NATIONAL ADMINISTRATION OF THE EMISSIONS TRADING SCHEME
NATIONAL EMISSION CENTRE

Poland's
National Inventory Report 1988

Submission under
the United Nations Framework
Convention on Climate Change

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Executive summary

ES 1. Background information on greenhouse gas inventories

Underlying National Inventory Report (NIR) presents results of the national emission inventory of greenhouse gases (GHGs) in Poland for the base year 1988 as concerns three main gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) as well as for the year 1995 as concerns the industrial gases such as: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). Emissions of SO_2 and indirect GHGs including: nitrogen oxides NO_x (NO and NO_2) and NMVOCs are also presented in the report.

The presented national inventory and accompanying tables of Common Reporting Format (CRF), have been prepared in accordance with the UNFCCC Reporting Guidelines on Annual Inventories. Methodologies used to calculate emissions and sinks of GHGs, are in accordance with methods recommended in two basic publications of Intergovernmental Panel on Climate Change - IPCC, namely *Revised 1996 Guidelines for National Greenhouse Gas Inventories* [IPCC 1997], and *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* [GPG 2000]. According to these guidelines country specific methods have been used where appropriate giving more accurate emission data. Here, we present and discuss the results of the GHG national inventory recalculated for the year 1988/1995. The previous inventory for the year 1988 was prepared according to former version of guidelines published by the IPCC before 1997. Additionally the activity database and emission factors were updated in certain categories.

The report has been prepared according to updated reporting guidelines on annual inventories contained in document FCCC/SBSTA/2006/9 published on 18.08.2006 following the decision 14/CP.11.

ES 2. Summary of national GHG emissions and removals

The GHG emissions in 1988, expressed as CO_2 equivalents, are presented in table ES.1 Total aggregated national emission of GHG were almost 587 million tonnes of CO_2-eq., excluding GHG emissions and sinks from category 5 (Land use change and forestry). Carbon dioxide is the main GHG in Poland with the 84.3% share (excluding LUCF), while the methane contributes with 8.4% to the national total. Nitrous oxide contribution is 7.2% and all industrial GHG together contribute only 0.05% (table ES.1). Category 5. LUCF in 1988 was estimated as net CO_2 sink removing about 6.6% of total CO_2 emissions in Poland.

Table ES.1 National emissions of greenhouse gases for the year 1988/1995

GHGs	Emission in CO_2 eq. [Gg]	Share [%]
CO_2 – net emission (with LUCF)	461 951.16	
CO_2 – without LUCF	494 885.88	84.3
CH_4	49 256.41	8.4
N_2O	42 478.82	7.2
HFCs	26.44	0.0
PFCs	250.18	0.0
SF_6	13.15	0.0
TOTAL without CO_2 from LUCF	586 910.88	100.0
TOTAL with CO_2 from LUCF	553 976.16	

ES 3. Overview of GHG source and sink categories

Carbon dioxide (CO_2)

In 1988, the net CO_2 emissions (with LUCF) were estimated for about 461,951 Gg, while when sector 5. *LUCF* is excluded the figure exceeds 494,886 Gg. The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission above 95.3% in 1988. The shares of the main subcategories were as follows: 1.A.1.*Energy industries* – 54.9%, 1.A.2.*Manufacture Industries and Construction* – 11.8%, 1.A.3.*Transport* – 4.7% and 1.A.4.*Other Sectors* – 22.7%. Sector 2.*Industrial Processes* contributed to the total CO_2 emission by about 4.4% in 1988. Subcategory 2.A.*Mineral Products* (especially 2.A.1.*Cement Production*) is the main emission source in this sector. The CO_2 emission/removal in sector 5. LUCF in 1988, was calculated to be approximately –32.9 million tonnes.

Methane (CH_4)

The CH_4 emission amounted to 2345 Gg in 1988 i.e. about 49 million tones of CO_2 equivalents. Three of main CH_4 emission sources include the following categories: 1.B.*Fugitive Emissions from Fuels,* 4.*Agriculture* and 6.*Waste*. They contributed to 46.1%, 39.4% and 13.1% of the national methane emission in 1988 respectively. The emission from the first mentioned sector was covered mostly by two types of activities: from *Underground Mines* (37.7% of total CH_4 emission) and *Natural Gas* system (8.4% of total CH_4 emission). *Enteric fermentation* was the main CH_4 source from agriculture sector with its share of 32.4% of total CH_4 emissions.

Nitrous oxide (N_2O)

The nitrous oxide emissions in 1988 were 137 Gg i.e. 42.5 million tonnes of CO_2 equivalents . The main N_2O emission sources and its shares in total N_2O emission in 1988 are: 4.D.*Agricultural Soils* – 55.6%, 4.B.*Manure Management* – 22.0%, 2.B.*Chemical Industry* – 11.8% and 1.A.*Fuel Combustion* – 7.6%.

Industrial gases (HFCs, PFCs, SF_6)

The total emission of HFCs in 1995 was about 290 Gg CO_2 equivalents with 0.05% share of entire GHGs emissions in base year. The main sources of HFCs emissions of 26 Gg CO_2 equivalents are 2.F.1.*Refrigeration and air conditioning equipment* as well as 2.F.4.*Aerosols*. The total emission of PFCs in 1995 was 250 Gg CO_2 equivalents and resulted from 2.C.3.*Aluminium production*. For SF_6 emissions of 13 Gg CO_2 equivalents is responsible leakage from electrical equipment. Insignificant emission of SF_6 occurs during production of soundproof windows (table 2.4).

ES 4. Indirect Greenhouse Gases and SO_2

Main sources of NO_x emissions in Poland include stationary fuel combustion as well as transportation. Majority of NMVOC emissions come from solvent use and fuel combustion processes. As concerns SO_x emissions – the main sources are fuel combustion activities. Estimates of emissions of indirect greenhouse gases in 1988 are as follow: nitrogen oxides (as NO_2) – 1550 Gg, carbon monoxide – 7406 Gg (in 1990), non-methane volatile organic compounds – 1026 Gg and sulphur oxides (as SO_2) 4180 Gg.

1. Introduction

1.1. Background information

The report and underlying CRF tables have been prepared according to updated reporting guidelines on annual inventories contained in document FCCC/SBSTA/2006/9 published on 18.08.2006 following the decision 14/CP.11.

The ultimate goal of the United Nations Framework Convention on Climate Change (UNFCCC) is "…stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system…". The basic evidence for fulfilling UNFCCC obligations is annual inventory made by Parties to the Convention.

The main goal of this report is to provide the updated inventory of greenhouse gases in Poland for the base year according to obligations resulting from UNFCCC as well as from decisions 280/2004/EC and 2005/166/EC. Poland has chosen the year 1988 as concerns the three main gases (CO_2, CH_4, N_2O) and 1995 for industrial gases (HFCs, PFCs, SF_6). Also emissions of SO_2 and indirect GHGs including: nitrogen oxides NO_x (NO and NO_2) and NMVOCs for 1988 are presented in the report. Detail inventory results are given in Annex 6 containing CRF tables.

Several new categories have been estimated comparing to the previous 1988 inventory like: N_2O emissions from CRF categories: 4.B. *Manure management*, 4.D.2. *Pasture, Range and Paddock Manure* and 4.D.3. *Indirect emissions from agricultural soils* as well as CO_2 and N_2O emissions from category 3. *Solvent and other product use*.

1.2. Institutional arrangement for inventory preparation

GHG inventory presented below has been compiled by the National Emission Centre (NEC) established in 2000 at the Institute of Environmental Protection in Warsaw. NEC has been commissioned by the Polish Ministry of Environment to carry out inventories for the GHGs and other air pollutants. Since 2006 NEC is located within the National Administrator of Emission Trading Scheme established also in the Institute of Environmental Protection.

When compiling the inventory, NEC have been collaborating with a number of individual experts as well as institutions. Among the latter are: Central Statistical Office (GUS), Agency of Energy Market (ARE), Institute of Ecology of Industrial Areas in Katowice (IETU), Institute of Automobile Transport (ITS) as well as Office for Forest Planning and Management (BULGiL).

1.3. Process for inventory preparation

The GHG emission estimates are based on methodologies elaborated by the Intergovernmental Panel on Climate Change (IPCC) and recommended by the UNFCCC, while emissions of indirect gases according to methodology elaborated by UN ECE/EMEP [IPCC 1997, IPCC 2000, IPCC 2003, EEA 2004]. Wherever necessary and possible, domestic methodologies and emission factors have been developed to reflect specific national conditions. The most important features of the inventory preparation and archiving can be briefly summarized in the following way:

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

1.4. Methodologies and data sources used

The GHG emissions and removals inventory presented in this report follow the recommended Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories [IPCC 1997], and the IPCC Good Practice Guidance and Uncertainty Management [GPG 2000]. According to these guidelines country specific methods have been used where appropriate giving more accurate emission data especially in case of key categories. More detail description of methodologies used in Polish GHG inventory are given in sections 3–8.

The calculated emissions can be presented by various combinations of fuels, sources and sectors. The emissions from fuel combustion are calculated by combining the fuel consumption distributed among emission sources and economy sectors with fuel, source, sector and pollutant specific emission factors. The non-combustion emissions are estimated by combining activity data with emission factors. The emission factors are either estimated from measurements or taken from special investigations. If not available domestically, emission factors are taken first of all from IPCC guidelines or other international publications. The emissions of non-CO_2 gases are expressed in units of CO_2 equivalents, based on Global Warming Potentials (GWP), calculated for a time horizon of 100 years [IPCC1995].

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

The example of evaluation of hard coal consumption is given in table 1.1. The examples of the fuel budgets for: coking coal, brown coal (lignite), fuel oil and high-methane and nitrified natural gas are presented in Annex 2. For each fuel, balance data are given both in natural units and in common (energy) units.

Table 1.1 Hard coal consumption in 1988

Evaluation of fuel consumption in national combustion processes	Hard coal	
	10^3 Mg	TJ
In	194100	4491689
From national sources	193015	4459798
1) Indigenous production	193015	4459798
2) Transformation output or return	0	0
3) Stock decrease	0	0
Import	1085	31891
Out	194101	4491690
National consumption	159293	3534418
1) Transformation input	120482	2548513
a) input for secondary fuel production	24774.4	716176.8
b) fuel combustion	95707.6	1832336.2
2) Direct consumption	38811	985905
Non-energy use	9	300
Combusted directly	38802	985605
Combusted in Poland	134510	2817941
Stock increase	2351	54313
Export	32341	808774
Losses	116	3030
Statistical differences		91155
Net Calorific Value	MJ/kg	20.95
CO_2 Emission Factor	kg/GJ	96.94
Maximum Emission of CO_2	Gg	273185

The data on quantity of the fuel combusted in whole country in a given year are used for calculation of the average net calorific value of the fuel. This calculated calorific value provides then the basis for the estimation of country specific CO_2 emission factor for the given fuel. The calculations of these CO_2 emission factors for main fuels are based on empirical formulas that apply the relationship between net calorific values and elemental carbon content. The maximum (potential) CO_2 emission from combustion of a given fuel is, in turn, calculated based on the estimated emission factor. It is one of the way of checking the CO_2 emission value, estimated according to sectoral approach.

Basic information on activity data regarding IPCC categories, are usually published in various 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.

Energy Statistics published by Central Statistical Office is the main source of activity data for *Energy* sector. The data on fuel consumption in *Transport* subcategory, including the fuel

consumption data for various types of vehicles, are worked out routinely by experts from the Institute of Automobile Transport, as well as the emission factors for road transport.

1.5. Key categories

Sixteen source categories have been identify as key sources (level assessment) in GHG inventory for 1988 in Poland. The most important of them are: stationary combustion of solid and liquid fuels and coal mining. Emission of direct GHG from these sources made up app. 76.0% of the total GHG emissions in Poland expressed in units of CO_2 equivalents. CO_2 emissions from stationary combustion of fuels (solid, gaseous and liquid) made up 75.5% of the total GHG emissions in Poland. Combustion of solid fuels in stationary sources alone, made up app. 68.3 % of total Poland's GHG emissions.

The complete tables with level and trend assessment are given in Annex 1.

1.6. Information on the QA/QC plan including verification

Poland has not yet implemented a formal QA/QC procedure, including verification plan, for the national emission inventory. However, several checks are routinely carried out to eliminate possible errors. The calculated emissions figures for a given year, are compared to the respective figures from entire time series, and outliers are scrutinized in more detail or in other words an extended QA/QC is carried out for doubtful figures.

The first draft of the inventory in form of IPCC tables and draft CRF, is usually produced 12-14 months after the end of the given year depending primarily on the availability of required activity data. During the following several weeks, extensive checks are done in form of consultations with data providers. The consultations cover both correctness of data and their proper interpretation. Wherever possible various different datasets are used for comparison purposes. Here the most important institutional sources include: Central Statistical Office, Agency of Energy Market, and a number of collaborating individual experts and institutions. After the checking period is completed, the final CRF is prepared together with the accompanying report.

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

Uncertainty evaluation made for 1988/1995 is based on calculations and national experts judgements/estimations prepared in 2006 as well as opinions expressed by international experts under UNFCCC Secretariat during in-depth review made in 2005. Calculations includes simplified method for sector 5 and for fluorinated gases.

Uncertainty for two GHGs were estimated to be relatively low and amounted to 5.3% for CO_2, and 16.6% for CH_4 respectively. Highest value of uncertainty of national total occurred in N_2O (49.8%). In Annex 5, the estimate of emission uncertainty for the year 1988 using *Tier 1* approach is given. The uncertainty figures varied significantly among various source categories. More details are included in Annexes 5 and 6.

1.8. General assessment of completeness

The Polish GHG emission inventory includes calculation of emissions from all relevant sources that we are aware of. However, there is a number of exceptions. All of them are expected to have a minor effect on the total national GHG emissions. These exceptions are:
in *Energy* sector (*Fugitive Emission from Fuels* only):

- CO_2 and CH_4 from *Solid Fuel Transformation*
- CO_2 from *Coal Mining and Handling*
- some individual processes in *Oil and Natural Gas* systems

in *Industrial Processes*:

- CO_2 from *Asphalt Roofing*
- CO_2 from *Road Paving with Asphalt*
- CH_4 from *Ferroalloys Production*
- CH_4 from *Aluminium Production*
- CO_2 from *Food and Drink Production*
- CH_4 from *Sinter*
- some minor gaps in estimation of the emissions of HFCs, PFCs, SF_6

in *Agriculture*

- CH_4 from *Agriculture Soils*

in *LULUCF*

- N_2O from *Forest and Grassland Conversion*
- CO_2 from *Decay*

in *Waste*

- N_2O from *Industrial Wastewater*
- N_2O from *Domestic and Commercial Wastewater except Humane Sewage*
- CH_4 from *Waste Incineration.*

2. Greenhouse gas emissions and removals in 1988

2.1. GHG aggregated emissions

Recalculated emissions of greenhouse gases in base year 1988/1995 were almost 587 million tonnes CO_2 equivalent excluding CO_2 emissions and removals from category 5.*Land Use Change and Forestry*. According to IPCC methodology, CO_2 emissions are given with (462 million tonnes CO_2) and without (495 million tonnes CO_2) 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 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. For industrial gases GWP varies between 650 for HFC-32 to 23 900 for SF_6.

The emissions of GHGs and its shares to the national total in 1988/1995 are presented in Table 2.1 and Figure 2.1.

Table 2.1 Emissions of greenhouse gases in 1988/1995

GHGs	1988/1995	
	Emission in CO_2 eq. [Gg]	Share [%]
CO_2 – net emission (with LUCF)	461 951.16	
CO_2 – without LUCF	494 885.88	84.3
CH_4	49 256.41	8.4
N_2O	42 478.82	7.2
HFCs	26.44	0.0
PFCs	250.18	0.0
SF_6	13.15	0.0
TOTAL without CO_2 from LUCF	586 910.88	100.0
TOTAL with CO_2 from LUCF	553 976.16	

Carbon dioxide is the main GHG in Poland with the 84.3% share (excluding LUCF), while the methane contributes with 8.4% to the national total. Nitrous oxide contribution is 7.2% and all industrial GHG together contribute only 0.05%.

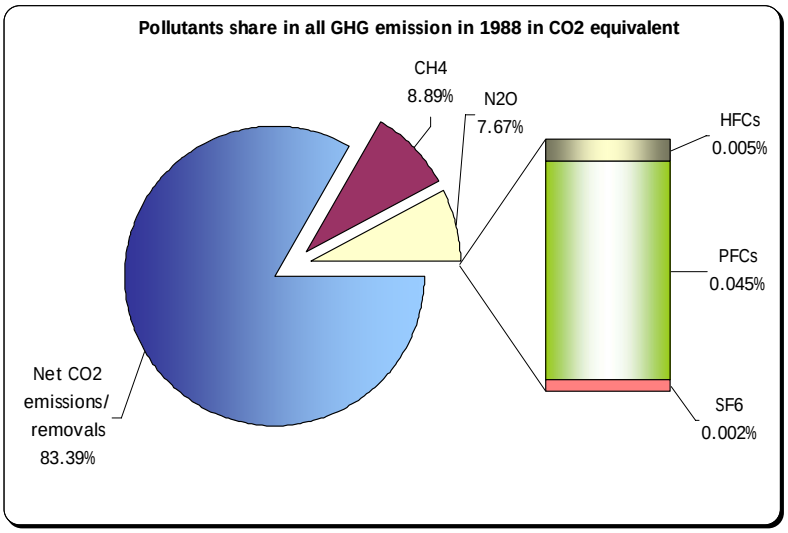

Figure 2.1. Percentage share of greenhouse gases including CO_2 from LUCF in national total emission total in 1988/1995

Emissions of main GHG in 1988, disaggregated into main source sub-sectors, are given in table 2.2. Respective values for the industrial gases for 1995 are presented in table 2.4. Additionally the percentage contributions of main source sectors to the national totals in 1988 for CO_2, CH_4 and N_2O are given in the table 2.3. Discussion of these results is given below.

Table 2.2 Emissions of CO_2, CH_4 and N_2O in 1988 [Gg]

GHG emission/removal categories	CO_2	CH_4	N_2O
TOTAL (without CO_2 from LUCF)	494 885.88	2 345.54	137.03
1. Energy	471 688.45	1 096.99	10.45
A. Fuel Combustion	471 636.28	15.88	10.45
1. Energy Industries	271 844.28	3.65	3.86
2. Manufacturing Industries and Construction	58 488.34	2.51	0.93
3. Transport	23 454.18	6.42	1.67
4. Other Sectors	112 180.94	2.57	2.04
5. Other	5 668.55	0.74	1.95
B. Fugitive Emissions from Fuels	52.17	1 081.12	0.00
1. Solid Fuels	2.17	884.93	0.00
2. Oil and Natural Gas	50.00	196.18	0.00
2. Industrial Processes	21 735.70	16.06	16.11
A. Mineral Products	10 802.63	0.00	0.00
B. Chemical Industry	3 970.89	11.94	16.11
C. Metal Production	6 962.18	4.12	0.00
D. Other Production	0.00	0.00	0.00
G. Other	0.00	0.00	0.00
3. Solvent and Other Product Use	882.46	0.00	0.40
4. Agriculture	0.00	924.77	106.32
A. Enteric Fermentation	0.00	759.73	0.00
B. Manure Management	0.00	163.59	30.11
D. Agricultural Soils	0.00	0.00	76.13
F. Field Burning of Agricultural Residues	0.00	1.45	0.08
5. Land Use, Land-Use Change and Forestry	-32 934.72	0.36	0.00
A. Forest Land	-42 705.20	0.00	0.00
B. Cropland	8 165.26	0.00	0.00
C. Grassland	4 530.69	0.00	0.00
D. Wetlands	0.00	0.00	0.00
E. Settlements	-2 925.46	0.36	0.00
F. Other Land	0.00	0.00	0.00
6. Waste	579.27	307.36	3.75
A. Solid Waste Disposal on Land	0.00	204.01	0.00
B. Wastewater Handling	0.00	103.34	3.68
C. Waste Incineration	579.27	0.00	0.07

Table 2.3. Percentage shares of individual source sectors in 1988 emissions

Percentage share of source sectors in 1988 emissions	Share [%]		
	CO_2 without LUCF	CH_4	N_2O
TOTAL	100.00	100.00	100.00
1. Energy	95.31	46.77	7.63
A. Fuel Combustion	95.30	0.68	7.63
1. Energy Industries	54.93	0.16	2.82
2. Manufacturing Industries and Construction	11.82	0.11	0.68
3. Transport	4.74	0.27	1.22
4. Other Sectors	22.67	0.11	1.49
5. Other	1.15	0.03	1.43
B. Fugitive Emissions from Fuels	0.01	46.09	0.00
1. Solid Fuels	0.00	37.73	0.00
2. Oil and Natural Gas	0.01	8.36	0.00
2. Industrial Processes	4.39	0.68	11.76
A. Mineral Products	2.18	0.00	0.00
B. Chemical Industry	0.80	0.51	11.76
C. Metal Production	1.41	0.18	0.00
D. Other Production	0.00	0.00	0.00
G. Other	0.00	0.00	0.00
3. Solvent and Other Product Use	0.18	0.00	0.29
4. Agriculture	0.00	39.43	77.59
A. Enteric Fermentation	0.00	32.39	0.00
B. Manure Management	0.00	6.97	21.98
D. Agricultural Soils	0.00	0.00	55.56
F. Field Burning of Agricultural Residues	0.00	0.06	0.06
5. Land Use, Land-Use Change and Forestry		0.02	0.00
A. Forest Land		0.00	0.00
B. Cropland		0.00	0.00
C. Grassland		0.00	0.00
D. Wetlands		0.00	0.00
E. Settlements		0.02	0.00
F. Other Land		0.00	0.00
6. Waste	0.12	13.10	2.74
A. Solid Waste Disposal on Land	0.00	8.70	0.00
B. Wastewater Handling	0.00	4.41	2.69
C. Waste Incineration	0.12	0.00	0.05

2.2. GHG emissions by gas

2.2.1. Carbon dioxide (CO_2)

In 1988, the net CO_2 emissions (with LUCF) were estimated for about 461,951 Gg, while when sector 5. *LUCF* is excluded the figure exceeds 494,886 Gg (table 2.2). The main CO_2 emission source is *Fuel Combustion* (1.A) subcategory. This sector contributed to the total CO_2 emission above 95.3% in 1988. The shares of the main subcategories were as follows: 1.A.1.*Energy industries* – 54.9%, 1.A.2.*Manufacture Industries and Construction* – 11.8%, 1.A.3.*Transport* – 4.7% and 1.A.4.*Other Sectors* – 22.7%. Sector 2.*Industrial Processes* contributed to the total CO_2 emission by about 4.4% in 1988. Subcategory 2.A.*Mineral Products* (especially 2.A.1.*Cement Production*) is the main emission source in this sector. The CO_2 emission/removal in sector 5. LUCF in 1988, was calculated to be approximately –32.9 million tonnes (figure 2.2).

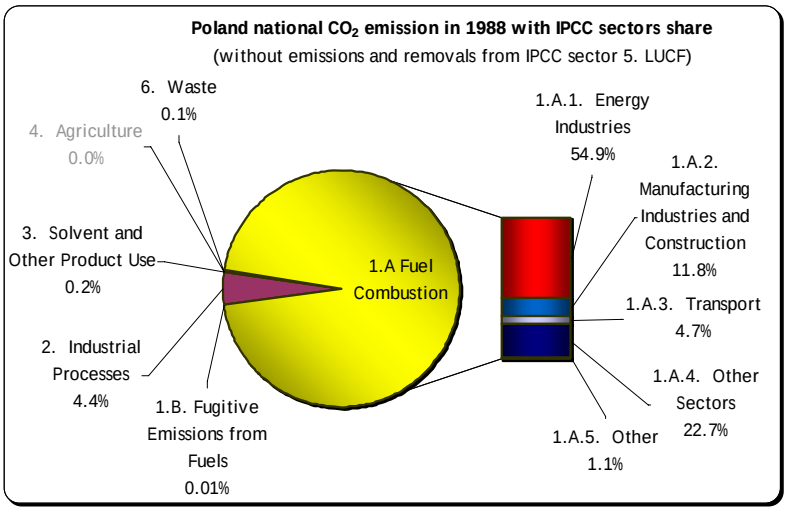

Figure 2.2. Carbon dioxide emission in 1988 by sector

2.2.2. Methane (CH_4)

The CH_4 emission amounted to 2345 Gg in 1988 i.e. about 49 million tones of CO_2 equivalents. Three of main CH_4 emission sources include the following categories: 1.B.*Fugitive Emissions from Fuels,* 4.*Agriculture* and 6.*Waste*. They contributed to 46.1%, 39.4% and 13.1% of the national methane emission in 1988 respectively. The emission from the first mentioned sector was covered mostly by two types of activities: from *Underground Mines* (37.7% of total CH_4 emission) and *Natural Gas* system (8.4% of total CH_4 emission). *Enteric fermentation* was the main CH_4 source from agriculture sector with its share of 32.4% of total CH_4 emissions. 6.A.*Solid Waste Disposal on land* contributed to 66% of the methane emission from *Waste* sector. The emission from 4.A.*Enteric Fermentation* dominated in *Agriculture* and amounted to app. 82% of methane emission in this sector in 1988 (figure 2.3).

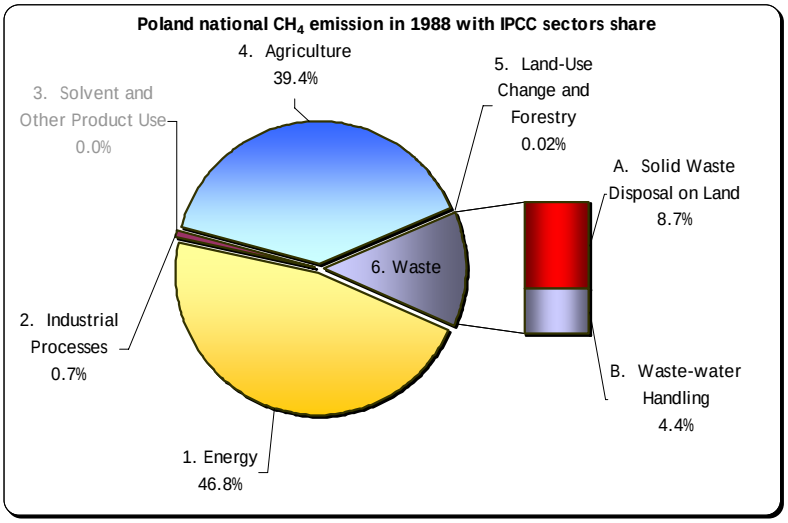

Figure 2.3. Methane emission in 1988 by sector

2.2.3. Nitrous oxide (N_2O)

The nitrous oxide emissions in 1988 were 137 Gg i.e. 42.5 million tonnes of CO_2 equivalents (table 2.2). The main N_2O emission sources and its shares in total N_2O emission in 1988 are: 4.D.*Agricultural Soils* – 55.6%, 4.B.*Manure Management* – 22.0%, 2.B.*Chemical Industry* – 11.8% and 1.A.*Fuel Combustion* – 7.6% (figure 2.4).

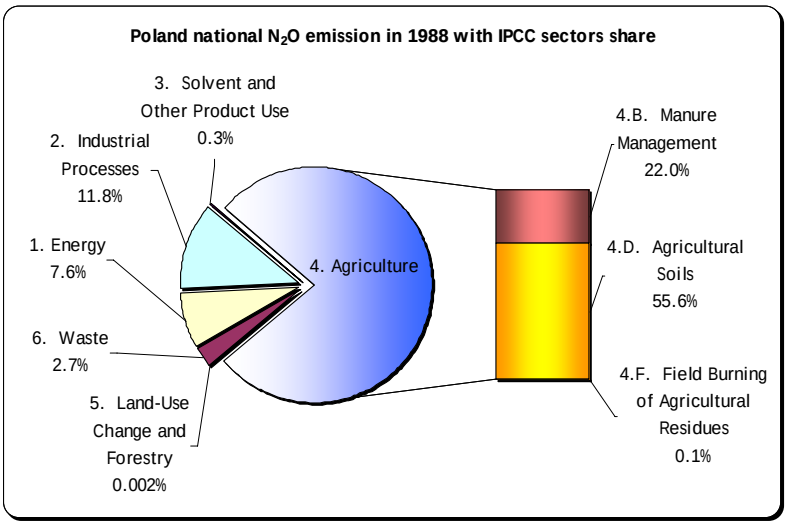

Figure 2.4. Nitrous oxide emission in 1988 by sector

2.2.4. Industrial gases

The total emission of HFCs in 1995 was about 290 Gg CO_2 equivalents with 0.05% share of entire GHGs emissions in base year. The main sources of HFCs emissions of 26 Gg CO_2 equivalents are 2.F.1.*Refrigeration and air conditioning equipment* as well as 2.F.4.*Aerosols*. The total emission of PFCs in 1995 was 250 Gg CO_2 equivalents and resulted from 2.C.3.*Aluminium production*. For SF_6 emissions of 13 Gg CO_2 equivalents is responsible leakage from electrical equipment. Insignificant emission of SF_6 occurs during production of soundproof windows (table 2.4).

Table 2.4. Emissions of industrial gases: HFCs, PFCs and SF_6 in 1995 [eq. Gg]

HFCs, PFCs and SF_6 emission categories	HFCs	PFCs	SF_6
2. Industrial Processes	26.44	250.18	13.15
2.C. Metal production		250.18	
2.C.3. Aluminium production		250.18	
2.F. Consumption of Halocarbons and SF_6	26.44		13.15
2.F.1 Refrigeration and air conditioning equipment	10.52		
2.F.4. Aerosols	15.93		
2.F.8. Electric equipment			13.15

2.3. GHG emissions by category

Here emissions of greenhouse gases are presented from all categories except sector 5. LULUCF described in section 7.

2.3.1. Energy (IPCC category 1)

The emission of GHGs from *Energy* sector in 1988 was close to 498 million tons of CO_2 equivalent. CO_2 emission share exceeded 94% of the total GHG emissions within 1.*Energy* category (table 2.5). The most emission intensive category was 1.A.1.*Fuel combustion activities* related mostly to heavy industry sector, highly energy consuming.

Table 2.5. GHG emissions from sub-sectors in category *Energy* in 1988

GHG emission categories	GHG Emission [Gg CO2-eq]	% Share in the total emission from Energy	% Share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
1. Energy	497 964.68	100.0	94.7	4.6	0.7
1.A. Fuel Combustion Activities	475 209.04	95.4	94.7	0.1	0.7
1.A.1. Energy Industries	273 116.77	54.8	54.6	0.0	0.2
1.A.2. Manufacturing Industries and Construction	58 829.25	11.8	11.7	0.0	0.1
1.A.3. Transport	24 106.91	4.8	4.7	0.0	0.1
1.A.4. Other Sectors	112 866.02	22.7	22.5	0.0	0.1
1.A.5. Other	6 290.09	1.3	1.1	0.0	0.1
1.B. Fugitive Emissions from Fuels	22 755.64	4.6	0.0	4.6	0.0
1.B.1. Solid Fuels	18 585.79	3.7	0.0	3.7	0.0
1.B.2. Oil and Natural Gas	4 169.85	0.8	0.0	0.8	0.0

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

Table 2.6 shows detailed information on emissions of CO_2, CH_4 and N_2O in *Industrial Processes* sector and in *Solvent and Other Use* sector in 1988. CO_2 is dominating among GHGs – it's contribution exceeds 79%. The main GHG emission sources in this category were: production processes of cement, nitric acid and lime.

The emissions of GHG from *Solvent and Other Use* sector includes N_2O emissions from anaesthesia and CO_2 emissions (recalculated from NMVOC) mostly from category 3.A.*Paint Application* (59%) and from 3.B.*Degreasing and Dry Cleaning* (25%).

Table 2.6. The emissions of CO_2, CH_4 and N_2O from sub-sectors in category *Industrial Processes* and in category *Solvents and Other Product Use* in 1988

GHG emission categories	GHG Emission [Gg CO2-eq]	% share in the total emission from Industrial Processes and Solvent Use	% Share in total GHG emission from a given sub-sector			
			CO_2	CH_4	N_2O	HFC, PFC i SF_6
2.Industrial Processes	27 356.20	100.0	79.5	1.2	18.3	1.1
2.A. Mineral Products	10 802.63	39.5	39.5	0.0	0.0	
2.B. Chemical Industry	9 215.16	33.7	14.5	0.9	18.3	
2.C. Metal Production	7 298.82	26.7	25.5	0.3	0.0	0.9
2.F. HFC, PFC i SF_6 application	39.59	0.1				0.1
3.Solvent and Other Product Use - Total	1 006.46	100	87.7	0.0	12.3	

2.3.3. Agriculture (IPCC category 4)

The main sources of GHG in category 4.*Agriculture* were: 4.D.*Agricultural Soils,* 4.B.*Enteric Fermentation* and 4.A.*Manure Management* (table 2.7). N_2O emission share was largest in total GHG emission from *Agriculture* in 1988 and came from both – direct (mineral and organic fertilisation –33%) and indirect (volatilisation, leaching and runoff from applied synthetic fertiliser and animal manure – 40%) N_2O emissions from soils.

Table 2.7. GHG emissions from sub-sectors in category 4.*Agriculture* in 1988

GHG emission categories	GHG Emission [Gg CO2-eq]	% share in the total emission from Agriculture	% Share in total GHG emission from a given sub-sector	
			CH_4	N_2O
4.Agriculture	52 378.10	100.0	37.1	62.9
4.A. Enteric Fermentation	15 954.36	30.5	30.5	0.0
4.B. Manure Management	12 770.49	24.4	6.6	17.8
4.D. Agricultural Soils	23 599.39	45.1	0.0	45.1
4.F. Field Burning of Agricultural Residues	53.85	0.1	0.1	0.0

2.3.4. Waste (IPCC category 6)

As it can be seen in table 2.8, the emission of CH_4 dominated in this sector in 1988 (almost 79%). The main part of GHG emissions came from s*olid waste disposal on land* and *wastewater handling*.

Table 2.8. GHG emissions from sub-sectors in category 6.*Waste* in 1988

GHG emission categories	GHG Emission [Gg CO2-eq]	% share in the total emission from Waste	% Share in total GHG emission from a given sub-sector		
			CO_2	CH_4	N_2O
6.Waste	8 197.19	100	7.1	78.7	14.2
6.A. Solid Waste Disposal on Land	4 284.31	52.3	0.0	52.3	0.0
6.B. Wastewater Handling	3 312.51	40.4	0.0	26.5	13.9
6.C. Waste Incineration	600.37	7.3	7.1	0.0	0.3

2.4. Emissions of indirect greenhouse gases and SO_2

Summary estimates of emissions of indirect greenhouse gases such as nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur oxides (SO_x) for 1988 are given in table 2.9. Detail description of emissions and methodology used is regularly provided for the purposes of UNECE/CLRTAP Convention.

Table 2.9. Emission of indirect GHGs and SO_2 in 1988 [Gg]

NO_x (as NO_2)	1550
CO (in 1990)	7406
NMVOC	1026
SO_x (as SO_2)	4180

Main sources of NO_x emissions in Poland include stationary fuel combustion as well as transportation. Majority of NMVOC emissions come from solvent use and fuel combustion processes. As concerns SO_x emissions – the main sources are fuel combustion activities.

3. *Energy* (CRF sector 1)

3.1. Key categories

Following categories from sector 1 have been identified as key sources:
- 1.A.1, 1.A.2, 1.A.4, 1.A.5 - Stationary combustion of solid, liquid and gaseous fuels (CO_2 emission), share in total GHG emission 75.5%,
- 1.A.3.b - Road Transportation (CO_2 emission), share in total GHG emission 2.7%,
- 1.A.5.b – Other mobile (CO_2 emission), share in total GHG emission 0.9%,
- 1.B.1 a - Coal Mining and Handling (CH_4 emission), share in total GHG emission 3.1%,
- 1.B.2.b - Natural Gas (CH_4 emission), share in total GHG emission 0.7%.

Share of these categories in total Poland's GHG emissions is 82.9%.

3.2. Methodological issues

3.2.1. *Fuel combustion* (CRF 1.A)

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

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

1.A.1. Energy industries
1.A.2. Manufacturing industries and construction
1.A.3. Transport
1.A.4. Other sectors:
  a. commercial/institutional
  b. residential
  c. agriculture/forestry/fishing
1.A.5. Other:
  a. stationary
  b. mobile

Inventory methodology for **all stationary sources** of emission is similar to calculation of emission from combustion in the assumed level of detail (*Tier 2*) and is based on the simple formula:

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

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

The domestic methodology of the emission calculation id based on the balance of used fuels in combustion processes on division or groups level.

Statistical data

The Polish statistical yearbooks include, in principle, all the data needed for *Tier 2* method:
1. the data given in the column "transformation input"[1] is divided into two streams:
   - fuel stream for substantial input that is transformed into derived fuel (coking plants, refineries, gas generators, briquetting plants and so on)
   - fuel stream burned in the hearth of installation that produces water vapour, hot water or other heat carrier
2. the data given in the column "direct consumption" is divided into:
   - fuel use for combustion
   - non-energy use of fuels

The national methodology introduces as a primary step estimation of the above described two streams of fuels with the use of special spreadsheets, one for each fuel. In the spreadsheet, the final calculation leads to the estimation of aggregated net calorific value (NCV) and calculation of elemental C content in the fuel - C_{max}, the maximum emission factor for CO_2 and in the end, the maximum CO_2 emission.

Fraction of oxidised carbon

- gas – 0.995
- oil and oil products – 0.99
- coal – depending on technology of combustion:
  pulverised coal - 0.984
  travelling grate stocker – 0.946 – 0.973
  underfeed stocker – 0.934 - 0.960
  domestic open fire – 0.988 - 0.994
  shallow bed AFBC (Advanced Fluidised Bed Combustion) - 0.960
  Circulating Fluidised Bed Combustion – 0.970
  Pressurised Fluidised Bed Combustion – 0.970

[1] Transformation input means the quantitities of energy ccommodities which are subject matter to tranformation into other (derived) energy commodities in the technological processes. Energy transformation is a technological process in which one form of energy (usually primary energy commodity e.g. coal is converted into other , derived or secondary form (e.g. electricity, heat, coke, manufactured gas etc.)

Fraction of carbon oxidised for hard coal – values for individual sub-sectors (these value have been selected based on the estimation of share of combustion technology mentioned above):

- 0.984 for *Public thermal plants* and *Public heat plants*
- 0.973 for: *Autoproducing thermal plants*, *Non-public heat plants*, *Boilers in public thermal plants* and for fuel combustion in industry sectors
- 0.988 for *Commercial / Institutional, Residential, Agriculture / Forestry* sectors

Fraction of carbon oxidised for coke and lignite – like in the case of hard coal

Emission factors for fuel combustion in stationary sources

Emission factors for elemental carbon were determined for major fuel types in form of formulae dependent on net calorific values - NCV, obtained with regression analysis. The following formulae were obtained:
the emission factor for elemental carbon from hard coal:

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

where: C_{hc} emission factor for hard coal,
NCV- net calorific value of hard coal [MJ/kg],

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

$$C_{bc}\ [kg\ C/GJ] = 10(1.9328*NCV + 10.067)/NCV$$

where: C_{bc} emission factor for brown coal,
NCV- net calorific value of brown coal [MJ/kg],

the emission factor for elemental carbon from coke and semi-coke:

$$C_c\ [kg\ C/GJ] = 53.139 - 0.811*\ NCV$$

where: C_c emission factor for coke [kg C/GJ],
NCV- net calorific value of coke [MJ/kg],

the emission factor for elemental carbon from motor gasoline and diesel oil:

$$C_{gdo}\ [kg\ C/GJ] = 28.03333 - 0.192*\ NCV$$

where: C_{gdo} emission factor for gasoline or diesel oil,
NCV- net calorific value of gasoline or diesel oil [MJ/kg],

the emission factor for elemental carbon from fuel oil:

$$C_{fo}\ [kg\ C/GJ] = 39.7549 - 0.450*\ NCV$$

where: C_{fo} emission factor for fuel oil [kg C/GJ],
NCV- net calorific value of fuel oil [MJ/kg],

the emission factor for high-methane natural gas:

$$C_{hmng}\ [kg\ C/GJ] = 24.9018 - 0.2843 * NCV$$

where: C_{hmng} emission factor for high-methane natural gas,
NCV- net calorific value of fuel oil [MJ/m^3],

the emission factor for nitrified natural gas:

$$C_{nng} = 15.0\ [kg\ C/GJ]$$

The following formula was derived for the emission factor for elemental carbon from city gas:

$$C_{cg}\ [kg\ C/GJ] = 10.678 - 0.029 * NCV$$

where: C_{cg} emission factor for city gas,
NCV- net calorific value of city gas [MJ/m^3].

Finally, following formula was derived for the emission factor for elemental carbon from blast furnace gas:

$$C_{bfg}\ [kg\ C/GJ] = 115.5 - 13.43 * NCV$$

where: C_{bfg} emission factor for blast furnace gas
NCV- net calorific value of blast furnace gas [MJ/m^3].

Calculation of the CO_2 emission factor, when the Cmax [kg/GJ] is already known is done with the following formula:

$$EF_{abc} = C_{max} * 44/12 * FO_{abc}\ [kgCO_2/GJ]$$

where: C_{max} - maximum content of elemental carbon in fuel [$kgCO_2/GJ$]
FO_{abc} - carbon oxidation factor in combustion processes dependent on fuel type and combustion technology

In national emission inventories carried out with "bottom-up" approach, in most cases it is necessary to assess the carbon oxidation factor at the level of aggregated fuel use in combustion processes in groups, sections and individual sub-sectors. Determination of the carbon oxidation factors for individual installations will be needed when domestic and international GHG emission trading will come into force within the framework of UNFCCC. Currently, in the Polish national inventory , it is the expert's estimation which helps to select the suitable value of the carbon oxidation factor. CO_2 emission factors were calculated for individual fuel types by applying the empirical functions given above. For these formulae, aggregated NCVs were used as well as estimated by experts carbon oxidation factors. The emission factors for the other pollutants: CH_4, N_2O, NO_x, CO and NMVOC, were selected from existing sets by taking into account industrial technologies and combustion conditions.

Sources of information

The correct inventory of GHG emissions for stationary sources, carried out by:

- precise determination of activities for categories: 1.A.1, 1.A.2, 1.A.4 and 1.A.5 and

- correct calculation or selection of emission factors for CO_2, CH_4 and N_2O

is supported by data found in the following periodic publications (annual or less frequent) or statistical yearbooks for some economy sectors:

- Electrical Power Statistics [GUS 1990a]
- Energy Balance Poland – OECD [ARE 1990]

Emission factors for stationary combustion in the sectors 1.A.1, 1.A.2 and 1.A.4 are presented in the tables 3.1-3.3. Empty cells for CO_2 emission factors mean that EFs are calculated based on the functions described above. Country specific EFs are estimated based on measurements or based on literature and expert opinion are shown in italic. The other emission factors are default values taken from [IPCC 2006].

Table 3.1. Applied EFs [kg/GJ] for 1.A.1. category

Type of Fuel	EF CO_2	EF CH_4	EF N_2O
LIQUID FUELS			
Fuel Oil		0.0030	0.0006
Liquid Petroleum Gas (LPG)	63.10	0.0010	0.0001
Rafinery Gas	51.30	0.0010	0.0001
Gaseous and Liquid Waste Fuels	*57.27*	*0.0015*	*0.0006*
GAS FUELS			
High – Methane Natural Gas		0.0010	0.0001
Coal-bed Methane		0.0010	0.0001
Nitrified Natural Gas	*54.73*	0.0010	0.0001
SOLID FUELS			
Hard Coal		0.0010	0.0015
Lignite		0.0010	0.0015
Coke		0.0010	0.0015
Coke Oven Gas		0.0010	0.0001
Blast Furnace Gas	44.70	0.0010	0.0001
Town Gas		0.0010	0.0001
Solid Waste Fuels	143.00	0.0300	0.0040
Gas Manufactured from coal	*116*	0.0010	0.0001
BIOMAS			
Fuel Wood	112.00	0.0300	0.0040

Table 3.2. Applied EFs [kg/GJ] for 1.A.2 category

Type of Fuel	EF CO_2	EF CH_4	EF N_2O
LIQUID FUELS			
Fuel Oil		0.0030	0.0006
Liquid Petroleum Gas (LPG)	63.10	0.0010	0.0001
Non-energy Products	*76,50*	0,0030	0,0006
Gaseous and Liquid Waste Fuels	*57.27*	*0.0015*	*0.0006*
GAS FUELS			
High – Methane Natural Gas		0.0010	0.0001
Coal-bed Methane		0.0010	0.0001
Nitrified Natural Gas	*54.73*	0.0010	0.0001
SOLID FUELS			
Hard Coal		0.0010	0.0015
Lignite		0.0010	0.0015
Coke		0.0100	0.0015
Coke Oven Gas		0.0010	0.0001
Blast Furnace Gas	44.70	0.0010	0.0001
Town Gas		0.0010	0.0001
Gas Manufactured from Coal	*116.00*	0.0010	0.0001
Solid Waste Fuels	143.00	0.0300	0.0040
BIOMAS			
Fuel Wood	112.00	0.0300	0.0040

Table 3.3. Applied EFs [kg/GJ] for 1.A.4 categories (stationary combustion)

Type of Fuel	EF CO_2	EF CH_4	EF N_2O
LIQUID FUELS			
Fuel Oil		0.0030	0.0006
Liquid Petroleum Gas (LPG)	63.10	0.0010	0.0001
GAS FUELS			
High – Methane Natural Gas		0.0010	0.0001
Nitrified Natural Gas	*54.73*	0.0010	0.0001
SOLID FUELS			
Hard Coal		0.0010	0.0015
Lignite		0.0010	0.0015
Coke		0.0010	0.0015
Town Gas		0.0010	0.0001
Coke Oven Gas	44.70	0.0010	0.0001
Solid Waste Fuels	143.00	0.0300	0.0040
BIOMAS			
Fuel Wood	112.00	0.0300	0.0040

As concerns sector 1.A.3 *Transport,* activity data for road transport are taken from [FEWE 1991] and CO_2 emissions factors come from [ITS 1995]. All other emission factors are default values from [IPCC 1997, 2006]. Applied emission factors are presented in the table 3.4. Activity data are as follows:

- OECD Energy Balance for Poland, [ARE 1990],
- Questionnaire/Report G-03, [GUS 1990e],
- Statistical Yearbook of The Republic of Poland 1990 [GUS 1990],
- unpublished data from Agency of Energy Market

Table 3.4 Emission factors for Transport in 1988

	Vehicle specification	Emission factors [kg/GJ]		
		CO_2	CH_4	N_2O
1.A.3.a.ii Civil Aviation, Domestic	1.i.PL.	70.33	0.0005	0.0022
1.A.3.a.i International Aviation - bunker	1.i.PL.	70.33	0.0005	0.0022
1.A.5.b. Other Aviation	1.ii.BL.	72.10	0.060	0.0009
	1.ii.PL.	72.80	0.002	0.002
1.A.3.b.i Passenger Cars without catal.	2.i.a.BS	72.83	0.030	0.002
	2.i.a.ON	73.93	0.002	0.004
	2.i.b.BS	72.83	0.020	0.001
1.A.3.b.i Passenger Cars with catal.	2.i.g.BS	72.83	0.007	0.0200
	2.i.g.ON	73.93	0.002	0.004
1.A.3.b.ii Light Duty Vehicles < 3.5 t without catal.	2.ii.a.BS	72.83	0.020	0.001
	2.ii.a.ON	73.93	0.001	0.0040
	2.ii.b.BS	72.83	0.020	0.001
1.A.3.b.ii Light Duty Vehicles < 3.5 t with catal.	2.ii.g.BS	72.83	0.020	0.001
	2.ii.g.ON	73.93	0.001	0.004
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t. without catal.	2.iii.a.BS	72.83	0.020	0.001
	2.iii.a.ON	73.93	0.006	0.003
1.A.3.b.iii Heavy Duty Vehicles > 3.5 t- with catal.	2.iii.g.ON	73.93	0.006	0.003
1.A.3.b.iii Buses	2.iii.a.ON	73.93	0.0039	0.0013
	2.iii.g.ON	73.93	0.0039	0.0013

	Vehicle specification	Emission factors [kg/GJ]		
		CO_2	CH_4	N_2O
1.A.3.b.iv Motorcycles	2.iv.BS	72.83	0.100	0.001
1.A.3.b.iv Mopeds	2.iv.BS	72.83	0.100	0.001
1.A.3.b.vi Tractors	2.vi.ON	73.93	0.004	0.0039
1.A.3.c. Railways	3.ON	73.00	0.004	0.030
	3.WK	75.00	0.006	0.002
1.A.3.d.ii Domestic Navigation - inland	4.ON	73.00	0.004	0.030
1.A.3.d.ii Domestic Navigation - marine	5.i.ON	74.10	0.007	0.002
	5.i.OP	77.60	0.007	0.002
1.A.3.d.i Domestic Navigation - bunker	5.i.ON	74.10	0.007	0.002
	5.i.OP	77.60	0.007	0.002
1.A.4.c.iii Fishery	5.ii.ON	74.10	0.007	0.002
	5.ii.OP	77.60	0.007	0.002
1.A.4.c.ii Agriculture - Off-Road Vehicles	6.i.ON	73.00	0.004	0.0039
1.A.4.c.ii Agriculture - Machines	6.ii.ON	73.00	0.004	0.030
1.A.2.g Off-Road Vehicles in Industry na Other	7.i.ON	73.00	0.004	0.030
1.A.3.e.ii Other Off-Road Transport	7.ii.BS	71.00	0.120	0.002
	7.ii.ON	73.00	0.004	0.0300

Abbreviation explanation to table 3.4:
- catal - catalytic converter
- BS - motor gasoline
- ON - diesel oil
- OP - fuel oil
- PL - jet fuel
- BL - aviation gasoline.

Domestic statistic for year 1988 does not contain activity data concerning consumption of non-energy products for all economy sectors. For that reason classification is based on total consumption of non-energy products in year 1988 [GUS 1990a] and four-years averages (from years 1996-1999) of shares energy consumption of non-energy products in each sector in proportion to total domestic consumption. Based on these calculations, for each subcategories IPCC, the following shares of energy consumption of non-energy products have been estimated: 1.A.1 – 10.6%, 1.A.2 – 29.9%, 1.A.4.- 21% and 1.A.5 – 1.4 %. Finally energy consumption stands for about 63% of total consumption of non-energy products.

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

The CO_2 emissions from fuel combustion category was estimated also by use of reference approach characterising "top–down" approach to GHG emissions estimations. When comparing the results the difference in energy consumption is about 6% and in CO_2 emissions 1.02% [Radwański 2006a]. This means that using reference approach CO_2 emissions from fuel combustion were higher by about 1% comparing to the sectoral approach ("bottom–up"). More data on energy consumption and CO_2 emissions for both approaches are given in annex 6, in CRF table 1.A(c).

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

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

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

Based on country study [Gawlik 1994, Gawlik, 2001] domestic emission factors were estimated for the following emission sources in mines: venting systems, methane capture systems, post-mining processes and production waste. For the year 1999 annual emissions for one of closed mines were estimated what allowed to calculate emission factor from this source relating to coal mined.

The newest emission factors were estimated by [Kwarciński 2005] based on detail data and measurements made in 2003. For the domestic inventory purposes emissions factors were calculated for 1 tone coal mined. The set of Polish emissions factors are presented in table 3.5.

Table 3.5. Methane emission factors analysis

Emissions sources	[Gawlik et al. 1994]		[Gawlik i Grzybek 2001]		[Kwarciński et al 2005]	
	Nm^3 CH_4 /Mg Coal	Nm^3 CH_4 /Mg Coal	Nm^3 CH_4 /Mg Coal	Nm3 CH_4 /Mg Coal	Nm^3 CH_4 /Mg Coal	Nm^3 CH_4 /Mg Coal
Venting systems	6.0050	4.0234	6.4430	4.3168	5.8011	3.8868
De-methane systems			0.5962	0.3994	0.9927	0.6651
Post-mining processes	1.4810	0.9923	1.0200	0.6834	0.4288	0.2873
Production waste	0.0649	0.0435	0.0630	0.0422	0.0289	0.0194
Closed mines			0.0489	0.0328		0.0000

Finally for the base year inventory (1988) the following data and references for estimating emission factors were used:
– venting processes – [Gawlik et al. 1994]
– methane capture systems – direct data
– post-mining processes – [Kwarciński et al. 2005]
– dumping grounds – [Kwarciński et al. 2005]
– closed mines – not estimated

Table 3.6 contains the data on coal mining as well as methane captured and used for 1988. Emission from de-methane systems stands as a difference between methane capture and use.

Table 3.6. Data relating to coal mining and methane captured and used for 1988

Coal mining	Methane capture	Methane use	Emission from methane capture systems		
mln Mg	mln m^3	mln m^3	mln m^3	mln Nm^3	Gg CH_4
191.6	280.4	205.9	74.5	72.04	48.27

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

Fugitive emission of CH_4 from surface mining was estimated based on the activity data concerning lignite extraction amount from the study published by Polish Geological Institute [PIG, 1989] 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 coal
- Ventilation emission from surrounding rocks - 0,012 m^3 CH_4 / t of extracted coal

The conversion factor applied for recalculation of emitted methane volume into mass of CH_4 is 0,67 kg/m^3.

3.2.2.2. *Fugitive emissions from fuels – coke oven gas* (CRF 1.B.1.c)

Tier 1 method has been used for calculation of fugitive emissions from coke oven gas system {GPG 2000], while emission factors presented in table 3.7 have been taken from domestic case study [Steczko 1994]. Activity data come from energy statistics [GUS 1990a].

Table. 3.7. Emission factors for CO_2 and CH_4 from coke oven gas system

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

3.2.2.3. *Fugitive emissions from fuels – oil* (CRF 1.B.2.a)

Tier 1 method has been used for calculation of fugitive emissions from oil system {GPG 2000]. Activity data come from energy statistics [GUS 1990a]:

production	PJ	6,578
distribution	Gg	15151

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 default factors were used from [GPG 2000] (tab. 3.8).

Table 3.8. Emission factors for CO_2 and CH_4 from oil production and transmission

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

3.2.2.4. *Fugitive emissions from fuels – natural gas* (CRF 1.B.2.b)

Estimation of CO_2 and CH_4 emissions from systems of high-methane and nitrified natural gases was carried out based on *Tier 1* method [GPG 2000]. Activity data come from energy statistics [GUS 1990a] and are given in table 3.9.

Table 3.9. Activities for high-methane and nitrified natural gas systems.

Highmethane gas system		
Gas production	Gas production [PJ]	71.374
Gas processing	Gas use [PJ]	350.074
Gas transmission	Gas use [PJ]	350.074
Underground gas storage	Gas use [PJ]	350.074
Gas distribution	Gas use [PJ]	350.074
nitrified natural gas system:		
Gas production	Gas production [PJ]	85.244
Gas processing	Gas use [PJ]	51.298
Gas transmission	Gas use [PJ]	51.298
Gas distribution	Gas use [PJ]	51.298

Emission factors for both gas systems were taken from country study [Steczko K. 1994] and are listed in tables 3.10 and 3.11.

Table 3.10. Emission factors for CO_2 and CH_4 from high-methane gas system.

CO_2 emission factors	[Gg/PJ]
Gas production	0.000402
Gas processing	0.014368
Gas transmission	0.000558
Underground gas storage	0.000011
Gas distribution	0.001234
CH_4 emission factors	
Gas production	0.100848
Gas processing	0.000004
Gas transmission	0.140189
Underground gas storage	0.002742
Gas distribution	0.309945

Table 3.11. Emission factors for CO_2 and CH_4 from nitrified natural gas system.

CO_2 emission factors	[Gg/PJ]
Gas production	0.000060
Gas processing	0.051321
Gas transmission	0.000192
Gas distribution	0.000558
CH_4 emission factors	
Gas production	0.034307
Gas processing	0.101227
Gas transmission	0.109475
Gas distribution	0.317671

4. Industrial Processes (CRF sector 2)

4.1. Key categories

Following categories from sector 2 have been identified as key sources:
- 2.A.1 - Cement Production (CO_2 emission), share in total GHG emission 1.2%,
- 2.B.1 - Ammonia Production (CO_2 emission), share in total GHG emission 0.6%,
- 2.B.2 - Nitric Acid Production (N_2O emission), share in total GHG emission 0.7%,
- 2.C.1 - Iron and Steel Production (CO_2 emission), share in total GHG emission 1.1%.

Share of these categories in total Poland's GHG emissions is 3.6%.

4.2. Methodological issues

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

4.2.1.1. *Cement Production* (CRF 2.A.1)
CO_2 emission from cement production was estimated based on data on clinker production from [GUS 1990b]. The applied emission factor is equal 525 kg / Mg clinker. This country specific emission factor is taken from [IMMB 2006].

4.2.1.2. *Lime Production* (CRF 2.A.2)
Emission of CO_2 from lime production was calculated based on data on lime production from [GUS 1990b]. The applied emission factor is equal 785 kg / Mg lime. This is default value given for quicklime (high calcium lime) production in [IPCC 1997].

4.2.1.3. *Soda Ash Production and Use* (CRF 2.A.4)
Soda Ash is produced in Poland in the Solvay Process. Emission of CO_2 from this process was assumed as 0. CO_2 emission from soda ash use was estimated based on assumption that amount of used soda ash is equal soda ash production. Data on soda ash production was taken from [ARE 1990b]. 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].

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

4.2.2.1. *Ammonia Production* (CRF 2.B.1)
CO_2 and CH_4 emissions for ammonia production are estimated based on the data on gas and liquid ammonia production from [Radwański 2005]. The CO_2 emission factor (1.5 Mg CO_2/Mg NH_3 was taken from [IPCC 1997]. Methane emission factor is 4.9 kg CH_4 /Mg NH_3 produced was taken from [CITEPA 1992]. Emission N_2O was estimated as 0, according to the study [Kozłowski 2001].

4.2.2.2. *Nitric Acid Producti*on (CRF 2.B.2)
Estimation of N_2O emission from nitric acid production was based on the annual HNO_3 production data from [GUS 1990b]. The applied country specific emission factor, which is equal 6.47 kg/Mg nitric acid [Kozłowski 2001].

4.2.2.3. *Adipic Acid production* (CRF 2.B.3)
Activity data concerning adipic acid production are taken from adipic production plant. CO_2 emission factor for this category, which is equal 0.300 Mg CO_2/ Mg, was taken from [IPCC 1997].

4.2.2.4. *Carbide Production* (CRF 2.B.4)
Activity data concerning calcium carbide production are published in [GUS 1990b]. CO_2 emission factor for this category, which is equal 1.100 Mg CO_2/ Mg carbide, was taken from [IPCC 1997].

4.2.2.5. *Other* (CRF 2.B.5)
- *Carbon Black Production*
CH_4 emission from production of black carbon was estimated based on annual black carbon production from [GUS 1990b]. The emission factor, which is equal 10 kg CH_4 /Mg black carbon, was taken from [CITEPA 1992].

- *Ethylene Production*
Emission of CO_2 from ethylene production was calculated based on ethylene annual production from [GUS 1990b]. Emission factor was taken from [CITEPA 1992]. Its value is 0.3 kg CO_2 / Mg ethylene produced.

- *Caprolactam Production*
Data on annual caprolactam production for inventory calculation purpose was taken from [GUS 1990b]. 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].

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

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

4.2.3.1.1. *Iron Ore Sintering* (CRF 2.C.1.a)
The value of annual iron ore sinter production was taken from [ARE 1990]. Country specific emission factor of CO_2, which is equal 75.79 kg CO_2 / Mg iron ore sinter, was taken from [KASHUE 2006].

4.2.3.1.2. *Steel Cast Production* (CRF 2.C.1.c)
The data on steel cast production for CO_2 emission calculation was taken from [GUS 1990b]. Country specific emission factor applied for CO_2 emission estimation is from [FEWE 1994]. Its value is 62 kg CO_2 / Mg steel cast produced.

4.2.3.1.3. *Iron Cast Production* (2.C.1.d)
Annual iron cast production for CO_2 emission estimation was taken from [GUS 1990b]. Country specific emission factor applied for CO_2 emission calculation is from [FEWE 1994]. Its value is 61 kg CO_2 / Mg iron cast produced. Applied CH_4 emission factor is 0.20 kg CH_4 / Mg iron cast produced. It was taken from [Radwański 1995].

4.2.3.1.4. *Blast Furnaces Process* (CRF 2.C.1.e)
Processing emission of CO_2 from blast furnaces was estimated based on elementary carbon budget in Blast Furnaces Process.

4.2.3.1.5. *Basic Oxygen Furnace Steel* (CRF 2.C.1.f)
Basic oxygen furnace steel production was taken from [GUS 1990b]. Country specific CO_2 emission factor used for inventory report, which value is 11.26 kg CO_2 / Mg steel produced, was calculated in [FEWE 1994] based on composition of gases from basic oxygen furnaces in Polish plants.

4.2.3.1.6. *Electric Furnace Steel* (2.C.1.g)
Annual electric furnace steel production was taken from [GUS 1990b]. Applied CO_2 country specific emission factor is equal 4.30 kg CO_2 / Mg steel produced and it was calculated in [FEWE 1994] based on composition of gases from electric furnaces in Polish plants. CH_4 emission factor, which value is 0.12 kg CO_2 / Mg steel produced, is country specific as well [FEWE 1994]. Results of measurements carried out in Polish steel plants were the sources of this emission factor [Olczak 1993].

4.2.3.1.7. *Coke production* (CRF 2.C.1.j)
Processing emission of CO_2 from coking plants was estimated based on elementary carbon budget in coking plants process. CH_4 emission was estimated based on coke production volume from [GUS 1990b] and emission factor is 0.2 kg CH_4 / Mg coke produced [EEA 2004].

4.2.3.2. *Ferroalloys production* (CRF 2.C.2)
Emission of CO_2 concerning ferroalloys production was estimated based on annual ferrosilicon production taken from [GUS 1990b]. Applied emission factor, which value is 3900 kg CO_2 / Mg ferrosilicon, was taken from [IPCC 1997] for ferrosilicon – 75% Si.

4.2.3.3. *Aluminium Production* (CRF 2.C.3)
Calculation of CO_2 emission from primary aluminium production is based on the data on aluminium production published in [GUS 1990b]. The emission factor, which is equal 1.8 Mg CO_2 / Mg primary aluminium, was taken from [IPCC 1997] as value recommended for Soderberg Process.

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

The year 1995 was chosen as the base year for F-gases in Poland. Emissions of HFC, PFCs and SF_6 are based on activity data available at public statistics data and data collected by surveys among importers and exporters of CFCs and F-gases. In case of refrigeration and air-conditioning equipment containing HFCs, some information concerning e.g. amounts of gas used, are collected by experts among main domestic producers and importers/exporters. Emission factors used in the national inventory are all taken from [IPCC 2000]. The activities and emission factors for HFC-134a are given in tables 4.1 and 4.2.

Table 4.1. Basic data for HFC-134a estimation from category 2.F.1.Refrigeration and Air Conditioning Equipment in 1995

Equipment type including HFC-134a	Number of devices at the beginning of year	Number of devices exported	Number of devices produced	Number of devices imported	Number of devices at the end of the year	HFC amount for one device [kg]	HFC amount In devices In the given year [Mg]
	a	b	c	d	e=a–b+c+d		
Refrigerators and freezers in households	72 000	111 716	292 731	28 232	281 247	0.14	39.375
Commercial window refrigerators and chamber freezers	25 000	8 749	0	52 490	68 741	0.50	34.371

Equipment type including HFC-134a	Number of devices at the beginning of year	Number of devices exported	Number of devices produced	Number of devices imported	Number of devices at the end of the year	HFC amount for one device [kg]	HFC amount In devices In the given year [Mg]
	a	b	c	d	e=a–b+c+d		
Passenger cars with A/C	500	0	0	3 352	3 852	1.20	4.622
Buses, trucks etc. with A/C	0	0	0	14	14	1.50	0.021

Table 4.2. HFC-134a emission factors

Emission sources	Emission factor
Devices used In households (refrigerators and freezers) - use	0.5 %
Commercial devices (window refrigerators and chamber freezers) – devices production	3 %
Commercial devices (window refrigerators and chamber freezers) – devices use	20 %

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

5.1. Key categories

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

5.2. Methodological issues

Calculations of CO_2 emissions within Sector 3, using the common methodology, were carried out on the basis of results of NMVOC emissions [IETU 1995]. from the following activities:

- Paint application (CRF 3.A)
- Degreasing and dry cleaning (CRF 3.B)
- Other solvents use (CRF 3.D)

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 formula:

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

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

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

6. *Agriculture* (CRF sector 4)

6.1. Key categories

Following categories from sector 4 have been identified as key sources:
- 4.A - Enteric Fermentation (CH_4 emission), share in total GHG emission 2.7%,
- 4.B - Manure Management (N_2O emission), share in total GHG emission 1.6%,
- 4.D.1 - Direct Soil Emissions (N_2O emission), share in total GHG emission 2.7%,
- 4.D.3 - Indirect Soil Emissions (N_2O emission), share in total GHG emission 1.1%.

Share of these categories in total Poland's GHG emissions is 8.1%.

6.2. Methodological issues

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

The emission factors for estimation of CH_4 emission from enteric fermentation were calculated based on IPCC Guidelines [IPCC 2000] as well as the national case study [Myczko 2001] and updated data on animal breeding [Walczak 2003, 2006]. The CH_4 emission factors were estimated for each livestock subcategory within cattle: dairy cows and non-dairy cattle disaggregated for: calves (under 6 months), young cattle (6–12 months) and other cattle (1 year and over). Also domestic emission factor for sheep was estimated based on disaggregating this livestock group for lambs under one year and mature sheep above one year. The emission factors for other livestock like goats, horses and swine come from [IPCC 1997].

CH_4 emissions for category 4.A Enteric fermentation for cattle and sheep were calculated using the IPCC *Tier 2* methodology. The emissions for goats, horses and swine were calculated using *Tier 1* methodology and default factors [IPCC 1997]. Activity data were obtained from national statistics [GUS 1990]. For goats population activity was taken from 1996 because of lack of data from earlier years.

The calculated Gross Energy Intake (GE) values and applied emission factors expressed in kg CH_4 per head per year, including the weighted mean for all non-dairy cattle subcategories, are given in Table 6.1.

Table 6.1. Livestock population, daily Gross Energy Intake (GE) and CH_4 emissions factors in 1988

Livestock	Population [millions]	GE Gross Energy Intake [MJ/animal/day]	EF Emission Factor [kg CH_4 / animal / year]
4.A Enteric Fermentation	35.534	---	21.210
1 Cattle	10.322	---	64.758
a. Dairy cattle	4.806	241.467	95.025
b Non-dairy cattle	5.516	101.074	39.776
3 Sheep	4.377	17.933	7.863
4 Goats	0.179	---	5.000
6 Horses	1.051	---	18.000
8 Swine	19.605	---	1.500

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

The IPCC *Tier 2* methodology was used to establish domestic CH_4 emission factors for cattle, sheep and swine. The *Tier 1* methodology was used for estimation of default emission factors for goats, horses and poultry [IPCC 1997]. Animal population was taken from [GUS 1990]. For goats population activity was taken from 1996 because of lack of data from earlier years.

Table 6.2. Livestock population, volatile solids excreted (Vs) and CH_4 emissions factors

Livestock	Population [millions]	Vs Volatile Solids Excreted [kg dm /animal/ day]	EF Emission Factor [kg CH_4 / animal / year]
4.B Manure Management	281.709	---	0.579
1 Cattle	10.322	---	3.817
a. Dairy cattle	4.806	4.985	6.016
b Non-dairy cattle	5.516	1.679	2.003
3 Sheep	4.377	0.358	0.166
4 Goats	0.179	0.280	0.120
6 Horses	1.051	1.720	1.390
8 Swine	19.605	0.500	5.214
9 Poultry	246.175	0.100	0.078

The factors recommended for cool climate were used. The country specific CH_4 emission factors for dairy and non-dairy cattle, sheep and swine were calculated based on:

- country specific data on the fraction of manure managed in given AWMS from [Walczak 2003, 2006] (see Table 6.3),
- B_o (methane-producing potential) factors were taken from [IPCC 1997],
- VS (average daily volatile excreted solids) for dairy, non-dairy cattle and sheep were estimated based on country specific GE (average feed intake); VS for swine was the default value from [IPCC 1997]
- MCFs (methane conversion factors) for individual manure management systems concerning cool climate are from [IPCC 2000].

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

Livestock population for N_2O emission calculation from manure management was taken from [GUS 1990]. For goats population activity was taken from 1996 because of lack of data from earlier years.

The fractions of manure managed in given AWMS for each type of animals, taken from [Myczko 2001] and [Walczak 2003, 2006], are presented in the table 6.3.

Table 6.3. Fractions of manure managed in given AWMS for each type of animals

Livestock	Type of AWSM		
	Liquid System	Solid Storage and Drylot	Pasture Range and Paddock
Dairy cattle	0.0278	0.7522	0.22
Non-dairy cattle	0.0492	0.7708	0.18
Sheep	--	0.5000	0.50
Goats	--	0.9000	0.10
Horses	--	0.9000	0.10
Swine	0,2230	0,7770	--
Poultry	0.2000	0.8000	--

The default values of nitrogen excretion per head of animal for each type of animals (values for Eastern Europe) from [IPCC 1997] were used for emission calculation. Default values of N_2O emission factors for management systems from [IPCC 1997] were applied (Tables 6.4.a, 6.4.b. and 6.5).

Table 6.4.a. Emissions of nitrogen excreted in livestock manure in:
a) liquid system

Livestock	Nitrogen excreted in manure Nex [kg/animal/year]	AWMS [% / 100]	Nitrogen excreted in AWMS [kg N / year / 1000]
1.a. Dairy cattle	70.0	0.0278	9352.476
1.b. Non-dairy cattle	50.0	0.0492	13569.360
3 Sheep	16.0	0.0000	0.000
4 Goats	25.0	0.0000	0.000
6 Horses	25.0	0.0000	0.000
8 Swine	20.0	0.2230	87451.200
9 Poultry	0.6	0.2000	29540.955

b) solid storage and drylot

Livestock	Nitrogen excreted in manure Nex [kg/animal/year]	AWMS [% / 100]	Nitrogen excreted in AWMS [kg N / year / 1000]
1.a. Dairy cattle	70.0	0.7522	253055.124
1.b. Non-dairy cattle	50.0	0.7708	212586.640
3 Sheep	16.0	0.5000	35016.000
4 Goats	25.0	0.9000	4034.610
6 Horses	25.0	0.9000	23647.500
8 Swine	20.0	0.7770	304648.800
9 Poultry	0.6	0.8000	118163.822

Table 6.5. Factors of N_2O–N emission for various manure management systems

Animal Waste Management Systems	EF Emission Factor [kg N2O-N/ kg N]
10. Anaerobic lagoons	0.001
11. Liquid systems	0.001
12. Solid storage and drylot	0.020
13. Other	0.005

6.2.4. *Agricultural Soils* (CRF 4.D)

6.2.4.1. *Direct Soil Emission* (CRF 4.D.1)

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

N_2O emission from synthetic fertilisers was estimated based on the amount of synthetic fertiliser nitrogen applied to agricultural fields published in [GUS 1990]. The nitrogen fraction converted to N_2O was estimated as 0.9 (1–0.1 $Frac_{gasf}$ – see 4.D.3) and this is default value from [IPCC 1997]. The country specific emission factor (0.008 kg N_2O-N / kg N applied) taken from [Mercik 2001] was corrected for 0.009 kg N_2O-N / kg N as the previous one included the fraction of nitrogen that is emitted as $NO_x + NH_3$.

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

Manure nitrogen use as fertiliser was estimated according to IPCC guidelines. The total amount of nitrogen in animal excreta was calculated based on animal population taken from [GUS 1990] and the default values of nitrogen excretion per head of animal for each type of animals (values for Eastern Europe) from [IPCC 1997]. The data on fraction of manure managed in each AWMS applied in Poland are the country specific data taken from Polish

studies [Myczko 2001] and [Walczak 2003, 2006]. The fractions of manure managed in given AWMS for each type of animals are given in table 6.3.

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

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

N_2O emission from N-fixing crops was calculated based on the data on sown area of N-fixing crops, published in [GUS 1990]. According to study [Mercik 2001] 1% of nitrogen fixed by papilionaceous plants is denitrificated to N_2O and in this connection the used emission factor value is 0,010 N_2O-N/ kg N contained in papilionaceous plants. Most above ground plant parts is removed from fields in Poland, so only plant residues were taken into account in N_2O emission calculation. Based on the data from the study mentioned above was assumed, that nitrogen amount in plant residues is 90 kg N/ha.

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

Emission of N_2O for non-N-fixing crop residues was calculated based on the information from [Mercik 2001], that quantity of dry residue from 1 ha of non-N-fixing crop harvested area is 2 Mg d.m. / ha and content of nitrogen in plant residues is 0.76%. The emission factor for inventory purpose was taken from this study as well. Its value is 0,010 kg N_2O-N/ kg N contained in residues. Data on sown area of other than N-fixing crops are published in [GUS 1990].

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

The area of histosols in Poland is estimated as 1269 ha [Mercik 2001] and this value was applied to entire inventory period from 1988. 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.

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

Animal population for calculation of N_2O emission from pasture range and paddock was taken from [GUS 1990]. Total amount of nitrogen in animal excreta was estimated based on the data presented in the table 6.6. The default values of nitrogen excretion per head of animal for each type of animals (values for Eastern Europe) from [IPCC 1997] were used. The data on fraction of manure related with grazing animal are the country specific data taken from Polish study [Myczko 2001].N_2O emission factor (0.02) for pasture range and paddock was taken from [IPCC 1997].

Table 6.6. Fraction of manure related with grazing animal, nitrogen excreted in AWMS systems and factor of N_2O–N emission

Livestock	Nitrogen excretion Nex [kg/head/yr]	Fraction of manure nitrogen per AWMS [% / 100]	Nitrogen excreted in AWMS [kg N / year / 1000]	EF Emission factor for AWMS [kg N2O-N/ kg N]
1.a. Dairy cattle	70.0	0.22	74012.400	
1.b. Non-dairy cattle	50.0	0.18	49644.000	
3 Sheep	16.0	0.50	35016.000	
4 Goats	25.0	0.10	448.290	
6 Horses	25.0	0.10	2627.500	
8 Swine	--	--	--	
9 Poultry	--	--	--	
		total	161748.190	0.020

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

The *Tier 1a* method was used for assessing indirect emissions of N_2O for 1988 in Poland. The basic equation for estimating a country's indirect N_2O emissions:

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

where:
$N_2O_{indirect} \rightarrow N$ – emissions of N_2O in units of nitrogen,
$N_2O_{(G)} \rightarrow N$ – N_2O produced from volatilisation of applied synthetic fertiliser and animal manure N, and its subsequent atmospheric deposition as nitrogen compounds (kg N/year),
$N_2O_{(L)} \rightarrow N$ –N_2O produced form leaching and runoff of applied fertiliser and animal manure N (kg N/year).

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

Atmospheric deposition of nitrogen compounds fertilises soils and surface waters. It results in enhanced biogenic N_2O formation. According to this methodology the amount of N applied to soils is equal to the total amount of synthetic fertiliser nitrogen applied to soils plus the total amount of animal manure nitrogen excreted in country. Those values have to be multiplied by appropriate volatilisation factors. This sum is then multiplied by an emission factor (table 6.7). Calculations were made according to the following equation:

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

where:
$N_2O_{(G)} \rightarrow N$ – N_2O produced from volatilisation of applied synthetic fertiliser and animal manure N, and its subsequent atmospheric deposition as nitrogen compounds,
N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soils, this value is taken from [GUS 1990],
Nex – total amount of animal manure nitrogen excreted in AWMS system (table 6.6),
$Frac_{GASF}$ – fraction of synthetic N fertiliser that volatilises to nitrogen compounds, default value,
$Frac_{GASM}$ – fraction of animal manure N that volatilises to nitrogen compounds, default value,

EF– emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, default value.

Table 6.7. Estimation of indirect emissions of N_20–N from atmospheric deposition

N_{fert} [Gg/year]	$Frac_{GASF}$ [kg N/kgN]	N_{ex} [kgN/year/1000]	$Frac_{GASM}$ [kg N/kg N]	EF [kgN_2O-N/kg N]	$N_2O_{(G)}\rightarrow N$ [GgN_2O-N]
1335	0.1	161748.190	0.2	0.01	1.658

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

Part of the nitrogen is lost from agricultural soils through leaching and runoff, an d gets to the groundwater, rivers and wetlands. It results in biogenic production of N_2O. To estimate the amount of applied N that leaches or runs off, the total amount of synthetic fertiliser nitrogen and the total amount of animal N excretion must be summed and then multiplied by a fraction of N input, that is lost through leaching and runoff. Then it must be multiplied by an appropriate emission factor (table 6.8). Calculations were made according to the following equation:

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

where:
$N_2O_{(L)}\rightarrow N$ – N_2O produced form leaching and runoff of applied fertiliser and animal manure N,
N_{FERT} – total amount of synthetic nitrogen fertiliser applied to soils, this value is taken from [GUS 1990],
Nex – total amount of animal manure nitrogen excreted in AWMS system (table 6.6),
$Frac_{LEACH}$ – fraction nitrogen input to soil that is lost through leaching and runoff, default value,
EF – emission factor for N_2O emissions for leaching/runoff, default value.

The values, that were taken to calculations and emissions, are presentedin table 6.8.

Table 6.8. Estimation of indirect emissions of N_20–N from nitrogen leaching and run-off

N_{fert} [Gg/year]	N_{ex} [kgN/year /1000]	$Frac_{LEACH}$ [kg N/kg N]	EF [kgN_2O-N/kg N]	$N_2O_{(L)}\rightarrow N$ [GgN_2O-N]
1335	161748.190	0.3	0.025	11.226

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

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

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

CH_4 and N_2O emissions from burning of agricultural residues in fields were estimated based on methodology described in [IPCC 1997]. For domestic purposes there were selected 38 crops containing cereals, pulses, tuber and root, oil-bearing plants, vegetables and fruits [Łoboda *at al* 1994] which residues could be burned on fields. Activity data concerning crop production was taken from [GUS 1990]. Factors applied for emissions calculation were taken

from country study [Łoboda 1994] where experimental and literature data as well as default emission factors were used. These values are presented in the table 6.9.

Table 6.9. Factors applied for CH_4 and N_2O emission estimation from field burning of agriculture residues

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

7. *Land Use Change and Forestry* (CRF sector 5)

7.1. Key categories

Sector 5 is not analyzed in key source analyses.

7.2. Methodological issues

All calculations within the GHG inventory for LUCF in Poland in 1988 were prepared using the [IPCC 1997] methodology. The land use transition matrix was not available during the inventory preparation hence the methodology suggested by GPG LULUCF could not be applied. The obtained GHG estimates were first inserted into the old CRF file, and then translated into the CRF required by GPG LULUCF. Majority of cells in the new CRF could not be filled in and those filled in were calculated by means of the transition matrix presented in table 7.2.

Reporting under the GPG LULUCF requires significant improvements in data collection and access to data on changes in land uses. The current calculations are based on net land use changes (with exception to afforestation/reforestation and deforestation for which gross data are available). This most likely underestimates the actual emissions and removals in this category. The underestimation may bias GHG estimates but direction and degree of the bias can not be easy inferred.

The inventory results for 1988 for LULUCF sector are presented in the following tables according to new [IPCC 2003] and previous [IPCC 1997] methodologies.

Table 7.1. Total CO_2 emissions and removals from Land Use Change and Forestry in 1988 [IPCC 2003]

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O
	(Gg)		
5. Total Land-Use Categories	-32934.72	0.356	0.002
5A. Forest Land	-42705.20		
1. Forest Land remaining Forest Land	IE		
2. Land converted to Forest Land	8165.26		
5B. Cropland	IE		
1. Cropland remaining Cropland	IE		
2. Land converted to Cropland	4530.69		
5C. Grassland	IE		
1. Grassland remaining Grassland	IE		
2. Land converted to Grassland	IE		
5D. Wetlands	IE		
1. Wetlands remaining Wetlands	IE		
2. Land converted to Wetlands	-2925.46	0.356	0.002
5E. Settlements	IE		
1. Settlements remaining Settlements	IE		
2. Land converted to Settlements	IE		
5F. Other Land	IE		
1. Other Land remaining Other Land	IE		
2. Land converted to Other Land	NE	NE	NE
5G. Other(please specify)	NE	NE	NE
Harvested Wood Products	NE		

* IE – included elsewhere
* NE – not estimated

Table 7.2. Transition matrix from [IPCC 1997] to [IPCC 2003] LULUCF categories

Sector 5 - Land Use Change and Forestry		New CRF data																				
		Land Use Change and Forestry	A. Forest Land	1. Forest Land remaining Forest Land	2. Land converted to Forest Land	B. Cropland	1. Cropland remaining Cropland	2. Land converted to Cropland	C. Grassland	1. Grassland remaining Grassland	2. Land converted to Grassland	D. Wetlands	1. Wetlands remaining Wetlands	2. Land converted to Wetlands	E. Settlements	1. Settlements remaining Settlements	2. Land converted to Settlements	F. Other Land	1. Other Land remaining Other Land	2. Land converted to Other Land	G. Other *(please specify)*	Harvested Wood Products
Old IPCC data	Total Land-Use Change and Forestry	1																				
	A. Changes in Forest and Other Woody Biomass Stocks																					
	1. Tropical Forests																					
	2. Temperate Forests		1	Inc. in A	Inc. in A																	
	3. Boreal Forests																					
	4. Grasslands/Tundra																					
	5. Other *(please specify)*																					
	Harvested Wood																					
	B. Forest and Grassland Conversion																					
	1. Tropical Forests																					
	2. Temperate Forests														1	Inc. in E	Inc. in E					
	3. Boreal Forests																					
	4. Grasslands/Tundra																					
	5. Other *(please specify)*																					
	C. Abandonment of Managed Lands																					
	1. Tropical Forests																					
	2. Temperate Forests																					
	3. Boreal Forests																					
	4. Grasslands/Tundra																					
	5. Other *(please specify)*																					
	D. CO2 Emissions and Removals from Soil																					
	1. Cultivation of Mineral Soils					0,64	Inc. in B	Inc. in B	0,36	Inc. in C	Inc. in C	Inc. in C										
	2. Cultivation of Organic Soils																					
	3. Liming of Agricultural Soils					0,64			0,36													
	4. Forest Soils		1	Inc. in A	Inc. in A																	
	5.Other Land *(please specify)*														1	Inc. in E	Inc. in E					
	E. Other *(please specify)*																					

Table 7.3. Total CO_2 emissions and removals from sector 5. Land Use Change and Forestry in 1988 [IPCC 1997]

Greenhouse gas source and sink categories	CO_2 emissions	CO_2 removals	Net CO_2 emissions/ removals	CH_4	N_2O
	Gg				
5. Total Land-Use Change and Forestry	56190.82	-89125.54	-32934.72	0.356	0.002
5A. Changes in Forest and Other Woody Biomass Stocks	43380.28	-67089.45	-23709.17		
I. Tropical Forests					
2. Temperate Forests	43380.28	-67089.45	-23709.17		
3. Boreal Forests					
4. Grasslands/Tundra					
5. Other (please specify)					
Harvested Wood					
5B. Forest and Grassland Conversion	114.60		114.60		
1. Tropical Forests					
2. Temperate Forests	114.60			0.356	0.002
3. Boreal Forests					
4. Grasslands/Tundra					
5. Other (please specify)					
5C. Abandonment of Managed Lands	0.00	0.00	0.00		
1. Tropical Forests					
2. Temperate Forests					
3. Boreal Forests					
4. Grasslands/Tundra					
5. Other (please specify)					
5D. CO_2 Emissions and Removals from Soil	12695.94	-22036.09	-9340.15		
Cultivation of Mineral Soils	10 396.13		10 396.13		
Cultivation of Organic Soils					
Liming of Agricultural Soils	2 299.80		2 299.80		
Forest Soils		-18 996.03	-18 996.03		
Other Land (please specify)		-3 040.06	-3 040.06		
5E. Other *(please specify)*					

According to calculation for 1988, Sector 5. Land-Use Change and Forestry, was net CO_2 sink. Emissions–Removals balance from that sector accounted for almost 33 thousand Gg CO_2 and included results from groups given below.

7.2.1. *Changes in Forest and Other Woody Biomass Stocks* (old CRF 5.A)

GHG balance in this group is a net sink. In 1988 net CO_2 removals accounted for about 23710 Gg CO_2.

Increase in forest

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

Data published in statistical yearbooks are of synthetic character – (apply to all types together or separately for conifers and broadleaves only).

Estimation of actual increase (m^3/ha/year) for all forests is based on data of increment in growing stock and harvest of thick. Data of harvest of thick are given as net volume of thick wood (without bark). For calculation of harvest of thick it is necessary to add estimated volume of thick bark to net harvest of thick (assume that thick bark is about 25% of thick wood without bark [Czuraj, 1991]. Increase is determined by forest type, age class and quality of forest habitats.

Harvest of thick and growing stock were converted into mass of biomass separately, using expansion ratio for timber removals and conversion for growing stocks.

Calculations were based on average values, regarded as approximation of real values. Methodology for biomass annual increase calculations should be still improved, among others for better show long and short term trends. For calculations there were used default factor describing fraction of elementary carbon in dry matter 0,5 [IPCC 1997].

7.2.2. *Forest and Grassland Conversion* (old CRF 5.B)

In 1988 this category was a net CO_2 emissions and accounted for 114 Gg CO_2. Emissions ratios for calculation CH_4, N_2O, CO and NO_x emissions from biomass burning are presented in table below.

Table 7.4. Emissions ratios for calculation CH_4, N_2O, CO and NO_x emissions from biomass burning.

Compound	Ratio		
CH_4	0.012	default	[IPCC 1997]
CO	0.060	default	[IPCC 1997]
N_2O	0.007	default	[IPCC 1997]
NO_x	0.121	default	[IPCC 1997]

Ratio of carbon to nitrogen in burning biomass was taken as 0.001 and default factor of carbon fraction in aboveground biomass is equal 0.5 [IPCC 1997]. Both default factors for fraction of carbon oxidized on and off site are equal to 0.9 [IPCC 1997].

In this category emission of other than CO_2 GHGs is reported from forest fires only. Assumption is made that woody biomass is not burnt entirely during fires (only canopies and underwood are damaged) so if there is a need for moving out damaged or dead woods it is included into total wood harvest. Controlled burning of forests is not practiced in Poland.

7.2.3. *Abandonment of Managed Lands* (old CRF 5.C)

According to [IPCC 1997] definition, there is no anthropogenic activity on abandonment lands in Poland, so such category is not considered here. Generally agriculture lands are converted to forests or come under municipal management.

7.2.4. *CO_2 Emissions and Removals from Soil* (old CRF 5.D)

GHG balance in this category is a net sink. In 1988 net CO_2 sink was about 9 340 Gg CO_2. CO_2 removals from this group were caused by afforestation of agriculture lands.

In order to calculate carbon emissions and removals in soils, area of country was divided into forestland, cropland and other lands. Other lands are used for balance country area.

Soil types occurring in Poland are as follow.

Forests soils

Estimation of different soil types area (high activity soils, low activity soils, sandy and wetland) is based on area of forest habitat types (Table 7.5). Next the percentage fractions of all soil types in forest management were calculated (Table 7.7).

Table 7.5. Forest soils type occur in Poland.

Soil type	Forest habitat types
High Activity Soils	Fresh mixed forest, moist mixed forest, mixed upland forest, mountain mixed forest, fresh broadleaved forest, moist broadleaved forest upland forest, mountain forest
Low Activity Soils	Moist coniferous forest, mountain coniferous forest, high- mountain coniferous forest, 0,5*fresh mixed coniferous forest, moist mixed coniferous forest, upland mixed coniferous forest, mountain mixed coniferous forest
Sandy	Dry coniferous forest, fresh coniferous forest, 0,5* fresh mixed coniferous forest
Wetland	Marshy coniferous forest, boggy mountain coniferous forest, boggy mixed coniferous forest, boggy mixed forest, alder forest, ash- alder swamp forest, mountain alder forest, floodplain forest, mountain floodplain forest

Agriculture soils

Estimation of area of different soil types (high activity soils, low activity soils, sandy and wetland) is based on area of soil valuation classes (Table 7.6). Then percentage fraction of all soil types in croplands, grasslands and other lands were calculated (Table 7.7).

Table 7.6. Agricultural land by soil valuation classes

Soil type	Soil Valuation classes
High Activity Soils	I, II, III
Low Activity Soils	IV
Sandy	V
Wetland	other

Table 7.7. Percentage fraction of soil tape by land use system (for time t and t–20)

Climate	Land use	Soil type (t)			
	Land-use/ management system	High Activity Soils	Low Activity Soils	Sandy	Wetland
		(%)			
Temperate	Forest management	39.6	19.0	37.2	4.2
	Grassland/Rangeland	14.6	43.1	31.5	10.7
	Agricultural crops	29.1	39.0	20.1	11.7
	Rest land	21.9	41.1	25.8	11.2
Climate	Land use	Soil type (t-20)			
	Land-use/ management system	High Activity Soils	Low Activity Soils	Sandy	Wetland
		(%)			
Temperate	Forest management	31.4	19.8	45.1	3.7
	Grassland/Rangeland	14.7	41.0	32.1	12.2
	Agricultural crops	27.8	39.3	20.6	12.3
	Rest land	21.3	40.1	26.3	12.3

Table 7.8. Area of soil type by land use system in 1988

Land-use/ management system	Soil type	Carbon in soils (Mg C/ha)	Area (Mha)
Forest management	High Activity Soils	3.510	3,510
	Low Activity Soils	1.684	1,684
	Sandy	3.297	3,297
	Wetland	0.372	0,372
Sum			8.864
Grassland/Rangeland	High Activity Soils	0.571	0,571
	Low Activity Soils	1.687	1,687
	Sandy	1.234	1,234
	Wetland	0.419	0,419
Sum			3.911
Agricultural crops	High Activity Soils	4.145	4,145
	Low Activity Soils	5.554	5,554
	Sandy	2.864	2,864
	Wetland	1.668	1,668
Sum			14.231
Rest land	High Activity Soils	0.932	0,932
	Low Activity Soils	1.751	1,751
	Sandy	1.101	1,101
	Wetland	0.478	0,478
Sum			4.263
Total			31.2685

Carbon stock rates in soils were taken as default factors from [IPCC 1997] and corrected to domestic conditions by experts.

Estimation of CO_2 emissions and removals by soils is approximate and will be corrected by new methodology presented in [IPCC 2003]. Emissions and removals from soils were calculated separately, then the net emission/removal balance was estimated.

7.2.5. *Carbon emissions from agricultural lime application* (old CRF 5.D)

The reported annual carbon emission from agricultural lime application is calculated as:

$$C_{lime} = M_{limestone} * EF_{limestone} + Md_{olomite} * EF_{dolomite}$$

where:
$M_{limestone}$ - annual amount of sold calcic limestone [$Gg \cdot yr^{-1}$],
$M_{dolomite}$ - annual amount of sold calcic dolomite [$Gg \cdot yr^{-1}$],
$EF_{limestone}$ - emission factor for limestone – 0.120,
$EF_{dolomite}$ - emission factor for dolomite – 0.122.

Domestic statistic publications contain only data of use of lime fertilizers in pure nutrient (CaO) [GUS 1989a], 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.

8. *Waste* (CRF sector 6)

8.1. Key categories

From sector 6 only one category have been identified as key source:
- 6.A - Solid Waste Disposal on Land (CH_4 emission), share in total GHG emission 0.7%.

8.2. Methodological issues

8.2.1. *Solid Waste Disposal on Land* (CRF 6.A)

The methane emissions from solid waste disposals in 1988 were calculated using the IPCC Waste Model published in [IPCC 2006]. The model establish multiyear series when methane is generated from organic matter decomposition in anaerobic conditions. The emission of CH4 is diminished by recapturing of this gas.

The following indicators were used for estimation of CH_4 emissions:
- DOC – degradable organic carbon in the year of deposition (table 8.1, default value [IPCC 2006])
- DOC_f – fraction of DOC that can decompose (fraction) (table 8.1, default value [IPCC 2006])
- MCF – CH_4 correction factor for aerobic decomposition in the year of deposition (table 8.2, default value [IPCC 2006])
- OX – Oxidation Factor reflecting the amount of CH_4 from solid waste disposal sites that is oxidised in the soil or other material covering the waste (table 8.3, default value [IPCC 2006])
- k – reaction constant [Steczko 2001] (table 8.3)
- F – fraction of CH_4 by volume, in generated landfill gas (fraction) [Steczko 2001] (table 8.3).
- R – methane recovery was assumed 0 because in 1970-1988 there was no methane recovery.

Table 8.1. DOC and DOC_f indicators

DOC (Degradable Organic Carbon)	Range	Default	Value
Food waste	0.08-0.20	0.15	0.15
Garden	0.16-0.19	0.2	0.2
Paper	0.36-0.45	0.4	0.4
Wood and straw	0.39-0.46	0.43	0.43
Textiles	0.20-0.40	0.24	0.24
Disposable nappies	0.18-0.32	0.24	0.24
Sewage sludge	0.04-0.05	0.05	0.05
Industrial waste	0-0.54	0.15	0.15
DOCf		0.5	0.5

Table 8.2. MCF indicators of organic carbon in disposed waste

Unmanaged, shallow	Unmanaged, deep	Managed	Managed, semiaerobic	Uncategorised
0.4	0.8	1	0.5	0.6

Table 8.3. Indicators k, F and OX assumed for calculations

Methane generation rate constant (k)	Range	Default	Value
Food waste	0.1–0.2	0.185	0.086
Garden	0.06–0.1	0.1	0.069
Paper	0.05–0.07	0.06	0.039
Wood and straw	0.02–0.04	0.03	0.023
Textiles	0.05–0.07	0.06	0.039
Disposable nappies	0.06–0.1	0.1	0.1
Sewage sludge	0.1–0.2	0.185	0.185
Industrial waste	0.08–0.1	0.09	0.09
Delay time (months)		6	6
Fraction of methane (F) in developed gas		0.5	0.618
Oxidation factor (OX)		0	0

Activities used for estimation of CH_4 emissions from solid waste disposals contain:
– Population – number of population was taken from [GUS 2003].
– Municipial Solid Wastes (MSW) – for years 1971-1973 data were interpolated on a basis of data from 1970 and 1974. 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 0.25 t/m^3.

Table 8.4. Data sources for amount of municipal waste

year	MSW in Gg	Source
1970	4113,98	RS 87
1971	4624,65	interpolation
1972	5135,31	interpolation
1973	5645,98	interpolation
1974	6156,64	OS 1974
1975	6788,96	OS 1986
1976	7397,99	interpolation
1977	8007,03	OS 1981
1978	8702,83	OS 1981
1979	9052,63	OS 1981
1980	9868,72	OS 1986
1981	10014,42	OS 1986
1982	10329,07	OS 1986
1983	10541,91	OS 1986
1984	10864,54	OS 1986
1985	11086,95	OS 1986
1986	11546,86	RS 1987
1987	11877,45	OS 1989
1988	12084,18	OS 1989

RS – GUS Statistical Yearbook
OS – GUS Environment Yearbook

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

Composition of waste (according to IPCC) was assumed on a basis of National Plan on Waste Management (table 8.5)

Table 8.5. Composition of waste

Food	Garden	Paper	Wood	Textile	Plastics, other inert
18%	2%	16%	3%	3%	57%

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

8.2.2.1. *Industrial wastewater* (CRF 6.B.1)

Emissions of methane have been estimated based on method contained in [IPCC 2006]. The activity data (wastewater output from individual industry sectors and fraction of treated wastewater) for CH_4 emission estimation were taken from [GUS 1989b]. Methane emission was estimated based on Chemical Oxygen Demand (COD) with default and country specific values [Przewłocki J. 2006] of COD parameters for industry sectors. Experts estimates describing emission factors applied to calculation of CH_4 emission were elaborated for selected industrial sectors for which such data were available for the year 1988. For other sectors default parameters were applied (show as Italic) (table 8.6).

Table 8.6. Data for CH_4 emission estimation from Industrial Wastewater Handling

Industry sectors		COD for organic wastewater [kg / dm^3]	Methane correction factor (fraction) for wastewater (MCF)	Maximum methane producing capacity for wastewater [kg CH_4/kg COD] (B_o)	Methane correction factor (fraction) for sludge (MCF)	Maximum methane producing capacity for sludge [kg CH_4/kg COD] (B_o)
Mining and quarrying		0.60	0.18	*0.25*	0.38	0.34
Iron and steel		0.60	0.18	*0.25*	0.38	0.34
Non-ferrous metals		0.60	0.18	*0.25*	0.38	0.34
Fertilizer		0.30	0.18	*0.25*	0.38	0.34
Food products	meat and poultry	2.02	0.25	*0.25*	0.68	0,34
	fish processing	*2.50*	0.25	*0.25*	0.68	0,34
	vegetable & fruit processing	*5.00*	0.28	*0.25*	0.43	0,29
	oil & grease	0.79	0.36	*0.25*	0.58	0,34
	dairy products	*2.7*	0.13	*0.25*	0.38	0,34
	sugar	2.51	0.52	*0.25*	0.38	0,34
	soft drinks	2.00	0.20	*0.25*	0.48	0,34
	beer	*2.90*	0.24	*0.25*	0.52	0,34
	Other edible	2.77	0.28	*0.25*	0.52	0,34
	All edible	2.92	0.28	*0.25*	0.52	0,33
Textiles		0.90	0.12	*0.25*	0.24	0.34
Leather		3.31	0.29	*0.25*	0.24	0.34
Wood, wood products and pulp & paper		2.65	0.25	*0.25*	0.15	0.34
Energy transformation sector		0.37	0.15	*0.25*	0.08	0.34
Chemicals		*3.00*	0.15	*0.25*	0.08	0.34
Rubber and plastic products		*3.70*	0.15	*0.25*	0.08	0.34
Non-metallic minerals		0.60	0.18	*0.25*	0.38	0.34
Machinery and transportation equipment		0.60	0.18	*0.25*	0.38	0.34
Other industrial branches		0.60	0.18	*0.25*	0.38	0.34

8.2.2.2. *Domestic and Commercial Wastewater* (6.B.2)

CH_4 emission from domestic and commercial wastewater was estimated based on methodology [IPCC 1997] and the data on population connected to sewage treatment plants taken from [GUS 1989b]. Organic load in biochemical oxygen demand per person is the default value, which is equal to 60 g BOD/person/day [IPCC 2000]. Fraction of BOD that readily settles and is removed as sludge was taken from [Bernacka 2006] and its value is 0.706. The emission factors calculated in the study mentioned above and applied in inventory report are:

- for wastewater: 0.060 kg CH_4 / kg BOD
- for sewage sludge: 0.383 kg CH_4 / kg BOD

Authors of this study applied default value (0.6 kg CH_4 / kg BOD) of maximum methane producing capacity for estimation of sludge and wastewater emission factors. Fractions of sludge anareobically degraded with and without methane recovery are estimated in [Bernacka 2006]. These value are as follow: fractions of sludge anareobically degraded – 63.9% of which with methane recovery – 23.7%. The same study is the source of data on percentage of wastewater anareobically treated which was estimated as 10%.

N_2O emission from humane sewage is calculated according to default method [IPCC 1997]. Population of country and value of protein consumption per capita per year are taken from [GUS 1990]. Default values are used for fraction of nitrogen in protein and for N_2O emission factor [IPCC 2000].

8.2.3. *Waste Incineration* (CRF 6.C)

CO_2 emission from industrial and medical waste incineration and N_2O emission from industrial waste incineration were assessed based on the default emission factors [IPCC 2000]. There are no activity data on waste incineration in public statistics for 1988. The estimation of the amount of incinerated industrial waste was based on industrial waste production and the fraction of thermal treated waste for 90-ties. The activity data for incineration of medical waste was based on expert estimation.

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ANNEXES

Annex 1. Key sources

Sixteen source categories have been identified as key sources (level assessment) in GHG inventory for 1988 in Poland.

The most important of them are: stationary combustion of solid and liquid fuels and coal mining. Emission of direct GHG from these sources made up app. 76.0% of the total GHG emissions in Poland expressed in units of CO_2 equivalents. CO_2 emissions from stationary combustion of fuels (solid, gaseous and liquid) made up 75.5% of the total GHG emissions in Poland. Combustion of solid fuels in stationary sources alone, made up app. 68.3% of total Poland's GHG emissions.

Level Assessment

		IPCC Source Categories	Direct GHG	Current Year Estimate	Level Assessment	Cumulative Total
1	1.A.1, 2, 4, 5.a	Stationary combustion Solid Fuels	CO_2	400745.92	0.6828	0.68
2	1.A.1, 2, 4, 5.a	Stationary combustion Liquid Fuels	CO_2	26824.08	0.0457	0.73
3	1.B.1.a.	1. B. 1. a. Coal Mining and Handling	CH_4	18455.82	0.0314	0.76
4	1.A.3.b	1.A.3.b Transport Road Transportation	CO_2	16068.28	0.0274	0.79
5	4.A	4.A. Enteric Fermentation	CH_4	15954.36	0.0272	0.81
6	4.D.1	4.D.1. Direct Soil Emissions	N_2O	15747.10	0.0268	0.84
7	1.A.1. 2. 4. 5.a	Stationary combustion Gaseous Fuels	CO_2	15562.17	0.0265	0.87
8	4.B	4.B. Manure Management	N_2O	9335.10	0.0159	0.88
9	2.A.1	2.A.1 Cement Production	CO_2	7028.18	0.0120	0.90
10	2.C1	2.C.1. Iron and Steel Production	CO_2	6556.09	0.0112	0.91
11	4.D.3	4.D.3. Indirect Soil Emissions	N_2O	6276.40	0.0107	0.92
12	1.A.5.b	1.A.5.b Other Mobile	CO_2	5049.93	0.0086	0.93
13	2.B.2	2.B.2. Nitric Acid Production	N_2O	4386.47	0.0075	0.93
14	6.A	6.A. Solid Waste Disposal on Land	CH_4	4284.31	0.0073	0.94
15	1.B.2.b.	1. B. 2. b. Natural Gas	CH_4	4111.13	0.0070	0.95
16	2.B.1.	2.B.1. Ammonia Production	CO_2	3516.60	0.0060	0.95

Source Category Analysis Summary

	IPCC Source Categories	Direct GHG	Key Source Category Flag
	ENERGY		
1.A.1, 2, 4, 5.a	Stationary combustion Liquid Fuels	CO_2	Yes
1.A.1, 2, 4, 5.a	Stationary combustion Solid Fuels	CO_2	Yes
1.A.1, 2, 4, 5.a	Stationary combustion Gaseous Fuels	CO_2	Yes
1.A.1, 2, 4, 5.a	Stationary combustion Liquid Fuels	CH_4	No
1.A.1, 2, 4, 5.a	Stationary combustion Solid Fuels	CH_4	No
1.A.1, 2, 4, 5.a	Stationary combustion Gaseous Fuels	CH_4	No
1.A.1, 2, 4, 5.a	Stationary combustion Biomass	CH_4	No
1.A.1, 2, 4, 5.a	Stationary combustion Liquid Fuels	N_2O	No
1.A.1, 2, 4, 5.a	Stationary combustion Solid Fuels	N_2O	No
1.A.1, 2, 4, 5.a	Stationary combustion Gaseous Fuels	N_2O	No
1.A.1, 2, 4, 5.a	Stationary combustion Biomass	N_2O	No
1.A.3.a	1.A.3.a Transport Civil Aviation	CO_2	No
1.A.3.b	1.A.3.b Transport Road Transportation	CO_2	Yes
1.A.3.c	1.A.3.c Transport Railways	CO_2	No
1.A.3.d	1.A.3.d Transport Navigation	CO_2	No
1.A.3.e	1.A.3.e Transport Other	CO_2	No
1.A.3.a	1.A.3.a Transport Civil Aviation	CH_4	No
1.A.3.b	1.A.3.b Transport Road Transportation	CH_4	No
1.A.3.c	1.A.3.c Transport Railways	CH_4	No
1.A.3.d	1.A.3.d Transport Navigation	CH_4	No
1.A.3.e	1.A.3.e Transport Other	CH_4	No
1.A.3.a	1.A.3.a Transport Civil Aviation	N_2O	No
1.A.3.b	1.A.3.b Transport Road Transportation	N_2O	No
1.A.3.c	1.A.3.c Transport Railways	N_2O	No
1.A.3.d	1.A.3.d Transport Navigation	N_2O	No
1.A.3.e	1.A.3.e Transport Other	N_2O	No
1.A.5.b	1.A.5.b Other Mobile	CO_2	Yes
1.A.5.b	1.A.5.b Other Mobile	CH_4	No
1.A.5.b	1.A.5.b Other Mobile	N_2O	No
1.B.1.a.	1. B. 1. a. Coal Mining and Handling	CH_4	Yes
1.B.1.c.	1. B. 1. c. Other	CO_2	No
1.B.1.c.	1. B. 1. c. Other	CH_4	No
1.B.2.a.	1. B. 2. a. Oil	CO_2	No
1.B.2.a.	1. B. 2. a. Oil	CH_4	No
1.B.2.b.	1. B. 2. b. Natural Gas	CO_2	No
1.B.2.b.	1. B. 2. b. Natural Gas	CH_4	Yes
	INDUSTRIAL PROCESSES		
2.A.1	2.A.1 Cement Production	CO_2	Yes
2.A.2	2.A.2. Lime Production	CO_2	No
2.A.4	2.A.4. Soda Ash (production)	CO_2	No
2.A.7	2.A.7. Other (Limestone)	CO_2	No
2.B.1.	2.B.1. Ammonia Production	CO_2	Yes
2.B.1.	2.B.1. Ammonia Production	CH_4	No

	IPCC Source Categories	Direct GHG	Key Source Category Flag
2.B.2	2.B.2. Nitric Acid Production	N_2O	Yes
2.B.3	2.B.3. Adipic Acid Production	N_2O	No
2.B.4	2.B.4. Carbide Production (calcium carbide)	CO_2	No
2.B.5	2.B.5. Other	CO_2	No
2.B.5	2.B.5. Other	CH_4	No
2.B.5	2.B.5. Other	N_2O	No
2.C1	2.C.1. Iron and Steel Production	CO_2	Yes
2.C1	2.C.1. Iron and Steel Production	CH_4	No
2.C2	2.C.2. Ferroalloys Production	CO_2	No
2.C3	2.C.3. Aluminium Production	CO_2	No
2.C3	2.C.3. Aluminium Production	PFC	No
2.F.1	2.F.1. Refrigeration and Air Conditioning Equipment	HFC	No
2.F.2	2.F.2. Foam Blowing	HFC	No
2.F.3	2.F.3. Fire Extinguishers	HFC	No
2.F.3	2.F.3. Fire Extinguishers	PFC	No
2.F.4	2.F.4. Aerosols/ Metered Dose Inhalers	HFC	No
2.F.8	2.F.8. Electrical Equipment	SF_6	No
	SOLVENT AND OTHER PRODUCT USE		
3.A	3.A. Paint Application	CO_2	No
3.B	3.B. Degreasing and Dry Cleaning	CO_2	No
3.C	3.C. Chemical Products, Manufacture and Processing	CO_2	No
3.D	3.D. Other	CO_2	No
3.D	3.D. Other	N_2O	No
	AGRICULTURE		
4.A	4.A. Enteric Fermentation	CH_4	Yes
4.B	4.B. Manure Management	CH_4	No
4.B	4.B. Manure Management	N_2O	Yes
4.D.1	4.D.1. Direct Soil Emissions	N_2O	Yes
4.D.2	4.D.2. Animal Production	N_2O	No
4.D.3	4.D.3. Indirect Soil Emissions	N_2O	Yes
4.F	4.F. Field Burning of Agricultural Residues	CH_4	No
4.F	4.F. Field Burning of Agricultural Residues	N_2O	No
	WASTE		
6.A	6.A. Solid Waste Disposal on Land	CH_4	Yes
6.B	6.B. Wastewater Handling	CH_4	No
6.B	6.B. Wastewater Handling	N_2O	No
6.C	6.C. Waste Incineration	CO_2	No
6.C	6.C. Waste Incineration	N_2O	No

Annex 2. 1988 Energy balance data for main fuels

Energy balances in 1988 for several main fuels: brown coal, fuel oil, high-methane and nitrified natural gas and coke, are given below. Similar balance data for hard coal are presented in Chapter 1.4.

Brown coal consumption

Evaluation of fuel consumption In national combustion processes	Brown coal	
	10^3 Mg	TJ
In	**73489**	**592689**
From national sources	73489	592689
1) Indigenous production	73489	592689
2) Transformation output or return	0	0
3) Stock decrease	0	0
Import	0	0
Out	**73490**	**592688**
National consumption	73442	591550
1) Transformation input	71800	575635
a) input for secondary fuel production	327.4	3184.5
b) fuel combustion	71473	572451
2) Direct consumption	1642	15915
Non-energy use	3	28
Combusted directly	1639	15887
Combusted in Poland	**73111.6**	**588337.5**
Stock increase	44	351
Export	0	0
Losses	4	43
Statistical differences		744
Net Calorific Value	MJ/kg	8.05
CO_2 Emission Factor	kg/GJ	116.74

Diesel oil consumption

Evaluation of fuel consumption In national combustion processes	Diesel oil	
	10^3 Mg	TJ
In	**6541**	**279277**
From national sources	5215	222676
1) Indigenous production	0	0
2) Transformation output or return	5215	222676
3) Stock decrease	0	0
Import	1326	56601
Out	**6541**	**279277**
National consumption	6417	273660
1) Transformation input	141	6023
a) input for secondary fuel production	107.5	4587.4
b) fuel combustion	33.5	1435.6
2) Direct consumption	6276	267637
Non-energy use	7	293
Combusted directly	6269	267344
Combusted in Poland	**6302.5**	**268779.6**
Stock increase	13	539
Export	107	4548
Losses	4	174
Statistical differences		356
Net Calorific Value	MJ/kg	42.65
CO_2 Emission Factor	kg/GJ	72.77

Fuel oil consumption

Evaluation of fuel consumption In national combustion processes	Fuel oil	
	10^3 Mg	TJ
In	**4317**	**174432**
From national sources	3262	131904
1) Indigenous production	0	0
2) Transformation output or return	3252	131511
3) Stock decrease	10	393
Import	1055	42528
Out	**4317**	**174432**
National consumption	4280	173085
1) Transformation input	1948	79135
a) input for secondary fuel production	0	0
b) fuel combustion	1948	79135
2) Direct consumption	2332	93950
Non-energy use	63	2531
Combusted directly	2269	91419
Combusted in Poland	**4217**	**170554**
Stock increase	0	0
Export	213	8568
Losses	0	2
Statistical differences	-176	-7223
Net Calorific Value	MJ/kg	40.44
CO_2 Emission Factor	kg/GJ	79.03

High-methane natural gas consumption

Evaluation of fuel consumption In national combustion processes	High-methane natural gas	
	10^6 m^3	TJ
In	**9622**	**343147**
From national sources	2649	91311
1) Indigenous production	1760	62039
2) Transformation output or return	889	29272
3) Stock decrease	0	0
Import	6973	251836
Out	**9627**	**343148**
National consumption	9304	326789
1) Transformation input	786	27335
a) input for secondary fuel production	179.9	6326.1
b) fuel combustion	606.1	21008.9
2) Direct consumption	8518	299454
Non-energy use	2692	94265
Combusted directly	5826	205189
Combusted in Poland	**6432.1**	**226197.9**
Stock increase	67	2387
Export	1	21
Losses	255	7875
Statistical differences		6076
Net Calorific Value	MJ/m^3	35.17
CO_2 Emission Factor	kg/GJ	54.65

Nitrified natural gas consumption

Evaluation of fuel consumption In national combustion processes	Nitrified natural gas	
	10^6 m^3	TJ
In	**3575**	**86846**
From national sources	3575	86846
1) Indigenous production	3521	85244
2) Transformation output or return	54	1602
3) Stock decrease	0	0
Import	0	0
Out	**3574**	**86847**
National consumption	3449	87280
1) Transformation input	1577	40322
a) input for secondary fuel production	1545	39511.2
b) fuel combustion	32	810.8
2) Direct consumption	1872	46958
Non-energy use	0	0
Combusted directly	1872	46958
Combusted in Poland	**1904**	**47768.8**
Stock increase	0	0
Export	0	0
Losses	125	3036
Statistical differences		-3469
Net Calorific Value	MJ/m^3	25.09
CO_2 Emission Factor	kg/GJ	55

Coke consumption

Evaluation of fuel consumption In national combustion processes	Coke	
	10^3 Mg	TJ
In	**17482**	**484687**
From national sources	17482	484687
1) Indigenous production	0	0
2) Transformation output or return	17482	484687
3) Stock decrease	0	0
Import	0	0
Out	**17482**	**484687**
National consumption	14515	400021
1) Transformation input	3826	106300
a) input for secondary fuel production	2892.5	82079.1
b) fuel combustion	933.5	24220.9
2) Direct consumption	10689	293721
Non-energy use	391	9928
Combusted directly	10298	283793
Combusted in Poland	**11231.5**	**308013.9**
Stock increase	116	3027
Export	2847	76514
Losses	4	117
Statistical differences		5008
Net Calorific Value	MJ/kg	27.42
CO_2 Emission Factor	kg/GJ	113.29

Annex 3. National energy balance 1988 [GUS, 1990a]

CZĘŚĆ I. ZBIORCZY BILANS PRZYCHODU I ROZDYSPONOWANIA ENERGII

TABL. 1. PODSTAWOWY (SYNTETYCZNY) BILANS ENERGII

PART I. BASIC ENERGY SUPPLY AND USE BALANCE

TABLE 1. BASIC (SYNTHETIC) ENERGY BALANCE

LP	NAZWA NOŚNIKA ENERGII *SPECIFICATION*	ROK *YEAR*	JEDNOSTKA MIARY *UNIT OF MEASURE*	POZYSKANIE *INDIGENOUS PRODUCTION*	IMPORT *IMPORT*	- W TYM BUNKIER *AMONG WHICH BUNKER*	EKSPORT *EXPORT*	ZMIANA ZAPASÓW *STOCK CHANGE*
1	***ENERGIA OGÓŁEM***	1988	***TJ***	***5302675***	***1089138***	***42S83***	***941137***	***64223***
	TOTAL ENERGY	1989		***4886251***	***1094097***	***32492***	***896527***	***-33713***
2	***ENERGIA PIERWOTNA***	1988	***TJ***	***5302675***	***902499***	***-***	***808795***	***63459***
	PRIMARY ENERGY	1989		***4886251***	***901585***	***-***	***729079***	***-38661***
3	WĘGIEL KAMIENNY	1988	tys.ton	193015	1085	-	32341	2351
	HARD COAL	1989	10^3 ton	177633	926	-	28943	-1611
		1988	TJ	4459798	31891	-	808774	54313
		1989		4068685	27458		729054	-37215
4	WĘGIEL BRUNATNY	1988	tys.ton	73489	-	-	-	44
	LIGNITE	1989	10^3 ton	71816	-	-	-	9
		1988	TJ	592689	-	-	-	351
		1989		584364	-	-	-	71
5	ROPA NAFTOWA	1988	tys.ton	159	14992	-	-	159
	CRUDE OIL	1989	10^3 ton	157	14725	-	-	-344
		1988	TJ	6578	618668	-	-	6560
		1989		6480	607766	-	-	-14195
6	GAZ ZIEMNY WYSOKOMETANOWY	1988	mln m^3	2175	6973	-	1	67
	HIGH - METHANE NATURAL GAS	1989	10^6 m^3	2114	7365	-	1	355
		1988	TJ	71374	251836	-	21	2387
		1989		68405	266271	-	25	12677
7	GAZ ZIEMNY ZAAZOTOWANY	1988	mln m^3	3521	-	-	-	-
	NITRIFIED NATURAL GAS	1989	10^6 m^3	3243	-	-	-	-
		1988	TJ	85244	-	-	-	-
		1989		76617	-	-	-	-
8	TORF I DREWNO	1988	tys. m^3	3693	-	-	-	-16
	PEAT AND WOOD	1989	10^3 m^3	3508	-	-	-	-
		1988	TJ	35079	-	-	-	-152
		1989		33326	-	-	-	-
9	ENERGIA WODY I WIATRU	1988	TJ	16783	-	-	-	-
	HYDRO AND WOOD ENERGY	1989		15089	-	-	-	-
10	PALIWA ODPADOWE STAŁE	1988	TJ	35131	104	-	-	-
	SOLID WASTE FUEL	1989		33285	91	-	-	-
11	***ENERGIA POCHODNA***	1988	***TJ***	-	***186640***	***42883***	***132341***	***764***
	DERIVED ENERGY	1989		-	***192513***	***32492***	***167448***	***4948***
12	BRYKIETY Z WĘGLA KAMIENNEGO	1988	tys.ton	-	-	-	-	-
	HARD COAL BRIQUETTES	1989	10^3 ton	-	-	-	-	-
		1988	TJ	-	-	-	-	-
		1989		-	-	-	-	-
13	BRYKIETY Z WĘGLA BRUNATNEGO	1988	tys.ton	-	-	-	-	-1
	LIGNITE BRIQUETTES (BKB)	1989	10^3 ton	-	-	-	-	-
		1988	TJ	-	-	-	-	-10
		1989		-	-	-	-	-
14	KOKS I PÓŁKOKS	1988	tys.ton	-	-	-	2847	116
	COKE AND SEMI-COKE	1989	10^3 ton	-	-	-	3151	27
		1988	TJ	-	-	-	765 U	3027
		1989		-	-	-	84646	747
15	GAZ CIEKŁY	1988	tys.ton	-	-	-	-	-
	LIPUEFIED PETROLEUM GAS (LPG)	1989	10^3 ton	-	-	-	-	-
		1988	TJ	-	-	-	-	-
		1989		-	-	-	-	-
16	BENZYNY	1988	tys. ton	-	868	126	49	-55
	GASOLINE	1989	10^3 ton	-	1271	153	24	39
		1988	TJ	-	37551	5469	2102	-2396

ZUŻYCIE GLOBALNE LUB SALDO WYM. *GLOBAL CONSUMPTION OR EXCHANGE BALANCES*	UZYSK Z PRZEMIAN LUB ODZYSK *TRANSFORMA-TIONS OUTPUT OR RETURNS*	ZUŻYCIE OGÓŁEM *TOTAL CONSUMPTION*	ZUŻYCIE NA WSAD PRZEMIAN *TRANSFORMA-TIONS INPUT*	ZUŻYCIE BEZPOŚREDNIE *DIRECT CONSUMPTION*	- W TYM ZUŻYCIE NIEENERGETY-CZNE *AMONG WHICH NON-ENERGY USE*	STRATY TRANSPORTU I MAGA-ZYNOWANIA *LOSSES OF TRANSPORT AND STORAGE*	RÓŻNICE BILANSOWE *STATISTICAL DIFFERENCE*	LP
5386454	***2861864***	***x***	***4139273***	***3953362***	***140061***	***65874***	***89810***	1
5117535	***2784309***	***x***	***4054269***	***3727524***	***133658***	***59368***	***60684***	
5332920	***30874***	***x***	***3853811***	***1401493***	***102594***	***13984***	***94506***	2
5097418	***33428***	***x***	***3784013***	***1277179***	***102881***	***8961***	***60693***	
159408	-	159408	120482	38811	9	116	0	3
151227	-	151227	116414	34807	9	6	0	
3628603	-	3628603	2548513	985905	300	3030	91155	
3404303	-	3404303	2463247	883169	305	132	57756	
73445	-	73445	71800	1642	3	4	0	4
71807	-	71807	71565	242	4	-	0	
592337	-	592337	575635	15915	28	43	744	
584293	-	584293	581291	2315	35	-	686	
14992	-	14992	14992	-	-	-	0	5
15226	-	15226	15226	-	-	-	0	
618685	-	618685	618686	-	-	-	0	
628441	-	628441	628441	-	-	-	0	
9081	889	9970	910	8808	2692	252	0	6
9123	876	9999	963	8769	2715	266	0	
320802	29272	350074	30108	306015	94265	7875	6076	
321974	29442	351415	32205	305240	94841	7715	6255	
3521	54	3575	1577	1872	0	125	0	7
3243	119	3362	1645	1671	-	47	0	
85244	1602	86846	40322	46958	0	3036	-3469	
76617	3986	80603	42037	41456	-	1115	-4004	
3709	-	3709	114	3595	-	0	0	8
3508	-	3508	63	3445	-	-	0	
35231	-	35231	1082	34148	-	0	0	
33326	-	33326	597	32729	-	-	0	
16783	-	16783	16783	-	-	-	-	9
15089	-	15089	15089	-	-	-	-	
35235	-	35235	22682	12552	8001	-	0	10
33375	-	33375	21106	12270	7699	-	0	
53534	***2830989***	***x***	***273895***	***2563435***	***20660***	***51889***	***-4696***	***11***
20117	***2750881***	***x***	***258058***	***2462542***	***17051***	***50407***	***-9***	
-	1301	1301	251	1050	-	-	0	12
-	496	496	194	302	-	-	0	
-	29916	29916	5640	24169	-	-	107	
-	11364	11364	4340	7024	-	-	0	
1	159	160	24	135	-	0	0	13
-	136	136	18	118	-	-	0	
10	2819	2829	415	2414	-	0	0	
-	2396	2396	323	2073	-	-	0	
-2963	17482	14519	3826	10689	391	4	0	14
-3178	16885	13707	3594	10113	261	-	0	
-79541	484687	405146	106300	293721	9928	117	5008	
-85393	467080	381687	100254	272897	6859	-	8536	
-	249	249	13	236	81	0	0	15
0	280	280	12	268	99	0	0	
-	11429	11429	606	10771	3736	3	49	
0	12823	12824	527	12255	4525	3	38	
875	2911	3785	313	3468	18	5	0	16
1208	2974	4183	341	3837	21	5	0	
37846	126030	163876	13543	150128	759	206	0	

LP	NAZWA NOŚNIKA ENERGII *SPECIFICATION*	ROK *YEAR*	JEDNOSTKA MIARY *UNIT OF MEASURE*	POZYSKANIE *INDIGENOUS PRODUCTION*	IMPORT *IMPORT*	- W TYM BUNKIER *AMONG WHICH BUNKER*	EKSPORT *EXPORT*	ZMIANA ZAPASÓW *STOCK CHANGE*
		1989		-	55034	6606	1021	1689
17	OLEJE NAPĘDOWE	1988	tys. ton	-	1326	116	107	13
	DIESEL OIL	1989	10^3 ton	-	1386	100	140	32
		1988	TJ	-	56601	4957	4548	539
		1989		-	59174	4267	5957	1385
18	OLEJE OPAŁOWE	1988	tys. ton	-	1055	805	213	-10
	FUEL OIL	1989	10^3 ton	-	764	536	587	30
		1988	TJ	-	42528	32458	8568	-393
		1989		-	30795	21620	23567	1204
19	PRODUKTY NIEENERGETYCZNE	1988	TJ	-	4924		11882	-3
	NON-ENERGY PRODUCTS	1989		-	3914		15202	-78
20	GAZ RAFINERYJNY	1988	tys. ton	-	-	-	-	-
	REFINERY GAS	1989	10^3 ton	-	-	-	-	-
		1988	TJ	-	-	-	-	-
		1989		-	-	-	-	-
21	GAZ KOKSOWNICZY	1988	mln m^3	-	-	-	-	-
	COKE OVEN GAS	1989	10^6 m^3	-	-	-	-	-
		1988	TJ	-	-	-	-	-
		1989		-	-	-	-	-
22	GAZ MIEJSKI	1988	mln m^3	-	12	-	-	-
	TOWN GAS	1989	10^6 m^3	-	12	-	-	-
		1988	TJ	-	194	-	-	-
		1989		-	184	-	-	-
23	GAZ CZADNICOWY I WYTLEWNY	1988	mln m^3	-	-	-	-	-
	BLAST FURNACE GAS	1989	10^6 m^3	-	-	-	-	-
		1988	TJ	-	-	-	-	-
		1989		-	-	-	-	-
24	GAZ WIELKOPIECOWY	1988	mln m^3	-	-	-	-	-
	GAS MANUFACTURED FROM COAL	1989	10^6 m^3	-	-	-	-	-
		1988	TJ	-	-	-	-	-
		1989		-	-	-	-	-
25	ENERGIA ELEKTRYCZNA	1988	GWh	-	12456	-	7980	-
	ELECTRICITY	1989		-	12059	-	10268	-
		1988	TJ	-	44842	-	28728	-
		1989		-	43413	-	36965	-
26	CIEPŁO	1988	TJ	-	-	-	-	-
	HEAT	1989		-	-	-	-	-
27	***ENERGIA Z ODZYSKU***	1988	TJ	-	-	-	-	-
	ENERGY FROM RETURNS	1989		-	-	-	-	-
28	PALIWA ODPAD. CIEKŁE I GAZOWE	1988	TJ	-	-	-	-	-
	LIQUID AND GASEOUS WASTE FUELS	1989		-	-	-	-	-
29	CIEPŁO Z ODZYSKU	1988	TJ	-	-	-	-	-
	HEAT FROM RETURNS	1989		-	-	-	-	-

ZUŻYCIE GLOBALNE LUB SALDO WYM. *GLOBAL CONSUMPTION OR EXCHANGE BALANCES*	UZYSK Z PRZEMIAN LUB ODZYSK *TRANSFORMA-TIONS OUTPUT OR RETURNS*	ZUŻYCIE OGÓŁEM *TOTAL CONSUMPTION*	ZUŻYCIE NA WSAD PRZEMIAN *TRANSFORMA-TIONS INPUT*	ZUŻYCIE BEZPOŚREDNIE *DIRECT CONSUMPTION*	- W TYM ZUŻYCIE NIEENERGETY-CZNE *AMONG WHICH NON-ENERGY USE*	STRATY TRANSPORTU I MAGA-ZYNOWANIA *LOSSES OF TRANSPORT AND STORAGE*	RÓŻNICE BILANSOWE *STATISTICAL DIFFERENCE*	LP
52324	128791	181115	14765	166127	896	224	0	
1206	5215	6421	141	6276	7	4	0	17
1214	4848	6062	32	6027	7	3	0	
51514	222676	274190	6023	267637	293	174	356	
51831	207010	258842	1346	257373	279	122	0	
852	3252	4104	1948	2332	63	0	-176	18
147	3686	3833	1878	2212	61	0	-257	
34353	131511	165864	79135	93950	2531	2	-7223	
5933	149955	155888	76452	88956	2423	2	-9522	
-6955	166133	159178	4761	154398	-	18	0	19
-11210	157425	146215	2178	144005	-	32	0	
-	-	278	26	252	-	-	-	20
-	251	251	24	228	-	-	0	
-	14842	14842	1365	13477	-	-	0	
-	14099	14099	1327	12772	-	-	0	
-	6856	6856	416	6358	196	82	0	21
-	6752	6752	462	6104	120	186	0	
-	120590	120590	7351	111200	3412	1446	594	
-	118472	118472	8072	106358	2069	3266	775	
12	304	316	1	330	-	-	-14	22
12	245	257	1	248	-	8	0	
194	5416	5609	11	5722	-	-	-123	
184	4292	4476	24	4141	-	133	178	
-	1855	1855	100	1755	-	-	-	23
-	1555	1555	88	1467	-	-	0	
-	10790	10790	713	10110	-	-	-32	
-	9082	9082	615	8484	-	-	-14	
-	19361	19361	7315	12959	-	-	-913	24
-	18702	18702	6985	11717	-	-	0	
-	74535	74535	28227	49740	-	-	-3432	
-	71785	71785	26890	44895	-	-	0	
4476	144370	148846	3308	131671	-	13863	0	25
1791	145467	147258	2922	131385	-	12951	0	
16114	519732	535846	11907	474015	-	49924	0	
6448	523681	530129	10520	472986	-	46624	0	
-	909883	909883	7899	901984	-	-	0	26
-	872625	872625	10426	862199	-	-	0	
-	***96052***	***x***	***11567***	***84485***	***16806***	-	***0***	***27***
-	***103581***	***x***	***12197***	***91383***	***13726***	-	***0***	
-	52682	52682	11567	41116	16806	-	0	28
-	52824	52824	12197	40627	13726	-	0	
-	43369	43369	-	43369	-	-	-	29
-	50757	50757	-	50757	-	-	-	

Annex 4. National energy balance 1988 – OECD

Poland : 1988

PRODUCTION AND USES OF ENERGY	Coal (TJ)							Gas (TJ)						
	Hard Coal	Brown Coal	Oven Coke and Gas Coke	Patent Fuel	BKB	Fuel Wood	Other Non-commercial Fuels	Natural Gas	Gas Works Gas	Coke Oven Gas	Blast Furnace Gas	Electricity Total	Electricity of which Hydro	Heat
Indigenous Production	4452877,2	592689,0	479092,2	29916,0	2819,0	35079,0	34313,0	163126,9	14941,5	126902,3	74535,0	511060,0	6454,8	809599,0
From Other Sources	6920,8		5594,8					9152,9	481,7	3650,9		8672,8	8672,8	2902,9
Imports	31891,0							277020,0	213,4			44841,6		
Exports	808774,0		76514,0					23,0				28728,0		
International Marine Bunkers														
Stock Changes	-54313,0	-351,0	-3027,0		10,0	152,0		-2625,7						
DOMESTIC SUPPLY	**3628602,0**	**592338,0**	**405146,0**	**29916,0**	**2829,0**	**35231,0**	**34313,0**	**446651,1**	**15636,6**	**130553,2**	**74535,0**	**535846,4**	**15127,6**	**812501,9**
Returns to Supply							45074,6							43369,0
Transfers								-2692,5	2403,2	289,3				
Total Requirements	3628602,0	592338,0	405146,0	29916,0	2829,0	35231,0	79387,6	443958,6	18039,8	130842,5	74535,0	535846,4	15127,6	855870,9
Statistical Difference	91155,0	744,0	5008,0	107,0	0,0	0,0		2867,7	-170,5	653,4	-3432,0			0,0
TRANSFORMATION SECTOR	**2421948,6**	**573236,8**	**95574,3**	**4907,5**	**329,1**	**318,2**	**20020,7**	**28758,2**	**724,3**	**6126,6**	**28227,4**	**0,0**	**0,0**	**7350,6**
Patent Fuel Plants	27144,1	2904,8												
Coke Ovens	658114,8		6294,6											
Gas Works	30917,9	279,7	1249,5					4759,7						
Blast Furnaces			74535,0											
Oil Refineries														
Autoproducers of Electricity	322481,1	1819,5					4296,1	2297,8	442,6	4763,9	25299,3			6468,1
Public Plants for CHP	988578,9	563536,8					70,0	245,6		2,8				882,5
Heating Plants	394711,8	4696,0	13495,2	4907,5	329,1	318,2	15654,6	21455,1	281,7	1359,9	2928,1			
Non-Specified														
ENERGY SECTOR	**12684,1**	**376,6**	**1228,5**	**20,2**	**27,7**	**4,5**	**16783,5**	**15057,6**	**6,0**	**55973,5**	**5632,5**	**113256,4**	**0,0**	**85317,3**
Coal Mines	5884,6	79,0	164,4		27,5			662,7		32,7		37784,5		22980,1
Oil and Gas Extraction	49,3		13,8					9641,0				954,0		230,0
Patent Fuel Plants	771,6											64,4		820,8
Coke Ovens							46,0			55818,0	5632,5	3006,7		16431,4
Gas Works	342,2		959,4			0,3	0,0	2116,2	6,0	116,2		963,4		1992,5
Oil Refineries	40,6		1,4				16736,3	2635,6				1626,5		14917,8
Electric Plants												36406,1		7212,7
Pumped Storage												11907,0		
Non-Specified	5595,8	297,6	89,5	20,2	0,2	4,2	1,2	2,1		6,6		20543,8		20732,0
Distribution Losses	3030,0	43,0	117,0					12002,1		1590,6		49924,8		
FINAL CONSUMPTION	**1099784,3**	**17937,6**	**303218,2**	**24881,3**	**2472,2**	**34908,3**	**42583,4**	**385273,0**	**17480,0**	**66498,4**	**44107,1**	**372665,2**		**763203,0**
INDUSTRY SECTOR	**198497,9**	**1196,7**	**177517,8**	**274,9**	**112,5**	**1042,5**	**17435,6**	**154386,6**	**11325,3**	**43578,4**	**44107,1**	**185907,6**	**0,0**	**474317,1**
Iron and Steel	2325,3		124230,0		0,0		3158,5	80881,0	4747,5	35836,4	43819,2	30661,2		40196,5
Chemical	9049,5	46,4	1850,4	6,6	0,8	3,2	3396,7	7052,6	209,2	1158,3	148,3	44557,2		149859,4
of which: Petrochemical	1,2		1,1									3268,8		26250,0
Non-Ferrous Metals	1330,5		9248,5	0,1			870,3	6169,1	412,8	507,2		8708,4		4517,3
Non-Metallic Minerals	104456,0	258,2	18122,3	17,1	35,3	142,0	2017,9	31610,2	4318,6	2953,8	139,6	13870,8		15728,3
Transport Equipment	4989,8	7,7	1801,1	14,1	3,8	4,8	8,3	4003,9	37,7	97,1		7189,2		17643,9
Machinery	16917,2	102,2	12033,6	91,9	10,2	83,2	30,3	14667,8	1492,4	2599,9		24573,6		40279,3
Mining and Quarrying	5455,0	6,8	1962,0	3,8	53,8	1,6	870,9	7039,1	58,6	8,5		13903,2		40239,7
Food and Tobacco	25510,5	82,2	3617,4	17,3	0,8	107,5	10,3	2161,2	29,9	369,0		11617,2		65445,3
Paper, Pulp and Print	1614,2	2,8	330,5	3,1		0,6	351,5	115,7	3,2	4,1		8244,0		34183,5
Wood and Wood Products	7004,8	162,1	605,0	6,6		565,4	6262,7	191,2	0,1	0,5		4996,8		12538,7
Constructions	9572,3	26,2	2638,9	102,8	2,5	86,7	98,3	239,9	6,9	11,9		6372,0		19171,3
Textiles and Leather	9396,1	500,2	742,5	8,2	1,0	42,0	181,9	211,2	8,0	26,3		10598,4		33252,5
Non-specified	876,7	1,9	335,6	3,3	4,3	5,5	178,0	43,7	0,4	5,4		615,6		1261,4
TRANSPORT SECTOR	**25294,1**	**53,6**	**3817,0**	**1095,3**	**40,9**	**30,1**	**1,8**	**146,9**	**17,1**	**7,6**	**0,0**	**25689,5**	**0,0**	**6924,6**
Air Transport	15,0											19,8		85,7
Road Transport	3748,4	28,0	1087,4	40,6	1,6	30,1	0,2	43,1	12,1	7,6		3883,0		6299,8
Railways	21373,3	25,6	2649,7	1054,1	39,3			103,5	4,7			21432,2		0,8
Internal Navigation	157,4		79,9	0,6			1,6	0,3	0,3			354,5		538,3
OTHER SECTORS	**875692,1**	**16659,1**	**111955,0**	**23511,1**	**2318,8**	**33835,7**	**338,7**	**127048,3**	**6137,6**	**19158,9**	**0,0**	**161068,1**	**0,0**	**281961,3**
Agriculture	29388,9	1699,6	1683,8	612,0	111,0	137,6	39,0	556,8	0,7	13,1		31248,0		14014,7
Commerce and Public														
Residential	617259,0	13360,0	31566,0					112871,0	5121,6	17600,0		64176,4		
Non-Specified	229044,2	1599,5	78705,2	22899,1	2207,8	33698,1	299,7	13620,5	1015,3	1545,8	0,0	65643,7	0,0	267946,6
NON-ENERGY USE	**300,2**	**28,2**	**9928,4**				**24807,3**	**103691,2**		**3753,5**		**0,0**	**0,0**	**0,0**
in Industry	300,2	28,2	9923,9				16616,2	103636,5		3753,5				

Poland : 1988

PRODUCTION AND USES OF ENERGY	Oil (TJ)							Petroleum Products (TJ)						
	Crude Oil + Feedstocks + Other Inputs	Crude Oil + NGL	Feed-stocks	Other Inputs	Rafinery Gas	Liquified Petroleum Gases	Motor Gasoline	Aviation Gasoline	Jet Fuel	Kerosene	Gas/Diesel Oil	Residual Fuel Oil	Naphta	Other Petroleum Products
Indigenous Production	7381,9	6578,0		803,9	13385,2	11780,4	118761,5		7758,6	175,0	224206,9	130708,5	48293,7	78819,0
From Other Sources														
Imports	630602,5	618668,0	11813,9	120,6			16261,9	1388,8	8739,5		52432,9	10048,3		4662,4
Exports							1612,8				4116,7	8159,2	5536,0	5828,0
International Marine Bunkers									535,1		14473,0	9043,4		
Stock Changes	-6560,0	-6560,0					2060,7	-89,6	-89,2	-87,5	-563,3	401,9		
DOMESTIC SUPPLY	**631424,4**	**618686,0**	**11813,9**	**924,5**	**13385,2**	**11780,4**	**135471,3**	**1299,2**	**15873,8**	**87,5**	**257486,8**	**123956,1**	**42757,7**	**77653,4**
Returns to Supply	8074,2		8074,2											
Transfers							224,0	-403,2	-312,1	306,3	43,3			120,6
Total Requirements	639498,6	618686,0	19888,1	924,5	13385,2	11780,4	135695,3	896,0	15561,7	393,8	257530,1	123956,1	42757,7	77774,0
Statistical Difference	0,0											-7676,9		
TRANSFORMATION SECTOR	**639498,6**	**618686,0**	**19888,1**	**924,4**	**1251,9**	**615,0**	**0,0**	**0,0**	**0,0**	**0,0**	**1386,8**	**73473,3**	**0,0**	**0,0**
Patent Fuel Plants														
Coke Ovens														
Gas Works						615,0								
Blast Furnaces														
Oil Refineries	639498,6	618686,0	19888,1	924,4							736,7			
Autoproducers of Electricity					1251,9						186,3	48107,3		
Public Plants for CHP											130,0	7717,1		
Heating Plants											333,8	17648,9		
Non-Specified														
ENERGY SECTOR	**0,0**	**0,0**	**0,0**	**0,0**	**8618,5**	**94,6**	**89,6**	**0,0**	**0,0**	**0,0**	**2036,6**	**15152,9**	**0,0**	**0,0**
Coal Mines							44,8				1603,3			
Oil and Gas Extraction											216,7			
Patent Fuel Plants														
Coke Ovens														
Gas Works											43,3			
Oil Refineries					8618,5	94,6						14911,7		
Electric Plants														
Pumped Storage														
Non-Specified							44,8				173,3	241,2		
Distribution Losses							134,4				173,3			
FINAL CONSUMPTION	**0,0**	**0,0**	**0,0**	**0,1**	**3514,8**	**11070,8**	**135471,3**	**896,0**	**15561,7**	**393,8**	**253933,5**	**43006,8**	**42757,7**	**77774,0**
INDUSTRY SECTOR	**0,0**	**0,0**	**0,0**	**0,0**	**3514,8**	**331,1**	**1971,2**	**0,0**	**0,0**	**0,0**	**19499,9**	**35289,7**	**0,0**	**0,0**
Iron and Steel											130,0	18207,6		
Chemical					3514,8		44,8				1386,7	3617,4		
of which: Petrochemical												763,7		
Non-Ferrous Metals											43,3	643,1		
Non-Metallic Minerals						47,3					1343,3	5988,8		
Transport Equipment						47,3	134,4				1083,3	321,5		
Machinery						94,6	224,0				1646,7	160,8		
Mining and Quarrying							89,6				1863,3	964,6		
Food and Tobacco						47,3	403,2				2123,3	1848,9		
Paper, Pulp and Print						47,3					86,7	1246,0		
Wood and Wood Products											173,3	1889,1		
Constructions						47,3	985,6				9100,0	401,9		
Textiles and Leather							44,8				216,7			
Non-specified							44,8				303,3			
TRANSPORT SECTOR	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**132693,9**	**896,0**	**15561,7**	**0,0**	**183863,5**	**2451,8**	**0,0**	**0,0**
Air Transport								896,0	15561,7					
Road Transport							132559,5				158036,8			
Railways							134,4				24006,7			
Internal Navigation											1820,0	2451,8		
OTHER SECTORS	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**6907,5**	**-0,2**	**0,0**	**0,0**	**0,0**	**50266,8**	**2733,1**	**0,0**	**0,0**
Agriculture											50266,7	2733,1		
Commerce and Public														
Residential						6245,0								
Non-Specified		0,0				662,5	-0,2	0,0		0,0	0,0	0,0	0,0	0,0
NON-ENERGY USE	**0,0**	**0,0**	**0,0**	**0,0**	**0,0**	**3832,2**	**806,4**			**393,8**	**303,3**	**2532,2**	**42757,7**	**77774,0**
in Industry			0,0			3832,2	806,4			393,8	303,3	2532,2	42757,7	77774,0

000 TOE	Coal	Other Solid Fuels	Crude Oil	Petroleum Products	Gas	Nuclear	Hydro	Geothermal Solar etc	Electricity	Heat	Total
Indigenous Production	120676,6	1657,4	176,3		3740,8		154,2				126405,3
Import	761,7		15061,7	2234,0	6019,6				1071,0		25148,0
Export	-21144,7			-603,2	-0,5				-686,2		-22434,6
Intl. Marine Bunkers				-574,5							-574,5
Stock Changes	-1377,7	3,6	-156,7	39,0	-57,0						-1548,8
TOTAL PRIMARY ENERGY SUPPLY	98915,9	1661,0	15081,3	1095,4	9702,9		154,2		384,8		126995,5
Statistical Differences	-2249,4			182,9	-58,4						-2125,1
Public Electricity Plant							-154,0		154,0		
Autoproducer of Electricity							-0,2		0,2		
CHP Plants	-37071,7			-187,4	-5,3				11327,0	4496,1	-21441,3
Autoproducer for CHP	-8453,5	-292,3		-202,7	-59,5				725,3	7825,9	-456,8
Distric Heating	-10085,8	-104,0		-1410,2	-472,0					7944,5	-4127,5
Gas Works	-399,7			-14,7	225,3						-189,1
Petroleum Refineries	-1,0		-15081,3	14558,3	-57,2				-38,8	-356,3	-976,3
Coal Transformation	-1762,7										-1762,7
Liquefaction											
Other Transformation											
Own Use	-1692,1	-0,1		-56,5	-269,8				-2459,1	-1681,5	-6159,1
Distribution Losses	-110,7			-7,3	-260,6				-1192,4		-1571,0
TOTAL FINAL CONSUMPTION	37089,3	1264,5		13957,8	8745,4				8900,8	18228,8	88186,6
INDUSTRY SECTOR	11018,5	260,9		1447,6	3598,4				4440,2	11328,9	32094,5
Iron and Steel	4847,4			438,0	1859,3				732,3	960,1	8837,1
Chemical	290,3	8,2		204,5	157,7				1064,2	3579,3	5304,2
of which : Petrochemical	0,1			18,2					78,1	627,0	723,4
Non-Ferrous Metals	263,7			16,4	142,9				208,0	107,9	738,9
Non-Metallic Minerals	3002,6	42,5		176,3	780,1				331,3	375,7	4708,5
Transport Equipment	164,9	0,1		37,9	87,8				171,7	421,4	883,8
Machinery	752,8	2,7		50,8	350,9				586,9	962,1	2706,2
Mining and Quarrying	178,9	20,8		69,7	154,1				332,1	961,1	1716,7
Food and Tobacco	706,1	2,7		105,6	47,6				277,5	1563,1	2702,6
Paper Pulp and Print	46,7	8,4		33,0	2,6				196,9	816,5	1104,1
Wood and Wood Products	185,8	163,1		49,3	4,2				119,3	299,5	821,2
Construction	295,1	2,7		251,6	5,4				152,2	457,9	1164,9
Textile and Leather	254,9	5,3		6,2	4,8				253,1	794,2	1318,5
Non-specified (Industry)	29,3	4,4		8,3	1,0				14,7	30,1	87,8
TRANSPORT SECTOR	723,9	0,8		8012,5	3,6				613,6	165,4	9519,8
Air Transport	0,4			393,1					0,5	2,0	396,0
Road Transport	117,3	0,7		6940,8	1,2				92,7	150,5	7303,2
Railways	600,5			576,6	2,4				511,9		1691,4
Internal Navigation	5,7	0,0		102,0					8,5	12,9	129,1
OTHER SECTORS	25020,4	811,7		1430,9	2891,9				3847,0	6734,5	40736,4
Agriculture	800,3	4,2		1265,9	12,1				746,3	334,7	3163,5
Commerce and Public Services											
Residential	16198,2			149,2	2562,0				1532,8		20442,2
Non-specified (Other)	8021,9	807,5		15,8	317,8				1567,9	6399,8	17130,7
NON-ENERGY USE	326,5	191,1		3066,8	2251,5						5835,9
in Industry/Transf/Energy	326,4	191,1		3066,8	2250,3						5834,6

Annex 5. Uncertainty estimation of the 1988 inventory

Uncertainty analysis for the year 1988 was performed with Tier1 methodology. This simplified methodology is based on the assumptions listed below:

- every value is independent (there is no correlation between values)
- probability distribution is symmetric (probability of underestimation and overestimation is the same)

Conclusions from the 2005 in-depth review of the Polish GHG emission inventory were taken into account and additional analyses were made in *Agriculture* sector. For sector 5. *LUCF* and *Industrial gases* (HFC, PFC, SF6) due to lack of appropriate information, uncertainty estimates were made directly to emission values.

First step of the analysis was to assign uncertainty to each activity and emission factor. Next step was to estimate error propagation and its influence of total results. To estimate error propagation from activity and emission factor to emission values, formula (1) was used.

$$U_{emission} = \text{square root}\,(U_{act}^2 + U_{EF}^2) \qquad (1)$$

where: $U_{emission}$ – uncertainty of emission value
U_{act} – uncertainty of activity value
U_{ef} – uncertainty of emission factor value

To estimate error propagation from sectoral emissions to national total, formula (2) was used

$$U_{emission} = \text{square root } (\Sigma (\text{Emission} * U_{emission})^2) / \Sigma \text{ Emission} \quad (2)$$

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 4: 4.A.1, 4.A.2 ..... 4.F.5
- sector 6: 6.A.1, 6.A.2; 6.B with disaggregation according to wastewater types and 6.C with disaggregation according to waste types.

To estimate uncertainty of input data, the results of research made in 2000 for the 1998 GHG emission inventory were used. These data were assigned for emission factors for CH_4 and N_2O in sector *1. Energy, 4. Agriculture* and partly in *6. Waste*. Another source of data on uncertainties was analysis of 2002 GHG Inventory of Scandinavian countries. Conclusions were applied to activities in sector *1. Energy* and for activities and emission factors in sector *2. Industrial processes.* Other uncertainties for activities and factors were estimated with expert's opinion in National Emission Centre in Warsaw (CO_2 emission factors in sector *1. Energy*; and activities and factors in 6.C Waste/Waste Incineration).

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

CO_2 – 5.3%	CH_4 – 16.5%	N_2O - 49.8%
HFC - 36.1%	PFC - 20.0%	SF6 - 100.0%

Activities

Most uncertain values of activity were assigned in category *4.F Agriculture/Field Burning of Agricultural Residues* and in *6.B Waste/Domestic and Commercial Wastewater* (30%). Lowest uncertainty values were assigned to *1.B Fugitive emission from fuels* (2%) and in *1.A.1 Energy/ Fuel Combustion/ Energy Industries* (3%).

CO_2 emission factors

Most uncertain values for CO_2 emission factors were assigned in sector *6.C Waste incineration* (50%), *2.A. Cement Production* (15%) and *2.C Metal Production* (10%), the most precise values were in *1.A Fuel Combustion* (1-2%).

Low level of uncertainty of national total of CO_2 (5.3%) comes from the fact, that major part of emission comes from sector *1.A Fuel Combustion* where data for activities and factors are most precise (relatively 2-5% and 1-2%).

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%), *4.A. Enteric Fermentation* and *4.B Manure Management (50%), 1.A.3 Transport* (50%), and for liquid fuels in *1.A Fuel Combustion* (41,8%), the most precise values were in *1.B.2 Fugitive emission from fuels/ Oil and natural gas* (8.1%).

Uncertainty of CH_4 emission is app. 16.5% which is result of share of agriculture and waste sectors in national totals – emission factors in those sectors have high uncertainty.

N_2O emission factors
Most uncertain values for N_4O emission factors were assigned in sector *4.B.11* and *4.B.12 Manure management* (150%), *4.D Agricultural Soils* (150%) and in *4.F Agriculture/Field Burning of Agricultural Residues* (150%), most precise values were for Natural gas combustion in *1.A.3 Transport* (2.3%) and *1.A Fuel Combustion* (3.8%).
Highest value of uncertainty of national total occurred in N_2O (49.8%) and is a result of high uncertainty of the emission factors in sector of *Agriculture* (4.B.11 *Liquid systems*, 4.B.12 *Solid Storage and Dry Lot, 4.D Agricultural Soils* and *4.Field Burning of Agricultural residues* – 150%).

Industrial Gases
Simplified analysis were made for industrial gases HFC, PFC and SF6 – uncertainty estimates were applied directly to emission values of each pollutant. Results are HFC – 36.1%, PFC – 20.0%, SF6 – 100.0%. Due to lack of information, additional analysis need to be done for these gases.

The uncertainty assessment of GHG Inventory for 1988 was made on the basis of calculations and experts opinions made in 2006 (during compiling inventories for years 2000-2004) and recommendations of the UNFCCC expert review team. The calculations were extended to cover simplified approach for LULUCF sector and industrial gases.

Sector *3. Solvents and Other Products Use* was included in calculations with high sectoral uncertainty 28.3%. Emission from this sector is small compared to total CO_2 and high uncertainty have very little influence on uncertainty of values of total national CO_2 emission.

GHG inventory 1988 – Uncertainty analysis, part 1, sectors 1-2

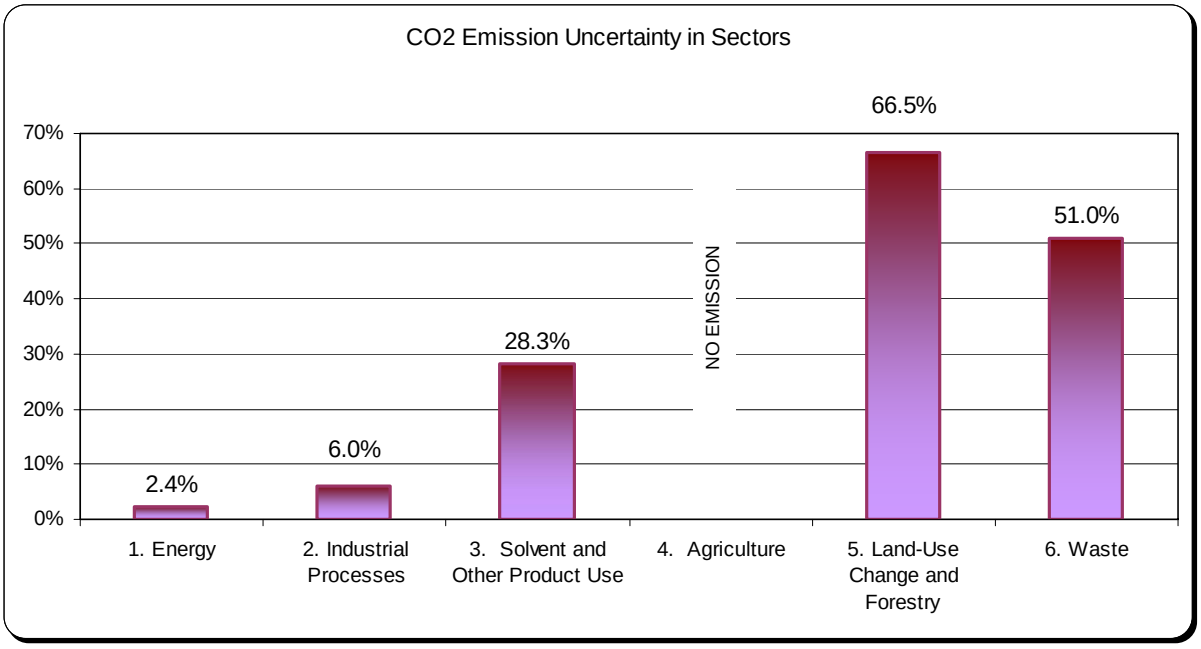
1988	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
TOTAL									461 951.16	2 345.54	137.03	5.3%	16.5%	49.8%	24 608.46	387.94	68.28
1. Energy									**471 688.45**	**1096.99**	**10.45**	2.4%	16.1%	2.8%	**11128.42**	**176.82**	**0.29**
A. Fuel Combustion									**471 636.28**	**15.88**	**10.45**	2.4%	7.7%	2.8%	11128.42	1.22	0.29
1. Energy Industries									271 844.28	3.65	3.86	3.4%	12.9%	3.5%	9354.56	0.47	0.14
Liquid Fuels	150 954	3.0%	72.32	2.58	0.54	1.0%	41.8%	3.8%	10 916.31	0.39	0.08	3.2%	41.9%	3.2%	345.20	0.16	0.00
Solid Fuels	2 564 402	3.0%	101.10	1.25	1.47	2.0%	13.5%	11.7%	259 266.90	3.20	3.77	3.6%	13.8%	3.6%	9348.00	0.44	0.14
Gaseous Fuels	29 639	3.0%	56.04	1.00	0.10	2.0%	17.0%	20.0%	1 661.06	0.03	0.00	3.6%	17.3%	3.6%	59.89	0.01	0.00
Biomass	1 082	3.0%				0.0%	24.0%	37.0%	121.18	0.03	0.00	3.0%	24.2%	3.0%		0.01	0.00
2. Manufacturing Industries and Construction									58 488.34	2.51	0.93	4.1%	12.9%	6.9%	2382.35	0.32	0.06
Liquid Fuels	104 904.26	5.0%	75.28	3.02	4.44	1.0%	41.8%	3.8%	7 897.16	0.32	0.47	5.1%	42.1%	6.3%	402.68	0.13	0.03
Solid Fuels	379 928.87	5.0%	112.98	5.37	1.18	2.0%	13.5%	11.7%	42 923.03	2.04	0.45	5.4%	14.4%	12.7%	2311.48	0.29	0.06
Gaseous Fuels	138 792.03	5.0%	55.25	1.00	0.10	2.0%	17.0%	20.0%	7 668.15	0.14	0.01	5.4%	17.7%	20.6%	412.94	0.02	0.00
Biomass	416.00	5.0%	112.00	30.00	4.00	0.0%	24.0%	37.0%	46.59	0.01	0.00	5.0%	24.5%	37.3%		0.00	0.00
3. Transport									23 454.18	6.42	1.67	6.6%	11.1%	5.4%	1549.27	0.71	0.09
Liquid Fuels	296 967.76	5.0%	73.58	21.17	5.48	5.0%	10.2%	2.3%	21 851.20	6.29	1.63	7.1%	11.4%	5.5%	1545.11	0.71	0.09
Solid Fuels	21 373.00	5.0%	75.00	6.00	NE	5.0%	13.5%	11.7%	1 602.98	0.13	0.04	7.1%	14.4%	12.7%	113.35	0.02	0.01
Biomass	NE	5.0%	0.00	0.00	0.00	0.0%	24.0%	37.0%	0.00	0.00	0.00	5.0%	24.5%	37.3%	0.00	0.00	0.00
Other Fuels	NE	5.0%	0.00	0.00	0.00	0.0%	50.0%	50.0%	0.00	0.00	0.00	5.0%	50.2%	50.2%	0.00	0.00	0.00
4. Other Sectors									112 180.94	2.57	2.04	4.7%	13.1%	9.8%	5309.11	0.34	0.20
Liquid Fuels	105 983.25	5.0%	74.03	3.83	3.54	1.0%	41.8%	3.8%	7 845.73	0.41	0.38	5.1%	42.1%	6.3%	400.06	0.17	0.02
Solid Fuels	1 030 724.00	5.0%	95.19	1.00	1.47	2.0%	13.5%	11.7%	98 110.19	1.03	1.51	5.4%	14.4%	12.7%	5283.40	0.15	0.19
Gaseous Fuels	115 194.00	5.0%	54.04	1.00	0.10	2.0%	17.0%	20.0%	6 225.02	0.12	0.01	5.4%	17.7%	20.6%	335.23	0.02	0.00
Biomass	33 820.00	5.0%	112.00	30.00	4.00		24.0%	37.0%	3 787.84	1.01	0.14	5.0%	24.5%	37.3%		0.25	0.05
5. Other									5 668.55	0.74	1.95	4.7%	99.5%	6.3%	266.99	0.73	0.12
Liquid Fuels	71 439.50	5.0%	73.00	10.27	27.28	1.0%	100.0%	3.8%	5 214.80	0.73	1.95	5.1%	100.1%	6.3%	265.90	0.73	0.12
Solid Fuels	4 221.00	5.0%	105.62	1.01	1.50	2.0%	80.0%	11.7%	445.80	0.00	0.01	5.4%	80.2%	12.7%	24.01	0.00	0.00
Gaseous Fuels	147.00	5.0%	54.05	1.00	0.10	2.0%	90.0%	20.0%	7.95	0.00	0.00	5.4%	90.1%	20.6%	0.43	0.00	0.00
Biomass	8.00	5.0%	112.00	30.00	4.00	0.0%	95.0%	37.0%	0.90	0.00	0.00	5.0%	95.1%	37.3%		0.00	0.00
B. Fugitive Emissions from Fuels									**52.17**	**1081.12**	**0.00**	5.4%	16.4%		2.81	176.81	0.00
1. Solid Fuels									2.17	884.93	0.00	6.6%	19.9%		0.14	176.46	0.00
1. B. 1. a. Coal Mining and Handling															0.00	0.00	0.00
i. Underground Mines [Activity in Mt, EF in kg/t]	191.60	2.0%		4.58198			20.0%			877.91			20.1%		0.00	176.46	0.00
ii. Surface Mines [Activity in Mt, EF in kg/t]	73.97	2.0%		0.01273			20.0%			0.94			20.1%		0.00	0.19	0.00
1. B. 1. c. Other [CO2 Emisson from Coking Gas Subsystem]	1.05	2.0%	2 060 765	5 791 695.00			20.0%		2.17	6.09		6.6%	15.0%		0.14	0.91	
2. Oil and Natural Gas									50.00	196.18	0.00	5.6%	5.7%		2.80	11.20	0.00
1. B. 2. a. Oil															0.00	0.00	0.00
ii. Production [Activity in PJ, EFs in kg/PJ]	6.58	0.5%	6 315 000	61 800.00		6.6%	8.1%		41.54	0.41		6.6%	8.1%		2.75	0.03	0.00
iii. Transport [Activity in Gg]	15 151.00	0.5%	NE	NE		6.6%	8.1%		0.10	0.01		6.6%	8.1%		0.01	0.00	0.00
1. B. 2. b. Natural Gas															0.00	0.00	0.00
i. Production / Processing [Activity in PJ, EFs in kg/PJ]	156.62	0.5%	49 140.68	97 795.23		6.6%	8.1%		7.70	15.32		6.6%	8.1%		0.51	1.24	0.00
ii. Transmission [Activity in PJ, EFs in kg/PJ]	401.37	0.5%	511.22	136 263.57		6.6%	8.1%		0.21	54.69		6.6%	8.1%		0.01	4.44	0.00
ii. Distribution [Activity in PJ, EFs in kg/PJ]	401.37	0.5%	1 157.20	313 323.98		6.6%	8.1%		0.46	125.76		6.6%	8.1%		0.03	10.21	0.00
2. Industrial Processes									**21735.70**	**16.06**	**16.11**	6.0%	15.4%	26.4%	1308.42	2.48	4.26
A. Mineral Products									10802.63		0	11.3%			1215.58	0.00	0.00
1. Cement Production [Activity in kt, EF in t/t]	13 387.00	5.0%	0.525			15.0%			7028.18			15.8%			1111.25	0.00	0.00
2. Lime Production [Activity in kt, EF in t/t]	4 430.00	10.0%	0.785			10.0%			3477.55			14.1%			491.80	0.00	0.00
4. Soda Ash (production) [Activity in kt, EF in t/t]	715.44	10.0%	0.415			0.0%			296.91			10.0%			29.69	0.00	0.00
7. Other (Limestone) [Activity in kt, EF in t/t]	0.00	5.0%	0			5.0%			0.00			7.1%			0.00	0.00	0.00
B. Chemical Industry									3970.89	11.94	16.11	6.3%	19.8%	26.4%	250.73	2.37	4.26
1. Ammonia Production [Activity in kt, EF in t/t]	2 344.40	5.0%	1.5	0.0049		5.0%	20.0%		3516.60	11.49		7.1%	20.6%		248.66	2.37	0.00
2. Nitric Acid Production [Activity in kt, EF in t/t]	2 187.00	2.0%			0.01			30.0%			14.15			30.1%	0.00	0.00	4.25
3. Adipic Acid Production [Activity in kt, EF in t/t]	5.00	5.0%			0.00			10.0%	NE		1.50			11.2%			
4. Carbide Production (calcium carbide) [Activity in kt, EF in t/t]	412.90	5.0%	1.1			5.0%			454.19			7.1%			32.12	0.00	0.00
5. Other (Carbon Black) [Activity in kt, EF in t/t]	45.69	5.0%		0.01			20.0%			0.46			20.6%		0.00	0.09	0.00
5. Other (Ethylene) [Activity in kt, EF in t/t]	327.92	5.0%	0.0003			5.0%			0.10			7.1%			0.01	0.00	0.00
5. Other (N2O for Medical Use) [Activity in kt, EF in t/t]	IE	5.0%			IE			20.0%			IE				0.00	0.00	IE
5. Other (Urea production) [Activity in kt, EF in t/t]	968.60	5.0%	0			5.0%						7.1%			0.00	0.00	0.00
5. Other (Caprolactam) [Activity in kt, EF in t/t]	96.62	5.0%			0.0047			20.0%			0.46			20.6%	0.00	0.00	0.09
C. Metal Production									6962.18	4.12	0	5.9%	17.6%		414.08	0.73	0.00
1. Iron and Steel Production															0.00	0.00	0.00
Sinter [Activity in kt, EF in t/t]	14 107.32	5.0%	0.08			10.0%			1069.19			11.2%			119.54	0.00	0.00
Coke [Activity in kt, EF in t/t]	17 482.43	5.0%	0.12	0.000200		10.0%	20.0%		2170.82	3.50		11.2%	20.6%		242.71	0.72	0.00
Open-heart Steel [Activity in kt, EF in t/t]	6 620.10	5.0%	0.052			10.0%			344.25			11.2%			NE		
Electric Furnace Steel [Activity in kt, EF in t/t]	2 801.70	5.0%	0.00430	0.000120		10.0%	20.0%		12.05	0.34		11.2%	20.6%		1.35	0.07	0.00
Pig Iron [Activity in kt, EF in t/t]	10 262.35	5.0%	0.27011			10.0%			2771.95			11.2%			309.91	0.00	0.00
Iron Cast [Activity in kt, EF in t/t]	1 422.70	5.0%	0.061	0.000200		10.0%	20.0%		86.78	0.28		11.2%	20.6%		9.70	0.06	0.00
Steel Cast [Activity in kt, EF in t/t]	281.40	5.0%	0.062			10.0%			17.45			11.2%			1.95	0.00	0.00
Basic Oxygen Furnace Steel [Activity in kt, EF in t/t]	7 424.70	5.0%	0.01126			10.0%			83.60			11.2%			9.35	0.00	0.00
2. Ferroalloys Production [Activity in kt, EF in t/t]	82.10	5.0%	3.9			5.0%			320.19			7.1%			22.64	0.00	0.00
3. Aluminium Production [Activity in kt, EF in t/t]	47.72	5.0%	1.8			5.0%			85.90			7.1%			6.07	0.00	0.00
D. Other Production															0.00	0.00	0.00
G. Other															0.00	0.00	0.00

GHG inventory 1988 – Uncertainty analysis, part 2, sector 3-6

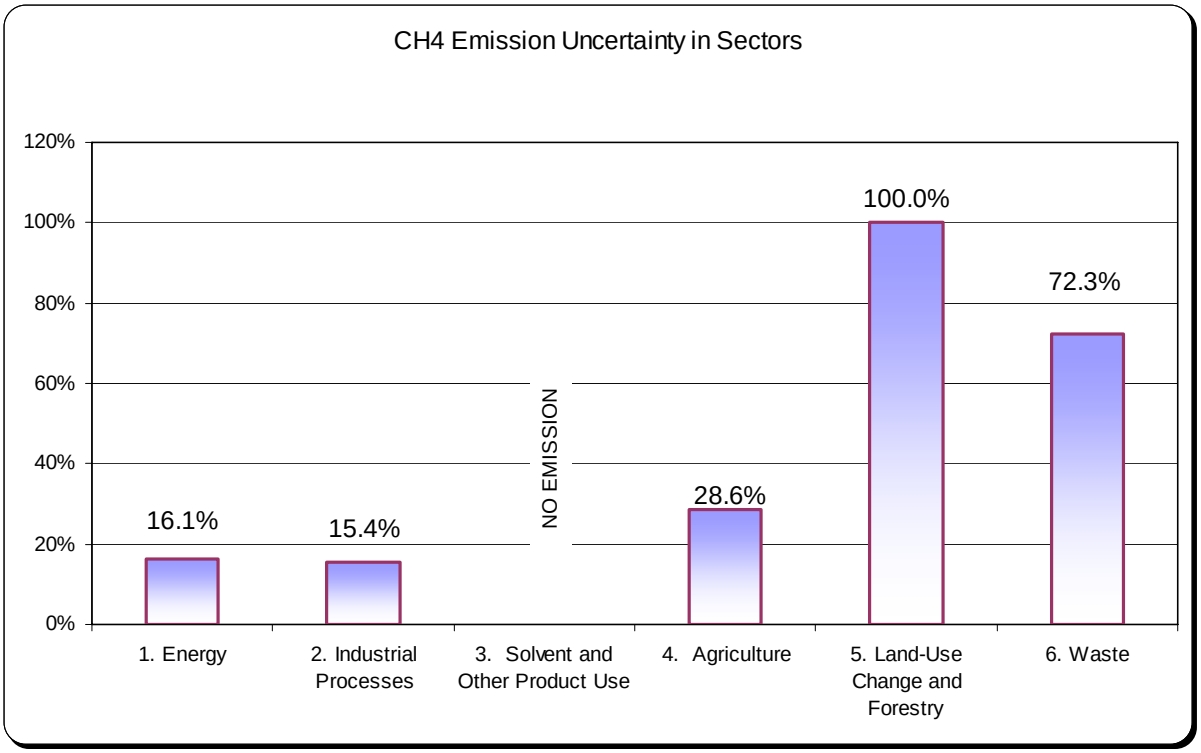
1988	Activity [TJ]	Activity uncertainty [%]	EF CO2 [t/TJ]	EF CH4 [kg/TJ]	EF N2O [kg/TJ]	EF CO2 Uncertainty [%]	EF CH4 Uncertainty [%]	EF N2O Uncertainty [%]	CO2 [Gg]	CH4 [Gg]	N2O [Gg]	CO2 Emission uncertainty [%]	CH4 Emission uncertainty [%]	N2O Emission uncertainty [%]	CO2 Emission absolute uncertainty [Gg]	CH4 Emission absolute uncertainty [Gg]	N2O Emission absolute uncertainty [Gg]
3. Solvent and Other Product Use	**277.78**		**NA**						**882.46**		**0.40**	28.3%		50.0%	249.74	0.00	0.20
4. Agriculture										**924.77**	**106.32**		28.6%	64.1%	0.00	264.22	68.11
A. Enteric Fermentation										759.73			33.7%		0.00	255.78	0.00
1. Cattle															0.00	0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	4 806.0	5.0%		95.02			50.0%			456.69			50.2%		0.00	229.48	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	5 516.0	5.0%		39.78			50.0%			219.40			50.2%		0.00	110.25	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	4 377.0	5.0%		7.86			50.0%			34.42			50.2%		0.00	17.29	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	179.3	5.0%		5.00			50.0%			0.90			50.2%		0.00	0.45	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	1 051.0	5.0%		18.00			50.0%			18.92			50.2%		0.00	9.51	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	19 605.0	5.0%		1.50			50.0%			29.41			50.2%		0.00	14.78	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	246 174.6	5.0%		0.00			50.0%			0.00			50.2%		0.00	0.00	0.00
B. Manure Management										163.59	30.11		40.5%	149.0%	0.00	66.24	44.87
1. Cattle															0.00	0.00	0.00
Dairy Cattle [Activity in 1000 heads, EF in kg/head]	4 806	5.0%		6.02			50.0%			28.91			50.2%		0.00	14.53	0.00
Non-Dairy Cattle [Activity in 1000 heads, EF in kg/head]	5 516	5.0%		2.00			50.0%			11.05			50.2%		0.00	5.55	0.00
3. Sheep [Activity in 1000 heads, EF in kg/head]	4 377	5.0%		0.17			50.0%			0.73			50.2%		0.00	0.37	0.00
4. Goats [Activity in 1000 heads, EF in kg/head]	179	5.0%		0.12			50.0%			0.02			50.2%		0.00	0.01	0.00
6. Horses [Activity in 1000 heads, EF in kg/head]	1 051	5.0%		1.39			50.0%			1.46			50.2%		0.00	0.73	0.00
8. Swine [Activity in 1000 heads, EF in kg/head]	19 605	5.0%		5.21			50.0%			102.21			50.2%		0.00	51.36	0.00
9. Poultry [Activity in 1000 heads, EF in kg/head]	246 175	5.0%		0.08			50.0%			19.20			50.2%		0.00	9.65	0.00
11. Liquid Systems [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%			0.001000			150.0%			0.22			150.1%	0.00	0.00	0.33
12. Solid Storage and Dry Lot [Activity in 1000 heads, EF in kg N2O-N/kg N]	0	5.0%			0.020000			150.0%			29.89			150.1%	0.00	0.00	44.86
D. Agricultural Soils											76.13			67.3%	0.00	0.00	51.25
1. Direct Soil Emissions															0.00	0.00	0.00
Synthetic Fertilizers [Activity in kg N, EF in kg N2O-N/kg N]	1 201 500 000	5.0%			0.01			150.0%			16.78			150.1%	0.00	0.00	25.19
Animal Wastes Applied to Soils [Activity in kg N, EF in kg N2O-N/kg N]	840 503 552	5.0%			0.01			150.0%			13.21			150.1%	0.00	0.00	19.82
N-fixing Crops [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	108 990 000	5.0%			0.01			150.0%			1.71			150.1%	0.00	0.00	2.57
Crop Residue [Activity in kg dry biomass, EF in kg N2O-N/kg dry biomass]	199 849 600	5.0%			0.01			150.0%			3.14			150.1%	0.00	0.00	4.71
Cultivation of Histosols [Activity in ha, EF in kg N2O-N/ha]	1 269 000	5.0%			8.00			150.0%			15.95			150.1%	0.00	0.00	23.94
2. Animal Production [Activity in kg N, EF in kg N2O-N/kg N]	161 748 190	5.0%			0.02			150.0%			5.08			150.1%	0.00	0.00	7.63
3. Indirect Emissions [Activity in kg N/yr, EF in kg N2O/kg N]	165 849 638	20.0%			1.22077174			150.0%			20.25			151.3%			30.64
F. Field Burning of Agricultural Residues										1.45	0.08		21.2%	110.6%	0.00	0.31	0.08
1. Cereals															0.00	0.00	0.00
Wheat [Activity in t of crop production, EF in kg/t dm]	7 582 000	30.0%		0.1816	0.0004		20.0%	150.0%		0.14	0.00		36.1%	153.0%	0.00	0.05	0.00
Barley [Activity in t of crop production, EF in kg/t dm]	3 804 000	30.0%		0.1473	0.0004		20.0%	150.0%		0.06	0.00		36.1%	153.0%	0.00	0.02	0.00
Maize [Activity in t of crop production, EF in kg/t dm]	204 000	30.0%		0.0367	0.0001		20.0%	150.0%		0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
Oats [Activity in t of crop production, EF in kg/t dm]	2 222 000	30.0%		0.1506	0.0004		20.0%	150.0%		0.03	0.00		36.1%	153.0%	0.00	0.01	0.00
Rye [Activity in t of crop production, EF in kg/t dm]	5 501 000	30.0%		0.2004	0.0004		20.0%	150.0%		0.11	0.00		36.1%	153.0%	0.00	0.04	0.00
Other Cereals [Activity in t of crop production, EF in kg/t dm]	5 191 000	30.0%		0.1540	0.0004		20.0%	150.0%		0.08	0.00		36.1%	153.0%	0.00	0.03	0.00
2 Pulses (Other non-specified)	565 000	30.0%		0.0439	0.0003		20.0%	150.0%		0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
3 Tuber and Root															0.00	0.00	0.00
Potatoes [Activity in t of crop production, EF in kg/t dm]	34 707 000	30.0%		0.1796	0.0014		20.0%	150.0%		0.62	0.05		36.1%	153.0%	0.00	0.22	0.08
Other Tuber and Root [Activity in t of crop production, EF in kg/t dm]	0	30.0%		0.0000	0.0000		20.0%	150.0%		0.00	0.00		36.1%	153.0%	0.00	0.00	0.00
5 Other															0.00	0.00	0.00
Fruits, Veget., Rape, Tabacco, Hop, Hey [Activity in t of crop prod., EF in k	36 037 000	30.0%		0.0113	0.0005		20.0%	150.0%		0.41	0.02		36.1%	153.0%	0.00	0.15	0.03
													0.0%	0.0%	0.00	0.00	0.00
5. Land-Use Change and Forestry									**-32934.72**	**0.36**	**0.00**	66.5%	100.0%	100.0%	-21906.00	0.36	0.002
A. Forest Land									-42705.20			50.0%			-21352.60	0.00	0.000
B. Cropland									8165.26			50.0%			4082.63	0.00	0.000
C. Grassland									4530.69			50.0%			2265.34	0.00	0.000
D. Wetlands									0.00			50.0%			0.00	0.00	0.000
E. Settlements									-2925.46	0.36	0.0025	50.0%	100.0%	100.0%	-1462.73	0.36	0.002
F. Other Land									0.00	0.00	0.0000	50.0%	100.0%	100.0%	0.00	0.00	0.000
6. Waste									**579.27**	**307.36**	**3.75**	51.0%	72.3%	51.3%	295.37	222.29	1.92
A. Solid Waste Disposal on Land										204.01			102.6%		0.00	209.34	0.00
1 Managed Waste Disposal on Land [Activity in Gg, EF in t/t MSW]							100.0%						100.0%		0.00	0.00	0.00
2 Unmanaged Waste Disposal Sites - deep (>5 m) [Activity in Gg, EF in t/t MSW]															0.00	0.00	0.00
3 Other - Total Waste Disposal on Land (Draft Guidlines 2006) [Activity in G	12 072.09	23.0%					100.0%			204.01			102.6%		0.00	209.34	0.00
B. Wastewater Handling										103.34	3.68		72.4%	52.2%	0.00	74.77	1.92
Industrial Wastewater [Activity in Gg DC(1), EF in kg/kg DC]	688.41			0.06			100.0%			50.75			100.0%		0.00	50.75	0.00
Domestic and Commercial Wastewater [Activity in Gg DC(1), EF in kg/kg D	234.65	30.0%		0.224148802			100.0%			52.60			104.4%		0.00	54.91	0.00
N2O from human sewage [Activity in 1000s of population, EF in kg N2O-N/kg sewage N produced]	37 879.00	15.0%			0.0000973			50.0%			3.68			52.2%	0.00	0.00	1.92
C. Waste Incineration									579.27		0.07	51.0%		27.2%	295.37	0.00	0.02
biogenic [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			129.91		0.01	51.0%		30.0%	66.24	0.00	0.00
plastics and other non-biogenic waste [Activity in Gg, EF in kg/t waste]		10.0%				50.0%			579.27		0.06	51.0%		30.0%	295.37	0.00	0.02

Industrial gases inventory 1988 – Uncertainty analysis for HFC, PFC and SF_6.

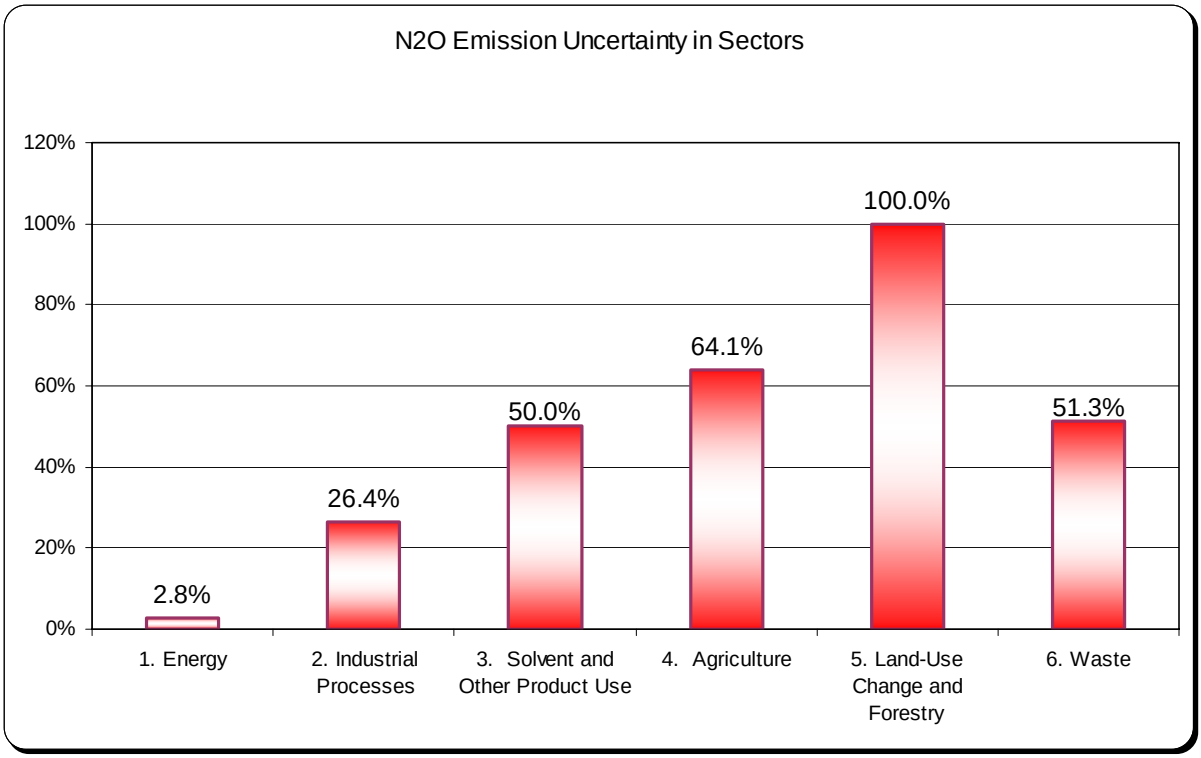
	HFC Emission [Gg of CO2 eq.]	PFC Emission [Gg of CO2 eq.]	SF_6 Emission [Gg of CO2 eq.]	HFC Emission uncertainty [%]	PFC Emission uncertainty [%]	SF6 Emission uncertainty [%]	HFC Emission absolute uncertainty [Gg of CO2 eq.]	PFC Emission absolute uncertainty [Gg of CO2 eq.]	SF6 Emission absolute uncertainty [Gg of CO2 eq.]
TOTAL	26.44	250.18	13.15	36.1%	20.0%	100.0%	9.54	50.04	13.15
2. Industrial Processes	**26.44**	**250.18**	**13.15**	**36.1%**	**20.0%**	**100.0%**	**9.54**	**50.04**	**13.15**
C. Metal Production		250.18			20.0%			50.04	
3. Aluminium Production		250.18			20.0%			50.04	
F. Consumption of Halocarbons and SF6	26.44	0.00	13.15	36.1%		100.0%	9.54	0.00	13.15
1. Refrigeration and Air Conditioning Equipment	10.52			50.0%			5.26		
2. Foam Blowing	NE			50.0%				0.00	
3. Fire Extinguishers	NA,NE	NE		50.0%	20.0%				
4. Aerosols/ Metered Dose Inhalers	15.93			50.0%			7.96		
8. Electrical Equipment			13.15			100.0%			13.15



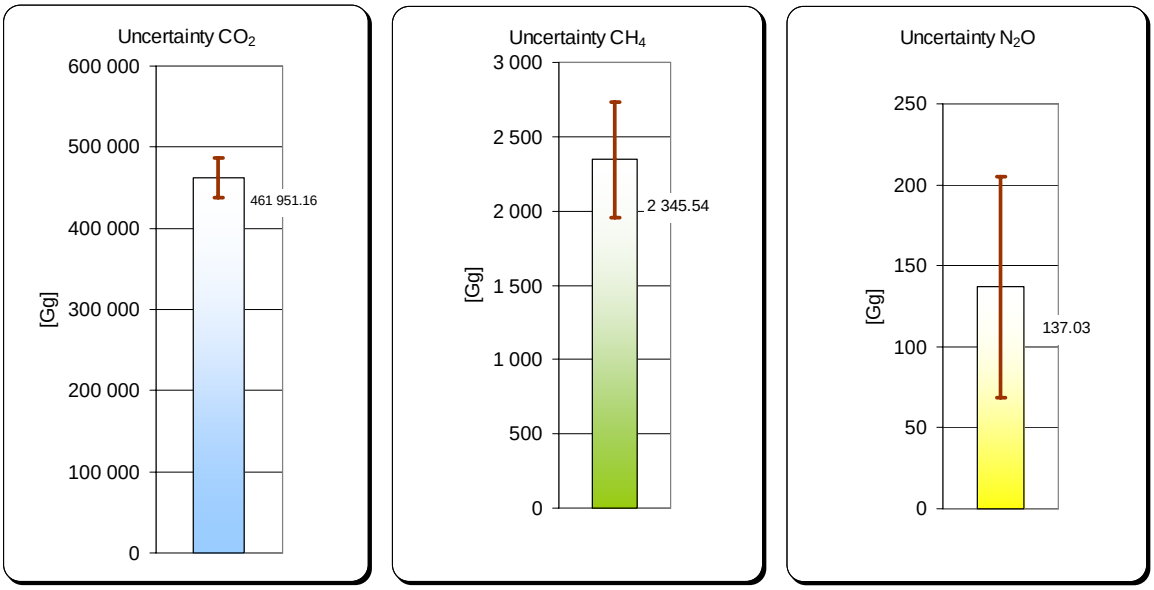
Results of uncertainty analysis in percents for CO_2 with sectoral split.



Results of uncertainty analysis in percents for CH_4 with sectoral split.



Results of uncertainty analysis in percents for N_2O with sectoral split



Emission results with uncertainties bars.

Annex 6

Common Reporting Format 1988