table>

Annex 8. Uncertainty assessment of the 2012 inventory

Uncertainty analysis for the year 2012 was performed with use of simplified approach described in *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* and *2006 IPCC Guidelines for National Greenhouse Gas Inventories*. Chosen methodology is based on the assumptions that every value is independent (there is no correlation between values) and probability distribution is symmetric (probability of underestimation and overestimation is the same).
Conclusions from the previous centralized reviews and in country review in 2013 were taken into account.
Latest major changes applied to uncertainties follow the recommendations of Emission Review Team from 2013, where uncertainty extending calculation environment to provide separate result for assessments including and excluding LULUCF sector. Another improvement triggered by ERT recommendation was calculation of overall uncertainty of inventory including information about uncertainties involved in estimation of Global Warming Potentials.

In submission 2014 for the first time was extended to provide uncertainty analysis of emission trend with use of 1998 emission inventory as a base year. Methodology of the analysis was described in Chapter 6 of mentioned above IPCC GPG Guidelines.

For industrial gases (HFC, PFC, SF6) due to lack of appropriate information, uncertainty estimates were applied directly to emission values.

First stage of the estimates was to assign uncertainty to each activity data and emission factor. Next step was to estimate error propagation and its influence on national total emissions. To estimate error propagation from activity and emission factor to emission values, formula (1) was used.

$$U_{emission} = \text{square root } (U_{act}^2 + U_{EF}^2) \quad (1)$$

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

$$U_{emission} = \text{square root } (\Sigma\ (\text{Emission} * U_{emission})^2) / \Sigma\ \text{Emission} \quad (2)$$

where: $U_{emission}$ – uncertainty of emission value in sector
Emission – emission from sector

As the base bottom level of analysis the following sectors were chosen:
- sector 1: levels 1.A.1, 1.A.2, 1.A.3., 1.A.4, 1.A.5 with disaggregation by fuel type (liquid, solid, gaseous, biomass etc.)
- sector 2: levels 2.A.1, 2.A.2 .... 2.C.3. (no estimates of emission from 2.D and 2.E)
- sector 3: top level only
- sector 4: 4.A.1, 4.A.2 .... 4.F.5
- sector 6: 6.A.1, 6.A.2; 6.B with disaggregation according to wastewater types and 6.C with disaggregation according to waste types.

Most of the estimates were based on default assumption described in methodology, but after investigation of socio-economic parameters literature data was applied to selected activities in sector *1. Energy* and for activities and emission factors in sector *2. Industrial processes.* Selected uncertainties for activities and factors in 6.C Waste/Waste Incineration were estimated with help expert's opinion in Emission Balancing and Reporting Unit (former National Emission Centre).

Results of analysis of error propagation of uncertainty of national totals for 2012 were shown below:

	CO_2	CH_4	N_2O	HFC	PFC	SF_6	All GHG recalculated to CO_2 eq.
Total uncertainty Including IPCC 5. LULUCF	3.7%	24.2%	43.3%	48.3%	76.6%	90.3%	**5.5%**
Emission recalculated to CO_2 eq [Gg] Including IPCC 5. LULUCF	286,189.28	43,305.05	30,134.92	7,700.22	41.81	42.06	367,413.33
Total uncertainty Excluding IPCC 5. LULUCF	2.1%	25.2%	44.1%	48.3%	76.6%	90.3%	**4.6%**
Emission recalculated to CO_2 eq [Gg] Excluding IPCC 5. LULUCF	320,861.67	41,032.63	29,589.58	7,700.22	41.81	42.06	399,267.97

Activity data

Most uncertain values of activity were assigned in category *4.F Agriculture/Field Burning of Agricultural Residues* and in *6.B Waste/Domestic and Commercial Wastewater* (30%). Lowest uncertainty values were assigned to *1.A.1 Energy/ Fuel Combustion,* especially in subsector 1.A.1 *Energy Industries* (2%,). In general Polish energy sector is responsible for 90 % of GHG emission and is covered with detailed national statistics, which allows to keep overall uncertainty of inventory low.

CO_2 emission factors

Most uncertain values for CO_2 emission factors were assigned in sector *6.C Waste incineration* (50%), *2.A. Cement Production* (15%) and *2.C Metal Production* (10%), the most precise values were reported in *1.A Fuel Combustion* (1-2%).

Low level of uncertainty of national total of CO_2 (3.7%) 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 relatively uncertainty.

N_2O emission factors

Most uncertain values for N_2O emission factors were assigned in sector *4.B.11* and *4.B.12 Manure management* (150%), *4.D Agricultural Soils* (150%) and in *4.F Agriculture/Field Burning of Agricultural Residues* (150%), most precise values were applied in sector *2.C Metal Production (20%)*. Data available from polish part of EU Emission Trading Scheme reporting were taken into account during this analysis with relatively low uncertainty.

Highest value of uncertainty of national total occurred in N_2O (43.3%) and is a result of high uncertainty of the emission factors in sector of *Agriculture* (4.B.11 *Liquid systems*, 4.B.12 *Solid Storage and Dry Lot, 4.D Agricultural Soils* and *4.Field Burning of Agricultural residues* – 150%).

Industrial Gases

Simplified analysis were made for industrial gases HFC, PFC and SF6, where uncertainty assumptions were applied directly to emission values of each pollutant. Final results of analysis where as follows: HFC – 48.3%, PFC – 76.6% and SF6 – 90.3%. Due to lack of information, simplified approach has to be used and country recognizes need of additional analysis in this sector as planned improvement for future inventories.

Uncertainty introduced into the trend in total national emissions

In submission 2014 uncertainty analysis was extended to provide information on uncertainty introduced into the trend in total national emissions. First step of the analysis was assessing of level uncertainty introduced to national total in base year (1988). Methodology used to assess trend uncertainties was described in chapter 6 of IPCC GPG. Results of level uncertainty analysis for base year with and without IPCCC 5.LULUCF are presented below.

	CO_2	CH_4	N_2O	HFC	PFC	SF_6	All GHG recalculated to CO_2 eq.
Total uncertainty Including IPCC 5. LULUCF	2.5%	21.4%	41.2%		76.6%		**4.5%**
Emission recalculated to CO_2 eq [Gg] Including IPCC 5. LULUCF	453,897.85	58,065.28	44,816.05		127.55		556,906.72
Total uncertainty Excluding IPCC 5. LULUCF	2.1%	22.1%	41.5%		76.6%		**4.3%**
Emission recalculated to CO_2 eq [Gg] Excluding IPCC 5. LULUCF	469,413.91	55,875.20	44,487.31		127.55		569,903.97

On the basis of results of analysis made for the base year and latest reported year analysis for trend was done and results are presented below:

	CO2	CH4	N2O
Trend uncertainty with IPCC 5.LULUCF	1.65%	4.87%	1.41%
Trend uncertainty without IPCC 5.LULUCF	1.52%	4.86%	1.41%

Planned improvements in 2014

- further investigation of data for industrial gases
- finalizing uncertainty assessment with analysis Monte Carlo
- collection of data and setting up model for KP art 3.3 and 3.4 uncertainty estimates

GHG inventory 2012 – Uncertainty analysis, part 1, sectors 1-3

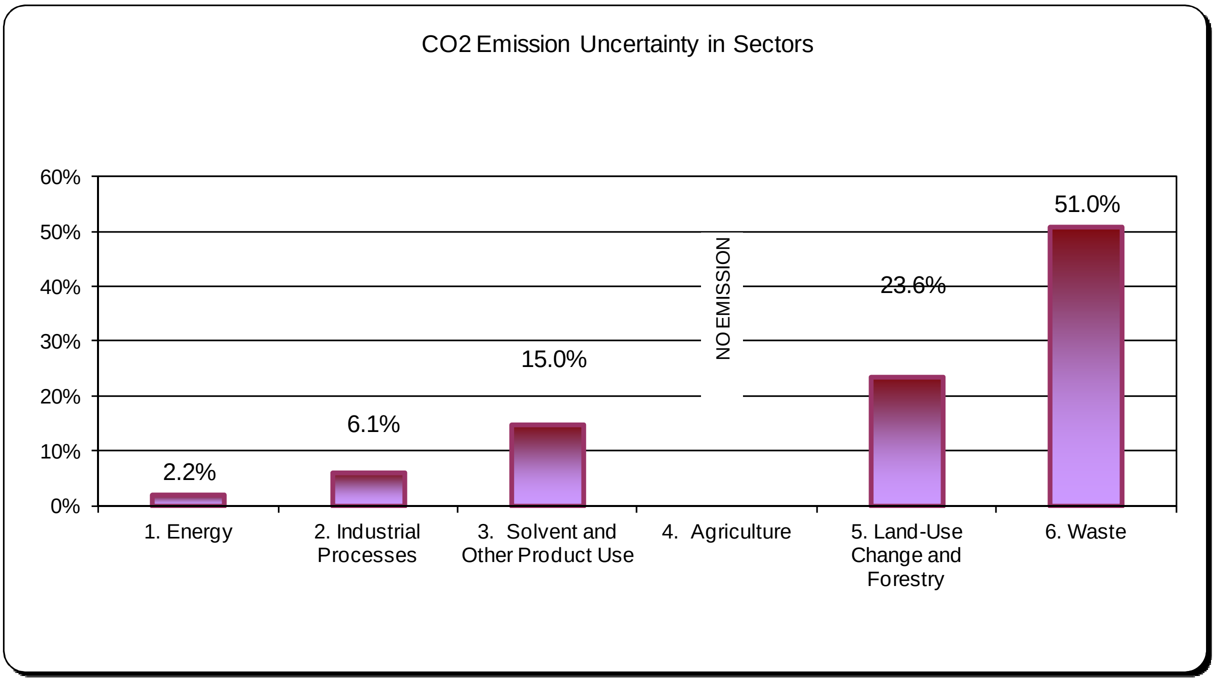
2012	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
TOTAL (without LULUCF)									**320,861.67**	**1,953.93**	**95.45**	**2.1%**	**25.2%**	**44.1%**	6,621.57	491.84	42.08
TOTAL (with LULUCF)									**286,189.28**	**2,062.15**	**97.21**	**3.7%**	**24.2%**	**43.3%**	10,530.44	499.22	42.10
1. Energy									**302,127.65**	**734.85**	**6.77**	2.2%	24.0%	22.1%	**6528.46**	**176.51**	**1.50**
A. Fuel Combustion									**298,403.80**	**149.46**	**6.77**	2.2%	11.8%	22.1%	6521.90	17.67	1.50
1. Energy Industries									168,641.71	5.07	2.76	3.4%	18.4%	11.6%	5685.89	0.94	0.32
Liquid Fuels	70,229	2.0%	72.13	2.19	0.40	2.0%	75.0%	75.0%	5,065.85	0.15	0.03	2.8%	75.0%	75.0%	143.28	0.12	0.02
Solid Fuels	1,587,434	2.0%	99.28	1.00	1.44	3.0%	13.5%	11.7%	157,606.80	1.59	2.29	3.6%	13.6%	11.9%	5682.59	0.22	0.27
Gaseous Fuels	104,013	2.0%	55.82	1.00	0.10	1.0%	17.0%	20.0%	5,805.95	0.10	0.01	2.2%	17.1%	20.1%	129.83	0.02	0.00
Biomass	109,866	15.0%	107.90	29.03	3.87	0.0%	24.0%	37.0%	11,854.90	3.19	0.43	15.0%	28.3%	39.9%	0.00	0.90	0.17
Other fuels	1,297	5.0%	125.76	30.00	4.00	3.0%	20.0%	25.0%	163.11	0.04	0.01	5.8%	20.6%	25.5%	9.51	0.01	0.00
2. Manufacturing Industries and Construction									30,635.46	4.49	0.56	2.4%	10.6%	14.5%	739.63	0.48	0.08
Liquid Fuels	36,845.00	3.0%	70.71	2.20	0.40	1.0%	41.8%	75.0%	2,605.35	0.08	0.01	3.2%	41.9%	75.1%	82.39	0.03	0.01
Solid Fuels	169,233.30	3.0%	103.28	10.23	1.53	2.0%	13.5%	11.7%	17,479.00	1.73	0.26	3.6%	13.8%	12.1%	630.21	0.24	0.03
Gaseous Fuels	132,159.00	4.0%	55.82	5.00	0.10	2.0%	17.0%	20.0%	7,377.05	0.66	0.01	4.5%	17.5%	20.4%	329.91	0.12	0.00
Biomass	43,394.00	15.0%	109.02	29.81	3.97	0.0%	24.0%	37.0%	4,730.86	1.29	0.17	15.0%	28.3%	39.9%	0.00	0.37	0.07
Other fuels	24,053.00	5.0%	131.96	30.00	4.00	3.0%	20.0%	25.0%	3,174.07	0.72	0.10	5.8%	20.6%	25.5%	185.08	0.15	0.02
3. Transport									46,148.22	4.89	1.85	5.8%	10.4%	75.0%	2690.88	0.51	1.39
Liquid Fuels	644,929.20	3.0%	70.62	7.41	2.84	5.0%	10.2%	75.0%	45,545.03	4.78	1.83	5.8%	10.6%	75.1%	2655.71	0.51	1.37
Solid Fuels	NA,NO	3.0%	NA	NA	NA	5.0%	13.5%	11.7%	0.00	0.00	0.00	5.8%	13.8%	12.1%	0.00	0.00	0.00
Gaseous Fuels	10,806.00	4.0%	55.82	1.00	0.10	2.0%	24.0%	37.0%	603.19	0.01	0.00	4.5%	24.3%	37.2%	26.98	0.00	0.00
Biomass	34,453.00	15.0%	70.80	3.00	NA	0.0%	50.0%	50.0%	2,439.27	0.10	0.02	15.0%	52.2%	52.2%	365.89	0.05	0.01
4. Other Sectors									52,978.41	135.01	1.60	2.9%	13.1%	28.0%	1554.95	17.63	0.45
Liquid Fuels	131,233.02	4.0%	70.84	5.41	3.85	1.0%	41.8%	75.0%	9,296.15	0.71	0.51	4.1%	42.0%	75.1%	383.29	0.30	0.38
Solid Fuels	332,066.00	4.0%	94.46	270.36	1.50	2.0%	13.5%	11.7%	31,367.47	89.78	0.50	4.5%	14.1%	12.4%	1402.80	12.64	0.06
Gaseous Fuels	220,553.00	4.0%	55.82	5.00	0.10	2.0%	17.0%	20.0%	12,311.16	1.10	0.02	4.5%	17.5%	20.4%	550.57	0.19	0.00
Biomass	147,695.00	15.0%	108.61	293.88	3.92	0.0%	24.0%	37.0%	16,041.21	43.40	0.58	15.0%	28.3%	39.9%	0.00	12.28	0.23
Other fuels	36.00	0.0%	101.04	300.00	4.00	3.0%	20.0%	25.0%	3.64	0.01	0.00	3.0%	20.0%	25.0%	0.11	0.00	0.00
5. Other									0.00	0.00	0.00	0.0%	0.0%	0.0%	0.00	0.00	0.00
Liquid Fuels	NO	5.0%	NA	NA	NA	1.0%	100.0%	75.0%	IE	IE	IE	5.1%	100.1%	75.2%	0.00	0.00	0.00
Solid Fuels	IE	5.0%	NA	NA	NA	2.0%	80.0%	11.7%	IE	IE	IE	5.4%	80.2%	12.7%	0.00	0.00	0.00
Gaseous Fuels	IE	5.0%	NA	NA	NA	2.0%	90.0%	20.0%	IE	IE	IE	5.4%	90.1%	20.6%	0.00	0.00	0.00
Biomass	IE	20.0%	NA	NA	NA		95.0%	37.0%	IE	IE	IE	20.0%	97.1%	42.1%	0.00	0.00	0.00
B. Fugitive Emissions from Fuels									**3723.85**	**585.38**	**0.00**	7.9%	30.0%	0.0%	292.64	175.62	0.00
1. Solid Fuels									1869.44	359.33	0.00	15.0%	48.8%	0.0%	280.21	175.20	0.00
1. B. 1. a. Coal Mining and Handling													0.0%		0.00	0.00	0.00
i. Underground Mines [Activity in Mt, EF in kg/t]	71.34	2.0%		4.90763			50.0%	0.0%		350.11			50.0%		0.00	175.19	0.00
ii. Surface Mines [Activity in Mt, EF in kg/t]	64.30	2.0%		0.01273			50.0%	0.0%		0.82			50.0%		0.00	0.41	0.00
1. B. 1. b. Solid Fuel Transformation [Activity in Mt, EF in kg/t]	NA	0.0%						0.0%	1868.03	4.45		15.0%	25.0%		280.21	1.11	0.00
1. B. 1. c. Other [CO2 Emisson from Coking Gas Subsystem]	0.64	2.0%	2,192,303	6,161,377.66		10.0%	50.0%	0.0%	1.41	3.96		10.2%	15.0%		0.14	0.59	0.00
2. Oil and Natural Gas									1854.405	226.06	0.00	4.6%	5.4%	100.1%	84.39	12.18	0.00
1. B. 2. a. Oil						0.0%	0.0%	0.0%	0	0		0.0%	0.0%	0.0%	0.00	0.00	0.00
ii. Production [Activity in PJ, EFs in kg/PJ]	28.27	0.5%	6,315,000	61,800.00		6.6%	8.1%	0.0%	178.500	1.75		6.6%	8.1%	0.0%	11.81	0.14	0.00
iii. Transport [Activity in Gg]	25,314.00	0.5%	0.56911	6.2718		6.6%	8.1%	0.0%	0.014	0.16		6.6%	8.1%	0.0%	0.00	0.01	0.00
iv. Refining/storage [Gg]	1,044.01	0.5%	0.000000	745.00		6.6%	8.1%	0.0%	NA	0.78		0.0%	8.1%	0.0%	0.00	0.06	0.00
1. B. 2. b. Natural Gas	0.00	0.0%	0.00	0.00		0.0%	0.0%	0.0%	0.000	0		0.0%	0.0%	0.0%	0.00	0.00	0.00
i. Production / Processing [Activity in PJ, EFs in kg/PJ]	160.25	0.5%	23,607.36	95,993.53		6.6%	8.1%	0.0%	3.783	15.38		6.6%	8.1%	0.0%	0.25	1.25	0.00
ii. Transmission [Activity in PJ, EFs in kg/PJ]	569.45	0.5%	522.73	53,265.03		6.6%	8.1%	0.0%	0.298	30.33		6.6%	8.1%	0.0%	0.02	2.46	0.00
iv. Distribution [Activity in PJ, EF in kg/PJ]	569.45	0.5%	1,168.86	310,689.50		6.6%	8.1%	0.0%	0.666	176.92		6.6%	8.1%	0.0%	0.04	14.36	0.00
v. Other Leakage [Activity in PJ, EFs in kg/PJ]	569.45	0.5%	9.94	1,294.74		6.6%	8.1%	0.0%	0.006	0.74		6.6%	8.1%	0.0%	0.00	0.06	0.00
1. B. 2. c. Venting - Oil	572.27	5.0%	11.95	0.00	1.14	6.6%	0.0%	100.0%	0.007	0.00	0.00	8.3%	0.0%	100.1%	0.00	0.00	0.00
1. B. 2. c. Flaring - Natural gas	4,658.43	5.0%	0.00	0.00	0.00	0.0%	0.0%	100.0%	IE,NO	0.00	0.00	0.0%	0.0%	0.0%	0.00	0.00	0.00
1. B. 2. d. Other (Process emission from refineries and flaring)	NA	5.0%	NA	0.00	0.00	NA	0.0%	0.0%	1671.132	0.00	0.00	5.0%	0.0%	0.0%	0.00	0.00	0.00
2. Industrial Processes									**17,819.61**	**14.47**	**3.39**	6.1%	17.9%	30.1%	1093.21	2.59	1.02
A. Mineral Products									10,064.05	0	0	10.4%	0.0%	0.0%	1043.15	0.00	0.00
1. Cement Production [Activity in kt, EF in t/t]	11,807.30	5.0%	0.540707927	0	0	15.0%	0.0%	0.0%	6,384.30	0	0	15.8%	0.0%	0.0%	1009.45	0.00	0.00
2. Lime Production [Activity in kt, EF in t/t]	1,798.80	10.0%	0	0	0	10.0%	0.0%	0.0%	1,378.78	0	0	14.1%	0.0%	0.0%	194.99	0.00	0.00
3. Limestone and dolomite Use [activitz in kt, EFs in t/t]	3,991.52	0.0%	NA	NA	NA	0.0%	0.0%	0.0%	1,764.55	0	0	10.0%	0.0%	0.0%	0.00	0.00	0.00
4. Soda Ash (production) [Activity in kt, EF in t/t]	37.72	10.0%	0.415	0	0	0.0%	0.0%	0.0%	15.65	0	0	10.0%	0.0%	0.0%	1.57	0.00	0.00
7. Other (ETS Data; Bricks, Tiles, Ceramic Materials and Glass production) [emission data only]	0.00	0.0%	0	0	0	0.0%	0.0%	0.0%	520.76	0	0	1.0%	0.0%	0.0%	5.21	0.00	0.00
B. Chemical Industry									4,316.53	13.21	3.39	7.1%	19.5%	30.1%	305.21	2.58	1.02
1. Ammonia Production [Activity in kt, EF in t/t]	2,467.46	5.0%	1.749326854	0.0049	0	5.0%	20.0%	0.0%	4,316.39	12.09	0.00	7.1%	20.6%	0.0%	305.21	2.49	0.00
2. Nitric Acid Production [Activity in kt, EF in t/t]	2,322.59	2.0%	0	0	0.00	0.0%	0.0%	30.0%	0.00	0.00	2.62	0	0.0%	30.1%	0.00	0.00	0.79
3. Adipic Acid Production [Activity in kt, EF in t/t]	NO	5.0%	0	0	0.00	0.0%	0.0%	10.0%	NO	0.00	0.00	0	0.0%	11.2%	0.00	0.00	0.00
4. Carbide Production (calcium carbide) [Activity in kt, EF in t/t]	NO	5.0%	0	0	0	5.0%	0.0%	0.0%	NO	0.00	0.00	7.1%	0.0%	0.0%	0.00	0.00	0.00
5. Other (Carbon Black) [Activity in kt, EF in t/t]	20.07	5.0%	0	0.01	0	0.0%	20.0%	0.0%	0.00	0.22	0.00	0	20.6%	0.0%	0.00	0.05	0.00
5. Other (Ethylene) [Activity in kt, EF in t/t]	452.62	5.0%	0.0003	0.00100	0	5.0%	20.0%	0.0%	0.14	0.45	0	7.1%	20.6%	0.0%	0.01	0.09	0.00
5. Other (N2O for Medical Use) [Activity in kt, EF in t/t]	111.84	5.0%	0	0	IE	10.0%	0.0%	20.0%	0.00	0.45	IE	0	0.0%	0.0%	0.00	0.00	IE
5. Other (Methanol) [Activity in kt, EF in t/t]	0.39	5.0%	0	0.00200	0	0.0%	20.0%	0.0%	0.00	0.00	0	0.0%	20.6%	0.0%	0.00	0.00	0.00
5. Other (Caprolactam) [Activity in kt, EF in t/t]	163.00	5.0%	0	0	0.0047	0.0%	0.0%	20.0%	0.00	0	0.77	0	0.0%	0.0%	0.00	0.00	0.00
C. Metal Production									2,297.08	1.25	0.00	4.5%	11.9%	0.0%	102.81	0.15	0.00
1. Iron and Steel Production																	
Sinter [Activity in kt, EF in t/t]	6,672.47	5.0%	0.05	0.000070	0.0000000	10.0%	20.0%	20.0%	351.14	0.47	0.00	11.2%	20.6%	20.6%	39.26	0.10	0.00
Coke [Activity in kt, EF in t/t]	IE	5.0%	NA	NA	0.0000000	10.0%	20.0%	0.0%	IE	IE	0	11.2%	20.6%	0.0%	NA	NA	0.00
Open-heart Steel [Activity in kt, EF in t/t]	0.00	5.0%	0.00	0	0.0000000	0.0%	0.0%	0.0%	0.00	0.00	0	0.0%	0.0%	0.0%	0.00	0.00	0.00
Electric Furnace Steel [Activity in kt, EF in t/t]	4,206.13	5.0%	0.05270	0.000120	0.0000000	10.0%	20.0%	20.0%	221.67	0.50	0.00	11.2%	20.6%	20.6%	24.78	0.10	0.00
Pig Iron [Activity in kt, EF in t/t]	3,941.43	5.0%	0.14102	0.000000	0.0000000	10.0%	20.0%	20.0%	555.81	0.00	0.00	11.2%	20.6%	20.6%	62.14	0.00	0.00
Iron Cast [Activity in kt, EF in t/t]	1,022.16	5.0%	0.007	0.000200	0.0000000	10.0%	20.0%	0.0%	7.04	0.20	0	11.2%	20.6%	0.0%	0.79	0.04	0.00
Steel Cast [Activity in kt, EF in t/t]	113.19	5.0%	0.046	0	0.0000000	10.0%	0.0%	0.0%	5.23	0.00	0	11.2%	0.0%	0.0%	0.59	0.00	0.00
Basic Oxygen Furnace Steel [Activity in kt, EF in t/t]	4,333.17	5.0%	0.12740	0.000000	0.0000000	10.0%	20.0%	20.0%	552.03	0.00	0.00	11.2%	20.6%	20.6%	61.72	0.00	0.00
2. Ferroalloys Production [Activity in kt, EF in t/t]	78.12	5.0%	3.9	0.001000	0	5.0%	20.0%	0.0%	304.65	0.08	0	7.1%	20.6%	0.0%	21.54	0.02	0.00
3. Aluminium Production [Activity in kt, EF in t/t]	11.09	5.0%	1.8	0	0	5.0%	0.0%	0.0%	19.96	0.00	0	7.1%	0.0%	0.0%	1.41	0.00	0.00
5. Other (Zinc Production) [Activity in kt, EF w t/t]	133.57	5.0%	0.5	0	0	5.0%	0.0%	0.0%	229.73	0.00	0	7.1%	0.0%	0.0%	16.24	0.00	0.00
5. Other (Lead Production) [Activity in kt, EF w t/t]	95.80	5.0%	0.0	0	0	5.0%	0.0%	0.0%	49.82	0.00	0	7.1%	0.0%	0.0%	3.52	0.00	0.00
D. Other Production									9.541	0	0	5.0%	0.0%	0.0%	0.48	0.00	0.00
G. Other									1,132.409	0	0	5.0%	0.0%	0.0%	56.62	0.00	0.00
3. Solvent and Other Product Use									**635.67**	**0**	**0.40**	15.0%	0.0%	50.0%	95.35	0.00	0.20

GHG inventory 2012 – Uncertainty analysis, part 2, sector 4-6

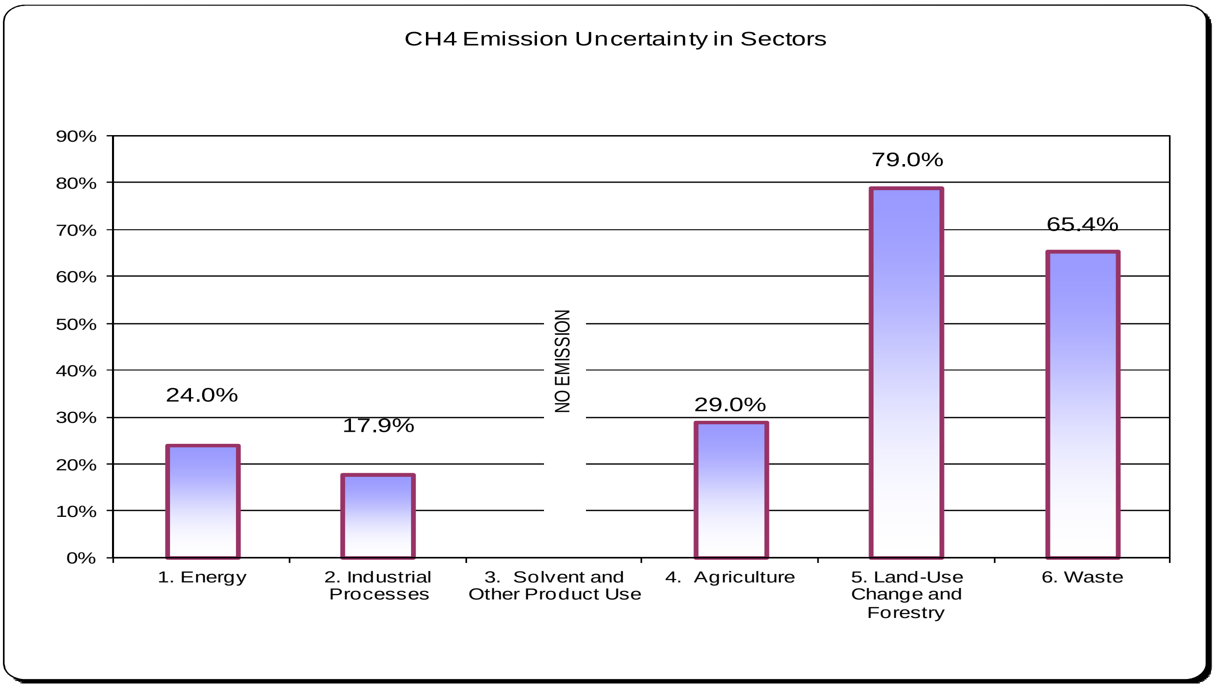
2012	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
4. Agriculture									0.00	**427.48**	**0.00**		34.8%	0.0%	0.00	148.92	0.00
A. Enteric Fermentation										0.00			0.0%	0.0%	0.00	0.00	0.00
1. Cattle																	
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	3,198.8	5.0%		45.87			50.0%			146.74			50.2%	0.0%	0.00	73.74	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	266.8	5.0%		7.71			50.0%			2.06			50.2%	0.0%	0.00	1.03	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	89.9	5.0%		5.00			50.0%			0.45			50.2%	0.0%	0.00	0.23	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	222.2	5.0%		18.00			50.0%			4.00			50.2%	0.0%	0.00	2.01	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	11,581.3	5.0%		1.50			50.0%			17.37			50.2%	0.0%	0.00	8.73	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	130,596.4	5.0%		0.00			50.0%			0.00			50.2%	0.0%	0.00	0.00	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	0.0	0.0%		0.00			0.0%			117.43			45.3%	148.9%	0.00	53.22	23.40
B. Manure Management										0.00	0.00		0.0%	0.0%	0.00	0.00	0.00
1. Cattle													50.2%	0.0%	0.00	17.31	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	3,199	5.0%		2.24			50.0%			7.17			50.2%	0.0%	0.00	3.60	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	267	5.0%		0.16			50.0%			0.04			50.2%	0.0%	0.00	0.02	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	90	5.0%		0.12			50.0%			0.01			50.2%	0.0%	0.00	0.01	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	222	5.0%		1.39			50.0%			0.31			50.2%	0.0%	0.00	0.16	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	11,581	5.0%		5.63			50.0%			65.26			50.2%	0.0%	0.00	32.79	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	130,596	5.0%		0.08			50.0%			10.19			50.2%	0.0%	0.00	5.12	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	0	5.0%		0.00			0.0%			0.00			0.0%	150.1%	0.00	0.00	0.18
11. Liquid Systems [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%		0.00	0.020000		0.0%	150.0%		0.00	15.59		0.0%	150.1%	0.00	0.00	23.40
12. Solid Storage and Dry Lot [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	0.0%		0.00	0.000000		0.0%	0.0%	0.00	0.00	0.00		0.0%	0.0%	0.00	0.00	0.00
D. Agricultural Soils											0.00		0.0%	0.0%	0.00	0.00	0.00
1. Direct Soil Emissions											19.35		0.0%	150.1%	0.00	0.00	29.05
Synthetic Fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	457,762,330	5.0%			0.01			150.0%			8.99		0.0%	150.1%	0.00	0.00	13.50
Animal Wastes Applied to Soils [Activity in kg N, EF in kg N2O-N/kg N]	21,239,322	5.0%			0.01			150.0%			0.42		0.0%	150.1%	0.00	0.00	0.63
N-fixing Crops [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	127,091,961	5.0%			0.01			150.0%			2.50		0.0%	150.1%	0.00	0.00	3.75
Crop Residue [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	693,350	5.0%			8.00			150.0%			8.72		0.0%	150.1%	0.00	0.00	13.08
Cultivation of Histosols [Activity in ha, EF in kg N2O-N/ha]	4,734,540	5.0%			0.01			150.0%			0.09		0.0%	150.1%	0.00	0.00	0.14
2. Animal Production [Activity in kg N, EF in kg N2O-N/kg N]	47,956,344	20.0%			0.31			150.0%			1.51		0.0%	151.3%	0.00	0.00	2.28
3. Indirect Emissions [Activity in kg N/yr, EF in kg N2O/kg N]	0	0.0%			0			150.0%			23.95		0.0%	0.0%	0.00	0.00	0.00
4. Sewage sludge aplied to fields	0	0.0%			0			0.0%			0.04		25.2%	114.1%	0.00	0.22	0.04
F. Field Burning of Agricultural Residues									0.00	0.00	0.00		0.0%	0.0%	0.00	0.00	0.00
1. Cereals									0.00	0.094224	0.002177		36.1%	153.0%	0.00	0.03	0.00
Wheat [Activity in t of crop production, EF in kg/t dm]	4,180,233	30.0%	0	0.0943	0.0002	0.0%	20.0%	150.0%	0.00	0.04	0.00		36.1%	153.0%	0.00	0.01	0.00
Barley [Activity in t of crop production, EF in kg/t dm]	3,995,851	30.0%	0	0.0382	0.0001	0.0%	20.0%	150.0%	0.00	0.02	0.00		36.1%	153.0%	0.00	0.01	0.00
Maize [Activity in t of crop production, EF in kg/t dm]	1,467,898	30.0%	0	0.1067	0.0003	0.0%	20.0%	150.0%	0.00	0.02	0.00		36.1%	153.0%	0.00	0.01	0.00
Oats [Activity in t of crop production, EF in kg/t dm]	2,888,137	30.0%	0	0.1734	0.0003	0.0%	20.0%	150.0%	0.00	0.05	0.00		36.1%	153.0%	0.00	0.02	0.00
Rye [Activity in t of crop production, EF in kg/t dm]	7,396,343	30.0%	0	0.1103	0.0003	0.0%	20.0%	150.0%	0.00	0.08	0.00		36.1%	153.0%	0.00	0.03	0.00
Other Cereals [Activity in t of crop production, EF in kg/t dm]	480,405	30.0%	0	0.0282	0.0002	0.0%	20.0%	150.0%	0.00	0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
2 Pulses (Other non-specified)	0	0.0%	0	0.0000	0.0000	0.0%	0.0%	0.0%	0.00	0.00	0.00		0.0%	0.0%	0.00	0.00	0.00
3 Tuber and Root									0.00	0.05	0.00		36.1%	153.0%	0.00	0.02	0.01
Potatoes [Activity in t of crop production, EF in kg/t dm]	0	30.0%	0	0.0000	0.0000	0.0%	20.0%	150.0%	0.00	0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
Other Tuber and Root [Activity in t of crop production, EF in kg/t dm]	0	0.0%	0	0.0000	0.0000	0.0%	0.0%	0.0%	0.00	0.00	0.00		0.0%	0.0%	0.00	0.00	0.00
5 Other									0.00	0.53	0.02		36.1%	153.0%	0.00	0.19	0.04
Fruits, Veget., Rape, Tabacco, Hop, Hey [Activity in t of crop prod., EF in kg/ t of crop]	0	0.0%	0	0.0000	0.0000	0.0%	0.0%	0.0%	0.00	0.00	0.00		0.0%	0.0%	0.00	0.00	0.00
									-34,672.39	108.21	1.76		79.0%	78.7%	-8188.11	85.50	1.38
5. Land-Use Change and Forestry									**-39,573.27**	**1.49**	**1.06**	20.6%	80.2%	80.2%	-8158.24	1.20	0.853
A. Forest Land	14,138.13	5.0%	0.092484543	0	47.7069	20.0%	0.0%	0.0%	1,307.56	0.00	0.67	20.6%	5.0%	5.0%	269.56	0.00	0.034
B. Cropland	4,169.58	5.0%	0.090612553			20.0%			377.82	0.07	0.001014	20.6%	80.2%	80.2%	0.00	0.05	0.001
C. Grassland	1,368.78	5.0%	2.266365843	0.077918824	13.8013	20.0%	80.0%	80.0%	3,102.17	106.65	0.02	20.6%	80.2%	80.2%	639.53	85.49	0.015
D. Wetlands	2,145.62	5.0%	0.052823699	0	0.0000	20.0%	0.0%	0.0%	113.34	0.00	0.00	20.6%	5.0%	5.0%	23.37	0.00	0.000
E. Settlements	92.13	5.0%	0			0.0%			0.00	0.00	0.0000	5.0%	5.0%	5.0%	0.00	0.00	0.000
F. Other Land	0.00	0.0%							278.74	658.83	3.6269	51.0%	65.4%	49.3%	142.13	430.97	1.788
6. Waste									**0.00**	**407.64**	**0.00**	0.0%	85.8%	0.0%	0.00	349.56	0.00
A. Solid Waste Disposal on Land										154.33		0.0%	102.6%	0.0%	0.00	158.36	0.00
1 Managed Waste Disposal on Land [Activity in Gg, EF in t/t MSW]	NA	23.0%		NA			100.0%			156.19		0.0%	0.0%	0.0%	0.00	0.00	0.00
2 Unmanaged Waste Disposal Sites - deep (>5 m) [Activity in Gg, EF in t/t MSW]	167.80	23.0%		0.208833734			100.0%			35.04		0.0%	102.6%	0.0%	0.00	35.96	0.00
3 Other - Industrial Waste Disposal on Land [Activity in Gg, EF in t/t MSW]	2,504.00	50.0%		0.023088267			100.0%			57.81		0.0%	0.0%	0.0%	0.00	0.00	0.00
3 Other - Unclassified and Unmanaged Waste Disposal on Land [Activity in Gg, EF in t/t M	1,064.30	0.0%		0.004			100.0%			4.26		0.0%	0.0%	0.0%	0.00	0.00	0.00
B. Wastewater									0.00	9.94	0.00	0.0%	104.4%	0.0%	0.00	10.38	0.00
Industrial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	579.00	30.0%		0.42			100.0%			241.25			104.4%			251.88	
Domestic and Commercial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	38,533.70	15.0%		0			0.0%			0.00			0.0%			0.00	
N2O from human sewage [Activity in 1000s of population, EF in kg N2O-N/kg sewage N produced]	0.00	0.0%			0.0000000			0.0%			0.05			21.2%			0.01
C. Waste Incineration									99.18		0.03	51.0%		30.0%	50.57		0.01
biogenic [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			278.74		0.02	51.0%		30.0%	142.13		0.01
plastics and other non-biogenic waste [Activity in Gg, EF in kg/t waste]		0.0%				0.0%			0.00		0.00	0.0%		0.0%	0.00		0.00

Industrial gases inventory 2012 – Uncertainty analysis for HFC, PFC and SF_6.

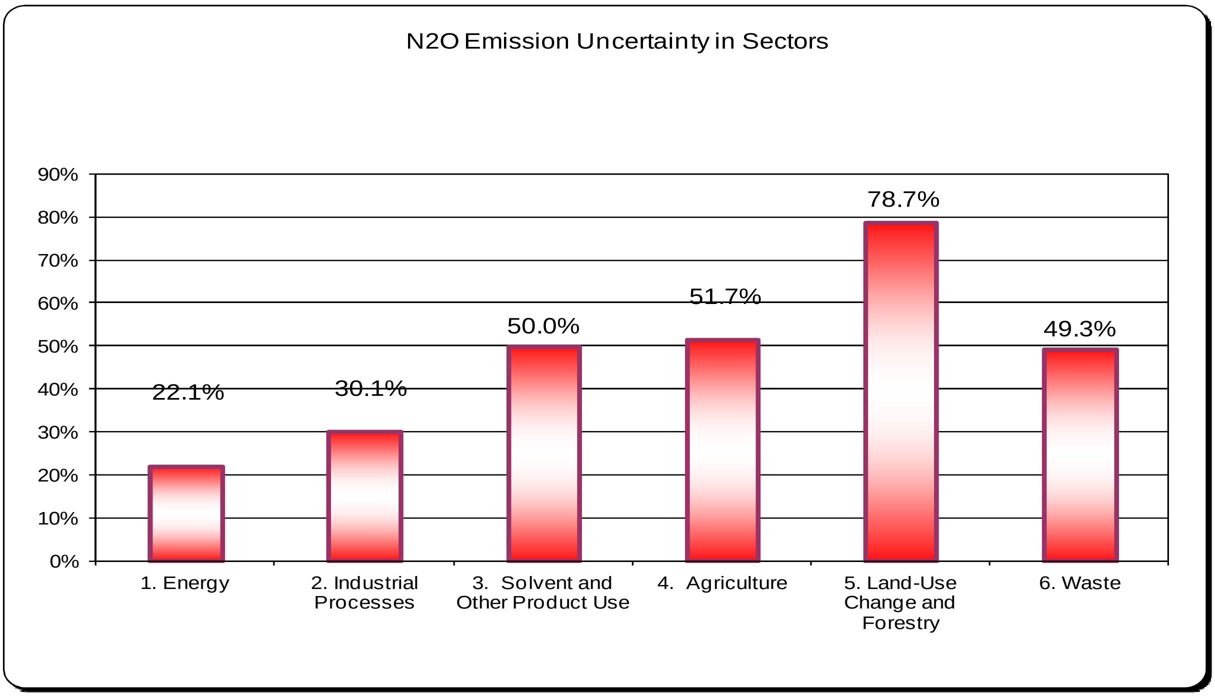
	HFC Emission [Gg of CO_2 eq.]	PFC Emission [Gg of CO_2 eq.]	SF_6 Emission [Gg of CO_2 eq.]	HFC Emission uncertainty [%]	PFC Emission uncertainty [%]	SF_6 Emission uncertainty [%]	HFC Emission absolute uncertainty [Gg of CO_2 eq.]	PFC Emission absolute uncertainty [Gg of CO_2 eq.]	SF_6 Emission absolute uncertainty [Gg of CO_2 eq.]
TOTAL	7,700.22	41.81	42.06	48.3%	76.6%	90.3%	3,719.60	41.81	37.72
2. Industrial Processes	**7,700.22**	**41.81**	**42.06**	**48.3%**	**76.6%**	**90.3%**	**3,719.60**	**41.81**	**37.72**
C. Metal Production		**29.63**	**4.35**		**100.0%**	**100.0%**		**29.63**	
3. Aluminium Production		29.63	4.35		100.0%	100.0%		29.63	4.35
F. Consumption of Halocarbons and SF6	**7,700.22**	**12.17**	**37.72**	**48.3%**	**100.0%**	**100.0%**	**3,719.60**	**12.17**	**37.72**
1. Refrigeration and Air Conditioning Equipment	7,437.48			50.0%			3,718.74		
2. Foam Blowing	105.33			50.0%			52.67		
3. Fire Extinguishers	44.24	12.17		50.0%	100.0%		22.12	12.17	
4. Aerosols/ Metered Dose Inhalers	111.89			50.0%			55.94		
5. Solvents	1.28			50.0%			0.64		
8. Electrical Equipment			37.72			100.0%			37.72



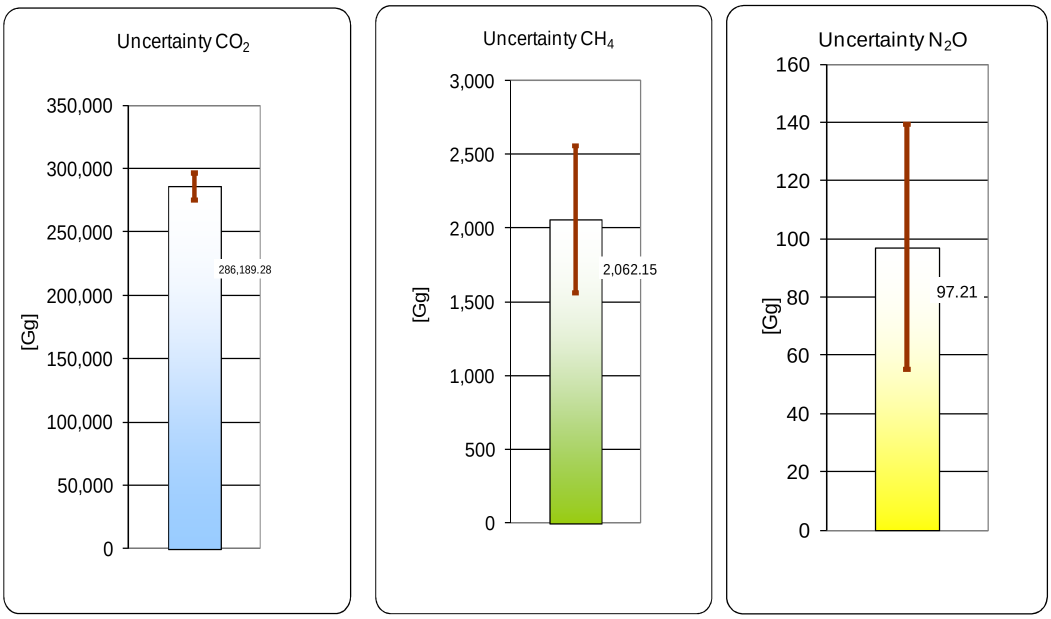
Results of uncertainty analysis in percents for CO_2 with sectoral split.



Results of uncertainty analysis in percents for CH_4 with sectoral split.



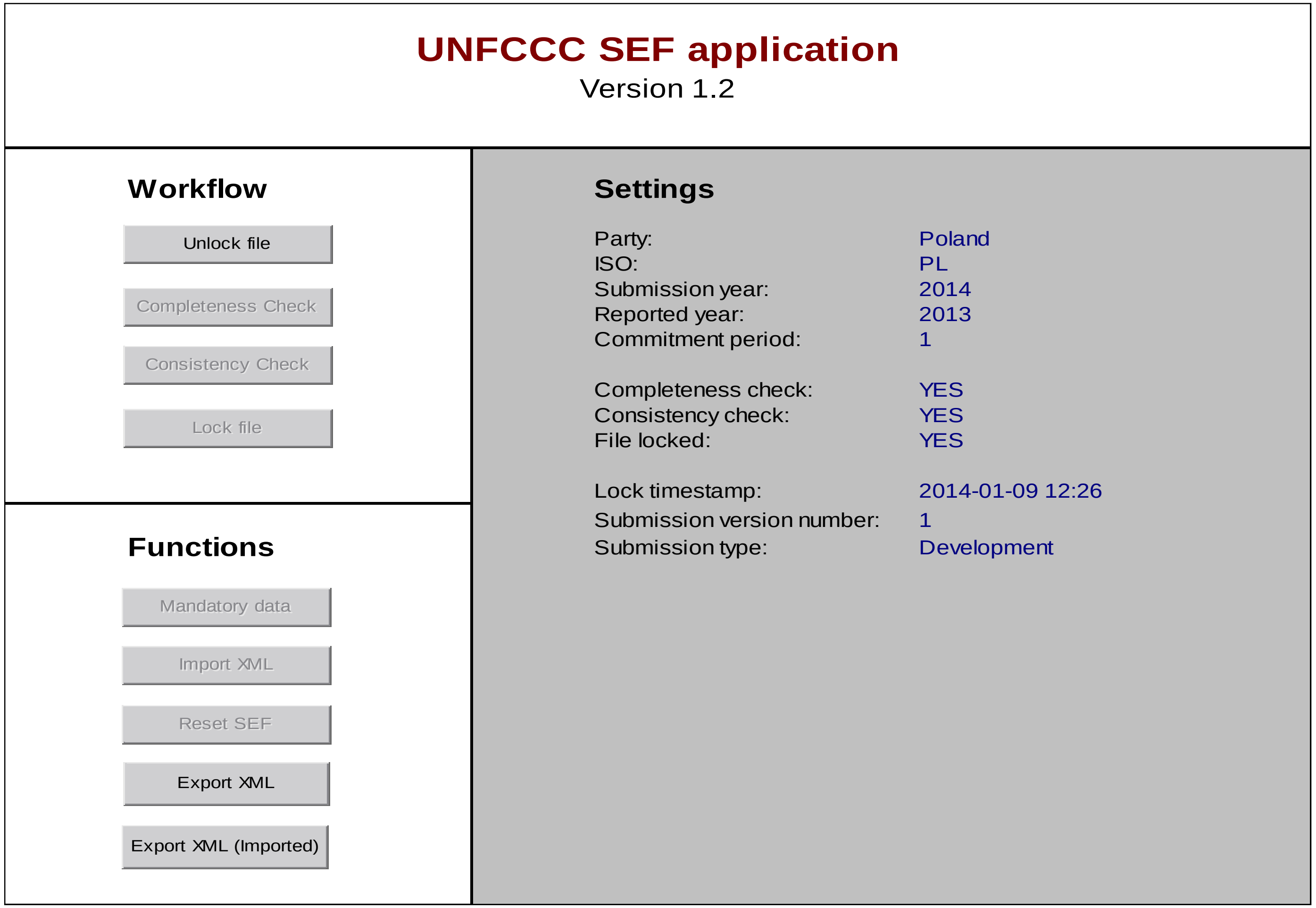
Results of uncertainty analysis in percents for N_2O with sectoral split



Emission results including IPCC 5.LULUCF with uncertainties bars.

Annex 9: Additional information on National registry

SEF tables for year 2013



Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Table 1. Total quantities of Kyoto Protocol units by account type at beginning of reported year

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Party holding accounts	1889243137	6609664	NO	19194476	NO	NO
Entity holding accounts	NO	513187	NO	584749	NO	NO
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	NO	NO	NO	NO	NO	NO
Retirement account	564089355	2061462	NO	28840820	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal of storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	2453332492	9184313	NO	48620045	NO	NO

Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Table 2 (a). Annual internal transactions

Transaction type	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Article 6 issuance and conversion												
Party-verified projects		6148056					6148056		NO			
Independently verifed projects		NO					NO		NO			
Article 3.3 and 3.4 issuance or cancellation												
3.3 Afforestation and reforestation			NO				NO	NO	NO	NO		
3.3 Deforestation			NO				NO	NO	NO	NO		
3.4 Forest management			NO				NO	NO	NO	NO		
3.4 Cropland management			NO				NO	NO	NO	NO		
3.4 Grazing land management			NO				NO	NO	NO	NO		
3.4 Revegetation			NO				NO	NO	NO	NO		
Article 12 afforestation and reforestation												
Replacement of expired tCERs							NO	NO	NO	NO	NO	
Replacement of expired lCERs							NO	NO	NO	NO		
Replacement for reversal of storage							NO	NO	NO	NO		NO
Replacement for non-submission of certification report							NO	NO	NO	NO		NO
Other cancellation							NO	NO	NO	2	NO	NO
Sub-total		6148056	NO				6148056	NO	NO	2	NO	NO

Transaction type	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Retirement	NO	NO	NO	NO	NO	NO

Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Add registry | Delete registry | No external transactions

Table 2 (b). Annual external transactions

	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Transfers and acquisitions												
EU	NO	22725822	NO	16861746	NO	NO	47558904	8990555	NO	611003	NO	NO
CH	NO	NO	NO	38091	NO	NO	NO	192771	NO	NO	NO	NO
NL	NO	276425	NO	NO	NO	NO	62177	430270	NO	NO	NO	NO
FR	NO	NO	NO	NO	NO	NO	NO	1127682	NO	NO	NO	NO
AT	NO	NO	NO	NO	NO	NO	NO	299853	NO	NO	NO	NO
UA	NO	12341887	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
JP	NO	NO	NO	NO	NO	NO	NO	416611	NO	NO	NO	NO
DE	NO	NO	NO	NO	NO	NO	NO	463610	NO	NO	NO	NO
GB	NO	NO	NO	NO	NO	NO	NO	1142341	NO	NO	NO	NO
DK	NO	NO	NO	NO	NO	NO	NO	339267	NO	NO	NO	NO
SE	NO	NO	NO	NO	NO	NO	NO	672766	NO	NO	NO	NO
Sub-total	NO	35344134	NO	16899837	NO	NO	47621081	14075726	NO	611003	NO	NO

Additional information

Independently verified ERUs								NO				

Table 2 (c). Total annual transactions

Total (Sum of tables 2a and 2b)	NO	41492190	NO	16899837	NO	NO	53769137	14075726	NO	611005	NO	NO

Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Table 3. Expiry, cancellation and replacement

Transaction or event type	Expiry, cancellation and requirement to replace		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Temporary CERs (tCERS)								
Expired in retirement and replacement accounts	NO							
Replacement of expired tCERs			NO	NO	NO	NO	NO	
Expired in holding accounts	NO							
Cancellation of tCERs expired in holding accounts	NO							
Long-term CERs (lCERs)								
Expired in retirement and replacement accounts		NO						
Replacement of expired lCERs			NO	NO	NO	NO		
Expired in holding accounts		NO						
Cancellation of lCERs expired in holding accounts		NO						
Subject to replacement for reversal of storage		NO						
Replacement for reversal of storage			NO	NO	NO	NO		NO
Subject to replacement for non-submission of certification report		NO						
Replacement for non-submission of certification report			NO	NO	NO	NO		NO
Total			NO	NO	NO	NO	NO	NO

Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Table 4. Total quantities of Kyoto Protocol units by account type at end of reported year

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Party holding accounts	1835474000	28641440	NO	36038195	NO	NO
Entity holding accounts	NO	5897875	NO	29862	NO	NO
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	NO	NO	NO	2	NO	NO
Retirement account	564089355	2061462	NO	28840820	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal of storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	2399563355	36600777	NO	64908879	NO	NO

Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Table 5 (a). Summary information on additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
Starting values	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**	**AAUs**	**ERUs**	**RMUs**	**CERs**	**tCERs**	**lCERs**
Issuance pursuant to Article 3.7 and 3.8	2648181038											
Non-compliance cancellation							NO	NO	NO	NO		
Carry-over	NO	NO		NO								
Sub-total	2648181038	NO		NO			NO	NO	NO	NO		
Annual transactions												
Year 0 (2007)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 1 (2008)	3952462	NO	NO	2161253	NO	NO	3206441	NO	NO	84000	NO	NO
Year 2 (2009)	17779729	114431	NO	9473211	NO	NO	43309348	113541	NO	530644	NO	NO
Year 3 (2010)	24545108	6130878	NO	15101585	NO	NO	52493428	3869202	NO	1628818	NO	NO
Year 4 (2011)	37148144	8656437	NO	24982121	NO	NO	80253156	4404065	NO	956857	NO	NO
Year 5 (2012)	8024797	15083026	NO	10202846	NO	NO	107036413	12413651	NO	10100652	NO	NO
Year 6 (2013)	NO	41492190	NO	16899837	NO	NO	53769137	14075726	NO	611005	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sub-total	91450240	71476962	NO	78820853	NO	NO	340067923	34876185	NO	13911976	NO	NO
Total	2739631278	71476962	NO	78820853	NO	NO	340067923	34876185	NO	13911976	NO	NO

Table 5 (b). Summary information on replacement

	Requirement for replacement		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Previous CPs			NO	NO	NO	NO	NO	NO
Year 1 (2008)		NO	NO	NO	NO	NO	NO	NO
Year 2 (2009)		NO	NO	NO	NO	NO	NO	NO
Year 3 (2010)		NO	NO	NO	NO	NO	NO	NO
Year 4 (2011)		NO	NO	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	NO	NO	NO	NO	NO

Table 5 (c). Summary information on retirement

	Retirement					
	Unit type					
Year	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Year 1 (2008)	NO	NO	NO	NO	NO	NO
Year 2 (2009)	NO	NO	NO	NO	NO	NO
Year 3 (2010)	379707621	245165	NO	14927693	NO	NO
Year 4 (2011)	184381734	1816297	NO	13912127	NO	NO
Year 5 (2012)	NO	NO	NO	1000	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO
Total	564089355	2061462	NO	28840820	NO	NO

Party	Poland
Submission year	2014
Reported year	2013
Commitment period	1

Add transaction | Delete transaction | No corrective transaction

Table 6 (a). Memo item: Corrective transactions relating to additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

Add transaction | Delete transaction | No corrective transaction

Table 6 (b). Memo item: Corrective transactions relating to replacement

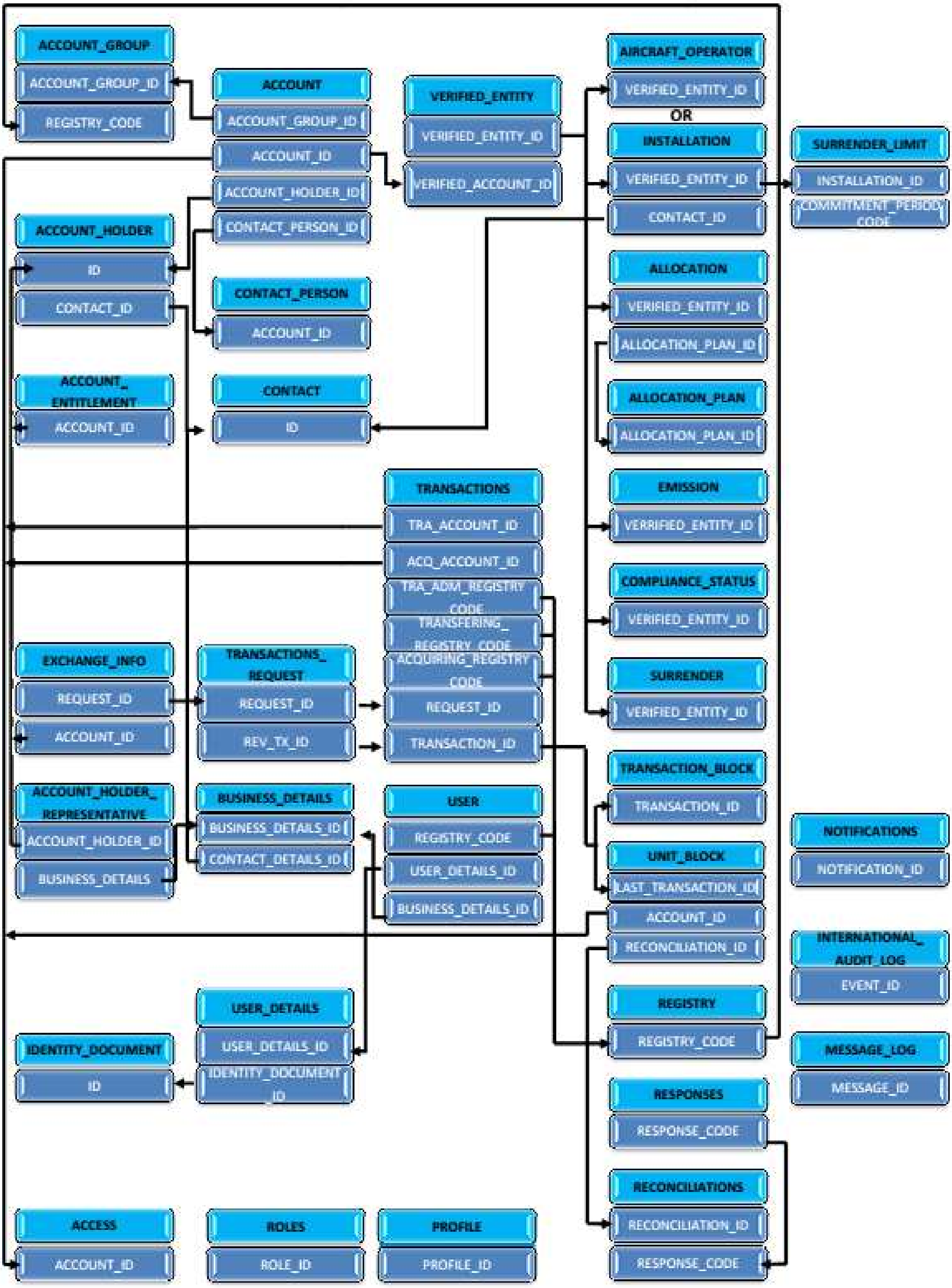
	Requirement for replacement		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

Add transaction | Delete transaction | No corrective transaction

Table 6 (c). Memo item: Corrective transactions relating to retirement

	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

The CSEUR database structure diagram



CSEUR_DB_model_20140114

Tests results report – releases 5.2-6.1.7.1

CR2013 v5.2 FAT & REGRESSION REPORT

Contract:	FC CLIMA.B.1/FRA/2012/0007, SC4
File location:	

Status information

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Current version number:	1.00	Date of first issue:	11-1-2013
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Name	Address	I/A	Name	Address	I/A

Document change record

Version	Date	Description	Affected sections
1.00	11-1-2013	Final version	

PURPOSE:
FAT Report includes the test cases covering the Use cases / requirements implemented in for QTM 01 (ETS V5.2)

FAT REPORT STRUCTURE:
Report includes:
* the execution status of each test case in FAT testing.
* the list of opened issues

TEST CASES	PRIORITY	FAT RELEASES 5.2 - 6.1.7.1 EXECUTION STATUS	COMMENTS / ISSUES
TC_QTM01_03: Verify that it is not possible to modify transaction data after a transaction's confirmation	HIGH	PASSED	
TC_QTM01_01: Browse Transaction Details of a Transaction with Less Than 10 Lines	MEDIUM	PASSED	
TC_QTM01_02: Browse Transaction Details of a Transaction with More Than 10 Lines	MEDIUM	PASSED	
TC_QTM01_08: Insert an Add to TAL transaction	HIGH	PASSED	
TC_QTM01_09: Insert an internal transfer transaction	HIGH	PASSED	
TC_QTM01_05: Insert a new Installation	HIGH	PASSED	Translations for the new activity type codes are not included in this v5.2 build. They will be included in the build that will be provided on 18/01/2013 for deployment at the UT environment.
TC_QTM01_06: Update an Existing Installation	HIGH	PASSED	
TC_QTM01_07: Browse an Installation	HIGH	PASSED	
TC_QTM01_11: Confirm new menu item for Portuguese exists	MEDIUM	PASSED	
TC_QTM01_04: Save Issuance Limits for Phase 3	HIGH	PASSED	
TC_QTM01_10: Upload XML files for different periods	MEDIUM	PASSED	
Request update of business details of Authorised Representative (Medium)	MEDIUM	PASSED	
Request update of business details of Additional Authorised Representative (Medium)	MEDIUM	PASSED	
Request update of business details of AR/ AAR that requires approval (Medium)	MEDIUM	PASSED	
Cancel the update of business details of AR/AAR (Low)	LOW	PASSED	
Request update of business details of AR/ AAR is approved by EUTL (High)	HIGH	PASSED	
Request update of business details of AR/ AAR is rejected by EUTL (High)	HIGH	PASSED	
Request update of business details of AR/ AAR is rejected by Administrator (High)	HIGH	PASSED	
Request update of business details of AR/ AAR is approved by Administrator and by EUTL (High)	HIGH	PASSED	
Request update of business details of AR/ AAR is approved by Administrator and rejected by EUTL (High)	HIGH	PASSED	
Enter CO_2 emissions to OHA (High)	High	PASSED	
Enter CO_2, N_2O and PFC emissions to OHA (High)	HIGH	PASSED	
Enter CO_2 emissions to AOHA (High)	HIGH	PASSED	
Enter emissions to Verified account as National Administrator (Medium)	MEDIUM	PASSED	
Enter emissions – Data Validation – Negative Testing (Low)	LOW	PASSED	
Yearly compliance status logging job – 1st May (Medium)	MEDIUM	PASSED	
Upload emissions with XML file for one installation/ operator (High)	HIGH	PASSED	
Upload XML file with multiple emissions elements-Data Validation (High)	HIGH	PASSED	
Upload emission file with invalid format – Negative testing (Low)	LOW	PASSED	
Upload XML file with invalid size – Negative testing (Low)	LOW	PASSED	
Upload XML file with invalid emissions elements – Negative testing (Low)	LOW	PASSED	
Upload XML file when pending emissions exists (Low)	LOW	PASSED	
Cancel the upload of XML file (Low)	LOW	PASSED	
Upload XML file when pending emissions exists (Low)	LOW	PASSED	
Log in as PT user and verify activity types are in PT	MEDIUM	PASSED	
Log in as GR user and verify activity types are in GR	MEDIUM	PASSED	
Insert an Installation with a new activity type in GR	MEDIUM	PASSED	
Update an Installation with a new activity type in GR	MEDIUM	PASSED	
Log in with a user with the new permission (PERM_ACC_STATEMENTS_VIEW) and confirm this user can access the "Statements" tab of an OHA	HIGH	PASSED	

Log in with a user without the new permission (PERM_ACC_STATEMENTS_VIEW) and confirm this user cannot access the "Statements" tab of an OHA	HIGH	PASSED	
Log in with a user who has the permission (PERM_ACC_STATEMENTS_VIEW) and is a Verifier and confirm this user cannot access the "Statements" tab of an OHA	HIGH	PASSED	
Log in as a user who can access account statements and confirm transferring and acquiring accounts are not reversed.	HIGH	PASSED	
Run a SEF report from the interface. Verify data against UN and database figures.	HIGH	PASSED	
As CA: Enter Issuance Limits for Phase3; As CA: Enter figures for P3 issueance; As NA: Upload Allocation Table for Phase 3 in EUCR and EUTL; As NA: Check installation(s) to receive units. Confirm allocations to OHA are performed and transaction(s) is/are generated which is/are completed and allocate to OHA(s) the amount(s) checked.	HIGH	PASSED	
Surrender allowances for OHA, CYP Registry. Confirm it is routed to EU Deletion account	MEDIUM	PASSED	
Surrender CERs for OHA, CYP Registry. Confirm it is routed to EU Cancellation account	MEDIUM	PASSED	
Surrender allowances for AOHA, CYP Registry. Confirm it is routed to EU Deletion account	MEDIUM	PASSED	
Surrender allowances for AOHA, CYP Registry. Confirm it is routed to EU Aviation Set-aside account	MEDIUM	PASSED	
Surrender allowances for OHA, MT Registry. Confirm it is routed to EU Deletion account	HIGH	PASSED	
Surrender CERs for OHA, MT Registry. Confirm it is routed to EU Cancellation account	HIGH	PASSED	
Surrender allowances for AOHA, MT Registry. Confirm it is routed to EU Deletion account	HIGH	PASSED	

Surrender allowances for AOHA, MT Registry. Confirm it is routed to EU Aviation Set-aside account	HIGH	PASSED	
Surrender allowances for OHA, GR Registry. Confirm it is routed to EU Deletion account	HIGH	PASSED	
Surrender CERs for OHA, GR Registry. Confirm it is routed to KP Greece Party Holding account	HIGH	PASSED	
Surrender allowances for AOHA, GR Registry. Confirm it is routed to EU Deletion account	HIGH	PASSED	
Surrender allowances for AOHA, GR Registry. Confirm it is routed to EU Aviation Set-aside account	HIGH	PASSED	
1. Choose an AOHA 2. Select account closure 3. Confirm account is closed. 4. Choose an OHA 5. Select account closure 6. Confirm account is closed.	HIGH	PASSED	Note: The user must NOT have permission PERM_ACC_CLOSE_BYPASS because it is not implemented correctly.
1. Connect as SD Agent 2. Go to Admin□Reconciliation page 3. Choose an open Reconciliation 4. Confirm “Close” is available 5. Close the Reconciliation 6. Confirm the status of the Reconciliation is now closed	HIGH	PASSED	Note: To access the "Administration" menu, the role of the user must have one of the following permissions: * PERM_USERS_SEARCH * PERM_ROLE_PERMISSION_UPDATE * PERM_BLOCKS_VIEW * PERM_GROUPS_LIST
1. Connect as NA 2. Go to Phase 2 NAP ***Add an entry*** 3. Add a NAP entry via the screen 4. Confirm the add is applied on the NAP 5. Add a NAP entry via the screen 6. Confirm the add is applied on the NAP 7. Check in EUTL=>NAP/NAAT menu=?Select CP & Registry=>NAP=>installations=>check the corresponding installation that the entry is added ***Delete an entry*** 9. Delete a NAP entry via the screen 10. Confirm the deletion is applied on the NAP 11. Delete a NAP entry via the screen 12. Confirm the deletion is applied on the NAP 13. Check in EUTL=>NAP/NAAT menu=>Select CP & Registry=>NAP=>installations=>check the corresponding installation that the entry is deleted	HIGH	PASSED	

1. Connect as NA 2. Go to Phase 2 NAP =>Aviation Allocation Plans ***Add an entry*** 3. Add a NAAT entry via the screen 4. Confirm the add is applied on the NAAT 5. Add a NAAT entry via the screen 6. Confirm the add is applied on the NAAT 7. Check in EUTL=>NAP/NAAT menu=?Select CP & Registry=>NAAT=>installations=>check the corresponding installation that the entry is added ***Delete an entry*** 9. Delete a NAAT entry via the screen 10. Confirm the deletion is applied on the NAAT 11. Delete a NAAT entry via the screen 12. Confirm the deletion is applied on the NAAT 13. Check in EUTL=>NAP/NAAT menu=>Select CP & Registry=>NAAT=>installations=>check the corresponding installation that the entry is deleted	HIGH	PASSED	
TC_V5.4_13: 1. Connect as NA 2. Go to Account Request 3. Submit an OHA open request 4. Declare a new Account Holder 5. Enter the birth date of the account holder as <<today>> +1 day -18 years 6. Ensure the on screen validation states "applicant must be at least 18 years old" 7. Enter the birth date of the account holder as <<today>> -1 day -18 years 8. Ensure the on screen validation does not reject the applicant 9. Enter the birth date of the account holder as <<today>> -18 years 10. Ensure the on screen validation does not reject the applicant	LOW	PASSED	
TC_V5.4_14: 1. Connect as NA 2. Go to Transactions 3. Click Search 4. Sort by Transaction ID 5. Ensure sorting is not string-based but number based (i.e. EU7 comes below EU27)	HIGH	PASSED	
TC_V5.4_15: 1. Connect as NA 2. Go to Accounts 3. Click Search 4. Sort by Account Holder Name 5. Ensure sorting is not affected by letter capitalization (i.e. "a" comes before "B")	LOW	PASSED	

TC_V5.4_16: 1. Connects as NA 2. Connect to menu Account Request 3. Select to open an Operator Holding Account 4. Select a new account holder 5. Provide details of the account holder 6. Add a new AR via the provision of its URID 7. Check that the table at the top of the page contains the full details of the AR corresponding to the provided URID 7. Repeat for second AR 8. Complete the account request 9. Confirm the full details of the entreed users appear on the application form	HIGH	PASSED	
TC_V5.4_17: 1. Connect as NA 2. Go to menu Administration==>Users==>Click the search button 3. Click on the radio button next to a user 4. Click the un-enroll button 5. From the subsequent confirmation screen click on "submit" without entering a reason 6. The following error message appears: "Please provide a reason for the un-enrolment request (maximum 255 characters)"	LOW	PASSED	
TC_V5.4_18: 1. Connect as NA 2. Go to menu Accounts==>Claim Account 3. Enter the Identifier of an account which is in status "Transfer Pending" 4. Click next 5. Enter the Identifier of an account holder already recorded in the Registry and is already linked to the specific account 6. Click Submit 7. The error message appears: "The account holder with identifier ZZZ is already linked to the account YYY" where ZZZ and YYY the identifiers of the account holder and account respectively.	HIGH	PASSED	
TC_V5.4_19: 1. Connect as NA 2. Go to menu EUETS==>Allocation Tables Phase 3 3. Select the tab National Aviation Allocation Tables 4. Click on an aircraft operator radio button 5. Click the Delete button 6. The alert mentions "Confirm the deletion of 1 aircraft operator"	LOW	PASSED	
	HIGH	PASSED	
TC_V5.4_20: 1. Connect as CA, EU Registry 2. Go to menu EUETS==>Pre-allocation 3. Confirm that in section: "Union-wide issuance" the second and third column are titled: "Issuance" and "Issued" respectively.	LOW	PASSED	
TC_V5.4_21: 1. Connect as NA 2. Go to EUETS==>Allocation Tables Phase 3 3. Confirm the term "Plans" does not appear in this screen but only the term "Tables"	HIGH	PASSED	

TC_V5.4_22: 1. Connect as NA 2. Observe EUETS menu 3. Confirm the available selections specify Allocation Plans Phase 2 & Allocation Tables Phase 3.	LOW	PASSED	
1. Log in as NA or AR. 2. Select an account 3. Select the "Account Statements" tab. Ensure the following: a. Commission flag is on the upper left b. Text “Registry admin of country XX” is on the upper right c. On the bottom of the report, a disclaimer appears from system translations; if a Registry provides text, this text appears instead.	HIGH	PASSED	
TC_V5.4.1_1: 1. Connects as NA 2. Connect to menu Account Request 3. Select to open an Operator Holding Account 4. Select a new account holder 5. Provide details of the account holder 6. Add a new AR via the provision of its URID 7. Check that the table at the top of the page DOES NOT contain the full details of the AR corresponding to the provided URID 7. Repeat for second AR 8. Complete the account request 9. Confirm the full details of the entreed users DO NOT appear on the application form	MEDIUM	PASSED	
TC_V5.4.1_2: 1. Confirm transaction requests and transactions respect statuses presented in sheet "Transaction statuses" of the current sheet in both screen and PDF form. 2. Confirm every transaction request offers "show PDF" button and presents details of the request 3. Confirm every transaction offers "show PDF" button and presents details of the transactions.	HIGH	PASSED	
TC_V5.4.1_3: 1. Log in as Czech NA 2. Select PDF generation of an account statement of an account. At the top right corner, the "OTE" logo must appear. 3. Log in an GR NA 4. Select PDF generation of an account statement of an account. At the top right corner, the "OTE" logo must not appear.	LOW	PASSED	
TC_V5.4.1_4: 1. Ensure a Registry has no front page text via the Administration=>Update Front Page text menu selection 2. Log in as a user of Registry's user 3. Visit the home page and ensure it shows an entry screen, with all usual menus in place	HIGH	PASSED	
TC_V5.4.1_5: <<This has been tested internally via database queries>>	MEDIUM	PASSED	

TC_V5.4.1_6: 1. Log in as NA 2. Exclude an account via the account list screen 3. Go to the "Additional Authorized Representatives" tab 4. Click the "Add AAR" button 5. Fill in the AAR details 6. Confirm the AAR is added on the specific account	MEDIUM	PASSED	
TC_V5.4.1_7: 1. For a BLOCKED AOHA account 2. Submit & verify 2012 emissions equal to zero for this AOHA 3. Confirm account status turns to INACTIVE of this AOHA TC_V5.4.1_8: 1. For an OPEN AOHA account 2. Submit & verify 2012 emissions equal to zero for this AOHA 3. Confirm account status turns to INACTIVE of this AOHA	HIGH	PASSED	
TC_V5.4.2_1: 1. Select an account. Set its status to SUSPENDED 2. Confirm the button REMOVE does not appear for any AR of the account TC_V5.4.2_2: 1. Select an account. 2. Set an AR to "view-only" 3. Confirm the button REMOVE appears next to the AR TC_V5.4.2_3: 1. Set the MIN_REP_ACCOUNT for a registry to 2 2. Select an account with two ARs. 3. Confirm the button REMOVE does not appear TC_V5.4.2_4: 1. Set the MIN_REP_ACCOUNT for a registry to 2 2. Select an account with three ARs. 3. Un-enrol two of its ARs 4. Confirm the enrolled AR cannot be removed The respective flowchart appears on the worksheet "Remove AR flowchart"	HIGH	PASSED	
TC_V5.4.2_5: 1. Select an account 2. Select "View Details" 3. Select the "Authorized Representatives" tab 4. Confirm a table with the following data appears: Minimum number of ARs allowed for this account Maximum number of ARs allowed for this account Number of view-only ARs of this account Number of un-enrolled ARs of this account Number of enrolled ARs of this account	HIGH	PASSED	

TC_V5.4.2_6: 1. Define MIN_REP_ACCOUNT for a Registry as 2 2. Set 2 ARs for an account 3. Confirm the "Remove" button does not appear next to any AR 4. Add an AR to the account 5. Confirm the "Remove" button appears next to every AR of the account	HIGH	PASSED	
TC_V5.4.2_7: 1. Locate a migrated transaction (i.e. without transaction request) 2. Open transaction details tab for this transaction 3. Ensure the screen works and shows empty comments	HIGH	PASSED	
It should be possible to remove an enrolled AR. See EUCR-319 and EUCR-320 above	HIGH	PASSED	
TC_V5.4.2_8: 1. Connext as any user 2. Claim a task 3. Assign it to a user 4. Confirm the list of SD agents of this Registry do not appear in the list	HIGH	PASSED	
The page KYOTO Protocol=>ITL Notifications contains an extra column which is empty. This column was removed.	MEDIUM	PASSED	
Banking is implemented by deleting installation and aviation allowances of Phase 2 and issuing equal number of Phase 3 allowances (Reg 920/2010, art.57). To track such transactions, the following new transaction types were introduced: • DeletionChapter2Banking (10,33) • IssuanceChapter2Banking (1,33) • DeletionChapter3Banking (10,34) • IssuanceChapter3Banking (1,34)	HIGH	PASSED	
TC_V6.1_1: 1. Connect as NA 2. Navigate to Accounts=> Transactions Screen 3. Enter search criteria and click "Search and Export" 4. On the geneated CSV file confirm the field "NB of Units" exists and contains the actual transaction units.	MEDIUM	PASSED	
UC_BL_001: Initial list upload	HIGH	PASSED	
UC_BL_003: Export lists from EUCR	HIGH	PASSED	
UC_BL_008: View Lists	HIGH	PASSED	
UC_BL_006: View List Change Logs	HIGH	PASSED	
UC_BL_007: View (in)eligible units of a Registry (Unit Block Management screen)	HIGH	PASSED	
UC_BL_027: Modify list projects	HIGH	PASSED	
UC_BL_028: Modify list unit blocks	HIGH	PASSED	
UC_BL_009: Perform transactions on (in-)eligible units	HIGH	PASSED	
UC_BL_033: Manage incoming transactions	HIGH	PASSED	
UC_BL_011: Select (in)eligible units for a transaction	HIGH	PASSED	

UC_BL_012: Block incoming transactions into EUETS accounts when they contain ineligible units	HIGH	PASSED	
UC_BL_031: Block in-eligible unit types	HIGH	PASSED	
UC_BL_013: View eligible and ineligible units of a user's accounts (Account Holdings screen)	HIGH	PASSED	
UC_BL_014: View entitlement, surrendered and exchanged quantities (Placeholder of future functionality)	HIGH	PASSED	
UC_BL_016: Account statements show balances of (in-)eligible units	HIGH	PASSED	
TC_V6.1_2: 1. Connect as AR of an account 2. Navigate via Accounts menu to the specific account 3. Propose a "transfer of allowances" transaction for the specific account 4. The transfer screen shows very clearly that the account entry fields are disabled and that the user can only click on the "select from trusted accounts" hyperlink. 5. Confirm that it is not possible to click on the account entry fields, which are clearly disabled.	HIGH	PASSED	Issue was implemented by presenting visually the inability of the account fields to be clicked.
TC_V6.1_3: 1. Connect as NA 2. Via the Accounts screen locate an account 3. Click on the "Close" hyperlink of the account 4. Connect as second NA 5. Claim the account closure task and observe its task description screen 6. Confirm the identified of the account to be closed is visible on the task description screen	MEDIUM	PASSED	
TC_V6.1_4: 1. Connect as NA 2. Select an account and navigate to Account Main => Account Holder section 3. Click on Update and change some details of the account holder 4. Connect as second NA 5. Claim the business details update of the account holder 6. Confirm the task description screen contains sections: Account Holder: Non-updatable details Account Holder: Updated details 7. COnfirm that the account holder name appears in "Account Holder: Non-updatable details" section	MEDIUM	PASSED	
TC_V6.1_5: 1. Connect as AR 2. Navigate to Accounts=>Transactions screen and locate a transaction 3. Click on "Request Details" tab 4. Confirm this tab contains the following columns: User Act: The action on the transaction (i.e. proposal, approval) Act Date: The respective date of the action User ID: The ID of the user performing the transaction User First Name: the first name of the user performing the update User Last Name: the last name of the user performing the update	MEDIUM	PASSED	Since response codes already appear on another tab, a new tab was introduced named "request details". This tab presents the lifetime of the request of the transaction.

TC_V6.1_6: 1. Connect as NA 2. Navigate to Administration => Unit Blocks screen 3. Enter any search criteria (or none at all) and click on "Search" 4. Confirm the generated account list contains the Holding Account 5. Confirm the Holding Account column contains the check digit of each account	MEDIUM	PASSED	
TC_V6.1_7: Confirm the following sections contain the term "External Trading Platform" and neither "External Platform" nor "Trading Platform" 1. Account Request screen: account type drop-down 2. Email notification with the request; the attachment name 3. Content of the account opening PDF; the account type 4. Account search: the account type filter drop-down 5. Account search results: the account type 6. View account details: the account type	HIGH	PASSED	
TC_V6.1_8: Confirm the three following scenarios: A 1. Go to Task List screen and click and claim three tasks 2. None of the tasks are claimed 3. All three of the tasks should now belong to the logged-in user B 1. Go to Task List screen and click and claim three tasks 2. One of the tasks is already claimed by the logged-in user; two other tasks are unclaimed 3. All three of the tasks should now belong to the logged-in user C 1. Go to Task List screen and click and claim three tasks 2. One of the tasks is already claimed by another user 3. The message " Claim task item error:One or more task items cannot be claimed, because they are not in unclaimed status." appears and claiming stops	MEDIUM	PASSED	1. It was not requested to alter the exection of tasks unclaiming 2. The error message might need to be altered as well since "Claim task item error:One or more task items cannot be claimed, because they are not in unclaimed status." is not always relevant
TC_V6.1_9: 1. Connect as NA 2. Navigate to Accounts search screen 3. Enter some criteria (or none at all) and click on "Search" 4. Click on a column to alter sorting 5. Click on an account from the list of returned accounts 6. View the details of the account 7. Click on "Return to Search" 8. Observe that the account search criteria and sorting are preserved	MEDIUM	PASSED	The up or down arrow of the sorted column is not preserved.

TC_V6.1_10: 1. Connect as AR 2. Request a new account via "Account Request" screen 3. Request the creation of a new Account Holder 4. Select account holder is company 5. Confiorm the VAT field can enter and save 55 characters totally	HIGH	PASSED	
TC_V6.1_11: 1. Connect as AR of an account 2. Navigate to the account 3. Propose a transaction 4. Enter comments 5. Confirm entered comments can reach 256 characters 6. Confirm the comments are preseved in the transaction details screen	HIGH	PASSED	
TC_V6.1_12: 1. Connect as NA 2. Navigate to Administration => Unit Blocks screen 3. Enter some criteria (e.g. Holding Account Type=Operator Holding Account) 4. On the presented list, alter sorting by clicking on column headers 5. Confirm that entered criteria are respected after altering the sorting	MEDIUM	PASSED	
TC_V6.1_13: 1. Connect as NA 2. Navigate to KYOTO protocol => JI projects screen 3. Enter some criteria (e.g. Track=TRACK_1) 4. On the presented list, alter sorting by clicking on column headers 5. Confirm that entered criteria are respected after altering the sorting	MEDIUM	PASSED	
TC_V6.1_14: 1. Connect as AR of an account 2. Select the account via Account search screen 3. Navigate to "Account Statements" tab 4. Enter Start Date and End Date the same date 5. Confirm the account statement is generated for this specific date in screen and PDF form.	MEDIUM	PASSED	
TC_V6.1_15: 1. Connect as AR of an account 2. Select the account via Account search screen 3. Navigate to "Account Statements" tab 4. Enter a start and an end date 5. Confirm the generated statement contains the following sections: A(Request), B(Pending), C(Completed) and D(Terminated). Default (original) tab is Completed tab.	MEDIUM	PASSED	

TC_V6.1_16: 1. Connect as NA for NL (or another Registry using the standard EN language translation) 2. Navigate to an AOHAccount 3. Navigate to Compliance tab 4. Hover over the question mark next to non-domestic emissions 5. Confirm the explanatory text is the following: "Relate to all flights which departed from an aerodrome situated in the territory of an EU Member State and arrived at an aerodrome situated in the territory of another EU Member State or a third country and to all flights which departed from an aerodrome situated in the territory of a third country and arrive at an aerodrome situated in the territory of an EU Member State".	MEDIUM	PASSED	
TC_V6.1_17: 1. Connect as AR of an account 2. Select the account via Account search screen 3. Navigate to Surrender tab 4. Confirm the Phase 3 duration presented on upper left corner is 2013~2020	MEDIUM	PASSED	
TC_V6.1_18: 1. Connect as SD_Agent 2. Confirm that under Administration, the menu entries Send Message, Reconciliation, Message Logs are shown and that they lead to respective screens Note: The functionality of those menu entries is defined in respective use case documents.	HIGH	PASSED	
UC_BL_001_TC_009: 1. Connect as CA 2. Add a project in CDM Negative list 3. Download CDM Negative list from EUCR 4. Upload CDM Negative list in EUTL 5. Add the same project in General Positive List 6. Download General Positive List from EUCR 7. Upload General Positive List in EUTL 8. Delete the project from CDM Negative list 9. Download CDM Negative list from EUCR 10. Upload CDM Negative list in EUTL 11. Confirm the specific project in EUCR and in EUTL is eligible Repeat the above for ERU Negative list and Application Procedure Positive list.	HIGH	PASSED	
TC_V6.1.1_01: 1. Login as NA or CA 2. Click the link Administration=>View List Log 3. Confirm the respective screen appears	HIGH	PASSED	

TC_V6.1.1_02: 1. Login as NA 2. Find an account and enter its Compliance tab 3. Enter/modify emissions for 2012 for this account 4. Login as verifier of this account 5. Approve emissions entered during step [3] 6. Go to EUTL Public => OHA Search => View Details - All Periods=> Navigate to the table Compliance Information for 2012. Next to the Compliance Code, a "*" must appear.	HIGH	PASSED	
TC_V6.1.1_03: Confirm AARs can be removed from an account.	HIGH	PASSED	
TC_V6.1.1_04: 1. Login as AR of account A 2. Enter a transfer from account A to account B 3. Programmatically set the transaction to status DELAYED-CANCELLED 4. Login as as AR of account B, without access to account A 5. The last logged-in user must NOT see the mentioned transactions	HIGH	PASSED	
TC_V6.1.1_06: 1. Login as NA 2. Assume the limit of minimum ARs for this Registry is 2 3. Find an account with 2 ENROLLED ARs 4. Add a VALIDATED user on this account as AR 5. Remove an ENROLLED AR 6. The AR should be allowed to be removed, because the remaining ARs (1 ENROLLED + 1 VALIDATED) is acceptable for the account	HIGH	PASSED	
TC_V6.1.1_07: 1. Connect as CA 2. Navigate to Administration => View List Details 3. Select a list 4. Delete a record 5. Confirm the deletion 6. The record is deleted without a screen refresh on the underlying "View List Details" screen	HIGH	PASSED	
TC_V6.1.1_08: 1. Connect as CA 2. Navigate to Administration => View List Details 3. Select a list 4. Click on "Insert" button 5. In the "Project Identifier" field enter "abc" and click "Insert" 6. The message "Project Identifier: the value provided must be numeric." should appear	HIGH	PASSED	

TC_V6.1.1_09: 1. Connect as any user 2. Open a transaction 3. Navigate to "Transaction Details" 4. Confirm the headers of the table are: User Action, Action Date, URID	HIGH	PASSED	
TC_V6.1.1_10: 1. Connect as CA 2. Navigate to Administration => View List Details 3. Ensure the name of list ERU Negative list appears with correct capitalisation.	HIGH	PASSED	
TC_V6.1.1_15: 1. Connect as CA 2. Navigate to Administration=>View List Details 3. Perform a search 4. Export the retrieved records 5. Ensure the proposed filename is related to the chose list & current date	HIGH	PASSED	
TC_V6.1.1_16: 1. Connect as NA 2. Navigate to Administration=>Unit Blocks 3. Ensure information on eligibility and flagging reason appears	HIGH	PASSED	
TC_V6.1.1_17: 1. Set DELAYED_START_SPREAD_RANGE =300 2. Enter a transfer and approve it, so that after 26 hours the time is non-working. 2. Confirm the transaction has execution time 26 hours + a random value between 0 and 300. So, practically, the transaction is entered between 10:00 AM and 10:05 AM.	HIGH	PASSED	
	MEDIUM	PASSED	
	HIGH	PASSED	
TC_V6.1.1_18: 1. Increase screen resolution to maximum 2. Ensure the top-screen banner in the homepage appears correctly	LOW	PASSED	
TC_V6.1.1_19: 1. Increase browser zoom 2. Ensure task list headers are correctly displayed	LOW	PASSED	
TC_V6.1.1_20: 1. View an account 2. Click on AR or AAR tab and click on add AR or add AAR 3. Click next directly without selecting a radio button (Representative is already related to the Account Holder OR Representative is not yet related to the Account Holder) 4. The presented error message is user-friendly	LOW	PASSED	

TC_V6.1.1_21: 1. Display the list of account 2. Click on Delegate link on the right 3. Click on Next without selecting an external platform	LOW	PASSED	
TC_V6.1.1_22: 1. Attempt a set-aside transaction 2. Confirm the allowed quantity can reach up to the surrendered amount by AOHA, including 30-APRIL.	HIGH	PASSED	
TC_V6.1.2_1: 1. Enter a transaction from one Registry account to an account of another Registry. 2. Approve the transaction request as AAR 3. Confirm that the tab "Request" is visible to: * The NA of the transferring Registry * The NA of the acquiring Registry * The AR(s) of the transferring account * The AAR(s) of the transferring account The AR(s) and AAR(s) of the acquiring account should not be able to view the "Request" tab.	HIGH	PASSED	
TC_V6.1.2_2: 1. Login as CA 2. Navigate to all lists management screens (view lists, view list logs, unit block management, account holdings) 3. Confirm the terms "Eligible" and "Ineligible" are now "Eligible for ICH" and "Ineligible for ICH" Repeat for NA. Repeat for AR, AAR for account holdings screen only.	LOW	PASSED	
TC_V6.1.2_3: 1. Login as NA 2. Enter a transfer from an account to another Registry account 3. Approve it as AAR 4. Login as transferring Registry NA 5. Ensure button "withdrawal" is visible for this transaction 6. Login as the acquiring Registry NA 7. Ensure the button "withdrawal" is not visible for this transaction	HIGH	PASSED	

TC_V6.1.2_4: 1. Login as NA 2. Enter a transfer from an account to another Registry account 3. Approve it as AAR 4. Login as transferring Registry NA 5. Ensure the transaction appears in the "Transactions" screen as DELAYED. 6. Login as acquiring Registry NA 7. Ensure the transaction does not appear in the "Transactions" screen. Repeat steps 6-7 as acquiring account AR, AAR.	HIGH	PASSED	
TC_V6.1.2_5: 1. Login as NA 2. Select an account and navigate to holdings screen 3. Ensure that under columns "Eligible for ICH" and "Ineligible for ICH" values 0 or positive appear only for CER and "ERU from AAU". 4. For AAU, Allowances there are not any values; the cell is empty. Repeat as AR, AAR	MEDIUM	PASSED	
TC_V6.1.2_6: 1. Login as CA 2. Navigate to "View ICH Lists" 3. Select a list type 4. Click on export to CSV 5. Ensure the geneated CSV file corresponds to the list selected. Note: full list contents are included in the CSV	HIGH	PASSED	
TC_V6.1.2_7: 1. Login as NA 2. Ensure the menu options "View ICH Lists" and "View ICH List Log" exist under menu "Administration" Repeat for CA	LOW	PASSED	
TC_V6.1.2_8: 1. Login as NA 2. Select an account and navigate to account statement 3. Enter a date range containing accounts with CER/ERU units contained in lists or in no lists 4. Generate account statement CSV 5. Ensure the last column of the CSV is "Eligible for ICH" or "not Eligible for ICH" accoridng to the flag of the specific unit blocks.	HIGH	PASSED	
TC_V6.1.2_9: 1. Login as NA 2. Select an account and navigate to account statement 3. Enter a date range which is longer than a month 4. Ensure the warning message "The selected period should not be longer than a month." appears	MEDIUM	PASSED	

TC_V6.1.2_10: 1. Login as NA 2. Navigate to ITL Notifications 3. Select a notification and click on "Fulfill" 4. Ensure that in the next screen the rightmost column is titled "Project Number"	MEDIUM	PASSED	
TC_V6.1.2_11: EUCR: 1. Login as NA 2. Navigate to Transactions 3. Ensure in Transaction Type drop-down the specified new transaction types exist; by selecting each of them, the appropriate transaction records appear. EUTL: 1. Login and navigate to Transaction Mgt. 2. Ensure that in the drop-down box "Supplementary Transaction Type" the records "33-Chapther II Banking" and "34-Chapter III Banking" exist and filter the transactions appropriately.	HIGH	PASSED	
TC_V6.1.2_13: 1. Login as NA 2. Locate an outgoing transaction and open its Request Details tab 3. Ensure the first two columns are "User Action" and "Action Date" 4. Ensure the third column is "User URID"	HIGH	PASSED	
TC_V6.1.2_14: 1. Login as NA 2. Locate an account and navigate to "Account Statements" tab 3. The buttons "Account Statement PDF" and "Account Statement CSV" must follow the defined translation for the specific Registry	LOW	PASSED	
TC_V6.1.2_15: 1. Login as NA 2. Locate a transaction 3. Ensure the button "Transaction PDF" follows the translation defined for this Registry	LOW	PASSED	

TC_V6.1.2_16: EUCR 1. Login as NA 2. Navigate to ICH View Lists 3. Ensure the lists contained in the "List Names" drop-down field are General Negative List, Article 58(1)Negative List, General Positive List, Application Procedure Positive List EUTL 1. Login and navigate to "Eligible/Ineligible Lists Upload" 2. Ensure the presented list types are as defined above.	MEDIUM	PASSED	
TC_V6.1.3_1: TC_1: In an account with AR equal to MIN_REP_ACCOUNT, all ARs are enrolled. Step 1: Remove AR view-only, ENROLLED Step2: Ensure the AR is removed Repeat step 1 for AR view-only: VALIDATED, UNENROLLED TC_2: In an account with AR equal to MIN_REP_ACCOUNT, all ARs are validated. Step 1: Remove AR view-only, ENROLLED Step2: Ensure the AR is removed Repeat step 1 for AR view-only: VALIDATED, UNENROLLED TC_3: In an account with AR equal to MIN_REP_ACCOUNT, one ARs is enrolled and the other is validated. Step 1: Remove AR view-only, ENROLLED Step2: Ensure the AR is removed Repeat step 1 for AR view-only: VALIDATED, UNENROLLED TC_4: In an account with one AAR in status ENROLLED. Step 1: Remove the AAR Step2: Ensure the AAR is removed Repeat for AAR view-only: VALIDATED, UNENROLLED	HIGH	PASSED	
TC_V6.1.3_2: 1. Connect as NA and request a new AOHA with first year of verification 2012 2. Approve the request as second NA 3. Open the account details of the new AOHA 4. Confirm data appear correctly	HIGH	PASSED	

TC_V6.1.3_4: TC_1: In an account with AR equal to MIN_REP_ACCOUNT, all ARs are enrolled. Step 1: Suspend a view-only AR Step2: Ensure the AR is suspended Repeat step 1 for AR view-only: VALIDATED, UNENROLLED TC_1: In an account with one AAR, the AARs is enrolled. Step 1: Suspend the AAR Step2: Ensure the AAR is suspended Repeat step 1 for AAR : VALIDATED, UNENROLLED	HIGH	PASSED	When an AAR is suspended then the button Restore appears. When an AR view-only is suspended the buttons Remove & Restore appear. When an unenrolled AAR is suspended, he is locked on the account because remove no longer works. When an AR view only is suspended and then removed and the task is rejected, the AR is no longer suspended. This last occurs for AR (non-view-only as well.
TC_V6.1.3_7: 1. Connect as CA for EU Registry 2. Navigate to Administration => View ICH Lists 3. Select a list type and click Search 4. Click on "Export to CSV" 5. Ensure the file generated has a ".csv" extension	HIGH	PASSED	
TC_V6.1.3_8: 1. Connect as CA for EU Registry 2. Navigate to Administration => View ICH Lists 3. Select a list type and click Search 4. Click on "Export to XML" 5. Save the file and open it with Wordpad or Notepad++ 6. Ensure the file contains line breaks on each line	HIGH	PASSED	Due to its treatment of carriage-returns, Notepad cannot show the contents properly; please use Wordpad instead.
TC_V6.1.3_9: 1.Connect to EUTLTC_V6.1.3_9: 2. Navigate to Eligible/Ineligible List Upload 3. Upload the list attached on issue TST-230 and specify it as "General Positive List" 4. Ensure the message "Invalid XML" appears	HIGH	PASSED	
TC_V6.1.4_08: 1. Connect as NA 2. Naviagate to an account 3. Open the "Trusted Account" tab 4. Click on "Add" 5. Ensure the digit "0" appears disabled in the next screen	HIGH	PASSED	
TC_V6.1.3_09: 1. Connect as NA 2. Select an account via the Accounts screen 3. Select View Details=>Holdings 4. Ensure the columns Eligible for ICH and Pending/Ineligible for ICH appear before the column Balance	HIGH	PASSED	
TC_V6.1.3_10: 1. Connect as CA for EU Registry 2. Navigate to Administration=>View ICH List Log and select a list type 3. Ensure the rightmost column is "Name" and contains the user who performed last action 4. Connect as NA for any Registry 5. Navigate to Administration=>View ICH List Log and select a list type 6. Ensure the column "Name" is not shown	HIGH	PASSED	The permission PERM_BW_LIST_USER_NAMES needs to be assigned to CA. This is hidden from the permissions management screen and needs to be set via database script.

TC_V6.1.3_11: 1. Connect as NA 2. Navigate to Transactions screen 3. Confirm that in transaction type drop-down list the following transaction types appear: 1-33 Issuance Aviation Allowances Banking 1-34 Issuance General Allowances Banking 10-33 Deletion Aviation Allowances Banking 10-34 Deletion General Allowances Banking Selecting each of them retrieves the corresponding type of transactions in the lower part of the screen.	HIGH	PASSED	
1. Login as any user; go to Task List. Select a task and click "Assign". 2. From the drop-down list at the field "New claimant" notice the names of the assignees. 3. Select another task and notice the names of the assignees via the same process. Make sure that the two tasks have some different assignees. 4. Having clicked the second task, select an assignee that appears only to the second task and not to the first one. 5. Check both tasks and then click "Save". 6. Ensure that the selected assignee is saved only to the second task and that the first task remains unaffected.	HIGH	PASSED	
1. Connect as NA 2. Navigate to EUETS=>Allocation Phase 3 3. Confirm that in "Installations" and "Aircraft Operators" tabs the years from the beginning of Phase 3 up to and including the current year appear as possible selections for "Year" drop-down listbox. No future years appear. 4. User selects allocations for a year 5. User clicks "Submit" 6. User connects as second NA and approves the allocations. 7. Allocations to the specified installations are performed at the next allocation job execution. Repeat for aircraft operators. Note that enough units must have been issued and transferred to EU Allocation account.	HIGH	PASSED	

A) Test Environment: 1. Firefox Browser 2. Tamper Data Firefox Plugin (TD hereafter) B) Test Case(s): 1. Open the TD Window 2. Login as NA 3. Navigate to the List of Accounts 4. Find an account that does not offer the "Block" action 5. Click "View Details" and from the TD note the "accountId" parameter 6. Return to the List of Accounts 7. Click the "Block" link on any other account from the list 8. Using TD change the "accountId" to the one you've noted in step (5) Expected Results: The system should not permit the action (either with an explicit message, or by returning the user to the previous page without applying the attempted change) Repeat the above test for the rest of the account actions: - Unblock - Suspend - Restore - Close - Delegate - Exclude - Unexclude	HIGH	PASSED	
1. Log in as AR. 2. Go to Task List. Select a task and click "Assign". 3. From the drop down list at the field "New claimant" check the names of the assignees. 4. Ensure that as an AR you can assign the task only to ARs. 5. Repeat the test with AARs. Ensure that as an AAR you can assign the task only to an other AAR.	HIGH	PASSED	

A) Test Environment: a. Firebug installed on your Firefox. b. Your ECAS account to be associated with two mobile phone numbers. B) Test Case(s): 1. Login as AR 2. Propose a transfer of allowance, sign it with Mobile A. 3. Navigate to the Task List. Locate the Approve Transaction task and Claim it. 4. Open its details. You will not see an Approve button. 5. Open your Firebug and inject the following code under the html of the details of the transaction <button id="trustedAccountRequestApproveButtonId" name="trustedAccountRequestApproveButtonId" onclick="confirmDialogApprove.show();" type="button" class="ui-button ui-widget ui-state-default ui-corner-all ui-button-text-only" role="button" aria-disabled="false">Approve</button> 6. The approve button appears. 7. Click it and sign the transaction with Mobile B. C) Expected Result: An application error page is displayed informing the user that his signature was not valid.	HIGH	PASSED	
1. Enter a transfer transaction 2. Directly afterwards click the "Accounts" link 3. Confirm an error does not appear and system operates normally	HIGH	PASSED	
	HIGH	PASSED	

(A) Test Setup: 1. In order to be able to reproduce this issue, you need to run EUCR on localhost and ECAS Mock on a remote server, otherwise the single sign out prevents you from completing step 1.8 since your http session will have been invalidated already 2. For test case 2 you need an ECAS account with 2 mobiles registered. (B) Test Cases: Test Case 1: 1.1. Log in as NA 1.2. Propose a transaction as NA 1.3. The system redirects to ECAS for signing 1.4. Logout from ECAS 1.5. Login to ECAS as another user. Since it is an ECAS login (and not a EUCR requested login) the user can login using any of the available options: Password, Mobile or Token options. 1.6. Using browser’s history, navigate back to the transaction’s signing page. 1.7. ECAS allows the second user to sign the transaction and returns to EUCR. Test Case 2: 2.1. Log in as NA using mobile A 2.2. Propose a transaction as NA 2.3. The system redirects to ECAS for signing 2.4 Sign the transaction using mobile B 2.7. ECAS allows the second user to sign the transaction and returns to EUCR. (C) Expected Results: The application should show an error page that the signature is invalid.	HIGH	PASSED	

Recertification Certificate for Poland

United Nations
Framework Convention on
Climate Change

Recertification Certificate

Party	***Poland***
Issue Date	**01-06-2012**

This certificate confirms that the national registry of *Poland* has successfully passed all recertification tests pursuant to the release of the change of the consolidation of European national registries:

Test Item	Date Passed
Common readiness documentation review	15/12/2011
Specific readiness documentation	31/05/2012
Connectivity reliability test	30/05/2012
Distinctness test	9/12/2011
Interoperability test	30/05/2012

As a result of the execution of the abovementioned tests, the following comments/remarks shall be taken into account:

Item	Comment
SEF	Support of the standard electronic format (SEF) shall be tested and implemented by September 2012

Jörg Kirschbaum

for the ITL Administrator

Tests results report – release v.4.0

DG CLIMA QA REPORT EUCR v4.0

Table of Content

I. INTRODUCTION

I.1. Purpose

This report contains the Quality Assessment Report (QAR) on the monitoring of the Site-Acceptance Test (SAT) for the release 4.0.

We also provide some recommendations about the:

- Tests execution
- Involved use cases

I.2. Scope

The scope of this Quality Assessment Report (QAR) is to:

1. Check the good execution of the test cases defined during the FAT and available at IT 4.0 Fat & Regression Report
2. Check the correction of bugs defined in Trasys's JIRA & in CLIMA's JIRA

The tests cases could be find in confluence: CR2012 Testing.

I.3. SAT environment

The SAT was performed at the DG CLIMA premises.

During the tests most of us were national administrator above some other rights. We took the assumption that this was not a problem for running the tests but ideally the test team should include all the types of roles (Verifier, AR, AAR, NA, CA).

Initially 6 days of SAT and days of reporting were foreseen. The SAT was performed as follows:

Date	Tester(s)	Tests' descriptions
Monday 18 June	MLE (1d) – SAT	Sat
Tuesday 19 June	MLE (1d) – SAT	Sun
Wednesday 20 June	MLE (1d) – SAT	Mon
Monday 25 June	MLE (1d) – SAT	Tue
Tuesday 26 June	MLE (1d) – SAT	Wed
Wednesday 27 June	MLE (1d) – SAT Report	Thu

II. Results of the review and monitoring of the Site-Acceptance test: EUCR - EUTL

II.1. Introduction

The EUCR and EUTL v4.0 was meant to be the final release of the Union Registry.

The SAT for this release were not performed by Trasys, but directly by DG CLIMA representatives.

II.2. Tested functionalities

Version 4.0 is a final version; the tests during the SAT were mostly covering the new use cases of the application:

- UC 19: Trusted Account List;
- UCS 20: Auctioning.

Those new main functionalities were also impacting existing use cases, therefore included in the SAT:

- UC 02: Users;
- UC 04: Account management;
- UC 08: Compliance;
- UC 09: Issuance;
- UC 10: Transactions;
- UC 13: Holdings and transfers.

Remark: a full regression of the whole set of use case was not foreseen for the SAT. See next section for a detailed picture of the test cases ran.

II.3. Detailed tests results

This section presents the tests results, which can be either:

- “passed” : the test was performed successfully according to the test case description;
- “failed” : the test failed either because the result was not conform to the expected one, or because of an unexpected external trouble;
- “not completed”: the test was not fully performed or not performed at all;
- “not relevant”: the test was skipped because not relevant for some reason (see remarks below).

SPEC	FUNCTIONALITY	UCE CASES	TEST CASES	STATUS	REMARKS
UCS.01	BASIC FUNCTIONALITY	DISPLAY MENU	SEARCH AND EXPORT TABLES	PASSED	
UCS.02	USERS	UC_UA_01:LOGIN	UNSUCCESSFUL LOGIN - ECAS MOBILE IS DIFFERENT THAN THE USER'S MOBILE IN PERSONAL DETAILS DATA	PASSED	
UCS.02			UNSUCCESSFUL LOGIN -UPDATE MOBILE NUMBER	PASSED	
UCS.02		UC_UA_010:REGISTER	USER REGISTRATION - PERSONAL DETAILS E-MAIL CONFIRMATION FIELD	PASSED	

UCS.02		UC_UA_056:APPROVE OR REJECT PERSONAL DETAILS UPDATE	UNSUCCESSFULL LOGIN - APPROVE REQUEST TO UPDATE MOBILE PHONE	**PASSED**	
UCS.04		UC_AM_10:REQUEST ACCOUNT OPENING	OPEN ACCOUNT REQUEST - ADD VIEW ONLY AR	**PASSED**	
UCS.04			OPEN ACCOUNT REQUEST - CAPTCHA	**PASSED**	
UCS.04	ACCOUNT MANAGEMENT	UC_AM_170: REQUEST ADDITION OF ACCOUNT REPRESENTATIVE	CANNOT PROCEED TO ACCOUNT MANAGEMENT REQUEST FOR A SPECIFIC ACCOUNT WHEN ONE PENDING REQUEST EXISTS - NEGATIVE TESTING	**PASSED**	
UCS.04			REQUEST OF ADDITION OF VIEW ONLY AR	**PASSED**	
UCS.04		UC_AM_330: UN-RELEASE ACCOUNT	UN-RELEASE ACCOUNT IS FORBIDDEN WHEN THERE IS PENDING CLAIM REQUEST	**PASSED**	
UCS.04		UC_AM_290: APPROVE OR REJECT A SPECIFIC ACCOUNT TRANSFER	TRANSFER AOHA TO THE SAME REGISTRY	**PASSED**	

UCS.04			TRANSFER AOHA TO DIFFERENT REGISTRY	**PASSED**	
UCS.04			TRANSFER AOHA TO DIFFERENT REGISTRY - WITH EXISTING ALLOCATION PLAN	**PASSED**	
UCS.04			TRANSFER AOHA TO DIFFERENT REGISTRY - WITH ALLOCATIONS AVAILABLE	**PASSED**	
UCS.04			TRANSFER AOHA TO DIFFERENT REGISTRY - LINKS TO EXTERNAL PLATFORM - VERIFIER ACCOUNT ARE DELETED	**PASSED**	
UCS.04		UC_AM_360: SUSPEND/ RESTORE ACCOUNT	SUSPEND ACCOUNT	**PASSED**	
UCS.04			CONSULT THE SUSPENSION REASON	**PASSED**	
UCS.05	WORKFLOW MANAGEMENT	UC_WF_015:COMPLETE TASK	TASK REQUESTER THAT BELONGS TO APPROVAL ASSIGNEE GROUP CAN REJECT THE TASK	**PASSED**	

UCS.05			TASK APPROVER ECAS SIGNATURE MOBILE SHOULD BE DIFFERENT THAN REQUESTER SIGNATURE MOBILE	**PASSED**	
UCS.09		UC_IS_001: VIEW AND MANAGE ISSUANCES	ISSUANCE TRANSACTION UNSUCCESSFUL - CANCEL THE BLOCKED UNIT BLOCKS	**PASSED**	
UCS.09	ISSUANCE	UC_IS_002: ALLOWANCE ISSUANCE	DISPLAY ISSUANCE ALLOWANCE PAGE	**PASSED**	
UCS.09			GENERAL ALLOWANCE ISSUANCE	**PASSED**	
UCS.09			AVIATION ALLOWANCE ISSUANCE	**PASSED**	
UCS.09			ALLOWANCE ISSUANCE NEGATIVE TESTING	**PASSED**	
UCS.13	HOLDINGS & TRANSFERS	UC_TF_030:TRANSFER ALLOWANCES	TRANSFER TRANSACTION - SELECT FROM TRUSTED LIST - DISPLAYS ONLY ACCOUNT THAT CAN HOLD ALLOWANCES	**PASSED**	

UCS.13			TRANSFER TRANSACTION - SELECT FROM TRUSTED LIST - NO AAR - NO APPROVAL REQUIRED	PASSED	
UCS.13			TRANSFER TRANSACTION - SELECT FROM TRUSTED LIST - AAR - APPROVAL REQUIRED	PASSED	
UCS.13			TRANSFER TRANSACTION - TRADING ACCOUNT - ENTER MANUALLY ACCOUNT NUMBER - APPROVAL REQUIRED	PASSED	
UCS.13			DELEGATED ACCOUNT - TRANSFER TRANSACTION IS NOT AVAILABLE	PASSED	
UCS.13		UC_TF_040:TRANSFER KYOTO UNITS	TRANSFER TRANSACTION - SELECT FROM TRUSTED LIST	PASSED	

UCS.13			TRANSFER TRANSACTION - SELECT FROM TRUSTED LIST - NO AAR - NO APPROVAL REQUIRED	**PASSED**	
UCS.13			TRANSFER TRANSACTION - SELECT FROM TRUSTED LIST - AAR - APPROVAL REQUIRED	**PASSED**	
UCS.13			TRANSFER TRANSACTION - TRADING ACCOUNT - ENTER MANUALLY ACCOUNT NUMBER - APPROVAL REQUIRED	**PASSED**	
UCS.13			DELEGATED ACCOUNT - TRANSFER TRANSACTION IS NOT AVAILABLE	**PASSED**	
UCS.19	TRUSTED ACOCUNT LIST	UC_TA_010: DISPLAY TRUSTED ACOCUNT LIST	DISPLAY THE TRUSTED ACCOUNT LIST PAGE	**PASSED**	
UCS.19			CLOSED ACCOUNTS ARE NOT DISPLAYED IN TRUSTED LIST	**PASSED**	

UCS.19			ACCOUNT FROM OTHERS TRUSTED LIST IS DISPLAYED IN HOLDER'S TRUSTED LIST AFTER ACCOUNT IS CLAIMED BY THIS HOLDER	**PASSED**	
UCS.19		UC_TA_020: ADD ACCCOUNT TO TRUSTED ACCOUNT LIST	ADD ACCOUNT TO TRUSTED LIST	**PASSED**	
UCS.19			ADD ACCOUNT TO TRUSTED LIST - NEGATIVE TESTING	**PASSED**	
UCS.19		UC_TA_030: APPROVE OR REJECT ADDITION OF ACCOUNT TO TRUSTED ACCOUNT LIST	AAR APPROVES THE ADDITION OF ACCOUNT TO TRUSTED LIST - ACCOUNT HAS AAR	**PASSED**	
UCS.19			AR APPROVES THE ADDITION OF ACCOUNT TO TRUSTED LIST - ACCOUNT HAS NO AAR	**PASSED**	
UCS.19			REJECT THE ADDITION OF ACCOUNT TO TRUSTED LIST	**PASSED**	

UCS.19		UC_TA_035: CANCEL ADDITION OF ACCOUNT TO TRUSTED ACCOUNT LIST	CANCEL ADDITION OF ACCOUNT TO TRUSTED ACCOUNT LIST	**PASSED**	
UCS.19			NO CANCELLATION EXECUTED AND ADDITION OF ACCOUNT TO TRUSTED ACCOUNT LIST IS COMPLETED	**PASSED**	
UCS.19		UC_TA_040: DELETE ACCOUNT FROM TRUSTED ACCOUNT LIST	DELETE ACCOUNT FROM TRUSTED ACCOUNT LIST	**PASSED**	
UCS.19			AAR APPROVES THE DELETION OF ACCOUNT FROM TRUSTED LIST	**PASSED**	
UCS.19			AR APPROVES THE DELETION OF ACCOUNT FROM TRUSTED LIST	**PASSED**	
UCS.19			REJECT THE DELETION OF ACCOUNT FROM TRUSTED LIST	**PASSED**	
UCS.20	AUCTIONING	UC_AU_010: DISPLAY AUCTION TABLES MANAGEMENT PAGE	DISPLAY AUCTION TABLES MANAGEMENT PAGE	**PASSED**	

UCS.20	UC_AU_020: IMPORT AN AUCTION TABLE	DISPLAY AUCTION TABLES MANAGEMENT PAGE – NEGATIVE TESTING	PASSED	
UCS.20		ADD A NEW AUCTION TABLE	PASSED	
UCS.20		ADD A NEW AUCTION TABLE – NEGATIVE TESTING	PASSED	
UCS.20		UPDATA AN EXISTING AUCTION TABLE	PASSED	
UCS.20		UPDATE AN EXISTING AUCTION TABLE – NEGATIVE TESTING	PASSED	
UCS.20		DELETE AN EXISTING AUCTION TABLE	PASSED	
UCS.20		DELETE AN EXISTING AUCTION TABLE – NEGATIVE TESTING	PASSED	
UCS.20		ADD MORE THAN ONE AUCTION TABLE	PASSED	
UCS.20		ADD AND UPDATE AN AUCTION TABLE	PASSED	

UCS.20			ADD, UPDATE AND DELETE AN AUCTION TABLE	PASSED	
UCS.20		UC_AU_030: VIEW DETAILS OF AN AUCTION TABLE	VIEW AUCTION TABLE DETAILS	PASSED	
UCS.20			VIEW DETAILS OF A DELETED TABLE	PASSED	
UCS.20		UC_AU_035: VIEW HISTORY OF AN AUCTION TABLE	VIEW HISTORY OF AN AUCTION TABLE	PASSED	
UCS.20			VIEW AUCTION DELIVERY PAGE	PASSED	
UCS.20		UC_AU_050: VIEW AUCTION DELIVERY PAGE	SUBMIT AN AUCTION WITH GENERAL ALLOWANCES	PASSED	
UCS.20			SUBMIT AN AUCTION WITH AVIATION ALLOWANCES	PASSED	
UCS.20			SUBMIT AN AUCTION WITH AVIATION ALLOWANCE BUT THE (AVIATION) AUCTION ACCOUNT DOES NOT EXIST	PASSED	

UCS.20	SUBMIT AN AUCTION – NEGATIVE TESTING	**PASSED**	

II.4. Tests results summary

We were fully executed the set of 65 test cases and we concluded all were passed.

III. Conclusions

III.1. Tests execution: troubles & remarks

This section reports the troubles and remarks that occurred during the execution of the SAT.

> **Wrong databases synchronisation:** EUCR, EUTL & ITL databases were not synchronised. This is due to one of the database which was reset and not the others. This problem was fixed in short time and the delay was limited.

Database synchronisation is something that should be taken into account carefully when preparing the SAT tests. This is something that Trasys is not encountering during the FAT as they use simulators but it could happen in real life and in the SAT. We could not perform such a check during the pre-SAT as we do not have access to the databases or the scripts ran, but we recommend that the different stakeholders coordinate their tests (or suspend those for a “to be specified” period of time) in order to avoid such problems in the future.

III.2. Conclusions for the current 4.0 iteration

Although the full set of test cases was executed, it is recommended to execute a full set of regression testing in a future version to obtain a full picture of the current quality of the system.

- No End-to-end business oriented tests (the goal should be to guaranty the availability of the real business processes) were run;
- Over 95% of effective tests were successful
- Tests were mostly ran with “NA” & “CA” role;
- No automatic testing for regression through scripting.