

# **POLAND'S INFORMATIVE INVENTORY REPORT 2016**

**Submission under the UN ECE Convention  
on Long-range Transboundary Air Pollution**

# Poland's Informative Inventory Report 2016

Submission under the UN ECE Convention on Long-range Transboundary Air Pollution

Report elaborated by:

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

Warszawa  
February 2016

## The Authors Team:

**Bogusław Dębski**

Anna Olecka

Katarzyna Bebkiewicz

Iwona Kargulewicz

Janusz Rutkowski

Damian Zasina

Magdalena Zimakowska - Laskowska

Marcin Żaczek



Działalność KOBiZE jest finansowana ze środków  
Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej



**REPUBLIC OF POLAND**

**P o l a n d ' s**  
**Informative Inventory Report 2016**

Submission under UN ECE Convention  
on Long-range Transboundary Air Pollution

Warsaw, March 2016

The Report has been elaborated by the  
Institute of Environmental Protection – National Research Institute  
National Centre for Emissions Management

and approved by the Ministry of Environment





## Contents

Executive Summary	5
1. Introduction	7
1.1 National Inventory Background	7
1.2 Institutional arrangements	8
1.3 Inventory preparation process	9
1.4 Methods and data sources	9
1.5 Key Categories	10
1.6 QA/QC and Verification methods	10
1.7 General uncertainty evaluation	11
1.8 General Assessment of Completeness	11
2. Explanation of key trends	25
3. Sectoral Methodologies	41
3.1 ENERGY (NFR sector 1)	44
4. INDUSTRIAL PROCESSES AND PRODUCT USE (NFR sector 2)	87
5. AGRICULTURE (NFR sector 3)	108
6. WASTE (NFR sector 5)	115
7. Other and Natural emissions	121
8. Recalculations and Improvements	123
9. Projections	125
10. Gridded emissions	125
Abbreviations	126
References	127
Appendix 1. Activity data - fuels consumption in NFR 1 A	
Appendix 2. Emission factors	
Appendix 3. Key category analysis	
Appendix 4. National energy balance for 2014 in EUROSTAT format	
Appendix 5. Uncertainty analysis	



## Executive Summary

Emission estimates in Poland account for sulphur dioxide, nitrogen oxides, ammonia, carbon monoxide, particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub> and total suspended particulates - TSP), non-methane volatile organic compounds (NMVOCs), heavy metals (HMs) and persistent organic pollutants (POPs) including dioxins and furans (PCDD/F), HCB, PCB and PAH.

The Poland's *Informative Inventory Report (IIR) 2016* contains information on the Poland's inventories for the years 1990 to 2014, including descriptions of methods, data sources, carried out QA/QC activities and a trend analysis. Emission inventories have been reported in the new reporting template (NFR 2014-1 format), following revised guidelines for reporting emissions and projections data under the Convention.

Referring to earlier submissions some methodology changes have been introduced; the major changes include verification of Hg emission factors for households. Nevertheless, there is still a scope for inventory improvement; planned programme of improvement is focused on the following tasks:

- verification of NMVOC emissions from the solvents use,
- gathering additional activity data to include new emission sources (eg. Venting and flaring),
- further methodology development by applying higher tier of estimation methodology, especially for key categories.

Emission volumes in the years 2013 – 2014 for the particular pollutants are presented below.

Pollutant	2013	2014	2014/2013
	<i>Mg</i>		<i>[%]</i>
SO <sub>2</sub>	853 438.3	800 101.2	93.74
NO <sub>x</sub>	774 087.2	723 114.2	93.48
NH <sub>3</sub>	269 753.3	265 130.2	98.29
CO	2 868 332.6	2 703 708.9	94.26
NMVOC	615 159.7	606 281.7	98.56
TSP	402 514.7	383 141.3	95.18
PM <sub>10</sub>	246 232.5	232 493.8	94.48
PM <sub>2.5</sub>	143 332.5	134 912.7	94.22
Pb	514.0	517.3	100.63
Cd	13.6	13.9	101.77
Hg	10.6	9.6	95.47
As	43.9	43.9	99.94
Cr	46.4	44.8	96.67
Cu	318.9	326.4	102.33
Ni	146.2	138.8	94.96
Zn	1 374.2	1 366.5	99.44
	<i>kg</i>		
PCB	752.7	685.2	91.04
HCB	13.0	13.6	104.26
WWA	155 280.0	143 388.1	92.34
	<i>g I-TEQ</i>		
PCDD/F	243.1	240.7	98.98

Total emissions of all main pollutants have decreased as compared to year 2013, especially for sulfur dioxide and nitrogen oxides - by about 6%. Emissions of heavy metals changed slightly – Copper emissions increased by about 2% while Nickel emissions decreased by 5%. Among POPs the biggest increase was observed for HCB – by about 7% while PCB emissions decreased by about 9%.





## 1. Introduction

The Poland's Informative Inventory Report (IIR) 2016 contains information on the Poland's inventories for the years 1990 to 2014, including descriptions of methods, data sources, carried out QA/QC activities, key categories analysis and a trend analysis.

Emission estimates in Poland account for sulphur dioxide, nitrogen oxides, ammonia, carbon monoxide, particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub> and total suspended particulates - TSP), non-methane volatile organic compounds (NMVOCs), heavy metals (HMs) and persistent organic pollutants (POPs) including dioxins (PCDD/F), HCB, PCB and PAH.

Emission inventories have been reported in the new reporting template (NFR 2014-1 format), following revised guidelines for reporting emissions and projections data under the Convention.

By means of this report Poland fulfils its obligation for preparing IIR Report under UN ECE Convention on Long-range Transboundary Air Pollution, signed in November 1979 in Geneva. Structure of the report follows the template for an Informative Inventory Report to LRTAP. The report includes inter alia for each pollutant or group of pollutants:

- key categories analysis,
- trends of national totals and NFR key sectors,
- methodology of emission estimates.

Volumes of emissions reported under the Directive 2001/81/EC of the European Parliament and the Council on National Emissions Ceilings (NECD) in December 2015 slightly differ from the data submitted with this report due to corrections of activity data - therefore NECD report will be updated in March 2016.

### 1.1 National Inventory Background

Emission estimates are mainly based on official Polish statistics, e.g. energy statistics, agricultural statistics, transport statistics, industry statistics and emission factors (nationally developed factors as well as internationally recommended ones).

Poland generally observes the Guidelines for Estimating and Reporting Emission Data for reporting to the Convention on Long-Range Transboundary Air Pollution (CLRTAP) under the Economic Commission for Europe (UNECE).

Some parts of the methodologies are taken directly from the EMEP/EEA Emission Inventory Guidebook, EMEP/CORINAIR Emission Inventory Guidebook, other international studies and some are nationally developed.

## 1.2 Institutional arrangements

The inventory system currently existing in Poland is presented in Figure 1.1. The Polish Ministry of the Environment takes the overall responsibility and submits the inventory report to CLRTAP. From 2010, following the organizational changes introduced<sup>1</sup>, the inventory team was constituted as Emission Inventory Unit (EIU) located in the National Centre for Emissions Management (NCEM; in Polish: KOBiZE), part of the Institute of Environmental Protection-National Research Institute. EIU develops the inventory reports and is also responsible for the final quality control and quality assurance (QA/QC) of the data submitted. After completing of the inventory it is reviewed by the Ministry of the Environment (MoE), officially approved by MoE and sent to CLRTAP and EEA. Emission inventories are the basis for preparation of Air Emissions Accounts (AEA) according to NACE classification which are sent via national statistical institute (GUS) to EUROSTAT.

### Current system of air emission inventories

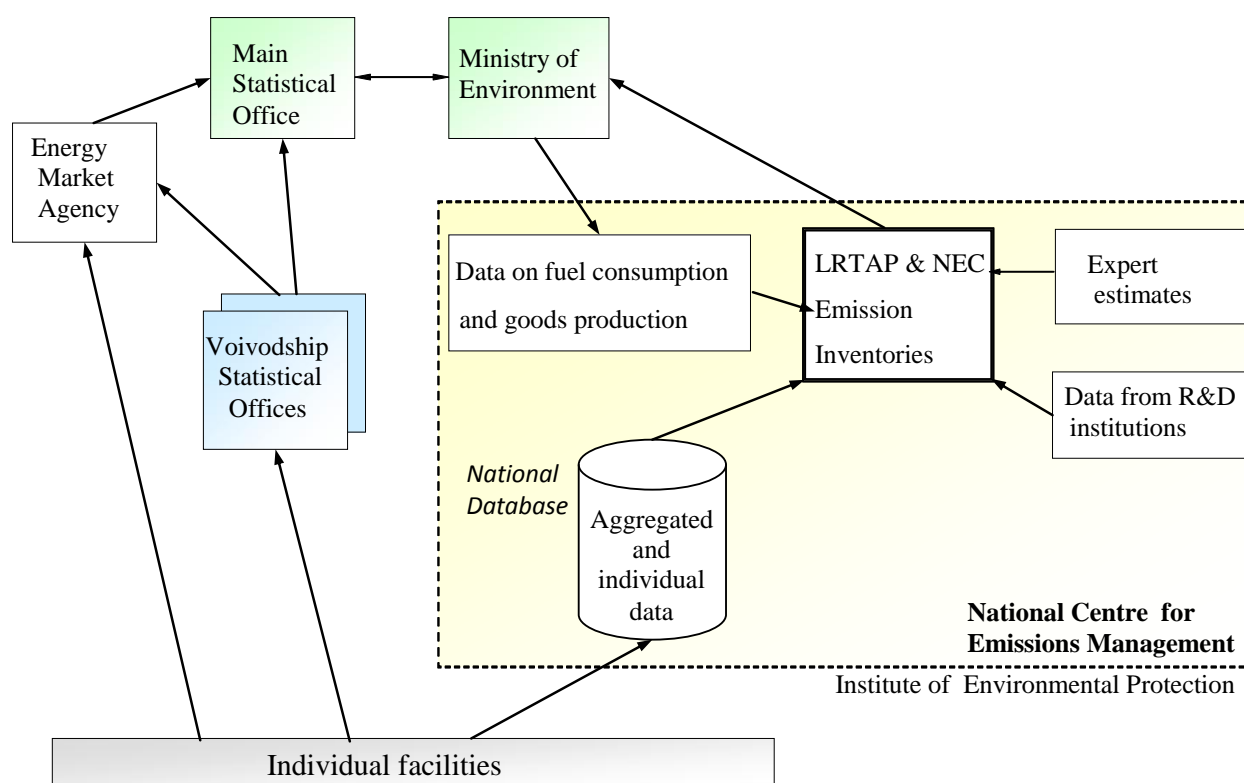


Figure 1.1 Current system of air emission inventories

<sup>1</sup> The Act of 17 July 2009 on the System to Manage the Emissions of Greenhouse Gases and Other Substances

### 1.3 Inventory preparation process

Basic information on activity data regarding particular emission source categories, are mostly taken from numerous official public statistics and Polish data in EUROSTAT database.

The activity data that are not available in public statistics, are worked out by experts through studies commissioned by the Ministry of the Environment or by the Institute of Environmental Protection specifically for emission inventory purposes. Other input data are received upon request.

To prepare the LRTAP inventory EIU collaborates with a number of institutions as well as individual experts. Among the collaborating institutions are: *Central Statistical Office (GUS)*, *Motor Transport Institute in Warsaw (ITS)*, *Energy Market Agency (ARE)*, *Institute of Technology and Life Sciences (ITP)*.

### 1.4 Methods and data sources

Emission factors for the emission sources are mostly taken from EMEP Inventory Guidebooks or reports on domestic research. The sources of particular emission factors are given below in the sectoral chapters.

The inventory team (*Emission Inventory Unit*), as a subunit of the NCEM (KOBiZE), has access to the individual data of entities reporting to the National Database run by KOBiZE. This ensures availability of data for major sources in emissions from stationary combustion sectors (NFR 1.A.1, 1.A.2) as well as from specific industrial processes. Such data are - after verification - successively included into emission inventory where possible.

To keep consistency with reports to UNFCCC Convention activity data (fuels use; goods production) are harmonized with GHG inventories.

Table 1.1 Main sources of information on activities

Emission source category	Main sources of information - Publications	Institution
Energy	Energy Statistics	GUS
	Statistical Yearbook of Poland	GUS
	Energy Balance for Poland	GUS/Eurostat
Industrial processes	Statistical Yearbook of Industry	GUS
	Statistical Yearbook of Poland	GUS
	Production of industrial goods	GUS
Use of chemical products	Import/export data	GUS
	Statistical Yearbook of Industry	GUS
Agriculture	Statistical Yearbook of Poland	GUS
	Agriculture Yearbook	GUS
Forestry	Forestry Yearbook	GUS
	Environment Yearbook	GUS
Waste	Environment Yearbook	GUS
	Statistical Yearbook of Poland	GUS
	Municipal infrastructure	GUS

## 1.5 Key Categories

Key categories are sources that together contribute up to 95 % of the level of reported emissions in Poland. In this Report level assessments have been carried out for the following pollutants: NO<sub>x</sub>, CO, SO<sub>2</sub>, NH<sub>3</sub>, NMVOC, TSP, Heavy metals and POPs. The level assessment was performed for 2014 and 1990. The results of the key source category analysis are presented in Appendix 3. Trends of key sectors according to NFR classification are presented in the chapter 2.

## 1.6 QA/QC and Verification methods

The programme for Quality Assurance and Quality Control has been elaborated to improve and assure high quality of the Polish annual greenhouse gas inventory. Rules of the programme apply also to the emissions inventory prepared for the UN ECE Convention on Long-range Transboundary Air Pollution. The QA/QC programme contains tasks, responsibilities as well as time schedule for performance of the QA/QC procedures. In 2009 QA/QC plan has been extended by automated back-up of inventory databases on separate server.

The Polish inventory is generated in two main steps. First calculations are produced approximately 9–11 months after the end of the inventoried year (n–1) depending primarily on the availability of required activity data. Initial check of activity data and estimation procedures is then done. When the official statistics are available the revision of data is made and final inventory is produced.

The calculated emissions figures for a given year, are compared to the respective figures from previous years (time series), and outliers are scrutinized in more detail. After the checking stage is completed, the final inventory files are prepared together with the accompanying reports.

After completing of the inventory it is reviewed by the Ministry of the Environment (MoE), including internal consultations with ministry departments. Then inventory data are officially approved by MoE.

The national inventory team – Emission Inventory Unit (EIU) – which is responsible for preparation of emission inventories, is also responsible for coordination and implementing the QA/QC activities.

These activities include Webdab check procedure and taking into account findings the three stages of the CEIP technical review of submitted data to improve consistency and completeness of the inventories.

Present QA/QC programme has been elaborated in parallel to QA/QC programme for GHG inventories in line with the IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories 2000 and is under implementation. Present QA/QC programme consists of double internal checking and external peer review carried out by the MoE. Since 2010 selected activities and emission volumes are derived from the National Emission Database (NED). For consistency maintenance, the data derived from the NED is verified or consulted with independent sectoral expert.

## Data management and archiving

All activity data, emission factors and resulting emission data are stored in the inventory databases, which are constantly updated and extended to meet the requirements for emission reporting, with respect to UNFCCC and LTRAP as well as their protocols.

Inventory databases are automatically archived on separate backup server.

Access to emission data for selected years, sectors and pollutants is possible via Internet. Inventory results are accessible from the EEA EIONET Central Data Repository (CDR) at <http://cdr.eionet.europa.eu/pl/un/EMEP%20emissions%20data>

Inventory reports are presented for downloading at NCEM website:

<http://www.kobize.pl/pl/article/krajowa-inwentaryzacja-emisji/id/385/zanieczyszczenia-powietrza>

### 1.7 General uncertainty evaluation

Most uncertain values of activity were assigned for burning of agricultural wastes (30 %). Lowest uncertainty values were assigned to 1.A.1 Energy Industries (solid and liquid fuels 2 %, gaseous 1 %). In general Polish energy sector is covered with detailed national statistics, which allows to keep overall uncertainty of inventory at low level.

Application of emission factors derived from expert assessments or obtained using small sample statistics in each case strongly affect magnitude of uncertainty. In this report (see Appendix 5) assessment of uncertainty is presented for: SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, CO, TSP, Pb, Cd, Hg and PCDD/F. Tier2 assessment (Monte Carlo simulation) is provided for each two main key categories considering all pollutants separately. For SO<sub>2</sub> and NO<sub>x</sub> emission data from 1.A.1.a (public power sector) were derived directly from emitters (bottom-up approach). The rest of uncertainty assessment represents indicative range of uncertainty for particular NFR categories and pollutants determined using Tier1 approach.

At this moment information on uncertainties of activity data and emission factors are collected from sectoral experts and literature. Monte Carlo analysis (Tier2 approach) was developed for public power and energy – the best known sector so far. Some experiences and conclusions from GHG uncertainty analysis were also taken into account. Carrying out presented analysis the highest priority has been given to SO<sub>2</sub>, NO<sub>x</sub> and NMVOC. Uncertainties of activity data (especially energy data) are of similar level as estimated for GHG inventory.

Uncertainty estimates for main pollutants have been listed under particular NFR categories. All uncertainty estimates are included in the Appendix 5.

### 1.8 General Assessment of Completeness

General assessment of the completeness presented in this chapter applies to the emission estimates in Poland. The completeness for each pollutant and major sources is discussed briefly below.

## Sulphur dioxide emissions

Estimated emissions are considered to be complete for most key sources. The most important source of sulphur dioxide emissions is the stationary combustion of fuels (mainly coal) in the energy sectors which made up app. 100 % of total Poland's SO<sub>2</sub> emissions.

Mobile sources are responsible only for 0.2% of sulphur dioxide emissions due to the low sulphur content in liquid fuels. Emissions from the sectors: *Extraction and distribution of fossil fuels and Geothermal Energy* (SNAP 05), *Solvent and other product use* (SNAP 06), *Agriculture* (SNAP 10) and *Other sources and sinks* (SNAP 11) are considered to be negligible. The disaggregation of SO<sub>2</sub> emissions in NFR is given below in Table 1.2.

Table 1.2. SO<sub>2</sub> emissions in 2013-2014 according to NFR classification

NFR	SO2 emissions in 2013 [Gg]	SO2 emissions in 2014 [Gg]
1A1a	434.786	401.559
1A1b	12.394	13.487
1A1c	0.821	0.907
1A2a	21.145	25.297
1A2b	3.189	3.389
1A2c	35.318	34.789
1A2d	8.392	8.188
1A2e	18.139	17.861
1A2f	24.435	23.954
1A3ai(i)	0.049	0.055
1A3aii(i)	0.004	0.004
1A3bi	0.681	0.725
1A3bii	0.221	0.236
1A3biii	0.288	0.237
1A3biv	0.004	0.004
1A3c	0.010	0.010
1A3dii	0.000	0.000
1A3ei	0.003	0.004
1A4ai	23.971	21.394
1A4bi	222.040	203.540
1A4ci	36.684	33.839
1A4cii	0.165	0.159
1A4ciii	0.002	0.002
1B1b	2.823	2.468
1B2aiv	4.022	3.803
2B10a	3.539	3.879
2C1	0.221	0.217
5C1a	0.020	0.013
5C1bi	0.007	0.007
5C1biii	0.049	0.058
5C1bv	0.017	0.016
<b>TOTAL</b>	<b>853.438</b>	<b>800.101</b>

## Nitrogen oxides (as NO<sub>2</sub>) emissions

Estimated emissions are considered to be complete for key sources. The major sources of emissions are stationary combustion of fuels for energy production in public power plants and road transport. Emissions from the sectors: *Extraction and distribution of fossil fuels and Geothermal Energy* (SNAP 05) and *Other sources and sinks* (SNAP 11) are considered to be negligible. The disaggregation of NO<sub>x</sub> emissions in NFR is given below in Table 1.3.

Table 1.3. NO<sub>x</sub> emissions in 2013-2014 according to NFR classification

NFR	NO <sub>x</sub> emissions in 2013 [Gg]	NO <sub>x</sub> emissions in 2014 [Gg]
1A1a	257.868	231.947
1A1b	4.006	3.110
1A1c	0.556	0.275
1A2a	8.940	10.043
1A2b	1.541	1.573
1A2c	11.336	9.853
1A2d	6.672	6.582
1A2e	6.453	6.438
1A2f	15.314	15.375
1A3ai(i)	0.629	0.705
1A3aii(i)	0.036	0.042
1A3bi	107.571	110.773
1A3bii	36.384	38.476
1A3biii	84.278	70.302
1A3biv	0.186	0.192
1A3c	5.346	5.281
1A3dii	0.213	0.268
1A3ei	2.049	0.883
1A4ai	16.623	14.205
1A4bi	68.690	61.922
1A4ci	8.436	7.909
1A4cii	87.552	84.580
1A4ciii	6.612	5.956
1B1b	4.656	4.367
1B2aiv	2.656	2.498
2B1	2.482	2.651
2B2	8.663	8.990
2B6	0.004	0.004
2B10a	2.621	2.855
2C1	1.475	1.515
2C3	0.016	0.016
2G	0.000	0.000
2H1	0.881	0.881
3Da1	11.623	10.828
5C1a	0.090	0.057
5C1bi	0.260	0.266
5C1biii	0.049	0.058
5C1bv	0.010	0.009
5C2	1.311	1.430
<b>TOTAL</b>	<b>774.087</b>	<b>723.114</b>



## Carbon monoxide emissions

Estimated emissions are considered to be complete for key sources. The most important of them (about 62 % of country total) is a combustion of fuels in households. Emissions from the sectors: *Extraction and distribution of fossil fuels and Geothermal Energy* (SNAP 05), *Solvent and other product use* (SNAP 06) and *Other sources and sinks* (SNAP 11) are considered to be negligible. The disaggregation of CO emissions in NFR is given below in Table 1.4.

Table 1.4. CO emissions in 2013-2014 according to NFR classification

NFR	CO emissions in 2013 [Gg]	CO emissions in 2014 [Gg]
1A1a	50.89	48.38
1A1b	0.14	0.16
1A1c	1.48	1.44
1A2a	142.48	153.94
1A2b	4.97	5.40
1A2c	26.28	26.02
1A2d	6.06	6.01
1A2e	13.22	13.20
1A2f	45.18	47.06
1A3ai(i)	0.05	0.06
1A3aii(i)	0.49	0.56
1A3bi	456.10	448.35
1A3bii	61.95	57.92
1A3biii	46.10	39.02
1A3biv	17.09	17.82
1A3c	2.92	2.88
1A3dii	0.10	0.13
1A4ai	16.49	14.38
1A4bi	1 647.94	1 501.25
1A4ci	178.93	165.44
1A4cii	76.51	73.91
1A4ciii	0.91	0.82
1B1b	12.20	13.68
1B2aiv	1.64	1.64
2A2	3.31	3.52
2A3	0.02	0.02
2B1	0.25	0.27
2B10a	2.71	3.21
2C1	22.08	24.29
2C3	1.95	1.97
2G	0.01	0.00
2H1	4.85	4.84
3F	2.55	5.72
5C1a	0.04	0.02
5C1bi	0.01	0.01
5C1biii	0.10	0.12
5C1bv	0.00	0.00
5C2	20.35	20.35
<b>TOTAL</b>	<b>2 868.33</b>	<b>2 703.71</b>

## Ammonia emissions

Estimated emissions are considered to be complete for key sources. The major source of emissions is *Agriculture* (98 %), of which manure management amounts for 69 %. Emissions from the combustion of fuels in stationary plants, solvents use and off-road transport are not significant. The disaggregation of NH<sub>3</sub> emissions in NFR is given below in Table 1.5.

Table 1.5. NH<sub>3</sub> emissions in 2013-2014 according to NFR classification

NFR	NH <sub>3</sub> emissions in 2013 [Gg]	NH <sub>3</sub> emissions in 2014 [Gg]
1A3bi	0.610	0.618
1A3bii	0.059	0.056
1A3biii	0.043	0.036
1A3biv	0.002	0.002
1A3c	0.001	0.001
1A4bi	0.531	0.480
1A4cii	0.013	0.013
1B1b	0.047	0.048
2B1	0.025	0.027
2B7	1.065	1.068
2D3g	0.009	0.011
3B1a	53.258	52.175
3B1b	48.599	50.335
3B2	0.364	0.325
3B3	53.265	56.097
3B4d	0.119	0.119
3B4e	2.015	2.015
3B4gi	14.567	12.195
3B4gii	3.390	4.057
3B4giv	2.508	2.469
3Da1	86.715	80.781
5D1	2.547	2.203
<b>TOTAL</b>	<b>269.753</b>	<b>265.130</b>

## Particulate matter emissions

The main source of TSP emissions in Poland are the combustion processes in the stationary and mobile sources.

Category *Non-industrial combustion plants* (SNAP 02) has the highest share in the emission of TSP within the group of stationary sources (SNAP categories 01 ÷ 05 + 09 + 11).

Means of transport and machines with combustion engines (categories SNAP 07 and SNAP 08) have 22 % share (in 2014) in the total national emission. Large part of this emission comes from automobile tire and brake wear.

Estimated emissions are considered to be complete for key sources. Tables 1.6 shows the respective emission estimates in NFR classification.

Table 1.6. PM2.5, PM10 and TSP emissions in 2013-2014 according to NFR classification

NFR	PM2.5 emissions		PM10 emissions		TSP emissions	
	2013	2014	2013	2014	2013	2014
	Gg	Gg	Gg	Gg	Gg	Gg
1A1a	14.77	13.88	25.61	24.11	35.07	32.75
1A1b	0.34	0.23	0.56	0.38	0.41	0.32
1A1c	0.26	0.24	0.40	0.41	0.19	0.19

NFR	PM2.5 emissions		PM10 emissions		TSP emissions	
	2013	2014	2013	2014	2013	2014
	Gg	Gg	Gg	Gg	Gg	Gg
1A2a	1.91	2.09	3.15	3.48	5.10	5.66
1A2b	0.50	0.49	1.03	1.01	1.69	1.67
1A2c	2.63	2.60	4.34	4.32	7.02	7.03
1A2d	0.61	0.60	1.00	1.00	1.62	1.62
1A2e	1.32	1.32	2.18	2.19	3.53	3.57
1A2f	1.70	1.69	2.80	2.81	5.20	5.19
1A3ai(i)	0.01	0.01	0.01	0.01	0.01	0.01
1A3aii(i)	0.00	0.00	0.00	0.00	0.00	0.00
1A3bi	7.44	8.01	7.44	8.01	7.44	8.01
1A3bii	2.49	2.57	2.49	2.57	2.49	2.57
1A3biii	7.18	5.98	7.18	5.98	7.18	5.98
1A3biv	0.00	0.00	0.00	0.00	0.00	0.00
1A3bvi	1.60	1.58	2.53	2.50	20.18	19.91
1A3bvii	NA	NA	1.83	1.84	38.64	38.22
1A3c	0.47	0.46	0.47	0.46	0.47	0.46
1A3dii	0.02	0.02	0.02	0.02	0.02	0.02
1A3ei	0.02	0.02	0.02	0.02	0.02	0.02
1A4ai	5.03	4.47	5.42	4.83	8.32	7.41
1A4bi	59.35	54.04	97.69	89.16	129.67	118.43
1A4ci	9.21	8.54	20.24	18.82	25.89	24.09
1A4cii	8.57	8.28	8.57	8.28	8.57	8.28
1A4ciii	0.45	0.41	0.45	0.41	0.45	0.41
1B1a	0.71	0.69	7.15	6.86	14.54	13.95
1B1b	0.94	0.96	1.87	1.91	0.76	0.66
1B2aiv	NA	NA	NA	NA	0.30	0.30
2A1	1.63	1.74	2.97	3.16	3.26	3.48
2A2	0.12	0.12	0.71	0.69	1.75	1.71
2A3	0.64	0.68	0.71	0.77	0.79	0.85
2A5a	0.17	0.18	1.73	1.75	3.52	3.56
2A5b	0.12	0.12	1.23	1.17	2.46	2.34
2B6	NA	NA	NA	NA	0.01	0.01
2B7	NA	NA	NA	NA	0.12	0.12
2B10a	1.34	1.41	1.79	1.89	2.68	2.75
2B10b	0.02	0.02	0.18	0.19	0.57	0.61
2C1	1.80	1.94	2.32	2.51	4.26	4.59
2C2	NA	NA	NA	NA	0.07	0.06
2C3	0.02	0.02	0.05	0.05	0.06	0.06
2C5	0.00	0.00	0.00	0.01	0.00	0.01
2G	1.67	1.42	1.67	1.42	1.67	1.42
2H1	0.53	0.53	0.71	0.70	0.88	0.88
2L	0.51	0.49	5.11	4.90	12.74	12.20
3B1a	0.02	0.02	1.01	0.99	2.25	2.20
3B1b	0.03	0.03	1.33	1.38	2.96	3.06
3B3	0.07	0.07	3.14	3.31	6.98	7.37
3B4e	0.00	0.00	0.08	0.08	0.18	0.18
3B4gi	0.04	0.03	0.19	0.16	0.41	0.35
3B4gii	0.06	0.07	0.28	0.33	0.61	0.73
3B4giv	0.10	0.09	4.29	4.23	9.52	9.37
3F	0.06	0.13	0.06	0.13	0.06	0.13
5A	0.27	0.19	1.77	1.24	3.74	2.62
5C1a	0.01	0.00	0.01	0.00	0.01	0.00
5C1bi	5.24	4.95	8.98	8.49	14.97	14.15
5C2	1.33	1.45	1.43	1.56	1.47	1.61
<b>TOTAL</b>	<b>143.33</b>	<b>134.91</b>	<b>246.23</b>	<b>232.49</b>	<b>402.51</b>	<b>383.14</b>

## NMVOCs emissions

The total emission of non-methane volatile organic compounds from the anthropogenic sources in 2014 was 606 Gg. Estimated emissions are considered to be complete for most sources.

Category SNAP 06 has the highest (about 36%) share in the emission of NMVOCs among the group of stationary sources. Other significant categories in the national emissions are *Road transport* and *Non-industrial combustion plants* with the shares of about 20%.

Finally, the natural sources (forests), classified as category SNAP 11, have emitted about 283 Gg of NMVOCs in 2014. Emissions from the natural sources (NFR category 7 & 11) are not included in the country total.

Table 1.7. NMVOC emissions in 2013-2014 according to NFR classification

NFR	NMVOC emissions in 2013 [Gg]	NMVOC emissions in 2014 [Gg]
1A1a	21.365	21.494
1A1b	0.161	0.119
1A1c	0.169	0.166
1A2a	0.499	0.531
1A2b	0.067	0.070
1A2c	1.043	0.963
1A2d	2.957	2.936
1A2e	0.601	0.624
1A2f	3.286	3.474
1A3ai(i)	0.025	0.028
1A3aii(i)	0.008	0.009
1A3bi	37.778	35.640
1A3bii	7.673	7.281
1A3biii	19.222	15.525
1A3biv	7.619	7.988
1A3bv	50.192	50.773
1A3c	1.257	1.242
1A3dii	0.049	0.062
1A4ai	1.504	1.329
1A4bi	104.469	95.075
1A4ci	17.211	16.087
1A4cii	13.982	13.507
1A4ciii	1.438	1.295
1B1a	7.706	7.327
1B1b	4.680	4.784
1B2ai	0.096	0.098
1B2aiv	29.101	29.537
1B2av	14.167	13.805
1B2b	9.374	9.255
2B10a	23.461	23.379
2C1	4.301	4.450
2D3a	46.195	46.195
2D3c	3.726	3.780
2D3d	112.678	120.105
2D3e	10.310	10.441
2D3f	5.774	5.774
2D3g	26.761	27.408
2D3i	7.267	7.608
2G	0.000	0.000
2H1	0.881	0.881

NFR	NMVOC emissions in 2013 [Gg]	NMVOC emissions in 2014 [Gg]
2H2	11.426	10.228
2I	0.957	0.962
3Da1	0.007	0.007
3F	0.241	0.540
5A	0.000	0.000
5C1a	0.371	0.234
5C1bi	2.209	2.264
5C1biii	0.258	0.309
5C1bv	0.000	0.000
5C2	0.636	0.693
5D1	0.000	0.000
<b>NATIONAL TOTAL</b>	<b>615.160</b>	<b>606.282</b>

### Heavy metal emissions

Main share of HM emissions comes from combustion processes. *Combustion in energy and transformation industries* is the biggest source of mercury emissions and for lead and cadmium the biggest source is *Combustion in manufacturing industries*. The highest amounts of arsenic and copper are emitted from primary copper production. The biggest source of chrome, zinc and nickel emissions is combustion of coal in households.

Estimated emissions are considered to be complete for key sources. Tables 1.8 and 1.9 below include emissions estimates for Pb, Cd, Hg, As, Cr, Cu, Ni and Zn in 2013 and 2014 according to NFR classification.

Table 1.8. Heavy metals emissions in 2013 according to NFR classification

NFR	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
1A1a	28.92	0.87	5.83	5.15	6.33	19.49	15.78	110.63
1A1b	0.73	0.57	0.01	0.55	0.73	1.58	14.64	1.10
1A1c	0.38	0.08	0.02	0.04	0.09	0.23	0.23	2.22
1A2a	6.17	1.01	0.10	0.53	0.89	3.33	3.82	25.53
1A2b	195.03	2.36	1.59	16.43	0.13	165.28	0.54	312.54
1A2c	8.49	1.39	0.14	0.73	1.23	4.58	5.25	35.12
1A2d	1.96	0.32	0.03	0.17	0.28	1.06	1.21	8.10
1A2e	4.27	0.70	0.07	0.37	0.62	2.30	2.64	17.66
1A2f	5.49	0.98	0.50	0.47	0.79	2.96	3.40	22.70
1A3aii(i)	NA	NA	NA	NA	NA	0.01	0.02	NA
1A3bi	13.52	0.18	NA	NA	1.57	2.04	3.41	NA
1A3bii	0.97	0.10	NA	NA	0.11	0.66	1.10	NA
1A3biii	IE	0.14	NA	NA	NA	0.86	1.44	NA
1A3biv	0.00	NA	NA	NA	0.02	0.01	0.02	NA
1A3c	NA	0.00	NA	NA	NA	0.03	0.05	NA
1A3dii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1A4ai	10.17	0.22	0.26	1.04	1.37	5.86	5.28	41.45
1A4bi	136.55	2.04	0.66	14.78	17.83	78.84	66.17	544.34
1A4ci	6.83	0.30	0.19	2.48	2.83	12.12	10.27	82.76
1A4cii	NA	0.08	NA	NA	NA	0.49	0.82	NA
1A4ciii	NA	0.01	NA	NA	NA	0.03	0.06	NA
1B1b	2.06	0.05	0.01	0.19	1.59	0.84	0.61	2.06

NFR	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
2A1	2.97	NA	NA	0.18	1.48	NA	1.48	2.97
2A3	9.93	0.15	0.05	0.10	2.48	0.50	1.99	9.93
2B10a	NA	0.19	0.07	NA	NA	NA	NA	NA
2C1	76.90	1.72	0.44	0.71	6.01	15.67	5.94	154.05
2C2	0.02	NA	NA	NA	NA	NA	NA	NA
2C3	NA	0.00	NA	NA	NA	NA	0.00	0.00
2C5	0.90	NA	NA	NA	NA	NA	NA	NA
2G	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
5C1a	1.75	0.15	0.06	0.00	0.02	0.15	0.01	1.05
5C1bv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA
<b>TOTAL</b>	<b>514.00</b>	<b>13.63</b>	<b>10.03</b>	<b>43.91</b>	<b>46.39</b>	<b>318.93</b>	<b>146.18</b>	<b>1 374.21</b>

Table 1.9. Heavy metals emissions in 2014 according to NFR classification

NFR	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
1A1a	27.77	1.07	5.34	5.16	6.27	19.11	19.55	107.49
1A1b	0.50	0.38	0.01	0.36	0.49	1.06	9.71	0.92
1A1c	0.46	0.09	0.03	0.05	0.09	0.27	0.27	2.50
1A2a	6.84	1.12	0.11	0.55	0.98	3.66	4.07	28.25
1A2b	205.74	2.66	1.87	18.07	0.13	181.05	0.54	355.26
1A2c	8.50	1.39	0.13	0.69	1.21	4.56	5.06	35.11
1A2d	1.96	0.32	0.03	0.16	0.28	1.05	1.17	8.11
1A2e	4.31	0.71	0.07	0.35	0.62	2.31	2.57	17.81
1A2f	5.53	1.00	0.39	0.45	0.79	2.96	3.29	22.85
1A3aii(i)	NA	NA	NA	NA	NA	0.01	0.02	NA
1A3bi	13.53	0.21	NA	NA	1.57	2.17	3.62	NA
1A3bii	0.79	0.11	NA	NA	0.09	0.71	1.18	NA
1A3biii	IE	0.12	NA	NA	NA	0.71	1.18	NA
1A3biv	0.00	NA	NA	NA	0.02	0.01	0.02	NA
1A3c	NA	0.00	NA	NA	NA	0.03	0.05	NA
1A3dii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
1A4ai	8.99	0.19	0.23	0.92	1.21	5.17	4.66	36.57
1A4bi	125.14	1.83	0.60	13.50	16.30	72.22	60.68	498.72
1A4ci	6.48	0.28	0.18	2.40	2.70	11.45	9.58	77.93
1A4cii	NA	0.08	NA	NA	NA	0.48	0.80	NA
1A4ciii	NA	0.01	NA	NA	NA	0.03	0.05	NA
1B1b	2.10	0.05	0.01	0.19	1.63	0.86	0.62	2.10
2A1	3.16	NA	NA	0.19	1.58	NA	1.58	3.16
2A3	10.93	0.16	0.05	0.11	2.73	0.55	2.19	10.93
2B10a	NA	0.22	0.07	NA	NA	NA	NA	NA
2C1	82.51	1.77	0.44	0.74	6.14	15.82	6.34	158.11
2C2	0.02	NA	NA	NA	NA	NA	NA	NA
2C3	NA	0.00	NA	NA	NA	NA	0.00	0.00
2C5	0.89	NA	NA	NA	NA	NA	NA	NA
2G	0.00	0.00	0.00	0.00	0.00	0.00	NA	NA
5C1a	1.11	0.09	0.03	0.00	0.01	0.09	0.00	0.66
5C1bv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NA
<b>TOTAL</b>	<b>517.26</b>	<b>13.87</b>	<b>9.59</b>	<b>43.89</b>	<b>44.84</b>	<b>326.36</b>	<b>138.81</b>	<b>1 366.49</b>

## PCDD/F emissions

The main source (about 59 %) of PCDD/F emissions comes from *Combustion processes in Non-industrial combustion plants*. Within this category the dominant source is *Residential: stationary plants*, which covers combustion processes in household boilers and furnaces.

Important source of PCDD/F emissions is the category *Other* which includes fires of: landfills, buildings (public, private and industrial), road vehicles and forests. In this category the dominant source are landfill fires.

Estimated emissions are considered to be complete for all sources. Table 1.10 shows the respective emission estimates in NFR classification.

Table 1.10. PCDD/F emissions in 2013-2014 according to NFR classification

NFR	PCDD/F emissions in 2013 [g i-TEQ]	PCDD/F emissions in 2014 [g i-TEQ]
1A1a	12.68	13.12
1A1b	0.56	0.37
1A1c	0.04	0.04
1A2a	10.23	11.03
1A2b	19.32	22.23
1A2c	1.35	1.31
1A2d	0.31	0.30
1A2e	0.68	0.66
1A2f	1.77	1.82
1A3bi	0.48	0.50
1A3bii	0.11	0.11
1A3biii	0.11	0.09
1A3biv	0.00	0.00
1A3c	0.00	0.00
1A3dii	0.00	0.00
1A4ai	2.00	1.44
1A4bi	151.83	138.32
1A4ci	1.52	1.40
1A4cii	0.07	0.07
1A4ciii	0.00	0.00
1B1b	2.81	2.87
2A2	17.10	18.17
2A3	0.52	0.56
2C1	11.17	11.00
2C3	0.03	0.03
2G	0.00	0.00
2H2	0.68	0.66
3F	5.32	11.91
5C1a	0.00	0.00
5C1bi	0.02	0.02
5C1biii	0.00	0.00
5C1biv	0.08	0.09
5C1bv	0.31	0.30
5C2	2.03	2.22
<b>TOTAL</b>	<b>243.14</b>	<b>240.67</b>

## HCB emissions

The largest (57 %) contribution to the national total of HCB emissions comes from category *Combustion in manufacturing industries*. Large emissions occur in secondary copper production and in sinter plants. Other two major sectors are *Road transport* (SNAP 07) and *Combustion processes in Non-industrial combustion plants* (SNAP 02). Significant contributions come from residential plants and from waste incineration both in industry and hospitals at installations equipped with merely basic APCs. Estimated emissions are considered to be complete for key sources. Table 1.11 shows the respective emission estimates in NFR classification.

Table 1.11. HCB emissions in 2013-2014 according to NFR classification

NFR	HCB emissions in 2013 [kg]	HCB emissions in 2014 [kg]
1A1a	0.95	0.94
1A1b	0.00	0.00
1A1c	0.00	0.00
1A2a	1.02	1.10
1A2b	5.67	6.18
1A2c	0.09	0.09
1A2d	0.02	0.02
1A2e	0.04	0.04
1A2f	0.28	0.31
1A3bi	1.29	1.44
1A3bii	0.52	0.57
1A3biii	0.22	0.18
1A3biv	0.00	0.00
1A4ai	0.04	0.04
1A4bi	1.81	1.66
1A4ci	0.10	0.10
2C1	0.01	0.02
5C1a	0.01	0.01
5C1bi	0.87	0.82
5C1biii	0.05	0.06
<b>TOTAL</b>	<b>13.02</b>	<b>13.57</b>

## PCB emissions

The dominant source of PCB emissions (67 %) are *Non-industrial combustion plants*, with main share from residential fuels combustion. The other important source is *Combustion in energy and transformation industries* (19 %). Estimated emissions are considered to be complete for key sources. Table 1.12 shows the respective emission estimates in NFR classification.



Table 1.12. PCB emissions in 2013-2014 according to NFR classification

NFR	PCB emissions in 2013 [kg]	PCB emissions in 2014 [kg]
1A1a	136.71	132.89
1A1b	0.34	0.22
1A1c	0.09	0.09
1A2a	2.82	3.38
1A2b	0.87	0.95
1A2c	3.27	3.60
1A2d	0.75	0.83
1A2e	1.65	1.83
1A2f	2.19	2.43
1A3bi	2.36	2.63
1A3bii	1.24	1.37
1A3biii	56.53	45.41
1A3biv	0.00	0.00
1A4ai	5.15	3.28
1A4bi	503.97	451.08
1A4ci	2.36	2.14
2C1	31.41	32.16
5C1a	0.01	0.01
5C1bi	0.91	0.86
5C1biii	0.04	0.05
<b>TOTAL</b>	<b>752.66</b>	<b>685.21</b>

### PAH emissions

The main source of PAHs emission (86 %) in Poland are *Non-industrial combustion plants* (mostly residential plants). The second large source of national emissions are *Production processes* with coke production as the dominant sub-sector. Estimated emissions are considered to be complete for key sources. Table 1.13 shows the respective emission estimates in NFR classification.

Table 1.13. PAH emissions in 2013-2014 according to NFR classification

NFR	BaP		BbF		BkF		IP		4-PAH emissions	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
1A1a	0.00	0.00	0.15	0.16	0.15	0.16	0.03	0.03	0.32	0.35
1A1b	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
1A1c	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
1A2a	0.00	0.00	0.04	0.05	0.07	0.07	0.02	0.02	0.14	0.14
1A2b	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.02
1A2c	0.00	0.00	0.06	0.06	0.10	0.09	0.03	0.03	0.19	0.18
1A2d	0.00	0.00	0.01	0.01	0.02	0.02	0.01	0.01	0.04	0.04
1A2e	0.00	0.00	0.03	0.03	0.05	0.05	0.02	0.01	0.10	0.09
1A2f	0.00	0.00	0.04	0.04	0.06	0.06	0.02	0.02	0.12	0.12
1A3bi	1.12	1.25	0.00	0.00	0.00	0.00	0.00	0.00	1.13	1.26
1A3bii	0.59	0.65	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.65
1A3biii	0.85	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.71
1A3biv	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1A3c	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03
1A3dii	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1A4ai	0.00	0.00	0.04	0.03	0.04	0.03	0.02	0.02	0.10	0.09
1A4bi	35.89	32.62	43.20	39.22	9.21	8.30	46.57	42.52	134.88	122.66
1A4ci	0.00	0.00	0.07	0.06	0.07	0.06	0.03	0.03	0.17	0.16
1A4cii	0.49	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.47
1A4ciii	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
1B1b	7.02	7.18	2.34	2.39	2.34	2.39	2.81	2.87	14.51	14.83
2C3	0.18	0.18	0.64	0.65	0.64	0.65	0.08	0.08	1.54	1.56
2D3i	0.00	0.00	NA	NA	0.00	0.00	0.00	0.00	0.01	0.01
<b>TOTAL</b>	<b>46.21</b>	<b>43.11</b>	<b>46.64</b>	<b>42.71</b>	<b>12.78</b>	<b>11.91</b>	<b>49.65</b>	<b>45.65</b>	<b>155.28</b>	<b>143.39</b>

For some air pollutants volumes of emissions have not been placed in the original emission source category but included in other NFR sub-category (usually on a higher level of aggregation). It is caused by the difficulties in appropriate disaggregation of activity data. Such cases have been listed in table 1.14. Some emission data due to the change of NFR classification have not been attributed to proper categories – it will be corrected in the next submission. Such cases have been listed in table 1.15.

Table 1.14 Air pollutant emissions included in other sub-categories (notation key IE)

NFR code	Substance(s)	Included in NFR
1A2gvii	NO <sub>x</sub> , NMVOC, SO <sub>2</sub> , PM, CO, HMs (excl. Cu, Se, Zn), POPs (excl. HCB, PCB)	1A3b
1A3biii	Pb (since 2005)	1A3bii
1A3ei	NMVOC, NO <sub>x</sub> , NMVOC, SO <sub>x</sub> ; reported only emission from gas turbines in pipeline systems	1A3
1A4aii	NEC, PM, HMs, PAHs	1A3b
1A4bii	NEC, PM, HMs, PAHs, PCDD/F	1A3b
2C3	SO <sub>2</sub>	1A2b
2C5	NO <sub>x</sub>	1A2b
2C6	NO <sub>x</sub> , HMs (excl. Se, Zn)	1A2b
2C7a	NO <sub>x</sub> , HMs (excl. Se, Zn)	1A2b
3B4giii	NH <sub>3</sub>	3B4giv

Table 1.15 Air pollutant emissions not properly attributed

NFR code	Substance(s)	Present notation	Proper notation
11 C	PCDD/F (Unintentional fires)	11 C	5 E

For some air pollutants volumes of emissions have not been estimated. Usually it is caused by the lack of verified emission factor. In some cases (listed below in table 1.16) there is no activity data available while the emission factor (at least default EF) is known. There are efforts made to gather needed activity data for the next inventory submission.

Table 1.16 Not estimated air pollutant emissions (notation key NE)

NFR code	NFR category	Substance(s)	Reason for not estimated
1 B 2 c	Venting and flaring	NMVOC; SO <sub>x</sub>	no activity data (gas burned)
1 B 2 c	Venting and flaring	PM; HMs	no final estimation made
2 D 3 b	Road paving with asphalt	NMVOC; PM	no activity data (Mg asphalt)
All		Se	no final estimation made
All		BC	no final estimation made

Initial inventory of selenium emissions for Poland based on methodology with default emission factors needs verification, especially development of country specific emission factors. Inventory of Black Carbon is under preparation.

## 2. Explanation of key trends

The description below applies to trends of emissions of several pollutants in the period 1990-2014. Performed recalculations of emission data from 1990 eliminate earlier time series inconsistencies though it seems that present emissions trends differ in a significant way only for some air pollutants. Due to the lack of direct statistical data for historical years some activity data were approximated based on interpolated data or those available for other years and may be subject to recalculation.

Improvements of methodology applied for 1990-2014 estimates are described in Chapters 3-7 (Sectoral Methodologies) and in Chapter 8 (Recalculations and Improvements).

### SO<sub>2</sub> emissions

Emissions of SO<sub>2</sub> decreased by over 70 % between 1990 and 2014. Most of the reductions were caused by the decline of the heavy industry in the late 1980s and early 1990s. In late 1990s the emissions decreased because of the diminished share of coal (hard and brown) among fuels used for power and heat generation.

The trend of sulphur dioxide emissions is influenced mainly by the combustion processes in the sectors SNAP 01÷03. It should be noted that during the mentioned period more and more power plants are equipped with desulphurization installations.

In 2014 emissions of sulphur dioxide decreased by 6.3% compared to the respective figure for the year 2013. The most significant decreases were in combustion processes in the Power Plants and in industries, as a result of lower coal use.

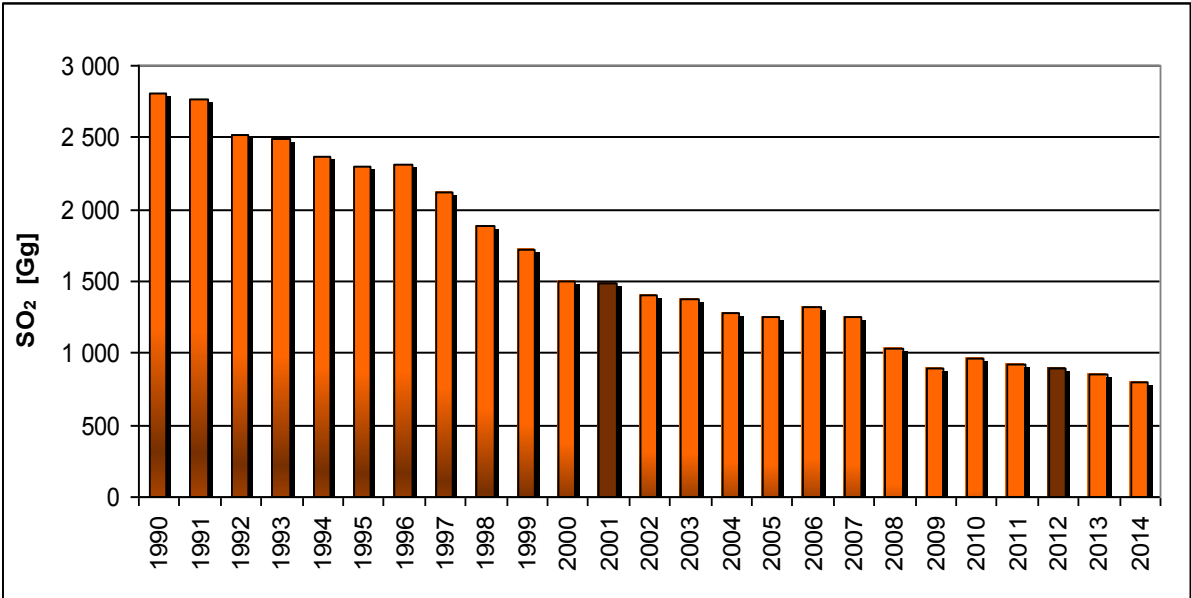


Figure 2.1.a Emissions trend of SO<sub>2</sub>

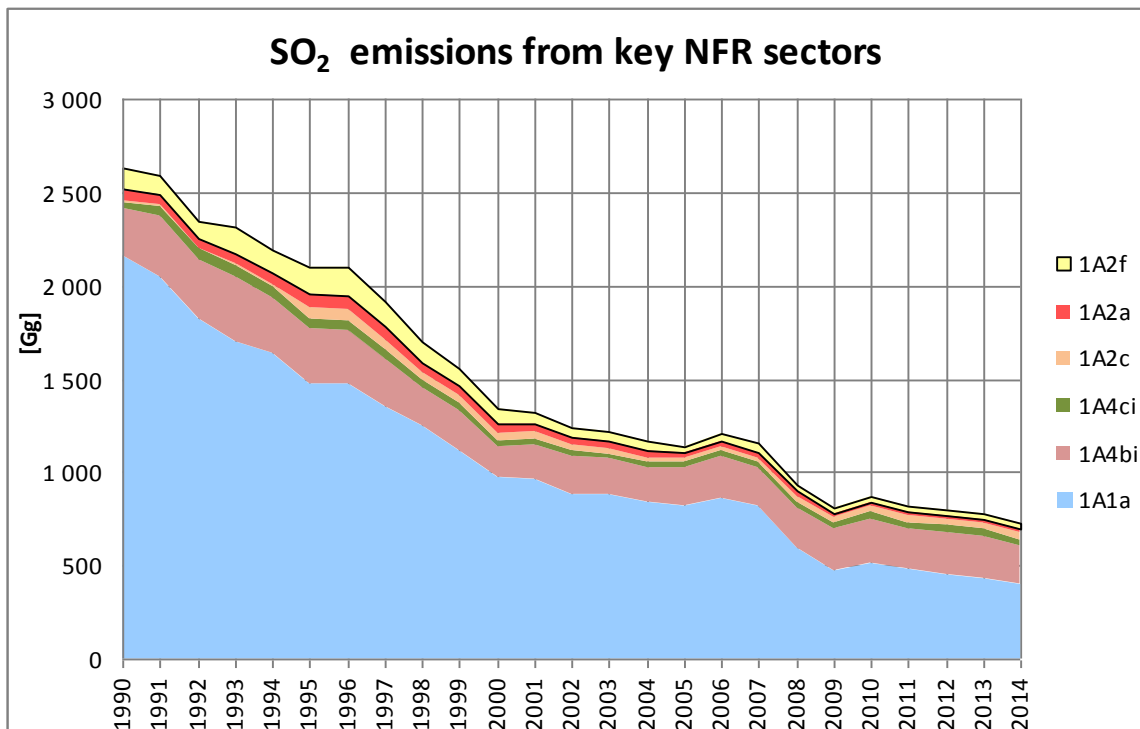


Figure 2.1.b Trend of SO<sub>2</sub> emissions for key NFR sectors

### NO<sub>x</sub> emissions

Emissions of NO<sub>x</sub> decreased by over 32 % between 1990 and 2014. Similarly to sulphur dioxide, most of the reductions were caused by the decline of the heavy industry and lower share of coal in the late 1980s and early 1990s. Substantial emissions from road traffic contribute to the national total, and cause comparatively lower emission reductions than in case of SO<sub>2</sub>.

Compared to the year 2013, in 2014 NO<sub>2</sub> emissions decreased by 6.5%. Decrease in emissions in *Road transport* was caused by lower use of liquid fuels.

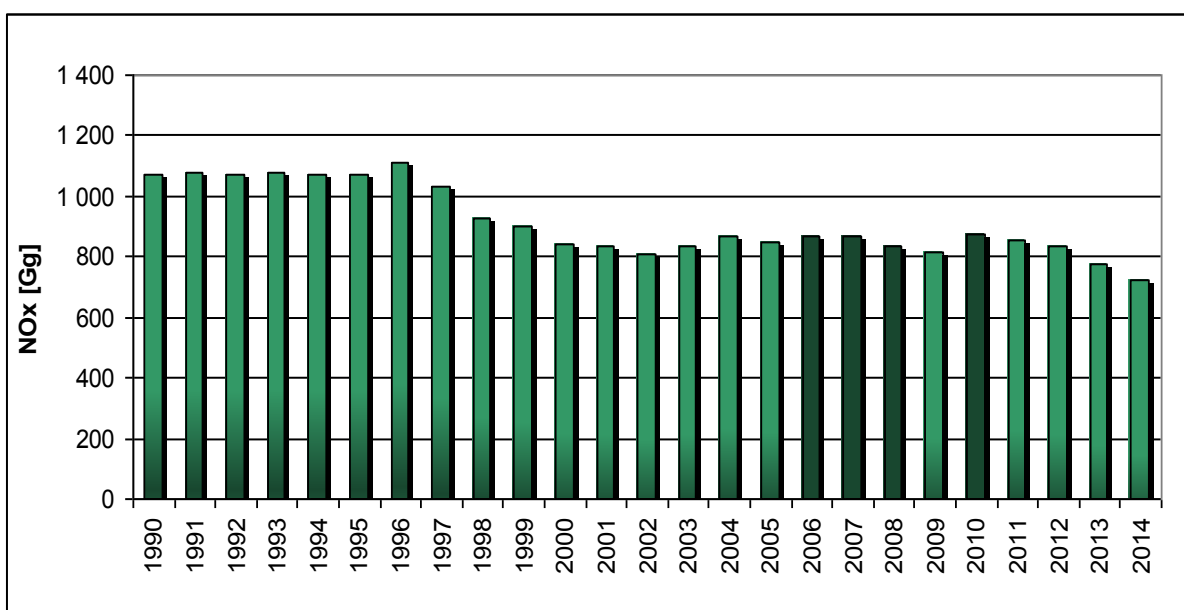


Figure 2.2.a Emissions trend of NO<sub>x</sub>

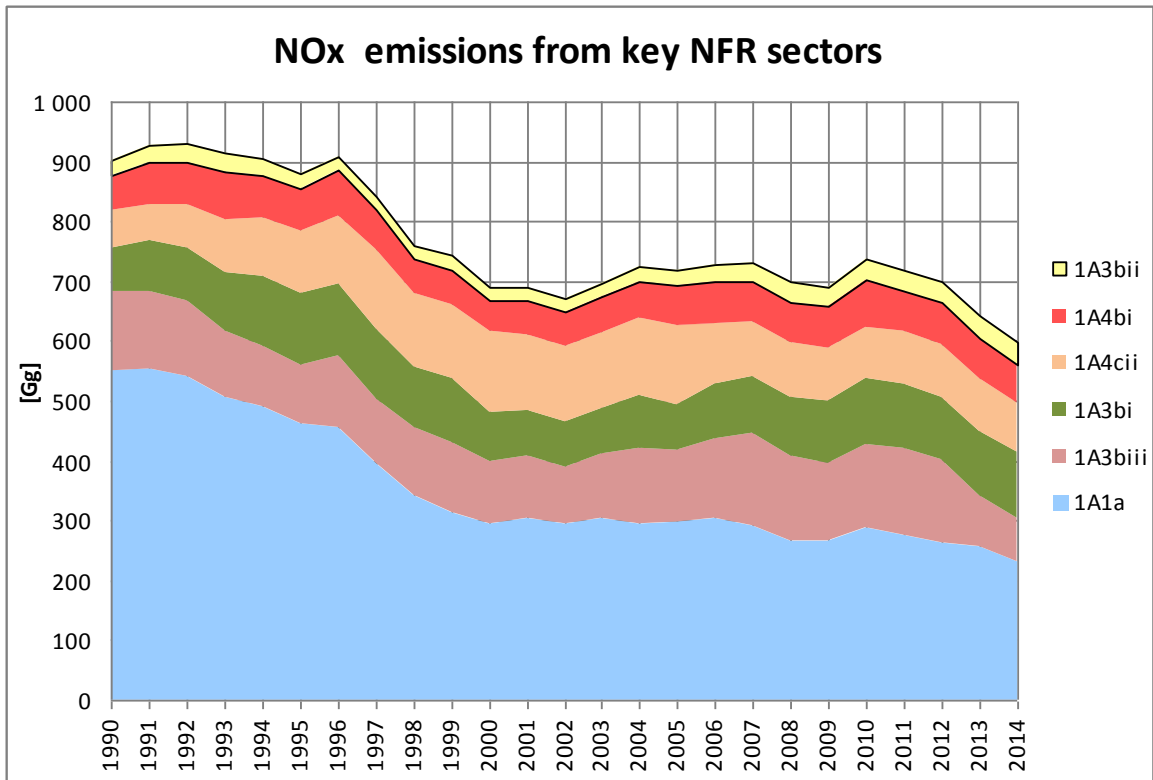


Figure 2.2.b Trend of NO<sub>x</sub> emissions for key NFR sectors

CO emissions

From 1990 to 2014 the emissions of CO have decreased by over 8%. Compared to the year 2013, in 2014 emission of CO decreased by 6% which was a result of lower use of coal and wood in households (SNAP 0202).

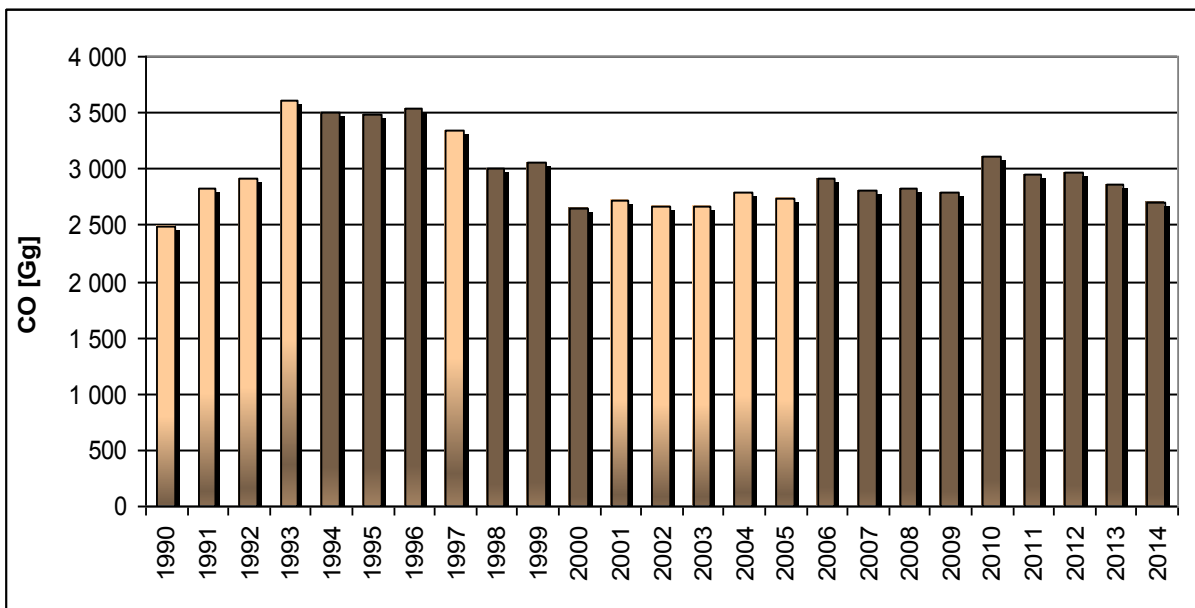


Figure 2.3.a Emissions trend of CO

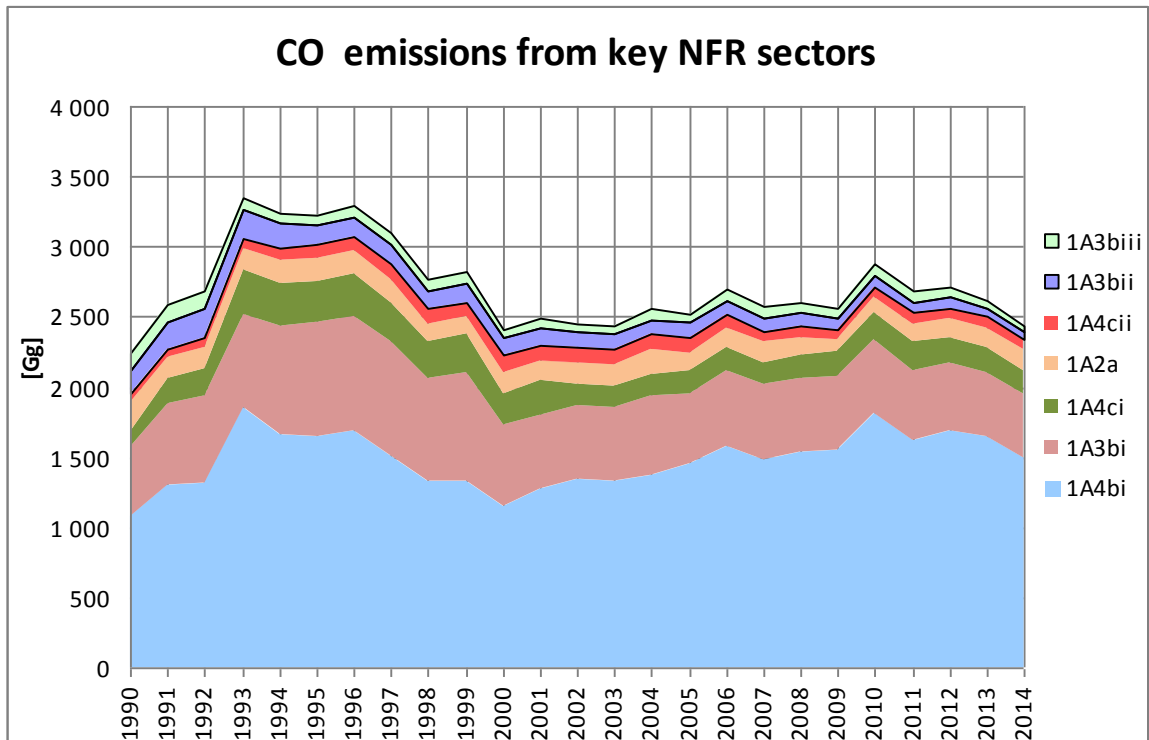


Figure 2.3.b Trend of CO emissions for key NFR sectors

Ammonia emissions

The trend of ammonia emissions is influenced mainly by the agriculture sector, namely by a number of animals and volume of N fertilizers applied. A small decrease by about 1.9% of NH<sub>3</sub> emissions in 2014 compared to 2013 was noted. The main influence on this interannual change had the lower volume of nitrogen synthetic fertilizers applied to agricultural fields.

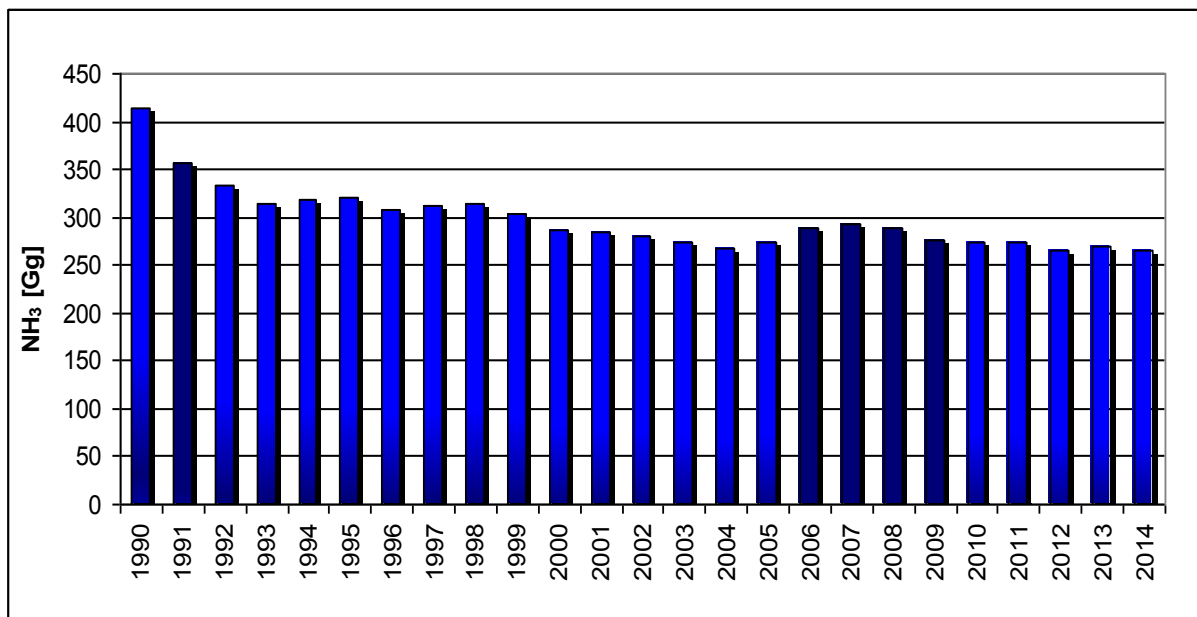


Figure 2.4.a Emissions trend of NH<sub>3</sub>

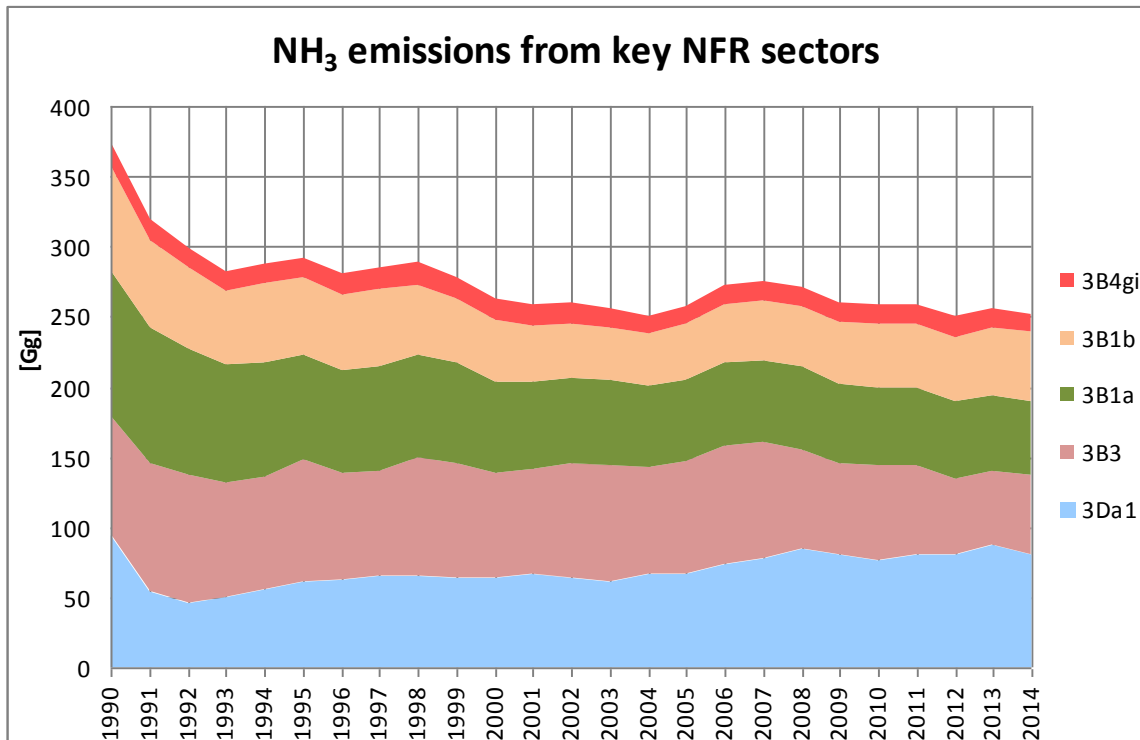


Figure 2.4.b Trend of NH<sub>3</sub> emissions for key NFR sectors

### PM emissions

Compared to estimates for the year 2013, emissions of TSP in 2014 slightly decreased (by about 4.8%). The major decrease was noted in the category *Non-Industrial Combustion Plants* due to a lower volume of coal and wood used in households. TSP emissions also decreased in *Road transport* due to a lower use of liquid fuels.

Figure 2.5 shows emission trend of TSP, PM<sub>10</sub> and PM<sub>2.5</sub> in the years 1990-2014. The volume of emissions in this period remained stable with small increases in 2005-2007, caused by a higher volume of combusted fuels.

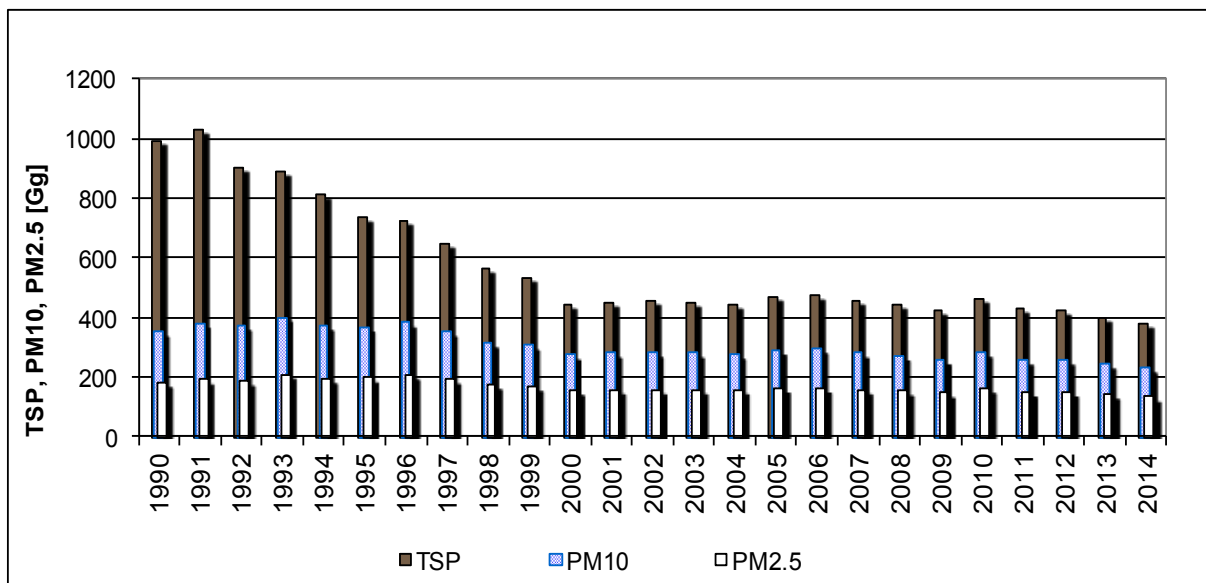


Figure 2.5.a Emissions of particulate matter



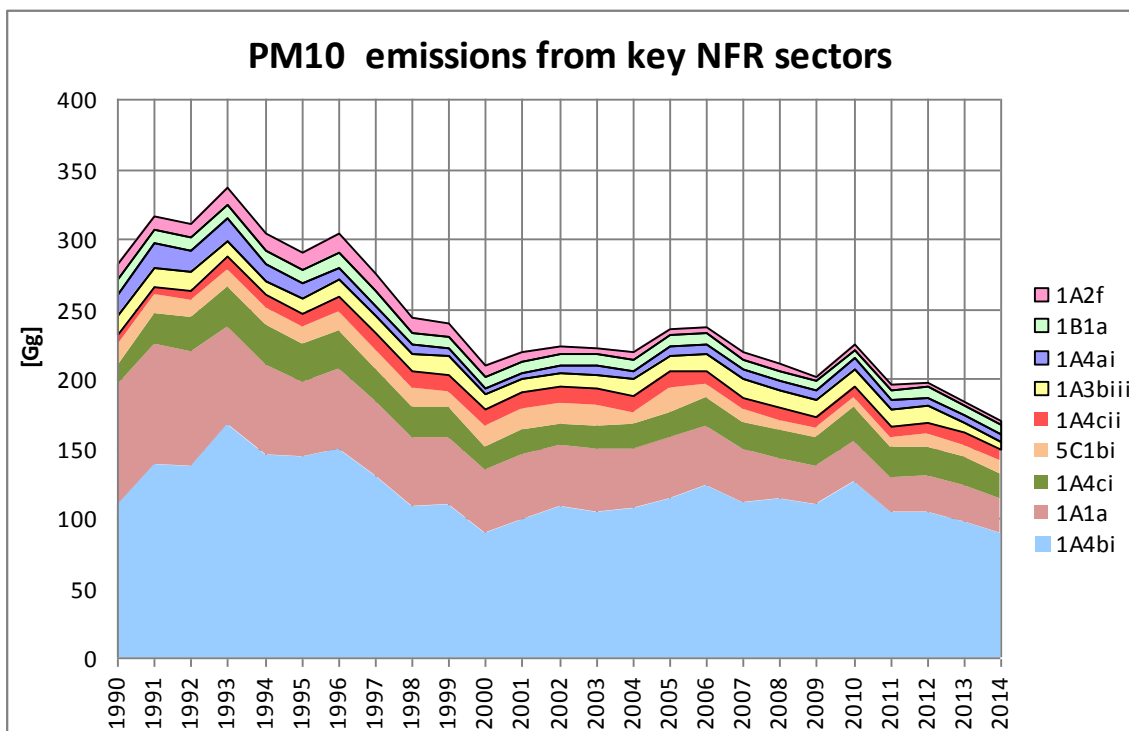


Figure 2.5.b Trend of PM10 emissions for key NFR sectors

### NMVOC emissions

Emissions of NMVOC decreased by over 11% between 1990 and 2014. According to calculations, the national total emission of NMVOCs in Poland in 2014 was 606 Gg. The assessed amount is lower by 1% compared to the respective figure for the year 2013. The biggest share in the decrease of the national total emission was due to lower volume of coal and wood used in households.

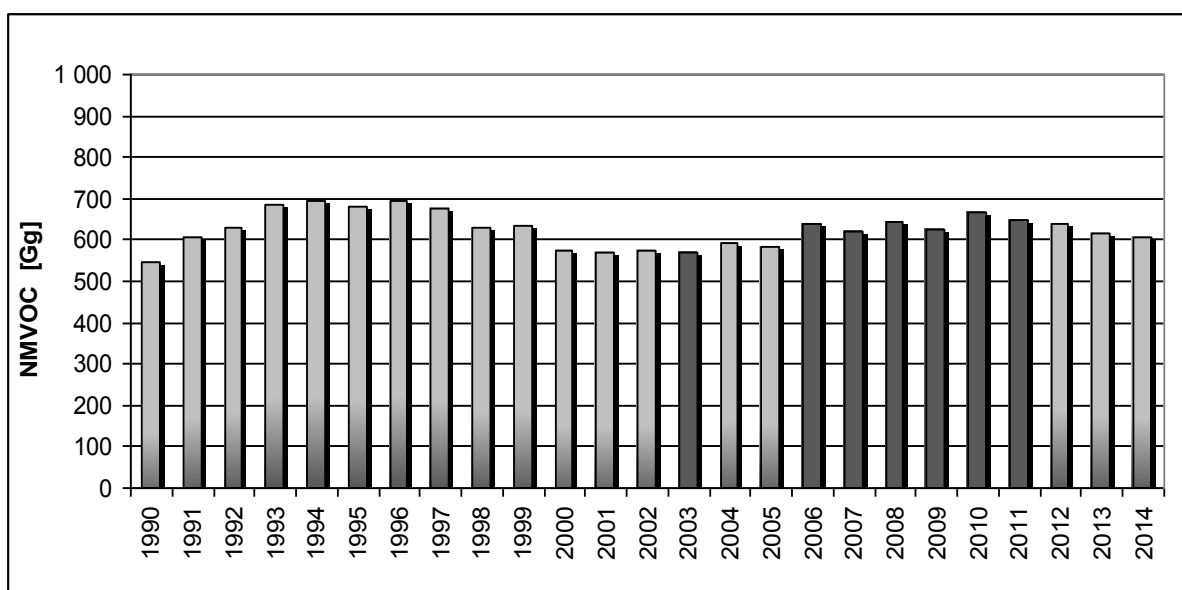


Figure 2.6.a Emissions of NMVOC

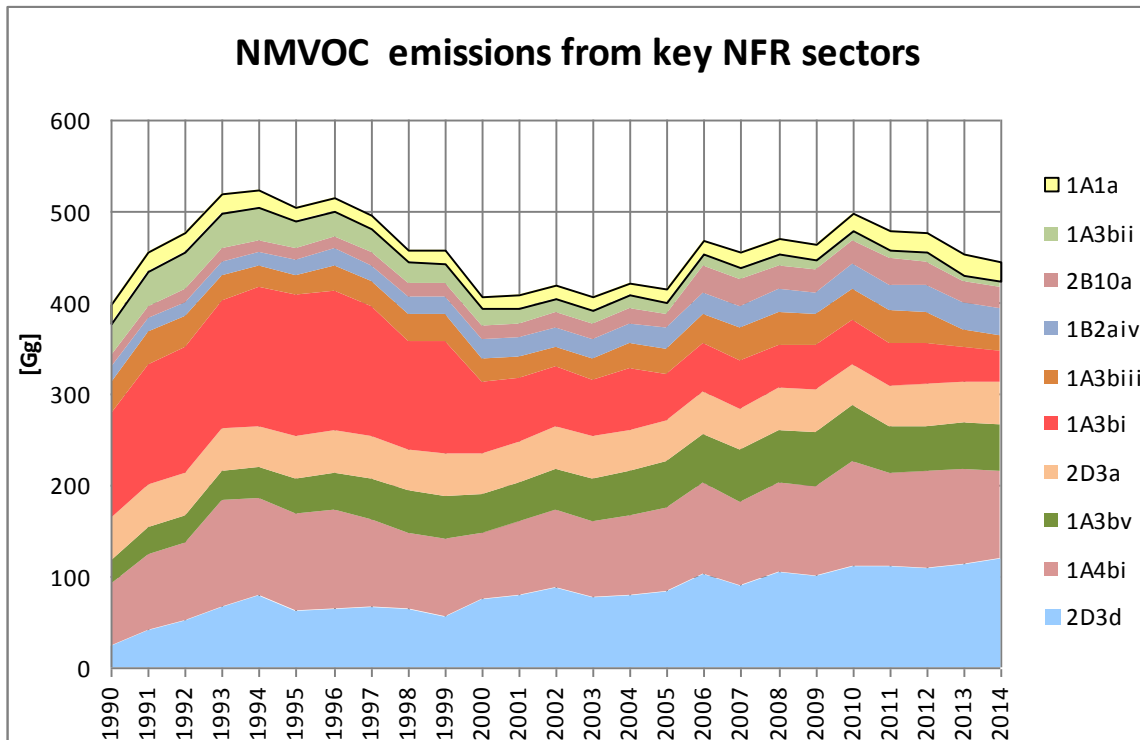


Figure 2.6.b Trend of NMVOC emissions for key NFR sectors

### Heavy metals emissions

Figures 2.7 and 2.8 show yearly emissions of heavy metals in the years 1990 - 2014. Visible downward trend in the 1990s has been caused by drop in economic activity.

The assessed national emission totals in 2014 for all of heavy metals are similar to the values calculated for the previous year. The highest decrease was noted for Ni – about 5 %, due to lower use of coal in households. The highest increase was noted for Cu – about 2 %, due to higher primary copper production.

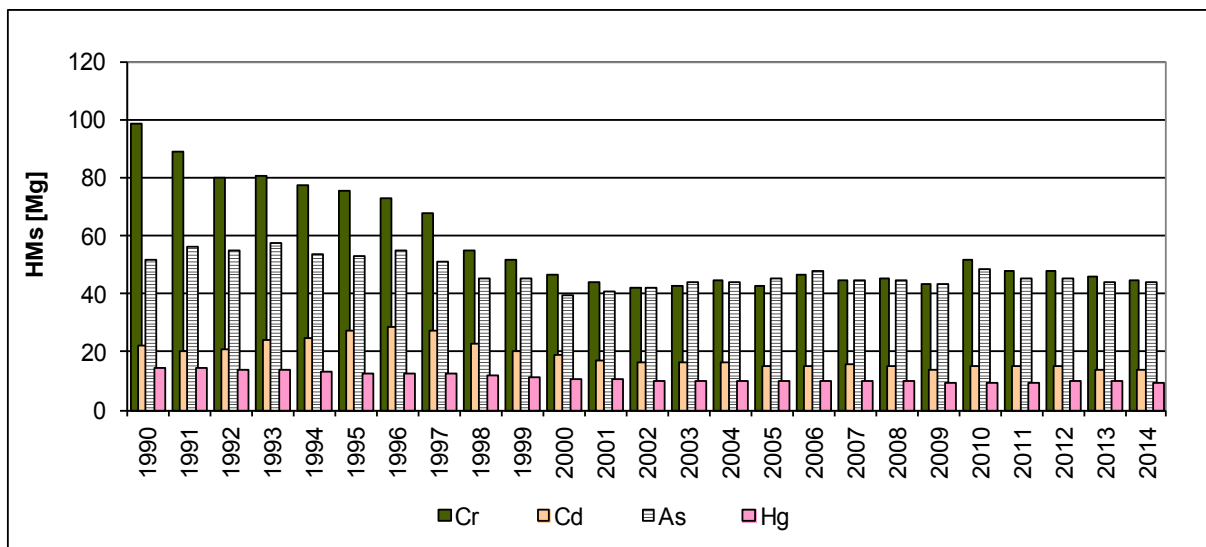


Figure 2.7.a Emissions of chrome, cadmium, arsenic and mercury

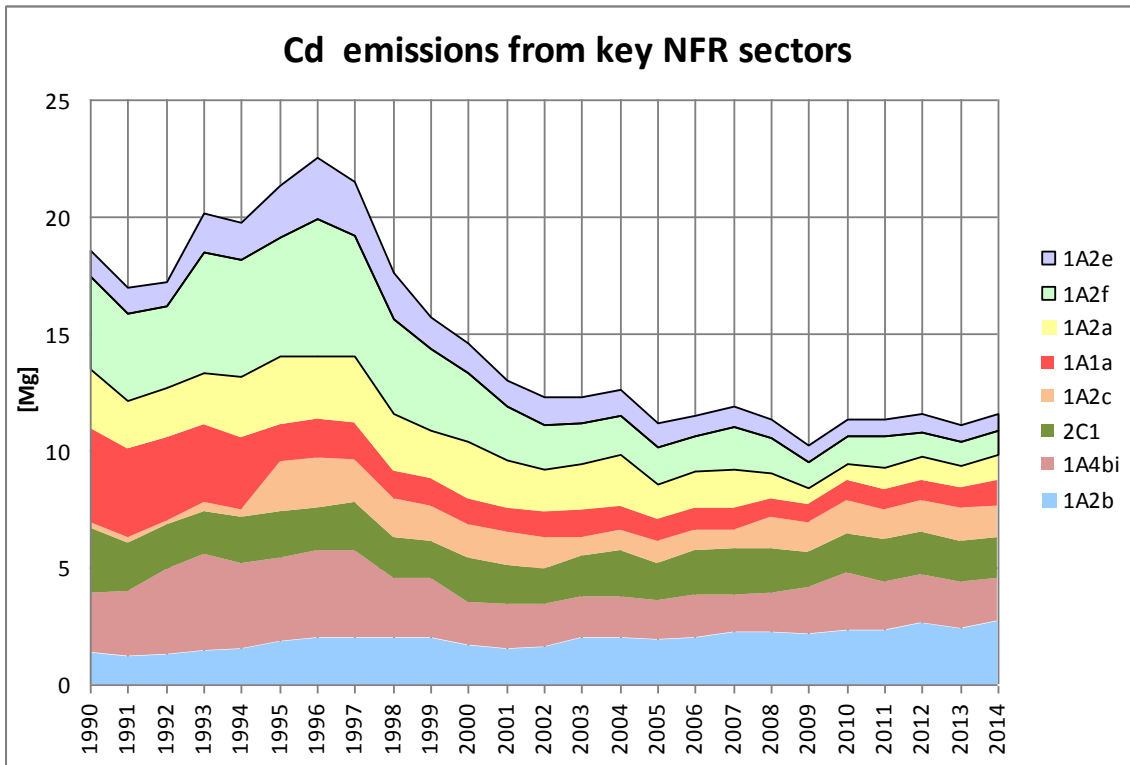


Figure 2.7.b Trend of Cd emissions for key NFR sectors

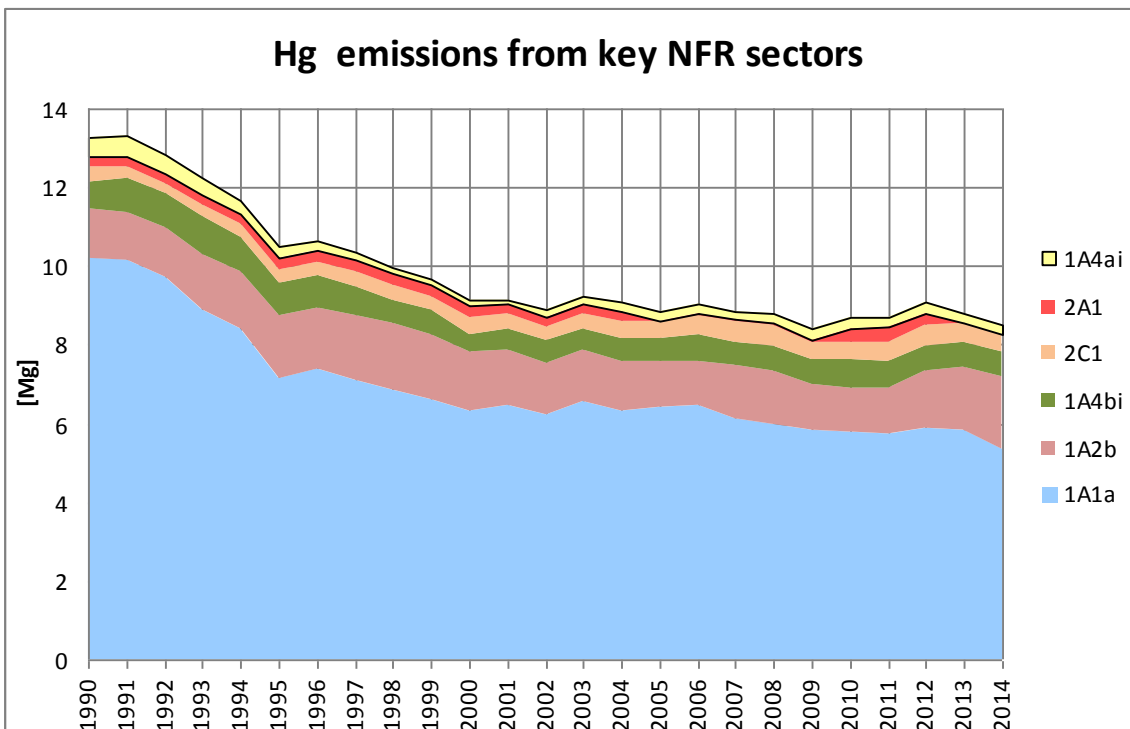


Figure 2.7.c Trend of Hg emissions for key NFR sectors

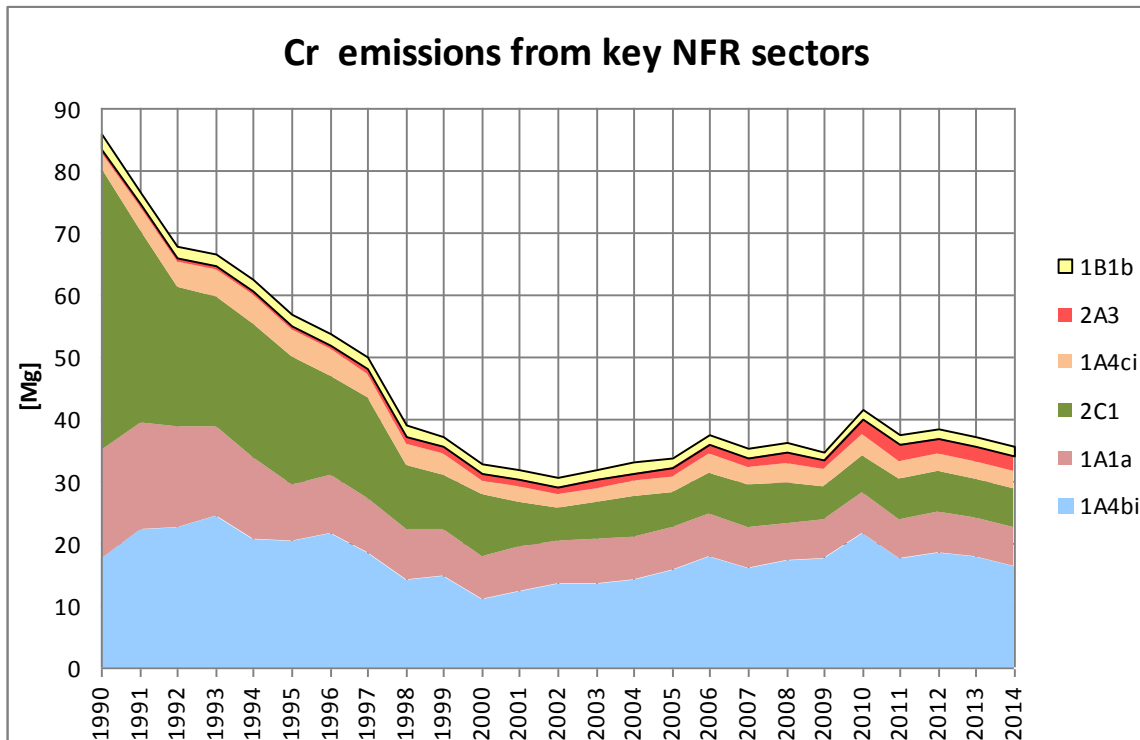


Figure 2.7.d Trend of Cr emissions for key NFR sectors

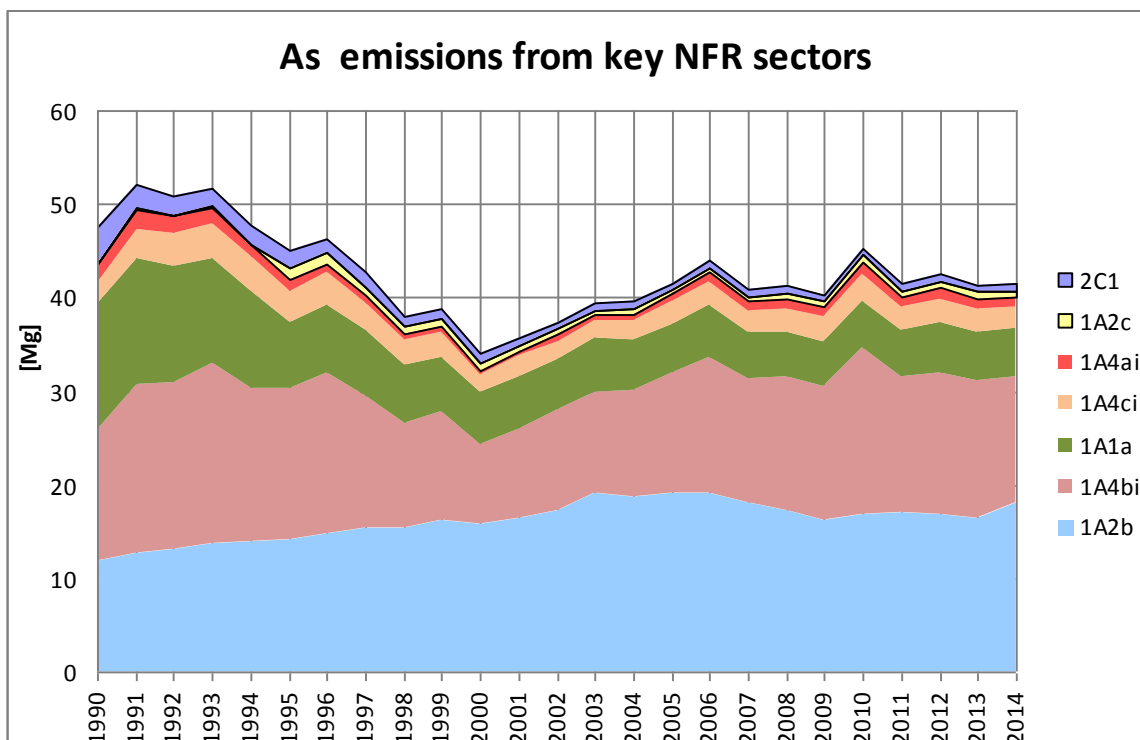


Figure 2.7.e Trend of As emissions for key NFR sectors

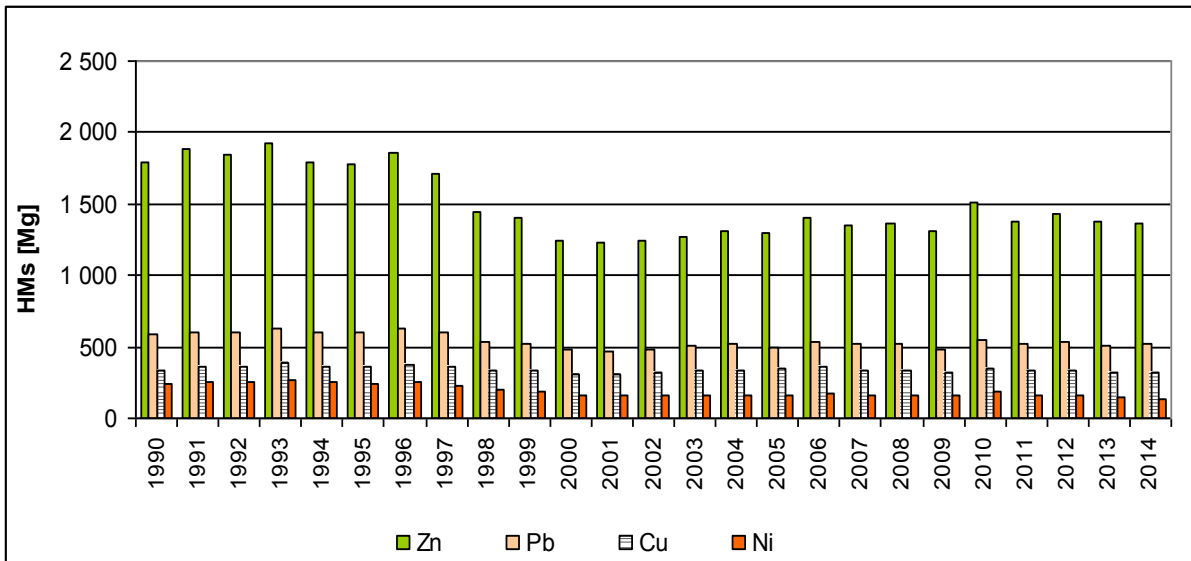


Figure 2.8.a Emissions of zinc, lead, copper and nickel

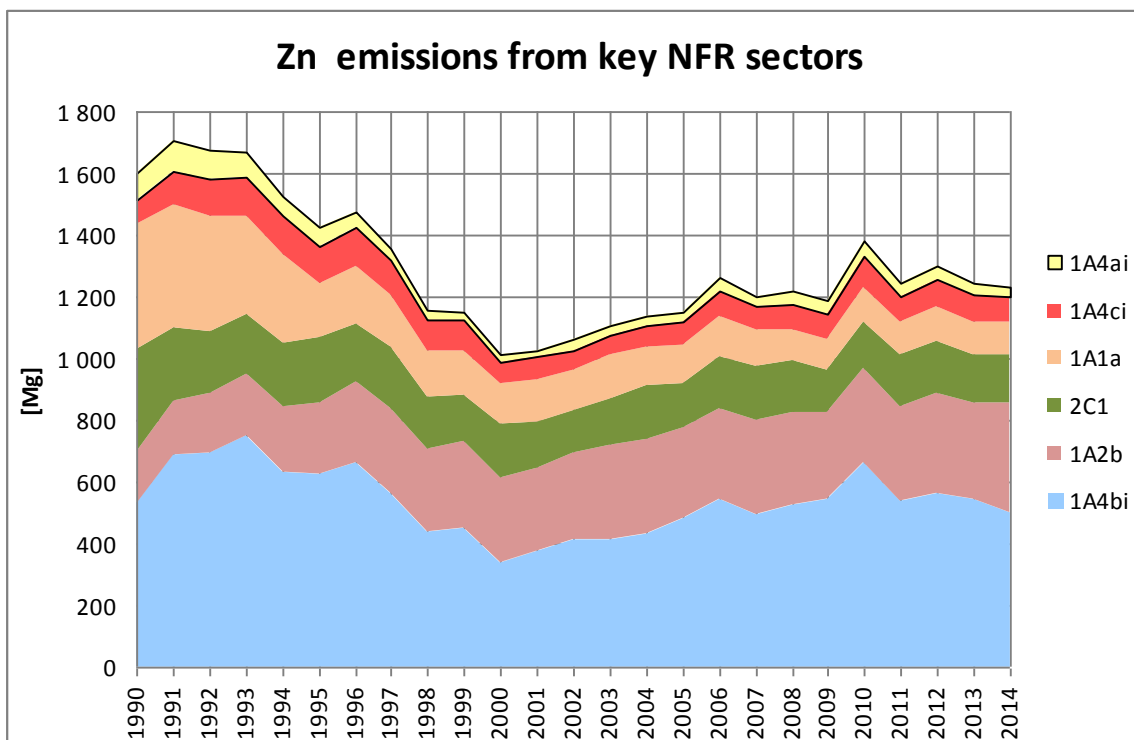


Figure 2.8.b Trend of Zn emissions for key NFR sectors

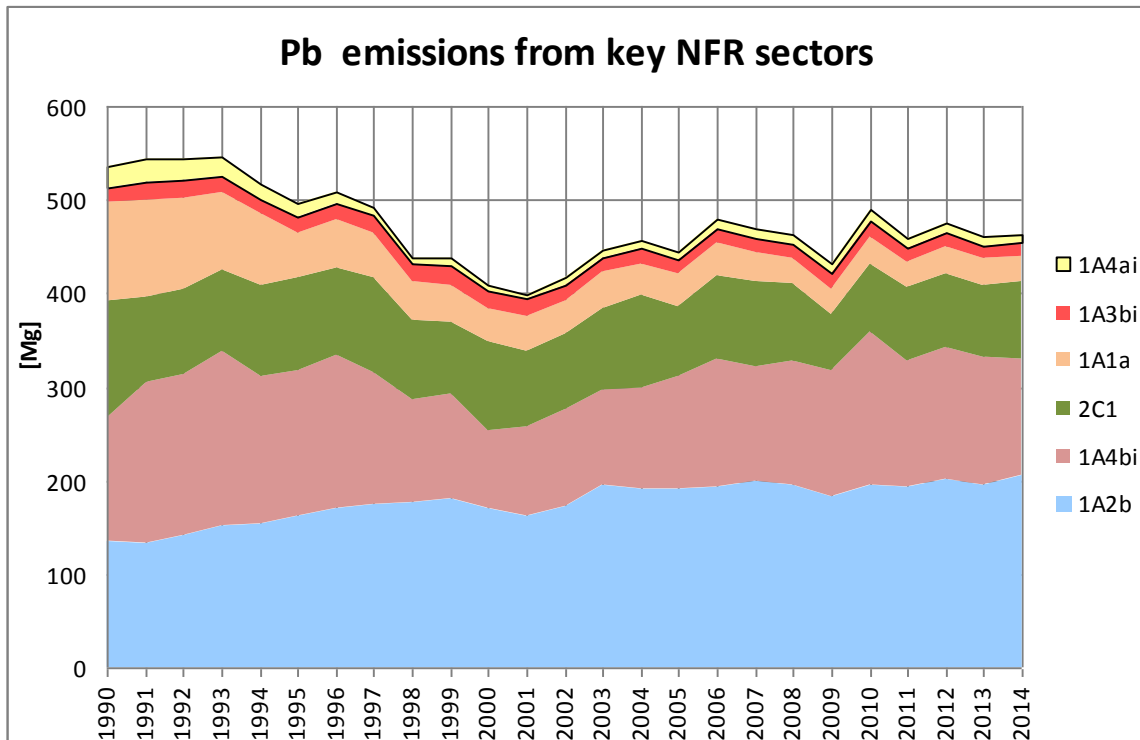


Figure 2.8.c Trend of Pb emissions for key NFR sectors

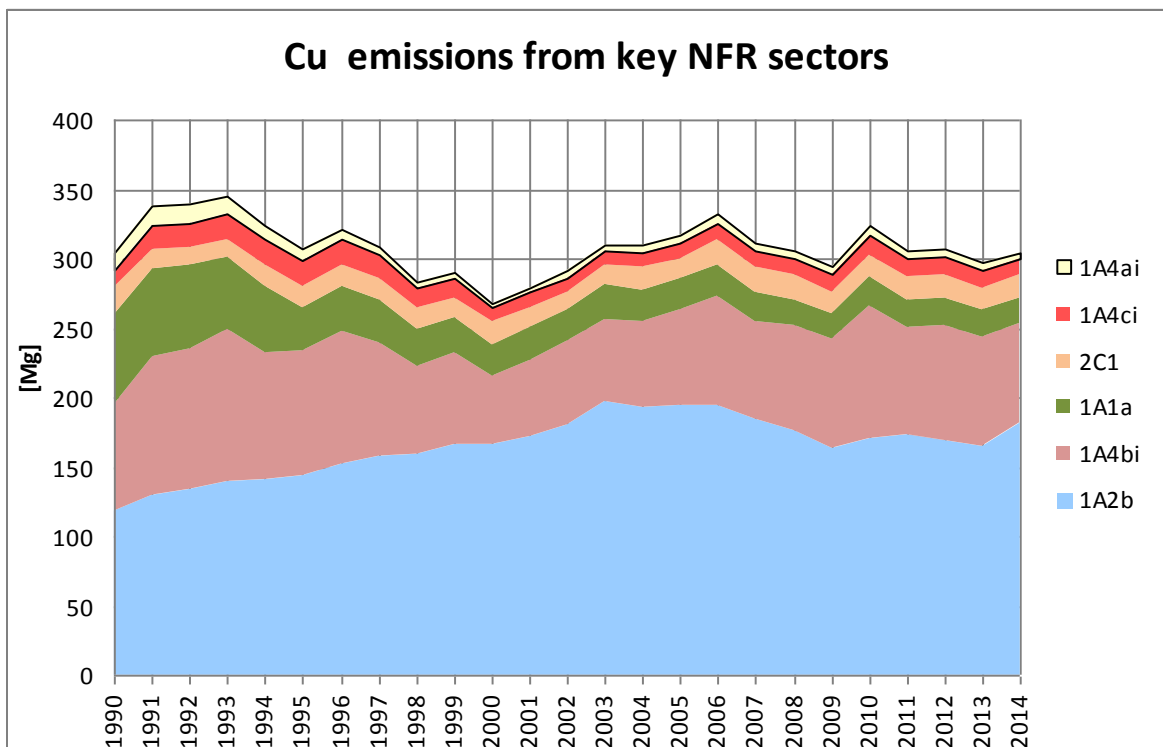


Figure 2.8.d Trend of Cu emissions for key NFR sectors

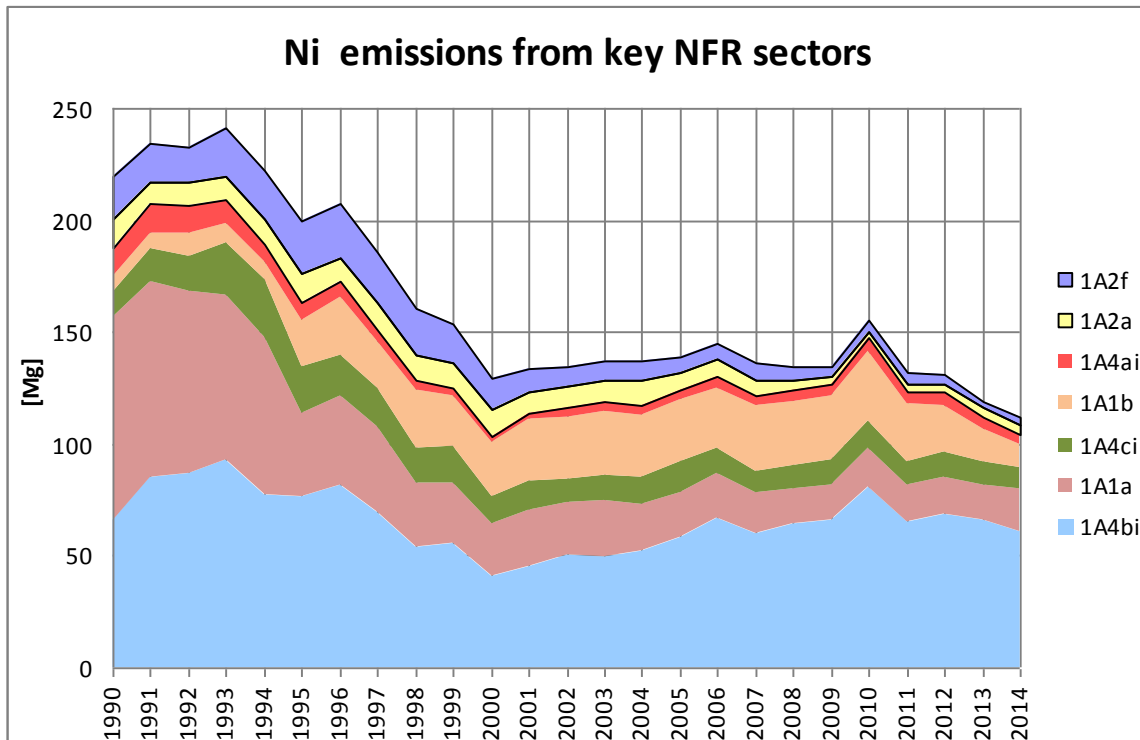


Figure 2.8.e Trend of Ni emissions for key NFR sectors

PCDD/F emissions

Figure 2.9 shows changes of dioxin emissions in the years 1990-2014. The trend of PCDD/F emissions is influenced mainly by the combustion processes in residential and commercial installations and in industry. Compared to the year 2013, in 2014 emissions of PCDD/F decreased by 1 %. It was because of the decrease of emissions connected with a combustion of coal and wood in households.

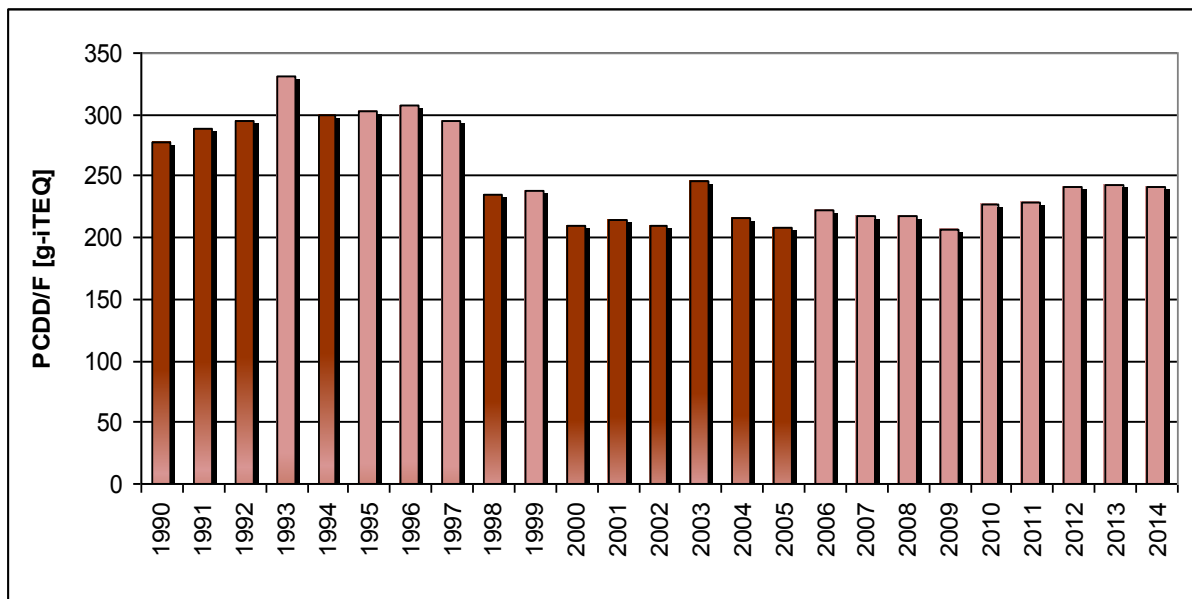


Figure 2.9.a Emissions of dioxins

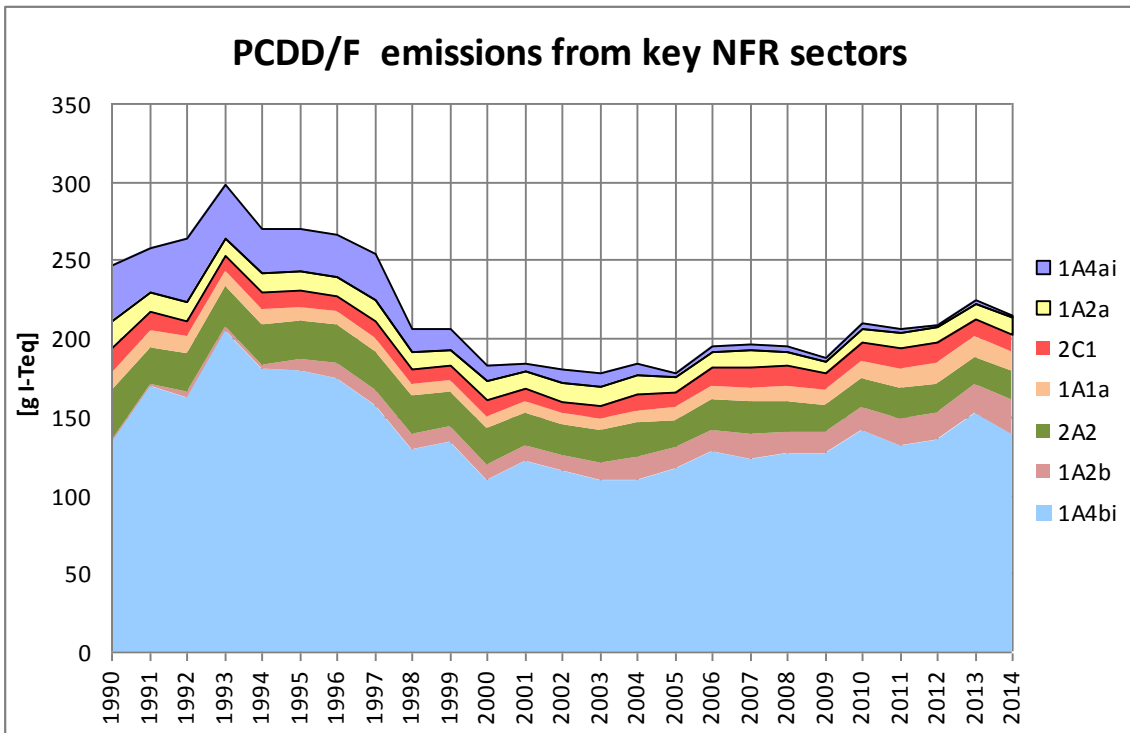


Figure 2.9.b Trend of PCDD/F emissions for key NFR sectors

### HCB emissions

Figure 2.10 shows changes of HCB emissions in the years 1990-2014. The trend of emissions of HCB is connected mainly with changes in production of secondary cooper. Compared to the year 2013, in 2014 emissions of HCB in increased by 4.3 %. The main reason for this change was the higher volume of secondary cooper production in *Combustion in manufacturing industries*.

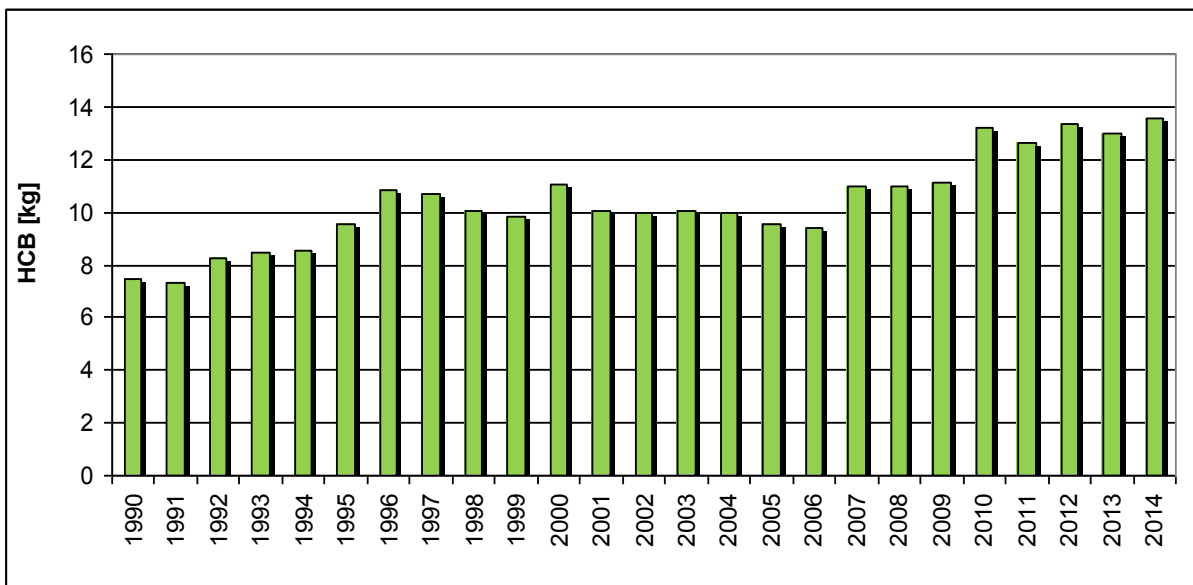


Figure 2.10.a Emissions of HCB



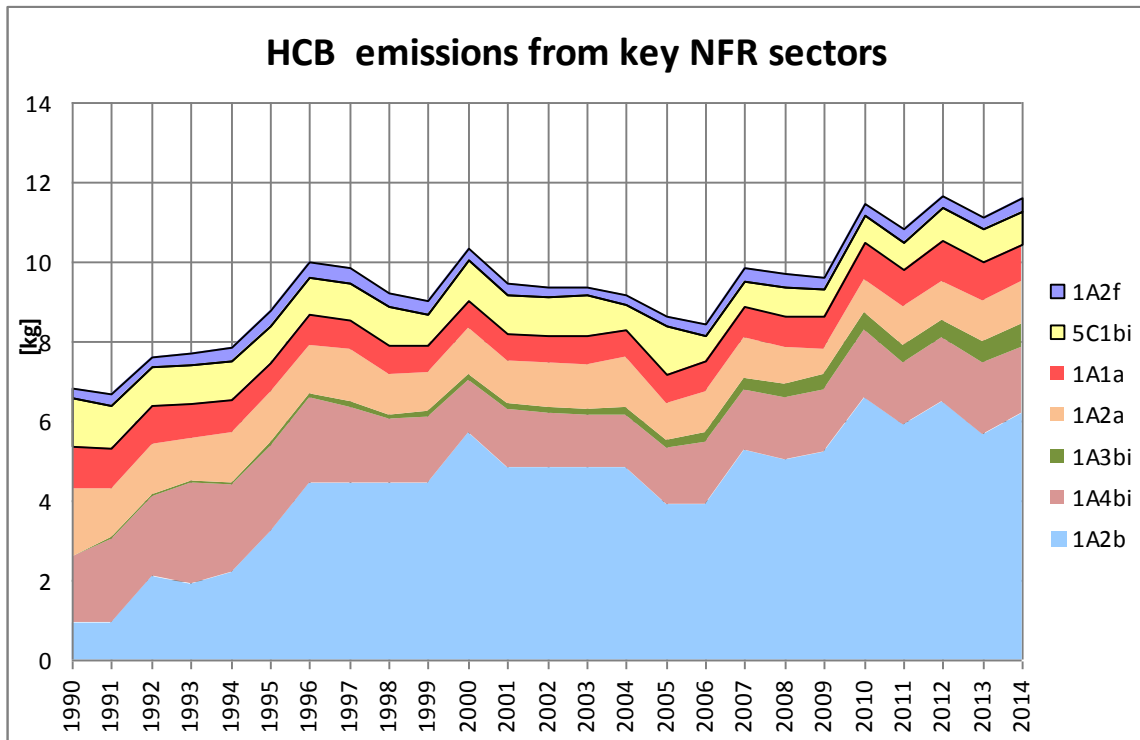


Figure 2.10.b Trend of HCB emissions for key NFR sectors

### PCB emissions

Figure 2.11 shows changes of PCB emissions in the years 1990-2014. PCB emissions trend depends mainly on use of fuels in *Non-Industrial Combustion Plants*. Compared to 2013, emissions in 2014 decreased by about 9%. The main reason for this change was lower coal and wood consumption in the residential sector.

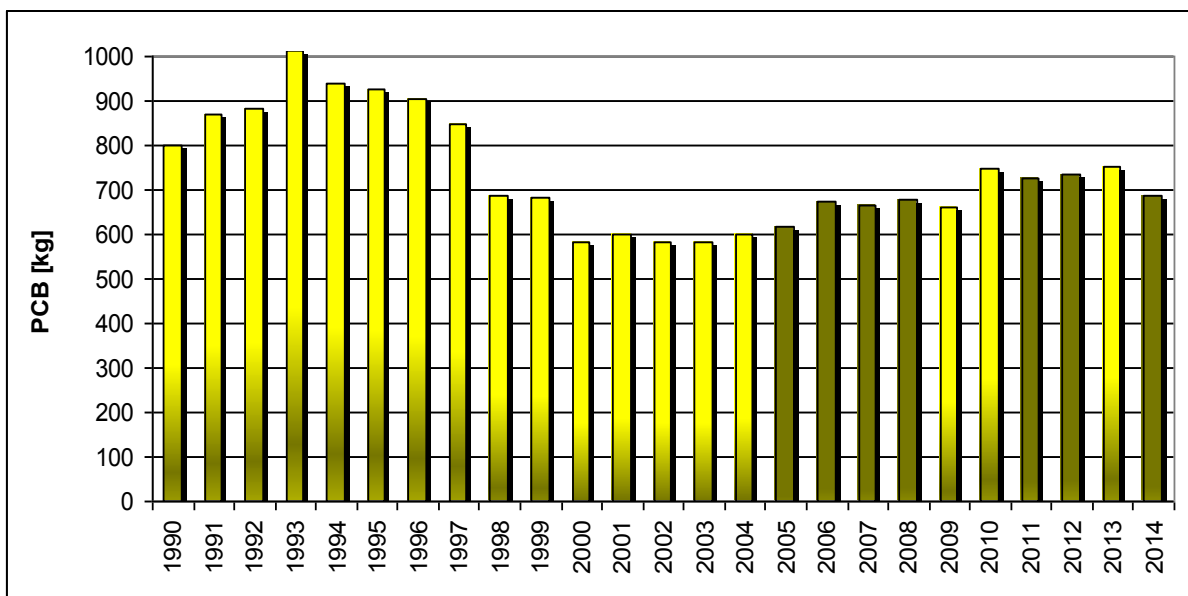


Figure 2.11.a Emissions of PCB

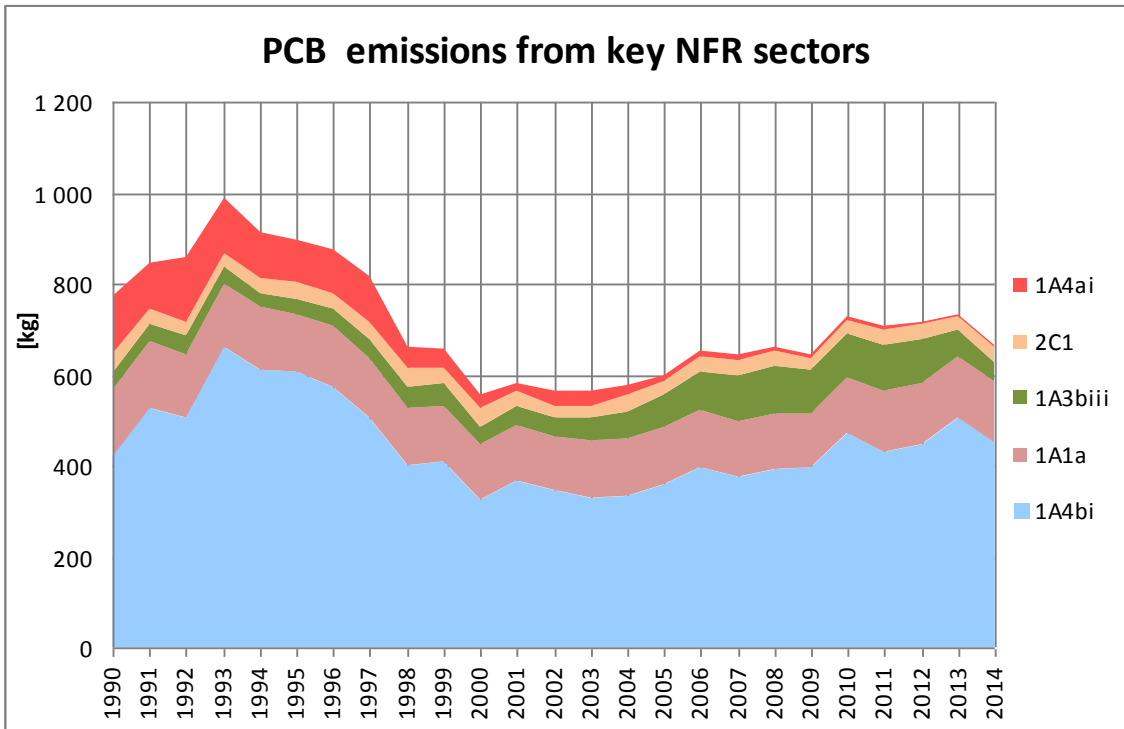


Figure 2.11.b Trend of PCB emissions for key NFR sectors

PAH emissions

Figure 2.12 shows changes of PAH emissions in the years 1990-2014. Changes in volume of PAH emissions are usually a result of changes in the amount of combusted fuels. The 2014 emissions are 7.7 % lower than the estimate for 2013. The reason for this change was the decrease in consumption of coal and wood in the residential sector.

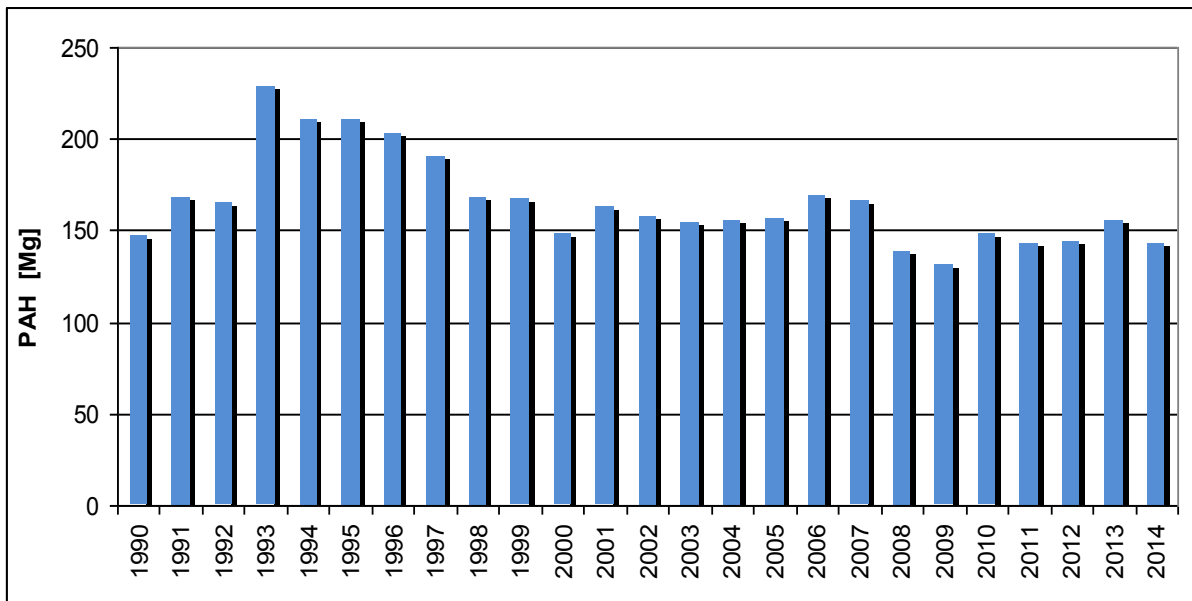


Figure 2.12.a Emissions of PAH

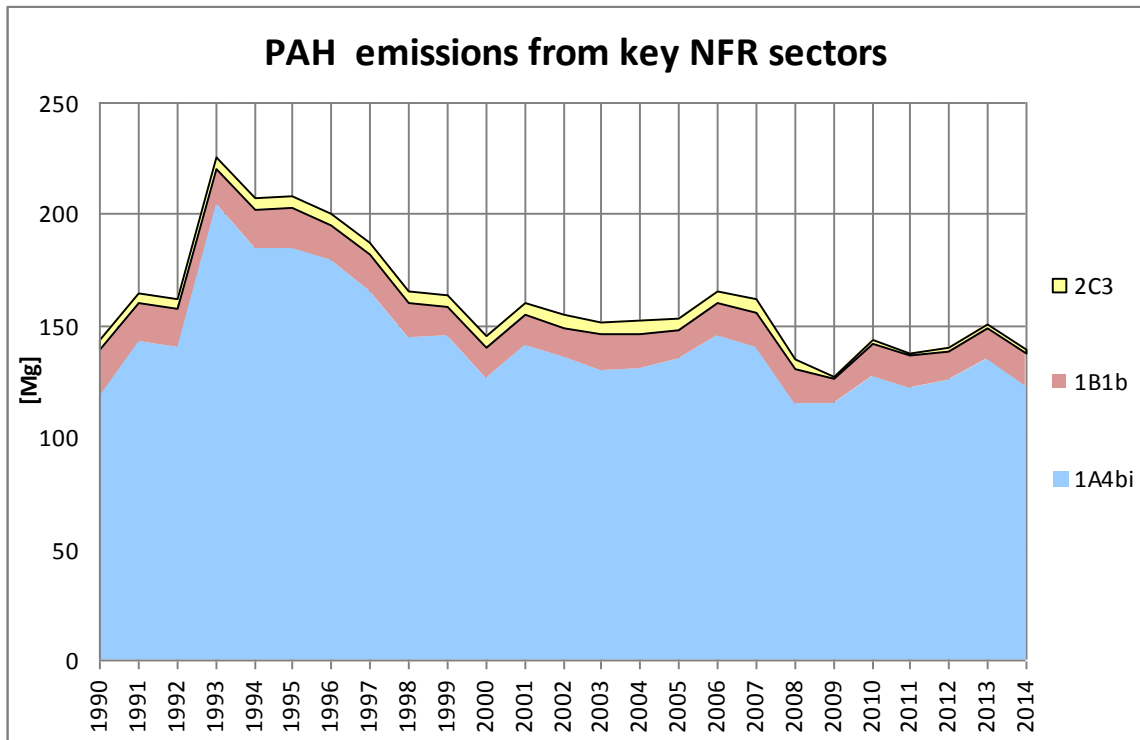


Figure 2.12.b Trend of PAH emissions for key NFR sectors

### 3. Sectoral Methodologies

Estimation of main (including SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> and CO) and other pollutant emissions is based on various activity data obtained mainly from the Central Statistical Office. They are as follows:

- national fuel consumption balance,
- statistical data on air pollutants emissions from large (app. 1700 enterprises) particularly hazardous for environment,
- data on production of goods and products and fuel consumption for their production,
- data on number of husbandry animal heads and consumption of fertilizers in agriculture, as well as plant production,
- data on industrial and municipal waste water and accumulated and generated solid wastes,
- other statistical data concerning industry, agriculture or forestry.

Activity data used in air emission inventories are presented in methodology chapters and Appendix 1.

The estimated values of emissions for main pollutants have been obtained from calculations based on national and international (EMEP, CORINAIR, RADIANT, TNO, etc.) emission factors.

Individual and aggregated emission data of entities reporting to the National Database run by KOBiZE were included into emission inventory, where possible, after verification.

#### Sulphur dioxide emissions

Estimation of SO<sub>2</sub> emission from combustion processes in stationary sources was generally based on reported values of sulphur contents in solid and liquid fuels. For public power plants aggregation of individual data is included. Estimation of SO<sub>2</sub> emission from mobile sources was based on standard concentration values for sulphur in liquid fuels.

#### Carbon oxide; Nitrogen oxides

For public power plants NO<sub>x</sub> emission is an aggregation of individual data. For the category *Open burning of agricultural wastes* (SNAP 0907) a country specific methodology was adopted. Carbon oxide and Nitrogen oxides emissions from burning of agricultural residues in fields were estimated based in general on methodology described in EMEP/EEA Emission Inventory Guidebook and Revised 1996 IPCC Guidelines for National GHG Inventories. For domestic purposes 43 crops were selected for which residues can potentially be burned<sup>2</sup>. Within this group certain plants were excluded for which residues can be composted or used as forage. So finally there were selected 38 crops containing cereals, pulses, tuber and root, oil-bearing plants, vegetables and fruits which residues could be burned on fields. Activity data concerning crop production was taken from [GUS 2015i]. Factors applied for emissions calculation were taken from country study, where experimental and literature data as well as default emission factors were used.

---

<sup>2</sup> Łoboda (1994). Łoboda T., Pietkiewicz S. Estimation of amount of CH<sub>4</sub>, CO, N<sub>2</sub>O and NO<sub>x</sub> released to atmosphere from agricultural residues burning in 1992, Warsaw Agricultural University, 1994 (in Polish).

### PM emissions

Following the increased scope of reporting requirements, Poland as Party to the *Convention on Long-range Transboundary Air Pollution*, has developed in 2000 the inventory of particulate matter emissions, including fine fractions PM10 and PM2.5. The emission estimates are based on various activity data obtained mainly from the Central Statistical Office, including national fuel consumption balance, data on manufacturing of products and fuel consumption for their production, data on number of husbandry animal heads, data on industrial wastes utilization.

The estimated values of emissions are a result of calculations based on national activity data and appropriate emission factors. The emission factors were partly derived from CEPMEIP, TNO and IIASA PM inventories but also some emission factors have been verified and adapted to Polish conditions based on country studies and surveys. The main source for these changes were the results of research done by the Institute for Ecology of Industrial Areas in Katowice in co-operation with the Institute for Chemical Processing of Coal in Zabrze.

In 2014 trend of emission factors for particulates for small emission sources has been verified [Kubica K. and Kubica R.].

### POPs emissions

Estimation of emissions of dioxins/furans – PCDD/F, hexachlorobenzene - HCB, polychlorinated biphenyls - PCBs, and four polyaromatic hydrocarbons PAHs indicators was based on national activity data including fuel statistics as well as on emission factors taken from literature and domestic measurements.

The significant source of PCDD/F in category *Other* are landfill fires but emission estimate here is uncertain as it is difficult to estimate the number of landfill fires.

### NMVOC emissions

Statistical data on production, consumption of fuels and raw materials and land use data, worked out by the Central Statistic Office, were used for national NMVOCs emission assessment.

For some emission sources, default emission factors published in EMEP/CORINAIR Atmospheric Emission Inventory Guidebook were applied. For other sources emission factors specific for processes in Poland were used.

## HM emissions

The presented HM emission assessments were produced on the basis of the Polish Central Statistical Office (GUS) data on goods and materials production as well as on raw materials consumption in Poland. The natural HM emission sources were not considered in the presented emission inventory.

For the HM emission assessments the emission factors used in the report were based on:

- data presented in the "EMEP Emission Inventory Guidebook" and
- the emission factors specific for processes in Poland.

Following doubts related to mercury EFs for coal combustion in public power plants an appropriate surveys has been undertaken in 2011-2013. EFs finally applied for Hg emissions have been based on a country study, conducted in 2011-2013 by Polish Energy Group PGE, data from Polish emissions database and own analyses.

EF for emissions from cement production (NFR: 2 A 1) is based on official information from producers.

In 2015 new emission factors for Cd emissions from hard coal has been developed, based on Cadmium content in Polish coals [34].

Mercury emission from small residential furnaces was estimated using methodology given by Hławiczka [35]. It was assumed that nearly 52% of Hg is released directly to air. The rest according to presented paper is associated with ash particles.

All emissions factors for the particular pollutants and emission source categories are presented in the tables in Appendix 2 following for the first time NFR classification.

### 3.1 Energy (NFR sector 1)

Energy sector consists of the following main subcategories:

- 1.A Fuels combustion
- 1.B Fugitive emissions.

The Energy sector, especially *Fuels combustion* (NFR 1 A), is one of the most important sources of pollutant emissions.

Shares of emissions from the 1 A category in the country total for the particular pollutants in 2014 are shown on the figure 3.1.

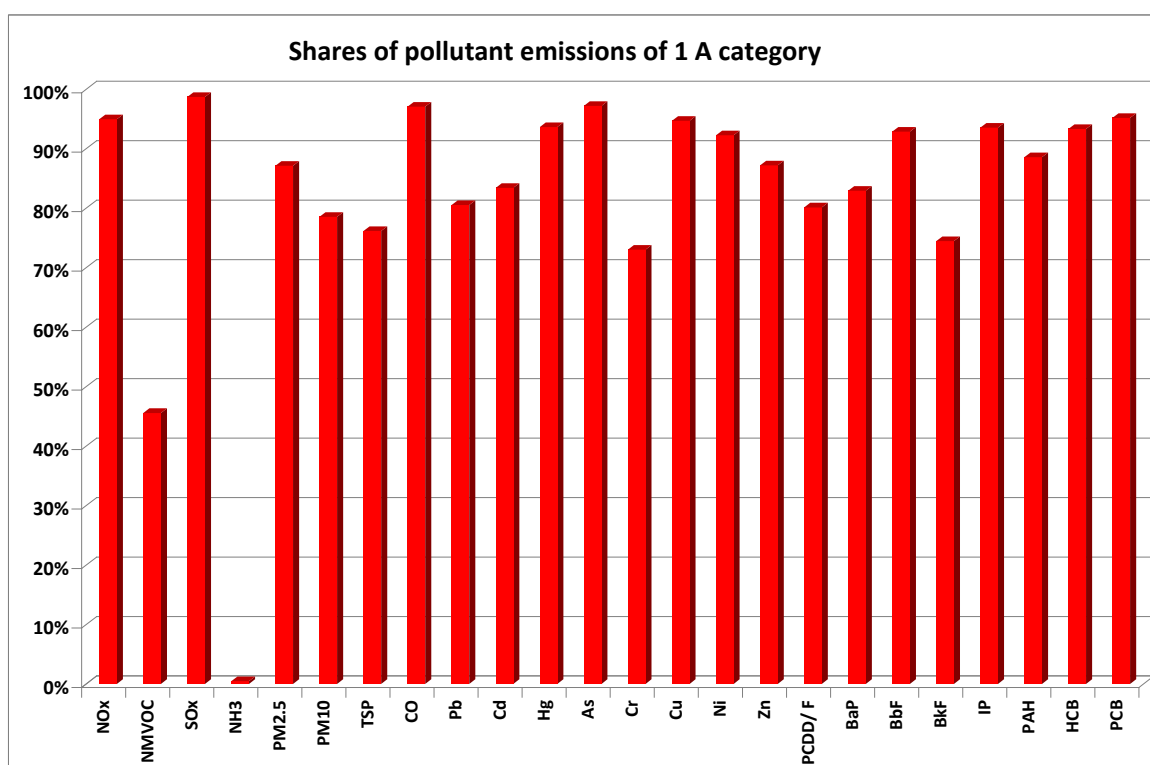


Figure 3.1. Shares of emissions from the 1 A category in the country total

Emissions of pollutants from fuel combustion (NFR sector 1.A) are mostly estimated on fuel quantities according to data included in the energy balance submitted by GUS to Eurostat (Eurostat database) and the relevant emission factors. Energy balance for 2014 is presented in Appendix 4. Energy data are harmonized with the Poland's GHG inventory for the UN FCCC Convention.

Generally, the emission calculations were based on the following equation:

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

where: E - emission

EF - emission factor

A - fuel consumption

a - fuel type, b – sector.

Activity data (fuel use) for this sector come from energy statistics. For some pollutants (SO<sub>2</sub>, NO<sub>x</sub>, CO) aggregated emission data from power plants reports to National Database are included in the inventory, without use of emission factors.

For road transport at first the fuel use for the particular vehicle types is determined. It is done by the analysis of fleet structure and number of vehicles. Then to estimate emissions domestic and default emission factors are used. Domestic emission factors for mobile sources, including emission factors for road transport, are taken from reports of Motor Transport Institute. Similar method is used for other forms of transport.

Combustion as a source of pollutant emissions 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.*

**3.2. Energy Industries (NFR sector 1.A.1.)**

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

- a) 1.A.1.a *Public Electricity and Heat Production*
- b) 1.A.1.b *Petroleum Refining*
- c) 1.A.1.c *Manufacture of Solid Fuels and Other Energy Industries.*

Methodology of emission estimation in 1.A.1 subcategory corresponds with methodology described above for fuel combustion in stationary sources. Detailed information on fuel consumption and applied emission factors for emission source subcategories are presented in Appendix 1 and 2. Shares of emissions from the 1.A.1 category in the country total for the particular pollutants in 2014 are shown on the figure 3.2.

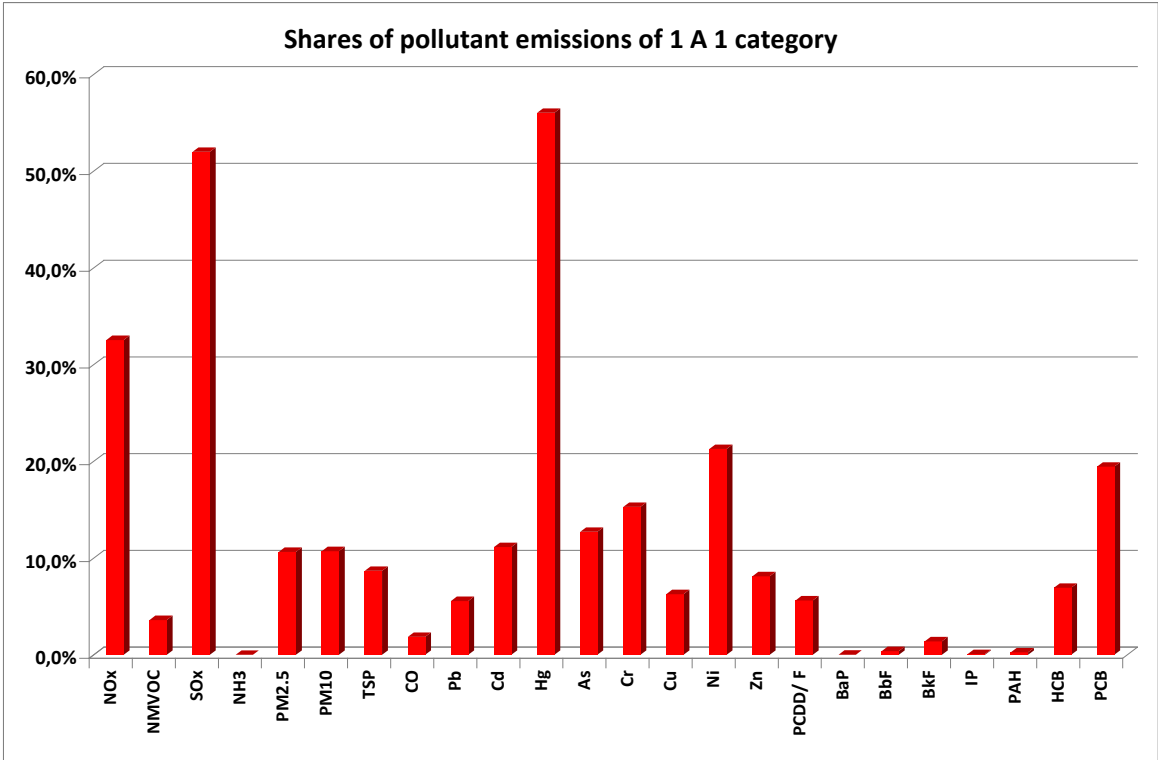


Figure 3.2. Shares of emissions from the 1.A.1 category in the country total



### 3.3.1. Public electricity and heat production (NFR sector 1.A.1.a)

Category *Public Electricity and Heat Production* consists of:

- public thermal power plants and cogeneration power plants (CHP)
- industrial cogeneration power plants
- district heating plants.

This category corresponds to categories SNAP 0101, SNAP 0301 and SNAP 0102.

Tables 3.1.1 and 3.1.2 present the amounts of main fuels used in the sub-category 1.A.1.a - *Public Electricity* and *Industrial Power* for the years 1991-2014.

Table 3.1.1 Fuel consumption for the years 1991-2014 in 1.A.1.a - *Public Electricity* [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	879.953	855.928	842.875	859.577	899.258	934.573	921.518	892.435
Lignite	557.422	545.139	548.823	537.834	528.123	531.967	529.899	534.764
Natural gas	0.268	0.279	0.276	0.257	0.333	1.733	1.803	2.082
Fuel wood and wood waste		0.004	0.008	0.011	0.003	1.162	1.150	1.384
Fuel oil	7.360	6.280	6.400	7.240	6.680	6.840	7.320	7.640
Coke oven gas	0.006	0.001		0.239	2.614	5.571	7.186	8.841
Blast furnace gas								

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	885.198	907.060	900.562	879.153	917.776	930.264	917.143	970.093
Lignite	520.692	504.805	511.871	494.449	518.326	514.306	533.690	525.529
Natural gas	5.949	10.399	14.430	22.928	28.959	36.403	40.048	36.167
Fuel wood and wood waste	1.259	1.301	1.217	1.134	2.008	3.841	9.643	13.440
Fuel oil	7.400	7.120	7.040	6.680	6.400	6.640	6.200	6.000
Coke oven gas	9.255	9.354	9.448	8.508	9.199	8.929	7.637	9.424

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	978.059	915.594	882.870	926.086	911.353	837.871	845.778	776.249
Lignite	502.046	522.436	494.456	478.308	518.202	527.410	539.384	513.090
Natural gas	36.907	38.844	39.448	38.062	41.348	42.713	31.498	29.214
Fuel wood and wood waste	17.527	30.448	46.544	55.096	65.643	92.948	73.215	84.159
Fuel oil	5.800	6.480	5.600	6.080	6.160	5.280	5.200	4.222
Coke oven gas	10.653	10.764	8.439	12.049	11.001	9.904	11.696	10.448
Blast furnace gas		7.595	5.787	8.316	9.166	8.740	8.689	11.257

Table 3.1.2 Fuel consumption for the years 1991-2014 in 1.A.1.a – *Industrial Power* [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	293.377	279.161	273.625	247.872	80.485	76.263	74.315	67.850
Natural gas	2.087	1.639	2.081	2.733	2.537	1.860	1.034	2.070
Fuel wood and wood waste	11.105	13.041	13.323	13.749	0.924	1.219	1.499	1.789
Biogas					0.117	0.130	0.081	0.169
Fuel oil	39.400	38.560	40.000	40.560	10.200	9.640	10.880	3.000
Coke oven gas	5.586	7.154	7.715	11.999	9.309	7.515	8.367	3.975
Blast furnace gas	11.170	12.107	10.099	13.023	5.854	2.976	2.902	2.602

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	65.730	57.975	58.314	61.537	79.319	62.109	65.294	65.685
Natural gas	2.271	2.187	2.709	3.804	4.658	4.687	4.873	4.355
Fuel wood and wood waste	1.614	1.628	3.058	2.878	2.742	3.598	6.194	5.954
Biogas	0.300	0.396	0.532	0.609	0.823	1.236	1.798	2.001
Fuel oil	3.280	2.400	2.000	2.080	1.520	1.840	1.080	0.960
Coke oven gas	5.908	6.779	6.710	7.160	7.821	6.982	5.573	7.758
Blast furnace gas	3.036	4.143	4.904	4.783	5.715	6.648	4.141	8.323

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	52.295	26.783	26.310	27.683	31.253	31.230	32.262	31.910
Natural gas	2.544	1.670	1.700	2.765	6.648	9.247	11.152	9.476
Fuel wood and wood waste	6.266	5.726	6.650	9.437	11.297	11.060	12.462	11.118
Biogas	2.286	3.017	3.096	3.638	3.312	4.204	4.872	5.718

	2007	2008	2009	2010	2011	2012	2013	2014
Fuel oil	0.920	0.080	0.280	0.400	0.240	0.160	0.080	7.038
Coke oven gas	8.564	10.456	8.244	10.622	5.164	5.676	5.776	5.207
Blast furnace gas	5.965	2.171	1.656	1.477	1.835	2.588	3.040	2.680

Table 3.2 presents the amounts of main fuels used in the sub-category 1.A.1.a - *Heat Production* for the years 1990-2014.

Table 3.2. Fuel consumption for the years 1991-2014 in 1.A.1.a - *Heat Production* [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	403.578	372.244	250.756	214.596	230.966	259.833	227.883	198.459
Natural gas	13.989	7.672	0.824	1.221	2.098	3.636	5.225	6.684
Fuel wood and wood waste	3.279	4.224	0.460	0.302	0.398	0.278	0.647	0.503
Fuel oil	14.560	11.640	9.040	8.040	9.080	11.400	9.160	7.480
Coke oven gas	1.966	1.708	0.429	0.909	0.907	0.889	0.897	0.881

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	177.661	155.463	171.164	153.122	149.953	132.096	127.145	125.967
Natural gas	8.062	9.104	11.269	12.306	12.532	13.067	12.282	12.435
Fuel wood and wood waste	0.528	0.535	0.647	0.805	1.056	1.470	1.665	1.796
Fuel oil	6.200	4.400	5.720	4.800	4.240	1.720	1.080	1.040
Coke oven gas	0.914	0.965	1.066	0.780	1.025	1.072	1.167	1.143

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	117.596	115.544	122.052	138.989	112.522	121.134	115.726	108.302
Natural gas	10.315	10.642	10.763	11.570	10.174	10.087	10.768	8.150
Fuel wood and wood waste	1.697	2.097	1.936	1.878	1.772	1.685	1.995	1.712
Fuel oil	0.720	0.880	0.840	1.000	0.640	0.920	0.320	0.286
Coke oven gas	0.696	0.526	0.815	1.028	0.478	0.415	0.398	0.358

The data in tables 3.1 and 3.2 show that the use of solid fuels is dominant in 1.A.1.a – mainly hard coal. Detailed data concerning all individual fuel consumptions in 1.A.1.a subcategory for the entire period 1990-2014 was presented in Appendix 1 (tables 1 and 2). Applied emission factors for subcategory 1.A.1.a are presented in Appendix 2.

For public power plants, emissions of SO<sub>2</sub> and NO<sub>x</sub>, as aggregated individual data, were taken from reports to the National Database.

### 3.3.2. Petroleum Refining (NFR sector 1.A.1.b)

This category corresponds to category SNAP 0103. Table 3.3 shows main fuels consumption data in sub-category 1.A.1.b *Petroleum Refining* for the years 1995-2013. Detailed data on all fuels consumptions in 1.A.1.b subcategory was presented in Appendix 1. Applied emission factors for subcategory 1.A.1.a are presented in Appendix 2.

Table 3.3. Fuel consumption in 1991-2014 in 1.A.1.b subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Natural gas	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244
Fuel oil	10.560	15.760	12.800	11.960	32.400	40.520	32.200	39.840
Refinery gas	7.623	8.514	9.256	10.444	12.028	8.960	10.197	6.286

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Natural gas	10.832	12.110	11.354	10.124	12.770	15.454	14.482	14.900
Fuel oil	35.080	36.160	42.280	42.560	43.520	42.880	42.560	41.720
Refinery gas	6.386	9.058	10.444	10.048	10.048	11.632	10.692	12.969

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Natural gas	20.816	18.816	17.381	19.232	27.399	30.638	34.779	31.592
Fuel oil	44.080	43.560	44.160	46.560	39.280	31.400	22.200	14.699
Refinery gas	16.582	17.424	15.246	22.869	21.532	28.215	20.988	14.132

Emissions of SO<sub>2</sub> and NO<sub>x</sub>, as aggregated individual data, were taken from reports to the National Database.

### 3.3.3. Manufacture of Solid Fuels and Other Energy Industries (NFR sector 1.A.1.c)

Category *Manufacture of Solid Fuels and Other Energy Industries* consists of:

- coke-oven and gas-works plants
- mines and patent fuel/briquetting plants
- other energy industries (oil and gas extraction; own use in Electricity, CHP and heat plants).

This category corresponds to categories SNAP 0104 and SNAP 0105. Table 3.4 and 3.5 show the main fuels use data in the sub-category 1.A.1.c category - Manufacture of solid fuels and other energy industries (including coal-mines) over the period 1995-2013. All particular fuels consumptions in 1.A.1.c subcategory were tabulated in Appendix 1.

Table 3.4. Fuel consumption in 1991-2014 in 1.A.1.c - *Manufacture of solid fuels* [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	0.068	0.046	0.803	2.156	1.302	1.705	0.280	0.070
Natural gas		0.181	0.269	0.462	0.518	0.398	0.570	0.744
Coke oven gas	38.485	39.121	34.084	40.237	36.851	34.676	36.572	33.476
Blast furnace gas	1.995	1.430	2.123	2.488	1.954	1.582	1.893	1.695

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	0.023			0.047	0.070	0.046		0.024
Natural gas	0.540	0.424	0.253	0.065	0.010			
Coke oven gas	29.642	32.403	32.647	31.702	35.822	36.156	32.637	36.291
Blast furnace gas	0.847	0.840	0.149	0.086	0.021	0.030	0.042	0.045

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	0.024		0.180	0.167	1.919	1.845	1.529	1.905
Natural gas	0.004	0.006	0.008	0.014	0.003	0.003	0.003	1.951
Coke oven gas	39.701	39.462	27.914	38.329	41.007	38.516	40.094	36.159
Blast furnace gas	0.037							

Table 3.5. Fuel consumption in 1991-2014 in 1.A.1.c - *Other energy industries* [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	5.380	3.355	20.145	50.782	51.744	54.960	53.298	50.142
Natural gas	12.416	14.456	12.010	16.822	14.102	22.798	20.471	16.966
Diesel oil	1.802	1.888	2.917	1.716	2.059	1.973	1.759	1.587

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	42.346	32.313	29.904	14.897	17.269	11.508	8.668	7.751
Natural gas	18.847	19.004	12.567	12.113	9.078	10.699	9.942	10.213
Diesel oil	1.415	1.330	1.287	0.944	1.029	0.901	1.030	0.944

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	14.894	11.582	6.578	1.734	2.410	0.614	0.587	0.717
Natural gas	9.563	9.128	8.767	10.139	9.664	11.119	11.987	9.536
Diesel oil	0.987	1.029	1.213	1.256	1.212	1.169	1.516	1.137

Applied emission factors for subcategory 1.A.1.c are presented in Appendix 2. For coking plants amounts of emissions of SO<sub>2</sub> and NO<sub>x</sub>, as aggregated individual data, were taken from reports to National Database.

Emission trends for the NFR sector 1.A.1

Volumes and trend of pollutant emissions for Public electricity and heat production are shown below on figures 3.3 ÷ 3.8.

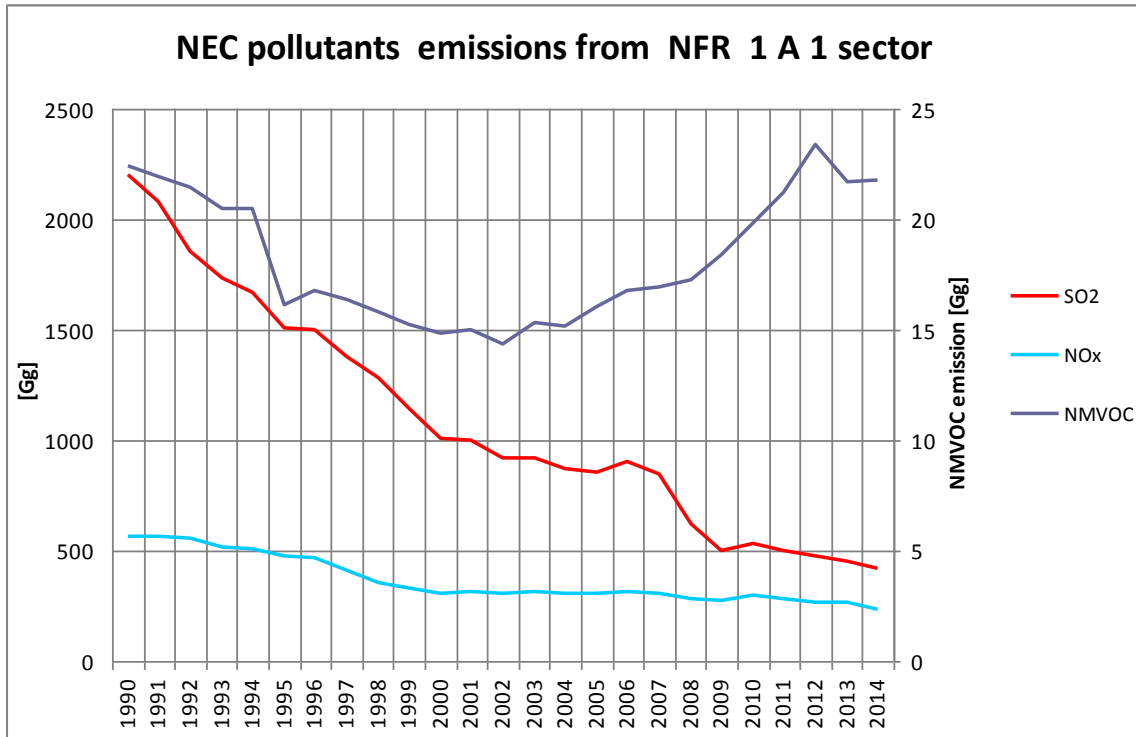


Figure 3.3. SO<sub>2</sub>, NO<sub>x</sub> and NMVOC emissions for 1.A.1 category in 1990-2014

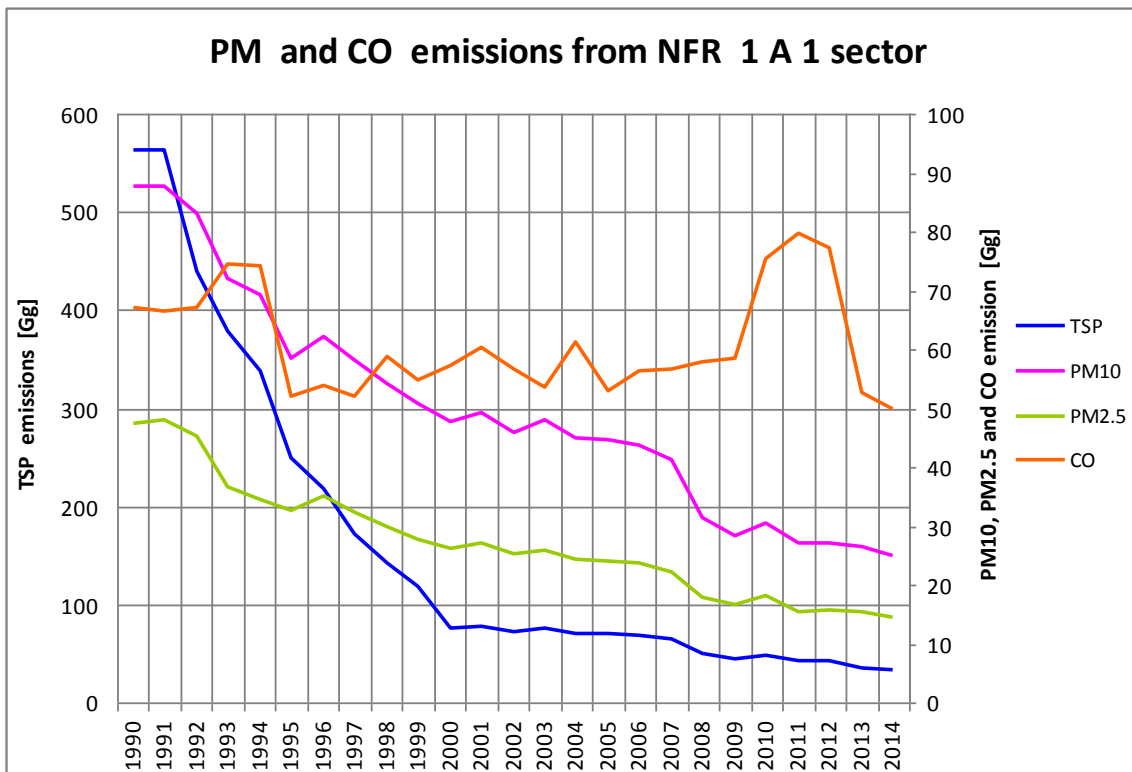


Figure 3.4. Particulates and CO emissions for 1.A.1 category in 1990-2014

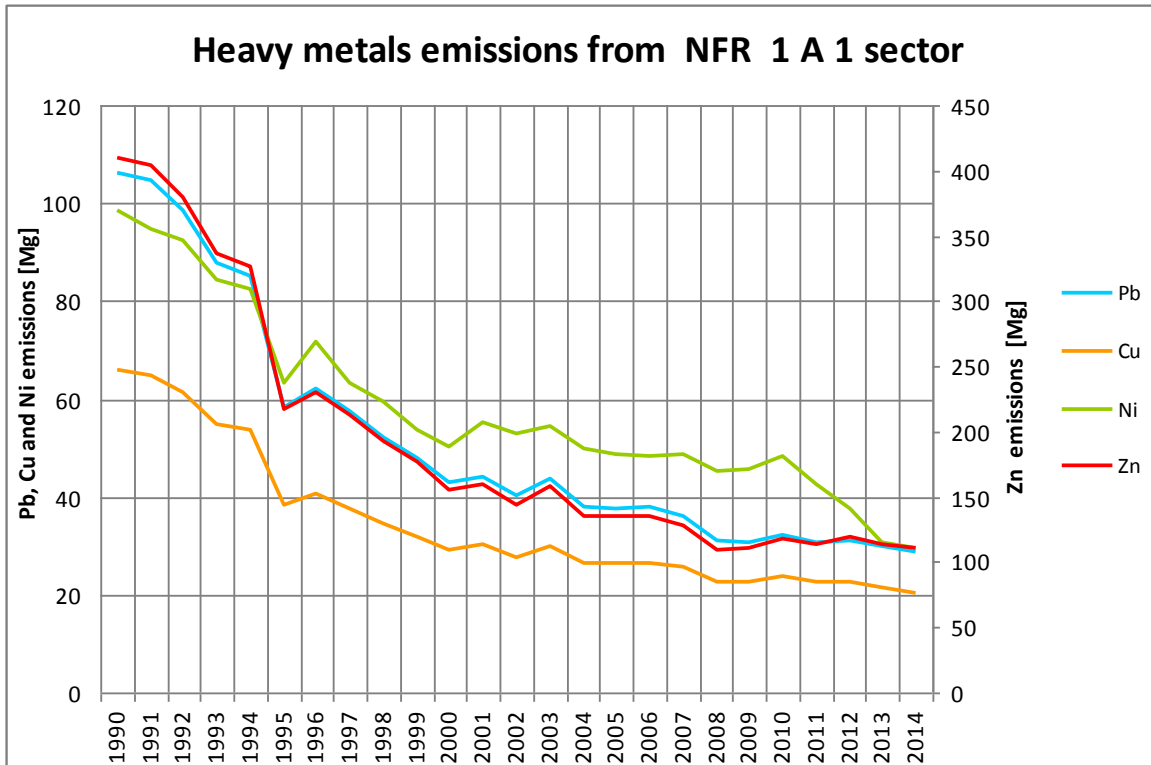


Figure 3.5. Pb, Cu, Ni and Zn emissions for 1.A.1 category in 1990-2014

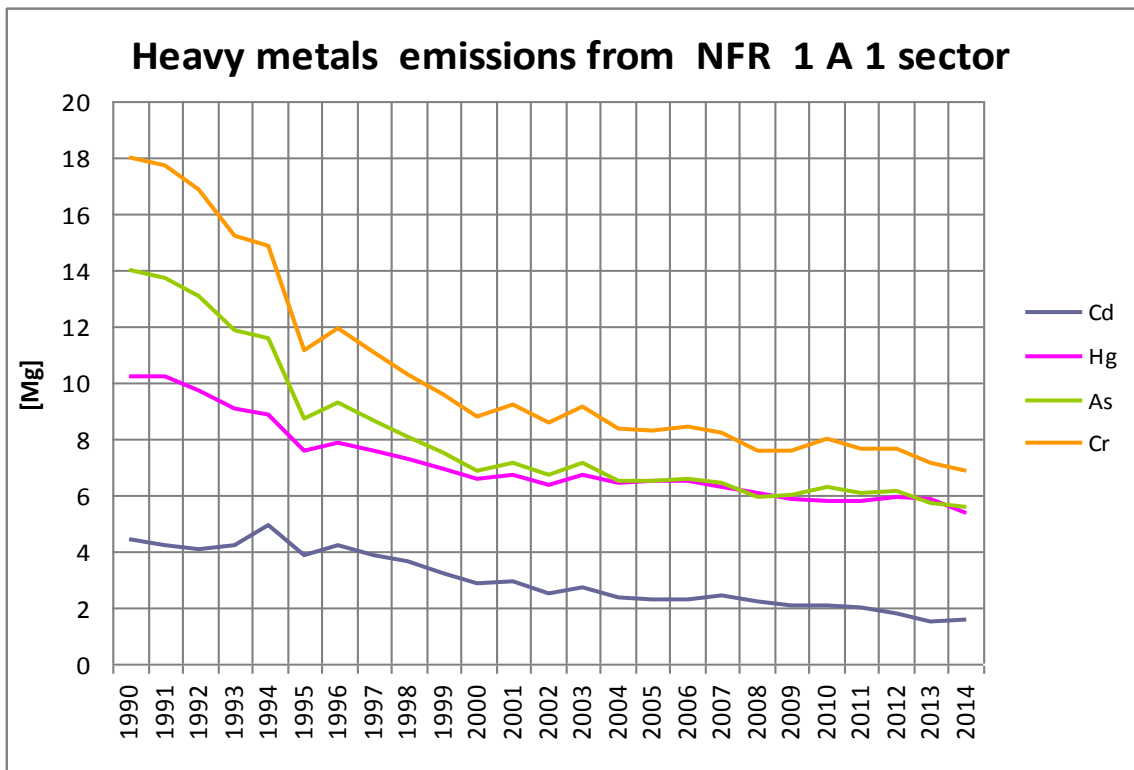


Figure 3.6. Cd, Hg, As and Cr emissions for 1.A.1 category in 1990-2014

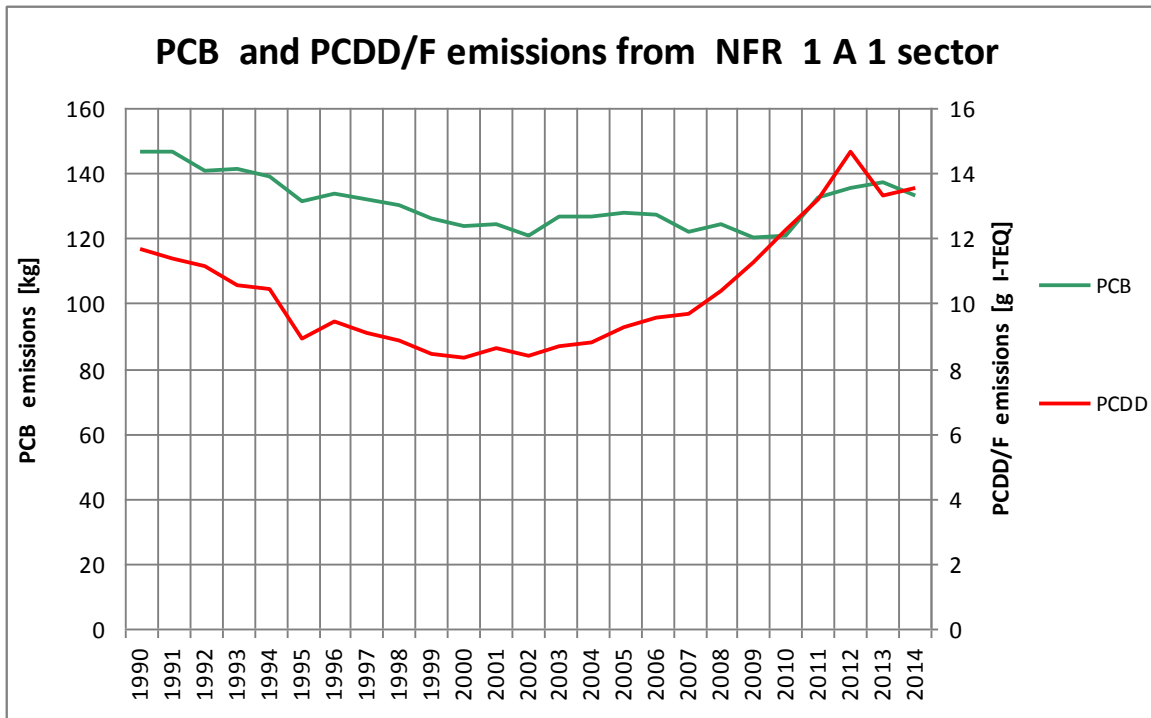


Figure 3.7. PCB and PCDD/F emissions for 1.A.1 category in 1990-2014

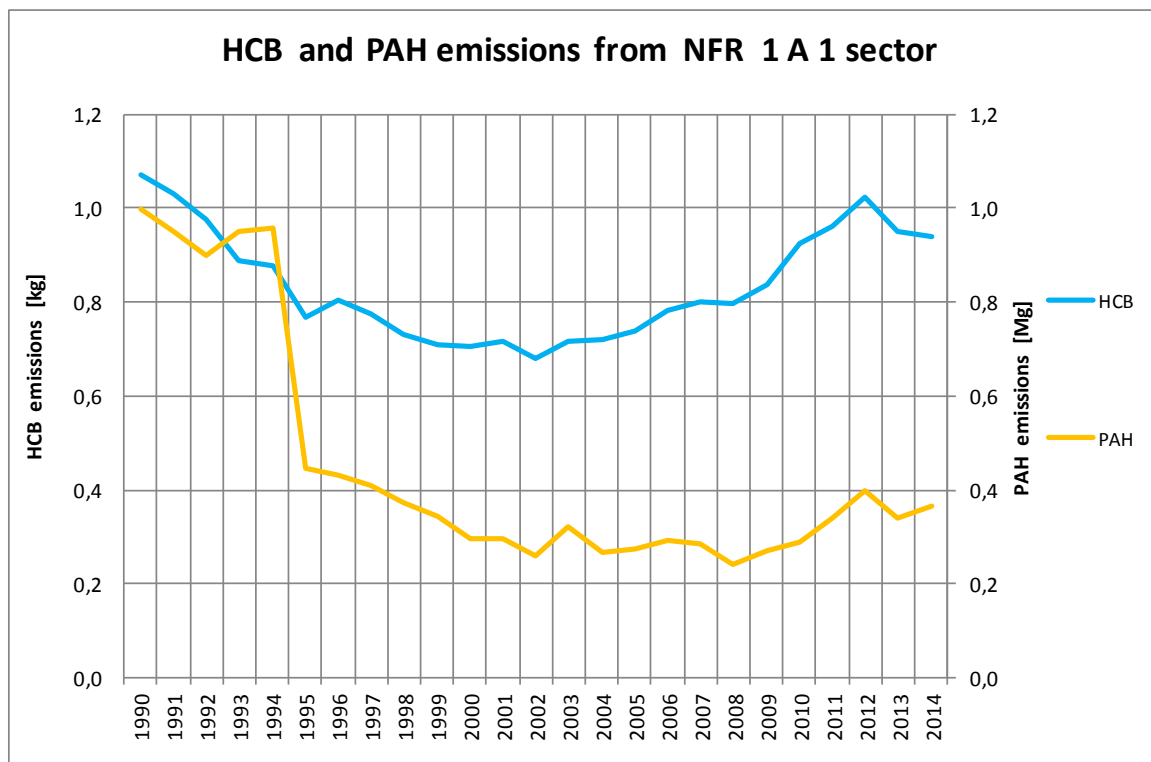


Figure 3.8. HCB and PAH emissions for 1.A.1 category in 1990-2014

Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 1.A.1 was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified

approach described in EMEP/EEA Guidebook (Chapter 5). More detailed calculations (including qualitative uncertainty estimation for the most of pollutants and Monte-Carlo analysis for SO<sub>x</sub> and NO<sub>x</sub> emissions from NFR 1.A.1 sector) are also included in appendix 5. Results of the sectoral uncertainty analysis for NFR sector *1.A.1* are given below. Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 3.6 Results of the uncertainty analysis for NFR sector *1.A.1*

NFR		NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%	%
1A1a	Public electricity and heat production	23	26	12	40	26	37	24	34	48
1A1b	Petroleum refining	30	26	20	50	50	62	64	44	100
1A1c	Manufacture of solid fuels and other energy industries	30	31	20	50	50	50	39	42	76

#### Source-specific recalculations

Activity data on fuel consumption for years 1990-2013 were updated due to changes made in EUROSTAT database.

#### Source-specific planned improvements

Further developing of cooperation with institutions responsible for compilation of Polish energy balances in order to explain and verify time-trends of activity data in 1.A category.

### 3.4. Manufacturing Industries and Construction (NFR sector 1.A.2)

#### Source category description

Category *Manufacturing Industries and Construction* consists of detailed sub-categories as follows:

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

Category NFR 1.A.2 corresponds to category SNAP03.

Shares of emissions from the 1.A.2 category in the country total for the particular pollutants in 2014 are shown on the figure 3-9.

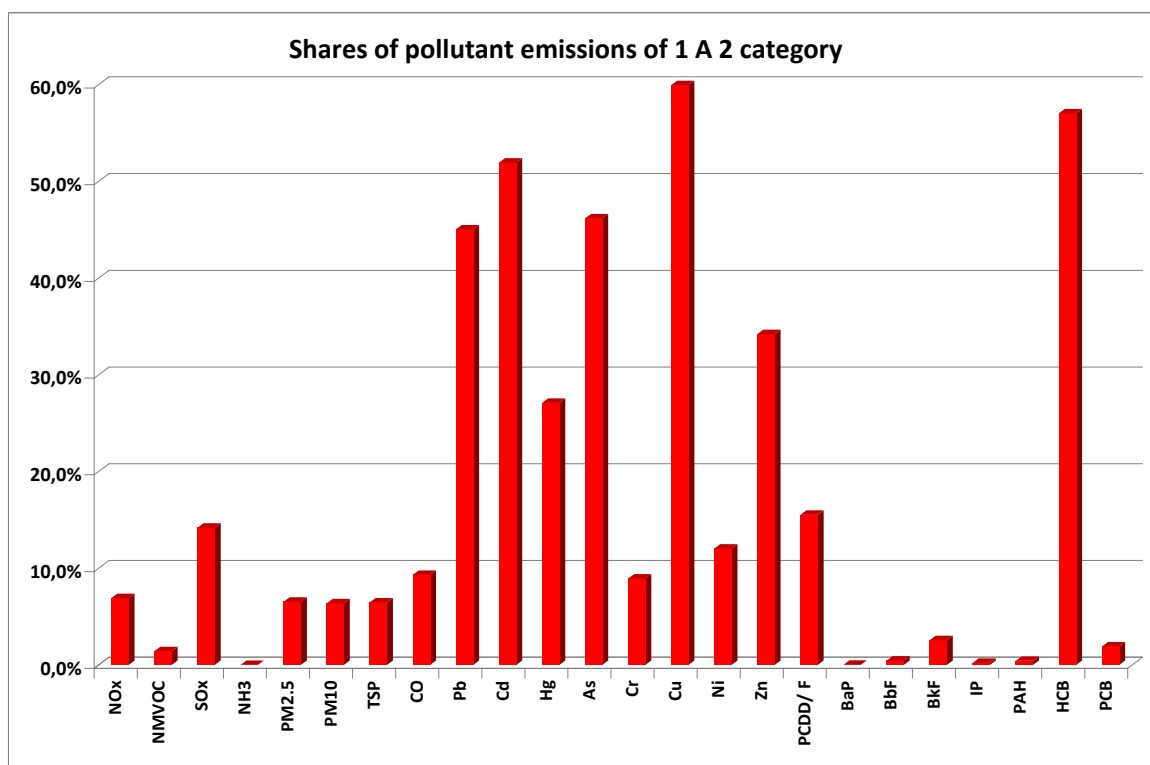


Figure 3-9. Shares of emissions from the 1.A.2 category in the country total

Methodology of emission estimation in 1.A.2 subcategory corresponds with methodology described for fuel combustion in stationary sources.

Activity data on fuel use for this sector come from energy statistics. For process emissions activity data come from production statistics [GUS 2015e].

Detailed information on fuel consumption and applied emission factors for subcategories listed below are presented in Appendix 1 and 2.



### 3.4.1. Iron and Steel (NFR sector 1.A.2.a)

This category corresponds to categories SNAP 030301 ÷ 030303.

Table 3.7 shows the main fuels use data in the sub-category 1.A.2.a *Iron and Steel* for the period 1991-2014. Detailed data on fuel consumptions in 1.A.2.a subcategory was presented in Appendix 1. Activity data for industrial processes in this category are shown in table 3.8. Applied emission factors for subcategory 1.A.2.a are presented in Appendix 2.

Table 3.7. Fuel consumption in 1991-2014 in 1.A.2.a subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1.243	1.494	9.159	8.513	25.320	28.922	23.636	21.085
Natural gas	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993
Coke	87.229	89.783	86.616	99.734	95.330	83.317	91.007	69.691
Coke oven gas	22.090	22.568	21.604	25.480	27.686	24.404	24.257	24.742
Blast furnace gas	27.903	25.909	25.676	28.350	37.610	34.205	36.120	29.520

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	19.074	18.262	14.701	12.424	12.593	17.281	11.379	9.636
Natural gas	21.440	22.024	18.328	15.463	14.827	19.969	20.460	21.008
Coke	60.019	77.048	64.276	58.231	63.248	67.122	44.292	49.584
Coke oven gas	15.875	17.574	16.994	15.122	16.132	15.368	12.643	12.770
Blast furnace gas	24.034	31.874	26.768	23.876	25.282	27.109	19.239	20.580

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	12.296	4.360	5.482	4.003	4.871	8.276	6.177	2.508
Natural gas	22.724	20.401	16.597	16.922	17.209	16.905	16.242	14.487
Coke	50.680	42.156	23.147	26.849	32.671	32.821	35.660	45.962
Coke oven gas	13.885	10.059	5.396	8.488	8.420	8.230	8.518	8.113
Blast furnace gas	28.624	18.785	10.160	12.220	11.258	11.352	10.797	11.863

Table 3.8. Activity data for industrial processes in 1.A.2.a subcategory [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Sinter and pelletizing plants	11 779 441	8 612 668	8 621 683	7 628 228	8 787 422	8 646 567	8 318 575
Pig iron	8 423 400	7 391 200	6 359 000	6 161 600	6 931 900	7 420 000	6 600 000
Casting of iron	887 800	603 200	549 600	583 200	629 800	1 137 438	1 073 413
Casting of steel	178 600	100 400	69 000	68 500	72 500	175 901	193 919
Primary lead production	64 812	50 776	53 693	62 305	61 248	66 421	66 000
Primary zinc production	132 131	126 067	134 594	149 107	157 618	166 421	165 000
Primary copper production	346 083	378 479	387 010	404 170	405 093	406 708	425 000

Industrial process	1997	1998	1999	2000	2001	2002	2003
Sinter and pelletizing plants	8 980 785	6 882 149	6 475 927	8 078 720	7 352 758	7 616 887	7 732 206
Pig iron	7 343 000	6 179 000	5 233 000	6 491 867	5 440 047	5 296 410	5 631 830
Casting of iron	1 054 730	904 220	882 894	982 735	984 608	876 968	865 238
Casting of steel	178 378	140 090	123 874	124 775	122 748	109 009	111 511
Primary lead production	64 700	64 300	64 000	45 412	28 823	34 000	55 563
Primary zinc production	173 000	178 000	178 000	161 835	160 147	145 725	131 938
Primary copper production	441 000	447 000	470 000	462 838	485 869	510 725	559 960

Industrial process	2004	2005	2006	2007	2008	2009	2010
Sinter and pelletizing plants	8 590 558	6 168 357	6 907 824	6 953 950	6 306 368	4 362 554	5 837 251
Pig iron	6 400 007	4 476 622	5 332 632	5 804 418	4 933 781	2 983 500	3 637 995
Casting of iron	893 865	914 745	962 163	1 019 085	998 703	1 084 065	769 232
Casting of steel	117 354	133 187	132 747	142 198	140 349	90 263	123 538
Primary lead production	56 827	62 455	67 298	80 060	85 907	79 154	91 174
Primary zinc production	131 332	113 822	110 300	127 034	129 172	110 268	97 942
Primary copper production	547 228	555 681	555 907	518 303	492 942	457 510	469 656

Industrial process	2011	2012	2013	2014
Sinter and pelletizing plants	6 512 751	6 672 473	6 854 234	7 389 438
Pig iron	3 974 930	3 943 968	4 013 877	4 639 571
Casting of iron	1 029 929	1 081 426	1 022 158	1 022 158
Casting of steel	156 923	164 769	113 187	113 187
Primary lead production	84 035	95 801	91 611	86 285
Primary zinc production	109 338	133 566	134 148	123 060
Primary copper production	481 875	466 715	458 789	503 111

### 3.4.2. Non-Ferrous Metals (NFR sector 1.A.2.b)

This category corresponds to categories SNAP 030204 and SNAP 030304 ÷ 030310.

The data on main fuels use in the sub-category 1.A.2.b *Non-Ferrous Metals* over the 1991-2014 period are presented in table 3.9. More detailed data concerning fuel consumptions was tabulated in Appendix 1. Activity data for industrial processes in this category are shown in table 3.10. Applied emission factors for subcategory 1.A.2.b are presented in Appendix 2.

Table 3.9. Fuel consumption in 1991-2014 in 1.A.2.b subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	0.565	0.850	1.916	1.771	4.172	4.285	3.907	3.331
Natural gas	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.638
Coke	5.216	2.280	2.793	6.412	6.327	6.612	6.584	6.384
Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	3.117	3.108	3.790	2.560	2.115	1.092	0.024	0.024
Natural gas	5.660	5.814	5.700	5.589	5.868	6.405	6.468	6.884
Coke	5.928	6.070	6.156	6.156	5.928	5.956	5.814	6.042
Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	0.570	0.000	0.000	0.000	0.250	0.114	0.113	0.108
Natural gas	6.743	6.542	5.852	6.048	6.670	6.890	6.703	6.254
Coke	6.441	6.640	6.270	6.042	6.214	6.384	6.270	6.449

Table 3.10. Activity data for industrial processes in 1.A.2.b subcategory [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Plaster furnaces	191 700	246 600	222 100	290 000	357 000	407 000	450 000
Secondary lead production	64 812	50 776	53 693	62 305	61 248	66 421	66 000
Secondary zinc production	132 131	126 067	134 594	149 107	157 618	166 421	165 000
Secondary copper production: BOF	17 304	18 924	19 351	20 209	20 255	20 335	21 250
Secondary copper production: excl. BOF's	6 147	4 527	34 322	29 132	36 475	61 947	93 002
Secondary aluminium production	22 520	22 520	31 102	17 948	34 092	91 629	116 925
Industrial process	1997	1998	1999	2000	2001	2002	2003
Plaster furnaces	504 000	511 000	459 000	444 700	1 034 500	1 243 600	1 442 800
Secondary lead production	64 700	64 300	64 000	45 412	28 823	34 000	55 563
Secondary zinc production	173 000	178 000	178 000	161 835	160 147	145 725	131 938
Secondary copper production: BOF	22 050	22 350	23 500	19 628	27 931	29 355	24 098
Secondary copper production: excl. BOF's	92 202	91 902	90 752	126 593	95 247	93 823	99 080
Secondary aluminium production	116 925	116 925	116 925	116 925	116 925	119 134	122 682
Industrial process	2004	2005	2006	2007	2008	2009	2010
Plaster furnaces	557 000	771 000	1 190 100	1 422 200	1 578 700	1 317 400	1 346 800
Secondary lead production	56 827	62 455	67 298	80 060	85 907	79 154	91 174
Secondary zinc production	131 332	113 822	110 300	127 034	129 172	110 268	97 942
Secondary copper production: BOF	33 317	28 254	33 477	40 346	44 062	57 641	78 420
Secondary copper production: excl. BOF's	89 861	71 880	66 551	94 851	84 766	76 493	90 815
Secondary aluminium production	251 587	246 700	250 232	293 747	214 126	198 652	238 787
Industrial process	2011	2012	2013	2014			
Plaster furnaces	1 349 300	1 220 300	1 263 700	1 072 700			
Secondary lead production	84 035	95 801	91 611	86 285			
Secondary zinc production	109 338	133 566	134 148	123 060			
Secondary copper production: BOF	68 186	82 297	78 009	72 585			
Secondary copper production: excl. BOF's	82 673	83 473	67 231	85 706			

Industrial process	2011	2012	2013	2014
Secondary aluminium production	294 838	302 388	416 492	390 210

### 3.4.3. Chemicals (NFR sector 1.A.2.c)

This category is a part of the category SNAP03.

The data on main fuels consumptions in 1.A.2.c subcategory for the entire period 1991-2014 was presented in table 3.11. Emission factors for subcategory 1.A.2.c are presented in Appendix 2.

Table 3.11. Fuel consumption in 1991-2014 in 1.A.2.c subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	6.623	4.550	13.125	7.945	70.221	71.191	63.913	54.992
Natural gas	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408
Industrial wastes	18.586	17.039	18.003	22.591	21.546	17.374	14.356	0.672
Coke	1.966	1.852	1.881	1.938	3.477	2.964	1.454	1.539
Diesel oil	0.858	0.772	0.729	0.729	0.944	1.072	1.072	1.416
Fuel oil	1.880	2.760	2.480	3.600	8.160	9.320	9.360	17.560
Refinery gas	3.465	5.445	4.455	0.198	1.584	6.584	9.652	18.513

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	50.522	50.115	48.485	45.458	27.959	28.709	30.107	27.683
Natural gas	9.041	9.464	8.481	7.199	6.457	7.498	8.104	9.053
Industrial wastes	0.582	0.607	0.618	0.567	0.875	1.122	0.628	0.721
Coke	1.624	1.596	1.710	1.738	1.568	1.881	1.454	2.964
Diesel oil	1.330	1.030	4.762	4.247	4.333	3.904	3.775	4.076
Fuel oil	15.680	13.520	7.360	7.640	7.080	7.320	3.920	3.920
Refinery gas	19.602	23.314	20.542	20.740	21.830	22.424	18.266	21.334

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	28.785	46.079	44.061	49.706	47.704	46.768	46.835	42.882
Natural gas	8.771	8.037	9.762	12.043	13.887	13.568	14.696	13.050
Industrial wastes	0.761	0.518	0.621	0.777	0.732	0.581	1.092	1.082
Coke	1.938	1.168	0.884	0.826	1.340	3.164	3.021	2.926
Diesel oil	3.732	3.689	4.590	4.200	3.637	3.334	4.027	2.434
Fuel oil	3.600	0.640	1.120	0.640	0.720	0.560	0.440	0.426
Refinery gas	22.473	19.156	20.889	17.176	15.890	13.414	17.870	10.313

### 3.4.4. Pulp, Paper and Print (NFR sector 1.A.2.d)

This category is a part of the category SNAP03.

The data on main fuels use in the sub-category 1.A.2.d *Pulp, Paper and Print* over the 1991-2014 period are presented in table 3.12. Detailed data on fuel consumptions in 1.A.2.d subcategory was presented in Appendix 1. Emission factors for subcategory 1.A.2.d are presented in Appendix 2.

Table 3.12. Fuel consumption in 1991-2014 in 1.A.2.d subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	1.741	1.379	4.524	3.836	22.318	22.233	23.979	18.936
Natural gas	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563
Fuel wood and wood waste	0.000	0.000	1.585	1.610	15.437	16.243	16.472	16.476
Fuel oil	1.200	1.320	1.560	1.400	2.360	1.040	1.040	1.320

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	17.528	15.696	15.564	14.317	14.050	13.797	13.430	11.592
Natural gas	1.007	1.210	1.445	1.461	2.094	2.657	2.288	2.976
Fuel wood and wood waste	15.545	15.938	15.138	16.622	17.950	18.957	18.611	19.379
Fuel oil	1.320	1.360	1.480	1.560	1.600	1.680	1.600	1.600

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	9.452	7.850	8.515	9.950	11.096	10.643	11.460	11.279
Natural gas	4.087	4.822	4.834	5.030	4.587	5.535	6.271	6.295
Fuel wood and wood waste	18.644	19.729	19.171	19.117	19.402	20.358	27.152	26.987
Fuel oil	1.720	1.640	1.600	1.640	1.680	1.520	1.520	1.281

### 3.4.5. Food Processing, Beverages and Tobacco (NFR sector 1.A.2.e)

This category is a part of the category SNAP03.

The data on main fuels use in the sub-category 1.A.2.e *Food Processing, Beverages and Tobacco* over the 1991-2014 period are presented in table 3.13. Detailed data on fuel consumption was tabulated in Appendix 1. Emission factors for subcategory 1.A.2.e are presented in Appendix 2.

Table 3.13. Fuel consumption in 1991-2014 in 1.A.2.e subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	35.940	32.724	55.643	53.801	73.024	88.777	78.207	64.659
Natural gas	1.984	2.339	3.171	7.180	3.839	15.051	12.927	10.694
Coke	2.936	2.650	3.249	2.708	2.565	3.192	2.850	2.080
Diesel oil	1.030	0.901	1.201	1.072	0.901	5.448	5.191	6.821
Fuel oil	1.480	1.320	3.280	3.920	6.120	2.720	2.400	2.680

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	46.327	43.417	40.020	41.803	39.030	36.095	35.894	30.864
Natural gas	9.255	10.494	11.363	12.490	15.075	16.164	17.456	18.623
Coke	1.710	1.624	1.368	1.539	1.340	1.226	0.969	0.855
Diesel oil	7.465	7.336	7.250	6.864	6.864	6.178	5.405	4.504
Fuel oil	2.280	2.520	2.720	2.960	3.040	3.280	3.160	2.920

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	31.165	26.778	25.814	25.907	25.614	26.172	24.724	25.562
Natural gas	20.614	20.725	20.950	21.610	22.128	23.704	24.475	22.584
Coke	0.912	0.656	0.656	0.627	0.542	0.314	0.370	0.449
Diesel oil	4.076	4.504	3.161	2.901	2.382	2.944	1.992	1.526
Fuel oil	2.760	2.000	1.440	1.240	1.360	1.360	1.080	0.996

### 3.4.6. Non-metallic minerals (NFR sector 1.A.2.f)

This category is a part of the category SNAP03.

The data on main fuels use in the sub-category 1.A.2.f *Non-metallic minerals (and other industries)* over the 1991-2014 period are presented in table 3.14. Detailed data on fuel consumption was tabulated in Appendix 1. Emission factors for subcategory 1.A.2.f are presented in Appendix 2.

Table 3.14. Fuel consumption in 1991-2014 in 1.A.2.f. subcategory [PJ]

Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	72.514	68.894	76.924	83.926	79.647	86.930	81.562	66.639
Natural gas	22.704	22.246	21.986	21.506	25.518	26.650	25.655	27.097
Coke	11.314	11.115	10.716	11.400	10.118	11.144	8.664	10.089
Diesel oil	0.815	0.772	0.772	0.944	1.330	1.802	2.788	2.016
Fuel oil	2.800	3.560	3.960	4.320	6.080	3.760	4.120	6.680
Coke oven gas	1.821	1.341	1.234	0.482	0.886	0.509	0.353	0.988

Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Hard coal	59.965	53.349	41.103	33.981	30.332	32.332	31.206	31.547
Natural gas	23.917	27.976	31.858	33.233	35.584	38.233	38.963	41.283
Coke	8.008	6.868	4.874	4.418	4.874	4.674	2.594	3.050
Diesel oil	1.716	1.630	1.973	2.145	2.274	2.788	2.188	1.888
Fuel oil	5.920	3.880	4.320	4.600	4.520	4.480	4.080	2.880
Coke oven gas	0.804	0.413	0.897	0.767	0.746	1.505	1.370	1.465

Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	43.869	36.998	26.468	28.048	34.403	26.766	22.808	26.320
Natural gas	42.473	39.708	41.422	42.894	44.492	42.349	40.911	36.785
Coke	4.503	2.679	2.280	2.536	2.679	2.508	2.366	2.529
Diesel oil	1.845	2.188	1.992	1.992	2.338	1.862	1.472	1.284
Fuel oil	2.120	2.400	1.960	1.840	1.640	1.400	1.320	0.685
Coke oven gas	1.614	1.523	1.233	1.614	1.866	1.687	1.552	1.756

### 3.4.7. Other (NFR sector 1.A.2.g)

This category is generally a part of the category SNAP03, however no stationary emission sources were identified and included in it (NFR sector 1.A.2.g viii).

According to methodology currently applied for inventory preparation, diesel oil consumed for mobile combustion (off-road vehicles and other machinery) in industry and construction sub-sectors is included in particular subsectors of NFR 1.A.2 categories (i.e. in particular branches of industry), where fuel is used. Therefore for NFR sector 1.A.2.g vii notation key IE has been applied.

#### Emission trends for the NFR sector 1.A.2

Volumes and trend of pollutant emissions for Manufacturing Industries and Construction (stationary) are shown below on figures 3.10 ÷ 3.15.

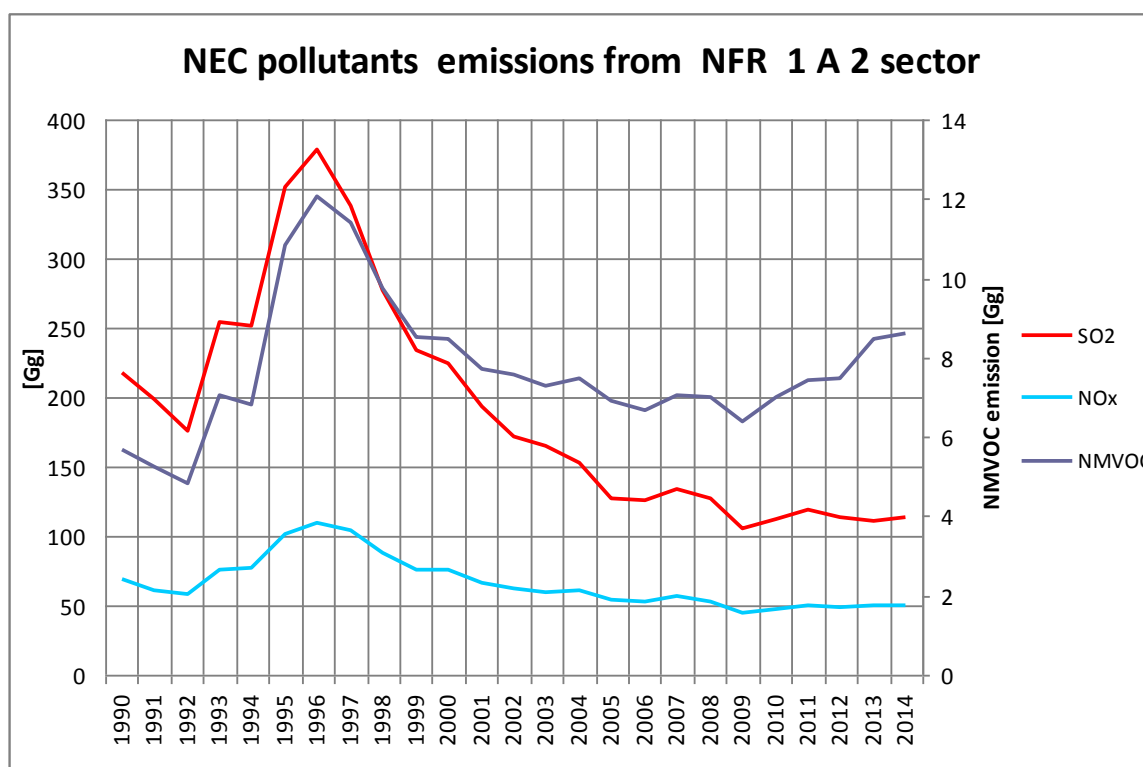


Figure 3.10. SO<sub>2</sub>, NO<sub>x</sub> and NMVOC emissions for 1.A.2 category in 1995-2013

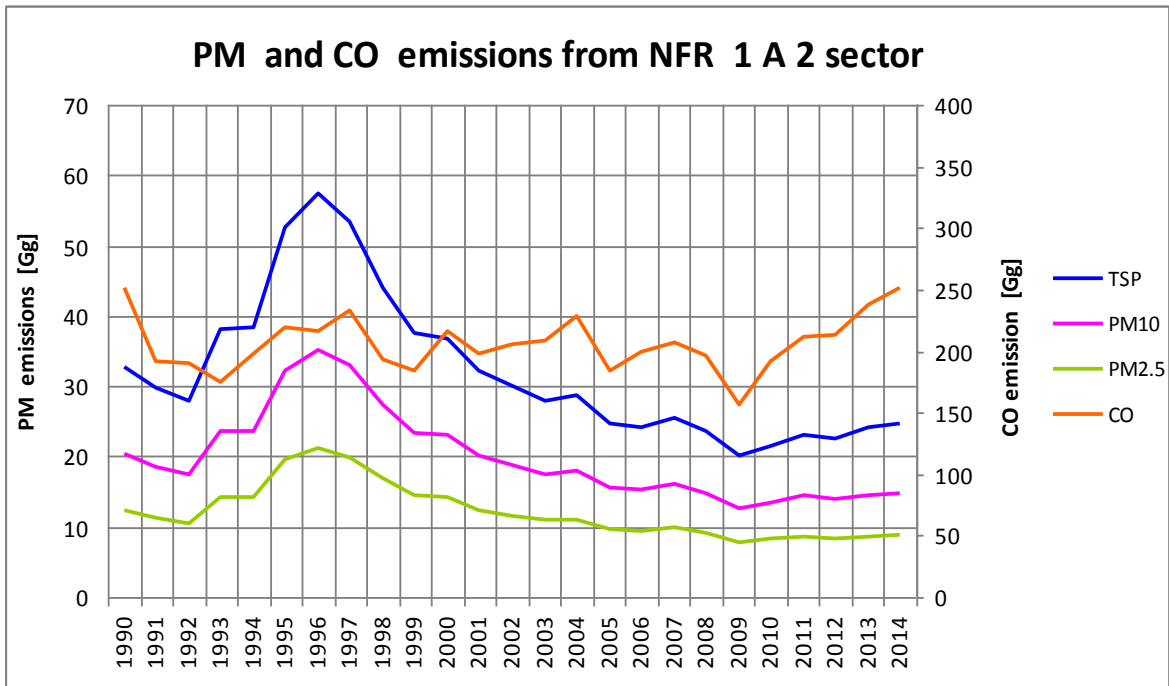


Figure 3.11. Particulates and CO emissions for 1.A.2 category in 1990-2014

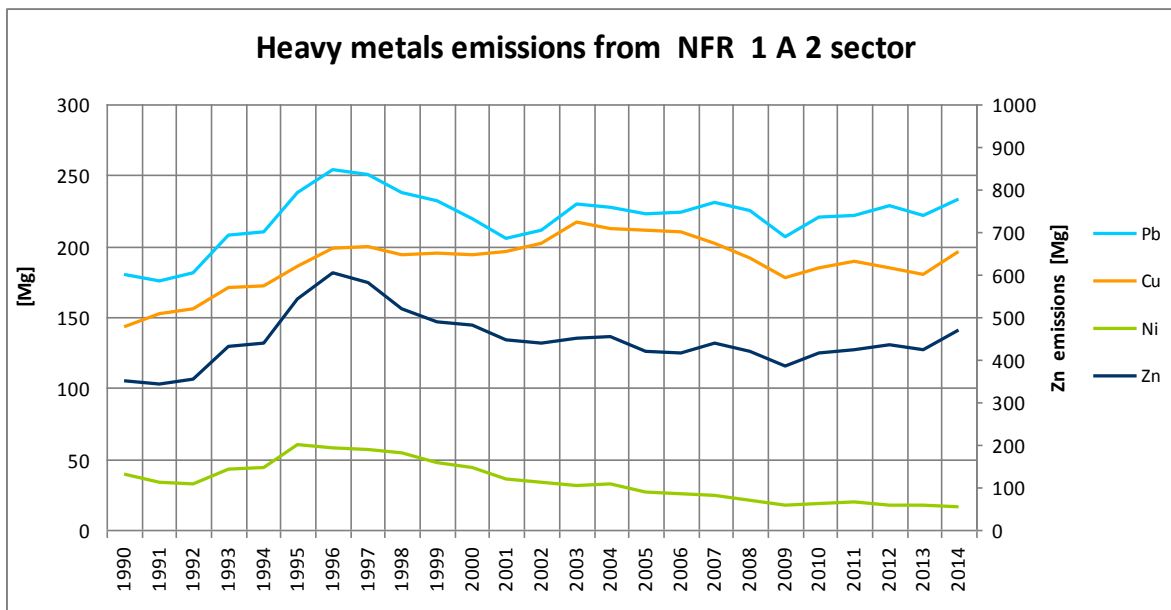


Figure 3.12. Pb, Cu, Ni and Zn emissions for 1.A.2 category in 1990-2014

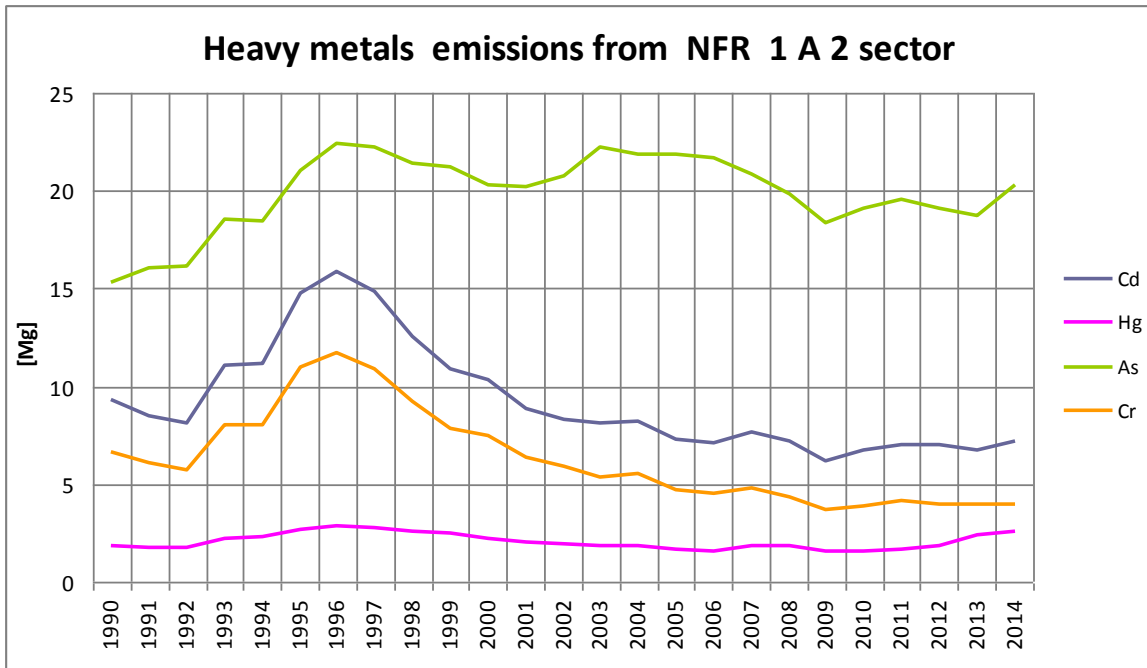


Figure 3-13. Cd, Hg, As and Cr emissions for 1.A.2 category in 1990-2014

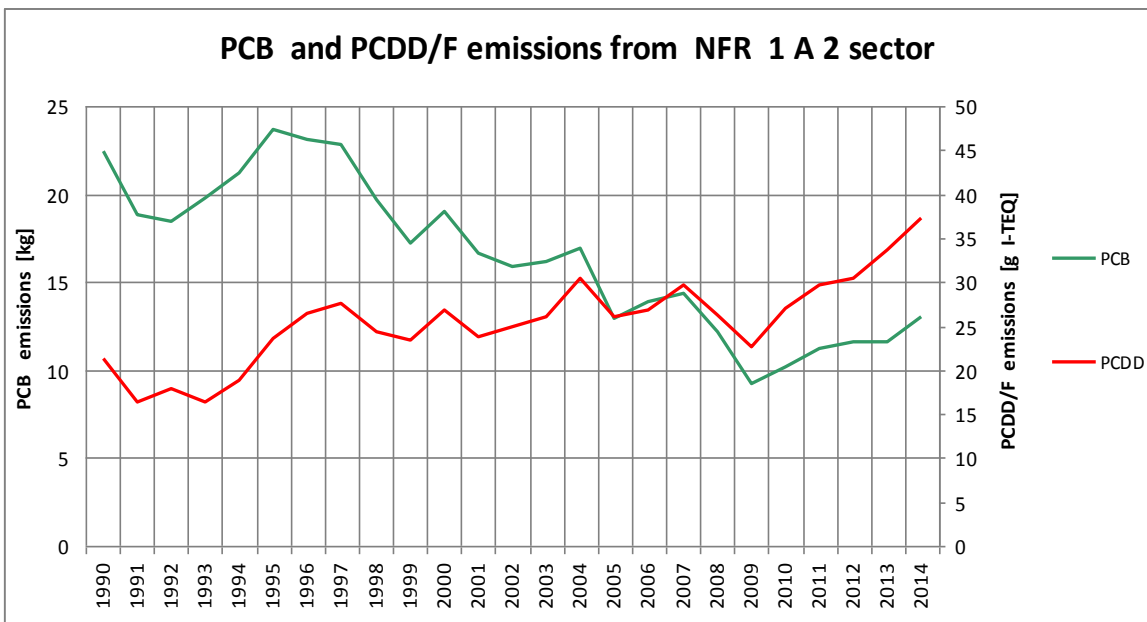


Figure 3-14. PCB and PCDD/F emissions for 1.A.2 category in 1990-2014

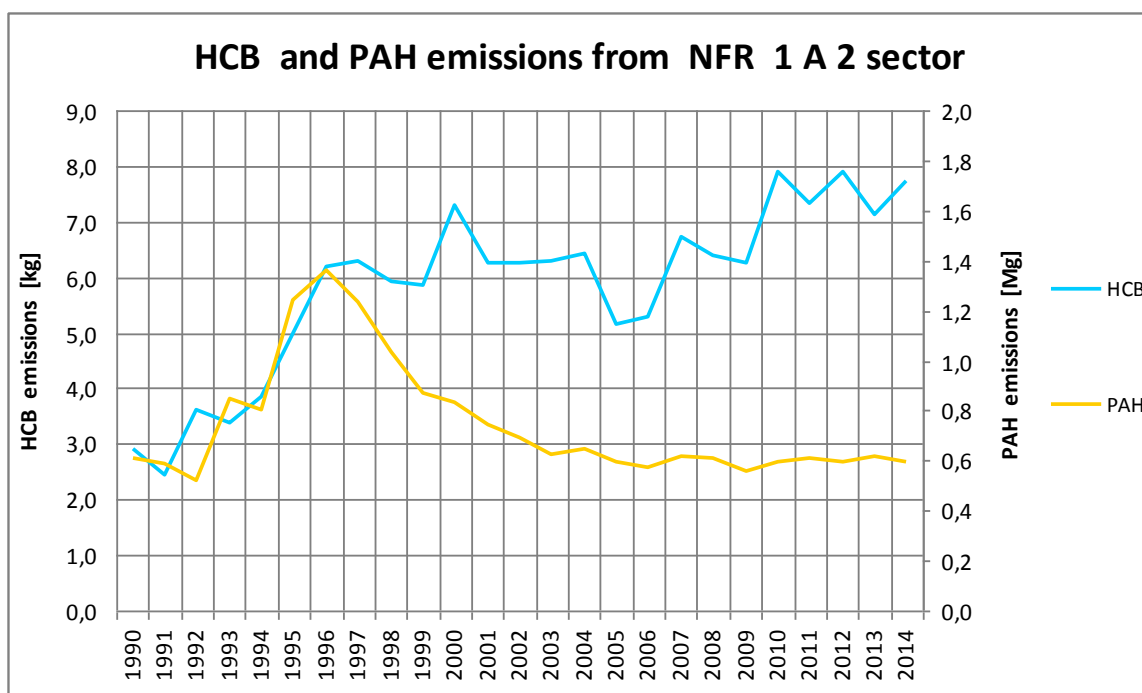


Figure 3-15. HCB and PAH emissions for 1.A.2 category in 1990-2014

#### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 1.A.2 was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 1.A.2 are given below.

Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 3.15. Results of the uncertainty analysis for NFR sector 1.A.2

NFR		NO <sub>x</sub>	NM <sub>VOC</sub>	SO <sub>x</sub>	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%	%
1A2a	Iron and steel	28	50	15	70	70	90	90	90	100
1A2b	Non-ferrous metals	29	50	10	70	70	90	90	90	100
1A2c	Chemicals	30	50	20	70	70	90	90	90	100
1A2d	Pulp, Paper and Print	30	50	20	70	70	90	90	90	100
1A2e	Food processing, beverages and tobacco	30	50	20	70	70	90	90	90	100
1A2f	Non-metallic minerals	28	50	14	29	50	90	90	90	85

#### Source-specific recalculations

Activity data on fuel consumption for years 1995-2012 were updated due to changes made in EUROSTAT database.



### 3.5. Transport (NFR sector 1.A.3)

#### Source category description

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

<i>Civil and International Aviation</i>	1.A.3.a
<i>Road Transportation</i>	1.A.3.b
<i>Railways</i>	1.A.3.c
<i>Navigation</i>	1.A.3.d
<i>Other Transportation</i>	1.A.3.e

Shares of emissions from the 1.A.3 category in the country total for the particular pollutants in 2014 are shown on the figure 3-16.

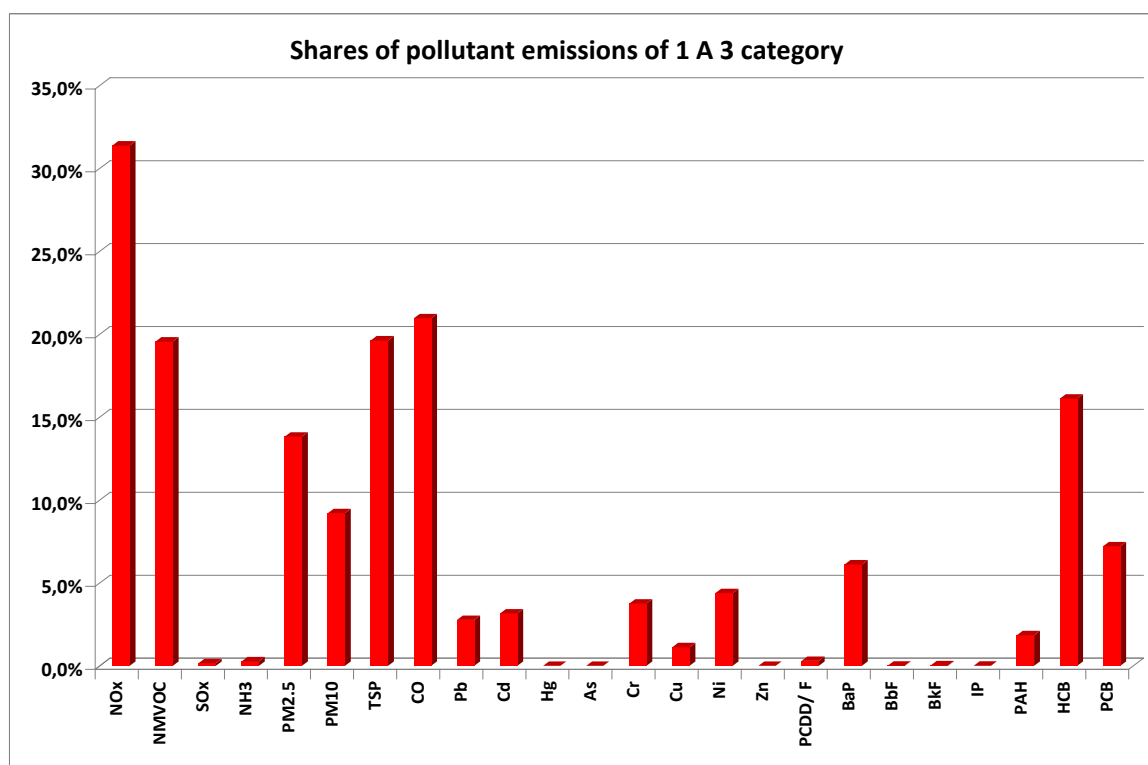


Figure 3-16. Shares of emissions from the 1.A.3 category in the country total

#### Methodological issues

The methodology used for estimation of pollutant emissions in the national inventory for mobile sources for the entire time series 1990-2014 is factor based – data on fuel used are multiplied by the corresponding emission factors.

Emission factors for road transport have been elaborated by the Motor Transport Institute based on research, analysis and literature. It is planned to introduce COPERT model for calculating road transport emissions in the nearest future.

Other emission factors for mobile sources were taken from EMEP/EEA guidebook or other international publications. All emission factors used are shown in the Appendix 2.

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

- Eurostat database – use of fuels (according to Energy Market Agency fuel used is equal to fuel sold) in the following sub-categories: 1.A.3.a – *Civil Aviation*, 1.A.3.b. - *Road Transportation*, 1.A.3.c – *Railways*, in part of the sub-category 1.A.3.d – *Navigation – i.e. inland water navigation*, in part of the sub-category 1.A.4.c – vehicles and machinery in agriculture, use of fuels included in the international aviation,
- report of the Motor Transport Institute [ITS 2014],
- Statistical Yearbook [GUS 2015g] – data on fishing used for fuel use estimation in the sub-category 1.A.4.c. iii – Fishing,
- ITS report [36] – data used for fuel use estimation in the sub-category 1.A.4.c. iii – Fishing.

For the years 1990-2014 data related to aviation gasoline and jet kerosene are those of the Eurostat database. As there was no split on international and domestic jet kerosene use in those statistics, the amounts of domestic fuels use in years 2005 – 2014 were calculated based on Eurocontrol data on fuel share of jet kerosene used for domestic aviation in Poland. Due to the lack of Eurocontrol data for the years before 2005, the share for years 1990-2004 was assumed as a 5-years average from Eurocontrol data for years 2005-2009. For the LTO cycle it was initially assumed that 10 % of the fuel use is used for that part of flight.

### 3.5.1. International Aviation (NFR sector 1.A.3.a i)

Table 3.17 presents the amounts of fuels used in the sub-category 1.A.3.a ii - International Aviation for the years 1990-2014.

Table 3.17. Fuel consumption for *International Aviation* [Gg]

category	1990	1991	1992	1993	1994	1995
1 A 3 a i (i) - International aviation (LTO)						
Jet kerosene	32.78	45.09	20.19	20.85	22.64	24.9
<i>Memo</i>						
1 A 3 a i (ii) - International aviation (Cruise)						
Jet kerosene	295.0	405.8	181.7	187.7	203.7	224.0

	1996	1997	1998	1999	2000	2001
1 A 3 a i (i) - International aviation (LTO)						
Jet kerosene	29.3	26.2	26.7	23.8	25.4	25.0
<i>Memo</i>						
1 A 3 a i (ii) - International aviation (Cruise)						
Jet kerosene	263.3	236.0	240.3	214.6	228.3	224.9

	2002	2003	2004	2005	2006	2007
1 A 3 a i (i) - International aviation (LTO)						
Jet kerosene	24.5	26.5	26.0	29.5	39.4	41.0
<i>Memo</i>						
1 A 3 a i (ii) - International aviation (Cruise)						
Jet kerosene	220.6	238.5	234.3	265.9	354.8	369.4

	2008	2009	2010	2011	2012	2013	2014
1 A 3 a i (i) - International aviation (LTO)							
Jet kerosene	49.3	44.7	47.0	42.7	65.0	49.1	55.1
<i>Memo</i>							
1 A 3 a i (ii) - International aviation (Cruise)							
Jet kerosene	443.7	401.9	423.2	383.9	585.0	442.0	495.7

All emission factors applied for International Aviation are shown in the Appendix 2.

### 3.5.2. Civil Aviation (NFR sector 1.A.3.a ii)

Table 3.18 presents the amounts of fuels used in the sub-category 1.A.3.a ii - Civil Aviation for the years 1990-2014.

Table 3.18. Fuel consumption for *Civil Aviation* [Gg]

category	1990	1991	1992	1993	1994	1995	
1.A.3.a.ii.(i) - Civil aviation (domestic. LTO)							
Jet kerosene	1.31	1.35	1.46	1.46	1.48	1.59	
Aviation gasoline	0.80	0.50	0.20	0.40	1.00	0.70	
<i>Memo</i>							
1 A 3 a ii (ii) - Civil aviation (Domestic. Cruise)							
Jet kerosene	11.75	12.13	13.17	13.11	13.28	14.31	
Aviation gasoline	7.20	4.50	1.80	3.60	9.00	6.30	
category	1996	1997	1998	1999	2000	2001	
1.A.3.a.ii.(i) - Civil aviation (domestic. LTO)							
Jet kerosene	1.87	1.68	1.71	1.52	1.62	1.60	
Aviation gasoline	0.40	0.60	0.40	0.30	0.30	0.30	
<i>Memo</i>							
1 A 3 a ii (ii) - Civil aviation (Domestic. Cruise)							
Jet kerosene	16.83	15.08	15.35	13.71	14.59	14.37	
Aviation gasoline	3.60	5.40	3.60	2.70	2.70	2.70	
category	2002	2003	2004	2005	2006	2007	
1.A.3.a.ii.(i) - Civil aviation (domestic. LTO)							
Jet kerosene	1.57	1.69	1.66	2.25	2.67	2.58	
Aviation gasoline	0.40	0.40	0.30	0.30	0.30	0.40	
<i>Memo</i>							
1 A 3 a ii (ii) - Civil aviation (Domestic. Cruise)							
Jet kerosene	14.10	15.24	14.97	20.27	23.99	23.26	
Aviation gasoline	3.60	3.60	2.70	2.70	2.70	3.60	
category	2008	2009	2010	2011	2012	2013	2014
1.A.3.a.ii.(i) - Civil aviation (domestic. LTO)							
Jet kerosene	2.72	2.57	2.98	3.19	4.74	3.29	3.94
Aviation gasoline	0.30	0.40	0.40	0.50	0.50	0.40	0.46
<i>Memo</i>							
1 A 3 a ii (ii) - Civil aviation (Domestic. Cruise)							
Jet kerosene	24.49	23.10	26.84	28.71	42.68	29.64	35.47
Aviation gasoline	2.70	3.60	3.60	4.50	4.50	3.60	4.16

All emission factors applied for Civil Aviation are shown in the Appendix 2.

### 3.5.3. Road Transportation (NFR sector 1.A.3.b)

Emission estimates from this category are based on fuel consumed by different vehicle types – including passenger cars, light and heavy duty vehicles, buses, tractors, motorcycles and mopeds. Activity data for years 1990-2014 for calculations are taken from Eurostat database and was disaggregated on individual type of vehicle according to ITS report [21].

All emission factors applied for Road Transportation are shown in the Appendix 2.

The amount of vehicles according to categories in 2011-2014 [GUS 2015d] is given in table below.

Table 3.19. Amount of vehicles by main categories in 2011-2014

Category	Amount [thous. vehicles]			
	2011	2012	2013	2014
Passenger cars	18 125	18 744	19 389	20 004
Light Duty Vehicles	2 498	2 528	2 564	2 633
Heavy Duty Vehicles	394	393	398	404
Buses	100	100	103	106
Motorcycles	1 069	1 107	1 153	1 190
Tractors	1 613	1 595	1 632	1 668
Mopeds	1 033	1 100	1 163	1 217

Tables below present the amounts of fuels used in road transport (gasoline, diesel oil and LPG) for the years 1990-2014.

Table 3.20. Fuel consumption for *Road transport: Passenger cars* [Gg]

vehicle category	1990	1991	1992	1993	1994	1995
1 A 3 b i - Road transport: Passenger cars						
Passenger Cars without catalysts - gasoline	1 994.87	2 327.13	2 480.96	2 690.10	3 246.67	3 251.37
Passenger Cars with catalysts - gasoline			14.78	50.66	94.60	296.19
Passenger Cars - 2 - stroke	136.22	158.91	147.79	107.40	33.21	35.85
Passenger Cars - liquid gas				23.57	69.01	147.73
Passenger Cars - liquid gas (new generation)				0.43	1.99	13.31
Passenger Cars - diesel oil (old generation)	188.87	187.15	237.40	218.44	216.37	243.15
Passenger Cars - diesel oil (new generation)			1.33	3.96	6.24	21.91

	1996	1997	1998	1999	2000	2001
1 A 3 b i - Road transport: Passenger cars						
Passenger Cars without catalysts - gasoline	3 150.17	2 885.15	2 306.30	2 316.92	1 343.81	1 107.46
Passenger Cars with catalysts - gasoline	623.21	1 205.82	1 866.07	2 336.71	2 838.55	2 700.96
Passenger Cars - 2 - stroke	32.47	21.41	15.42	14.41	16.34	12.95
Passenger Cars - liquid gas	183.98	203.55	167.09	201.16	85.77	113.72
Passenger Cars - liquid gas (new generation)	36.02	84.45	134.30	201.63	245.96	362.27
Passenger Cars - diesel oil (old generation)	303.87	282.84	252.79	245.36	190.81	165.05
Passenger Cars - diesel oil (new generation)	59.50	117.34	203.18	245.92	212.66	247.66

vehicle category	2002	2003	2004	2005	2006	2007
1 A 3 b i - Road transport: Passenger cars						
Passenger Cars without catalysts - gasoline	1 002.44	896.16	912.02	528.03	562.44	465.09
Passenger Cars with catalysts - gasoline	2 492.85	2 463.48	2 549.92	2 806.25	2 879.38	3 054.90
Passenger Cars - 2 - stroke	9.44	8.73	7.41	3.37	3.38	2.12
Passenger Cars - liquid gas	199.52	205.64	268.46	255.33	246.73	302.41
Passenger Cars - liquid gas (new generation)	503.40	696.53	895.63	1 025.74	1 166.38	1 162.34
Passenger Cars - diesel oil (old generation)	137.24	150.97	182.73	142.04	203.96	316.89
Passenger Cars - diesel oil (new generation)	273.19	354.24	582.14	711.83	820.41	1 063.91

vehicle category	2008	2009	2010	2011	2012	2013	2014
1 A 3 b i - Road transport: Passenger cars							
Passenger Cars without catalysts - gasoline	384.16	425.27	396.51	375.01	358.97	168.00	108.75
Passenger Cars with catalysts - gasoline	3 076.28	3 132.68	3 109.82	2 941.25	2 815.39	2 975.22	3 037.61
Passenger Cars - 2 - stroke							
Passenger Cars - liquid gas	289.41	267.01	238.78	231.30	231.02	210.23	203.22
Passenger Cars - liquid gas (new generation)	1 148.68	1 141.11	1 176.46	1 139.61	1 138.24	1 136.53	1 135.11
Passenger Cars - diesel oil (old generation)	310.04	311.10	314.23	328.82	313.56	107.32	47.67
Passenger Cars - diesel oil (new generation)	1 344.13	1 972.45	2 463.03	2 577.40	2 457.78	3 563.71	4 052.98

Table 3.21. Fuel consumption for *Road transport: Light Duty Vehicles* [Gg]

vehicle category	1990	1991	1992	1993	1994	1995
1 A 3 b ii - Road transport: Light duty vehicles						
Light Duty Vehicles < 3.5 t without catalysts - gasoline	708.69	826.73	903.51	844.01	750.78	601.97
Light Duty Vehicles < 3.5 t with catalysts - gasoline						35.76
Light Duty Vehicles < 3.5 t - diesel oil (old generation)	147.21	145.87	176.57	182.74	221.24	248.12
Light Duty Vehicles < 3.5 t - diesel oil (new generation)						14.74
Light Duty Vehicles < 3.5 t - liquid gas						14.12
Light Duty Vehicles < 3.5 t - liquid gas (new generation)						0.84

	1996	1997	1998	1999	2000	2001
1 A 3 b ii - Road transport: Light duty vehicles						
Light Duty Vehicles < 3.5 t without catalysts - gasoline	518.86	460.16	385.37	397.43	313.04	284.99
Light Duty Vehicles < 3.5 t with catalysts - gasoline	99.96	212.10	305.86	368.52	384.56	431.54
Light Duty Vehicles < 3.5 t - diesel oil (old generation)	323.67	302.48	287.61	306.28	202.11	180.51
Light Duty Vehicles < 3.5 t - diesel oil (new generation)	62.36	139.42	228.26	283.99	284.24	343.83
Light Duty Vehicles < 3.5 t - liquid gas	27.67	32.86	27.10	33.32	32.06	34.77
Light Duty Vehicles < 3.5 t - liquid gas (new generation)	5.33	15.14	21.51	30.89	61.21	75.24

vehicle category	2002	2003	2004	2005	2006	2007
1 A 3 b ii - Road transport: Light duty vehicles						
Light Duty Vehicles < 3.5 t without catalysts - gasoline	243.45	203.67	197.24	115.60	129.70	97.35
Light Duty Vehicles < 3.5 t with catalysts - gasoline	411.66	407.35	373.56	455.31	439.59	394.35
Light Duty Vehicles < 3.5 t - diesel oil (old generation)	143.35	161.75	183.21	176.13	188.78	229.39
Light Duty Vehicles < 3.5 t - diesel oil (new generation)	370.12	461.35	571.56	604.37	781.21	942.71
Light Duty Vehicles < 3.5 t - liquid gas	41.84	43.74	45.13	42.72	46.21	36.40
Light Duty Vehicles < 3.5 t - liquid gas (new generation)	84.24	124.10	131.78	225.21	240.68	248.85

vehicle category	2008	2009	2010	2011	2012	2013	2014
1 A 3 b ii - Road transport: Light duty vehicles							
Light Duty Vehicles < 3.5 t without catalysts - gasoline	86.10	64.67	61.23	57.91	55.44	16.60	4.48
Light Duty Vehicles < 3.5 t with catalysts - gasoline	417.56	337.08	346.32	327.54	313.53	210.00	178.37
Light Duty Vehicles < 3.5 t - diesel oil (old generation)	226.53	128.19	166.55	174.28	166.19	63.47	34.16
Light Duty Vehicles < 3.5 t - diesel oil (new generation)	1 161.11	1 304.12	1 442.94	1 509.94	1 439.86	1 918.92	2 146.21
Light Duty Vehicles < 3.5 t - liquid gas	34.05	22.33	23.00	22.28	22.25	24.99	25.87
Light Duty Vehicles < 3.5 t - liquid gas (new generation)	246.86	222.56	221.76	214.81	214.56	221.25	223.29

Table 3.22. Fuel consumption for *Road transport: Heavy Duty Vehicles* [Gg]

vehicle category	1990	1991	1992	1993	1994	1995
1 A 3 b iii - Road transport:, Heavy duty vehicles						
Heavy Duty Vehicles > 3.5 t - gasoline	106.14	123.81	106.41	40.53	25.16	15.94
Heavy Duty Vehicles > 3.5 t - diesel oil (old generation)	1 784.17	1 767.93	1 671.34	1 450.30	1 255.43	1 183.41
Heavy Duty Vehicles > 3.5 t - diesel oil (new generation)			58.76	117.53	176.29	235.06
Buses - diesel oil (old generation)	376.77	373.34	354.29	308.96	269.16	255.30
Buses - diesel oil (new generation)			11.06	22.12	33.18	44.24
Road transport: Tractors	249.98	247.70	243.24	209.95	186.09	199.08

vehicle category	1996	1997	1998	1999	2000	2001
1 A 3 b iii - Road transport:, Heavy duty vehicles						
Heavy Duty Vehicles > 3.5 t - gasoline	15.18	13.18	13.30	10.25	7.27	7.20
Heavy Duty Vehicles > 3.5 t - diesel oil (old generation)	1 468.96	1 433.12	1 564.26	1 539.20	1 157.26	1 161.49
Heavy Duty Vehicles > 3.5 t - diesel oil (new generation)	293.82	352.58	411.35	470.11	528.88	603.75
Buses - diesel oil (old generation)	316.95	310.73	339.77	335.83	256.52	244.25
Buses - diesel oil (new generation)	55.30	66.36	77.42	88.49	99.55	113.50
Road transport: Tractors	296.57	241.12	256.35	262.81	209.97	216.96

vehicle category	2002	2003	2004	2005	2006	2007
1 A 3 b iii - Road transport:, Heavy duty vehicles						
Heavy Duty Vehicles > 3.5 t - gasoline	7.01	3.88	3.90			
Heavy Duty Vehicles > 3.5 t - diesel oil (old generation)	973.63	1 044.11	1 182.60	1 075.07	1 176.03	1 289.45
Heavy Duty Vehicles > 3.5 t - diesel oil (new generation)	713.01	1 030.64	1 241.63	1 901.43	2 272.78	2 753.28
Buses - diesel oil (old generation)	189.12	202.09	231.18	138.62	138.45	146.47
Buses - diesel oil (new generation)	134.94	177.67	233.37	316.30	366.75	411.12
Road transport: Tractors	208.38	244.19	276.58	290.22	316.63	380.79

vehicle category	2008	2009	2010	2011	2012	2013	2014
1 A 3 b iii - Road transport:, Heavy duty vehicles							
Heavy Duty Vehicles > 3.5 t - gasoline							
Heavy Duty Vehicles > 3.5 t - diesel oil (old generation)	1 056.01	1 004.25	1 009.38	1 056.25	1 007.23	542.01	419.73
Heavy Duty Vehicles > 3.5 t - diesel oil (new generation)	3 135.28	2 917.78	3 045.59	3 187.01	3 039.10	1 514.92	1 103.63
Buses - diesel oil (old generation)	117.59	147.83	165.83	173.53	165.48	96.33	78.81
Buses - diesel oil (new generation)	413.61	381.06	397.76	416.23	396.91	460.08	498.52
Road transport: Tractors	453.69	285.21	297.70	311.53	297.07	265.23	266.19

Table 3.23. Fuel consumption for *Road transport: Mopeds and Motorcycles* [Gg]

category	1990	1991	1992	1993	1994	1995
1 A 3 b iv - Road transport: Mopeds & motorcycles						
Mopeds and Motorcycles < 50 cm3	23.40	27.30	28.57	28.37	28.18	26.17
Motorcycles > 50 cm3	62.68	73.12	68.97	70.93	62.40	35.76

category	1996	1997	1998	1999	2000	2001
1 A 3 b iv - Road transport: Mopeds & motorcycles						
Mopeds and Motorcycles < 50 cm3	23.61	31.84	32.14	24.45	21.55	21.34
Motorcycles > 50 cm3	30.54	23.33	23.55	35.31	34.89	34.56

category	2002	2003	2004	2005	2006	2007
1 A 3 b iv - Road transport: Mopeds & motorcycles						
Mopeds and Motorcycles < 50 cm3	9.64	8.73	8.81	6.80	5.27	5.04
Motorcycles > 50 cm3	36.50	32.01	32.14	27.64	25.24	20.16

category	2008	2009	2010	2011	2012	2013	2014
1 A 3 b iv - Road transport: Mopeds & motorcycles							
Mopeds and Motorcycles < 50 cm3	6.18	8.82	9.03	8.54	8.18	10.74	11.59
Motorcycles > 50 cm3	20.71	25.48	25.10	23.74	22.72	24.42	25.05

Table 3.24. presents amounts of vehicles for NFR 1 A 3 b v - Gasoline evaporation from vehicles for the years 1990-2014.

Table 3.24. Amounts of vehicles for NFR 1 A 3 b v - *Gasoline evaporation* [thousands]

Amounts of vehicles	1990	1991	1992	1993	1994	1995
Passenger cars	4 998.00	5 832.00	6 190.00	6 430.00	6 789.00	7 517.30
Light duty vehicles < 3.5 t	630.00	650.00	672.00	690.00	710.00	1 150.99
Mopeds and Motorcycles	1 357.00	1 236.00	1 134.00	1 068.00	1 008.00	929.00

	1996	1997	1998	1999	2000	2001
Passenger cars	8 054.40	8 533.40	8 890.80	9 283.00	8 498.77	8 910.42
Light duty vehicles < 3.5 t	1 216.69	1 264.29	1 328.38	1 430.47	990.00	973.23
Mopeds and Motorcycles	876.00	842.00	820.00	804.00	567.64	638.93

	2002	2003	2004	2005	2006	2007
Passenger cars	9 342.01	9 794.50	10 268.91	10 717.22	11 342.09	12 007.34
Light duty vehicles < 3.5 t	956.46	939.69	922.92	920.21	890.75	864.40
Mopeds and Motorcycles	719.16	809.48	911.13	1 067.22	1 165.54	1 336.61

	2008	2009	2010	2011	2012	2013	2014
Passenger cars	12 584.94	12 889.32	13 167.51	10 735.32	10 810.70	10 937.61	11 085.54
Light duty vehicles < 3.5 t	840.20	832.93	842.35	715.83	694.71	678.12	668.88
Mopeds and Motorcycles	1 561.15	1 732.10	1 867.29	1 069.20	1 107.26	1 153.17	1 189.53

Table 3.25 presents total mileage of vehicles for category 1 A 3 b vi – *Automobile tyre and brake wear* and 1 A 3 b vii - *Road abrasion* for the years 1995-2013.

Table 3.25. Total mileage of vehicles [mln km]

Total mileage	1990	1991	1992	1993	1994	1995
Passenger cars	39 342.8	45 187.6	48 898.0	52 268.2	61 548.9	71 037.0
Light duty vehicles < 3.5 t	9 433.7	10 637.1	11 869.1	11 340.6	10 891.3	12 918.6
Heavy duty vehicles > 3.5 t and buses	11 575.1	11 551.8	11 239.7	9 939.4	9 173.2	13 377.2
Mopeds and Motorcycles	3 367.7	3 928.7	3 816.3	3 884.8	3 543.7	2 629.1

	1996	1997	1998	1999	2000	2001
Passenger cars	83 815.6	87 552.4	89 619.5	91 466.3	81 386.0	79 894.0
Light duty vehicles < 3.5 t	14 657.1	16 217.7	17 334.2	18 526.8	17 060.0	17 715.0
Heavy duty vehicles > 3.5 t and buses	14 109.8	14 584.5	15 291.0	15 268.9	10 958.0	11 122.0
Mopeds and Motorcycles	2 413.9	2 359.2	2 359.2	2 304.4	2 195.2	2 195.2

	2002	2003	2004	2005	2006	2007
Passenger cars	80 788.0	83 179.0	92 895.0	95 385.0	101 197.0	105 868.0
Light duty vehicles < 3.5 t	17 614.0	18 083.0	18 255.0	20 050.0	21 442.0	21 245.0
Heavy duty vehicles > 3.5 t and buses	11 121.0	11 720.0	12 101.0	14 250.0	15 153.0	16 137.0
Mopeds and Motorcycles	1 854.5	1 643.2	1 600.2	1 791.0	1 058.0	1 058.0

	2008	2009	2010	2011	2012	2013	2014
Passenger cars	114 008.8	128 344.0	133 318.0	133 192.2	128 347.2	172 252.8	180 471.1
Light duty vehicles < 3.5 t	24 640.0	25 624.0	26 921.0	28 502.7	27 358.3	31 673.3	33 471.4
Heavy duty vehicles > 3.5 t and buses	17 862.0	19 471.0	19 296.0	20 865.8	19 897.4	10 238.6	7 582.7
Mopeds and Motorcycles	1 236.9	1 559.0	1 465.0	1 136.6	1 088.0	1 238.2	1 290.4

### 3.5.4. Railways (NFR sector 1.A.3.c)

Railway locomotives used in Poland are diesel and electric. Up to year 1998 coal was used in steam locomotives. The amounts of fuels used in railway transport in the 1990-2014 period are shown in table 3.26. Emission factors applied for Railways are shown in the Appendix 2.

Table 3.26. Fuel consumption for *Railways* [Gg]

Fuels	1990	1991	1992	1993	1994	1995	1996	1997
1 A 3 c - Railways								
Diesel oil	414.0	316.0	247.0	243.0	275.0	268.0	225.0	202.0
Coal	141.0	75.0	15.0	13.0	7.0	6.0	8.0	8.0

Fuels	1998	1999	2000	2001	2002	2003	2004	2005
1 A 3 c - Railways								
Diesel oil	190.0	180.0	165.0	161.0	153.0	161.0	161.0	158.0
Coal	6.0							

Fuels	2006	2007	2008	2009	2010	2011	2012	2013	2014
1 A 3 c - Railways									
Diesel oil	145.0	143.0	125.0	120.0	111.0	115.0	107.1	99.0	97.8
Coal									

### 3.5.5. Navigation (NFR sector 1.A.3.d)

The structure of fuels used in Navigation has been calculated based on G-03 questionnaires and statistical data on levels of international vs. domestic shipping activity. The amounts of fuels (diesel and fuel oil) used in both inland water and maritime navigation in the 1990-2014 period are shown in table 3.27. All emission factors applied for National navigation are shown in the Appendix 2.

Table 3.27. Fuel consumption for *National navigation* [Gg]

Fuels	1990	1991	1992	1993	1994	1995
1.A.3.d.ii - National navigation						
Inland waterways - Diesel oil	20.0	16.0	19.0	16.0	7.0	16.0
Maritime activities						
National sea traffic within EMEP area - Diesel oil	5.5	4.3	2.8	1.9	2.3	2.2
National sea traffic within EMEP area - Fuel oil	22.6	20.7	13.7	8.5	10.7	10.8

Fuels	1996	1997	1998	1999	2000	2001
1.A.3.d.ii - National navigation						
Inland waterways - Diesel oil	16.0	15.0	9.0	7.0	6.0	6.0
Maritime activities						
National sea traffic within EMEP area - Diesel oil	1.7	0.6	0.6	0.6	0.5	0.4
National sea traffic within EMEP area - Fuel oil	9.9	3.2	3.9	3.5	3.0	2.9

Fuels	2002	2003	2004	2005	2006	2007
1.A.3.d.ii - National navigation						
Inland waterways - Diesel oil	5.0	7.0	6.0	5.0	6.0	5.0
Maritime activities						
National sea traffic within EMEP area - Diesel oil	0.4	0.4	0.3	0.4	0.4	0.4
National sea traffic within EMEP area - Fuel oil	2.9	2.7	1.3	0.9	1.0	1.0

Fuels	2008	2009	2010	2011	2012	2013	2014
1.A.3.d.ii - National navigation							
Inland waterways - Diesel oil	5.0	3.0	0.1	3.0	2.8	3.0	4.2
Maritime activities							
National sea traffic within EMEP area - Diesel oil	0.3	0.2	0.1	0.1	0.2	0.3	0.3
National sea traffic within EMEP area - Fuel oil	0.8	0.5	0.2	0.2	0.3	0.6	0.5



### 3.5.6. Other transportation (NFR sector 1.A.3.e)

Pipeline transport is the source of combustion related emissions from the operation of pump stations and maintenance of pipelines. Emission data from 2011 were taken from reports to National Database.

#### Emission trends for the NFR sector 1.A.3

Volumes and trend of pollutant emissions for Transport are shown below on figures 3.17 ÷ 3.22. Drop of SO<sub>2</sub> emissions results from new limit of sulfur contents in fuels.

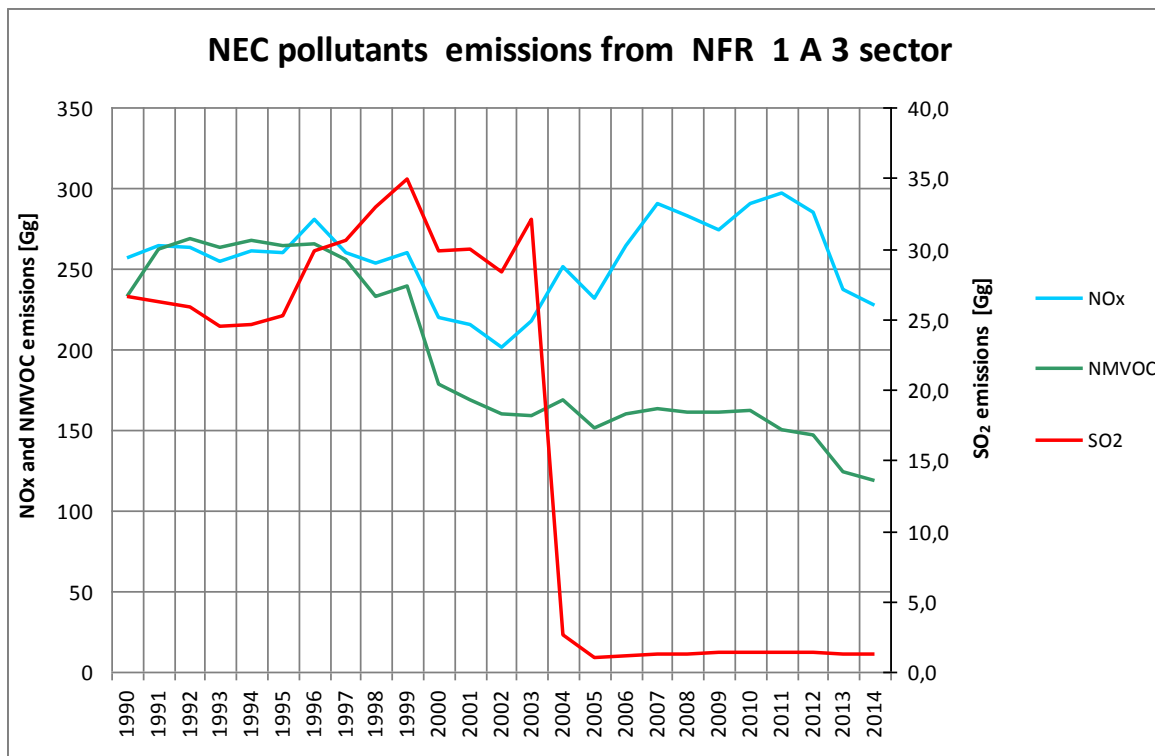


Figure 3.17. SO<sub>2</sub>, NOx and NMVOC emissions for 1.A.3 category in 1990-2014

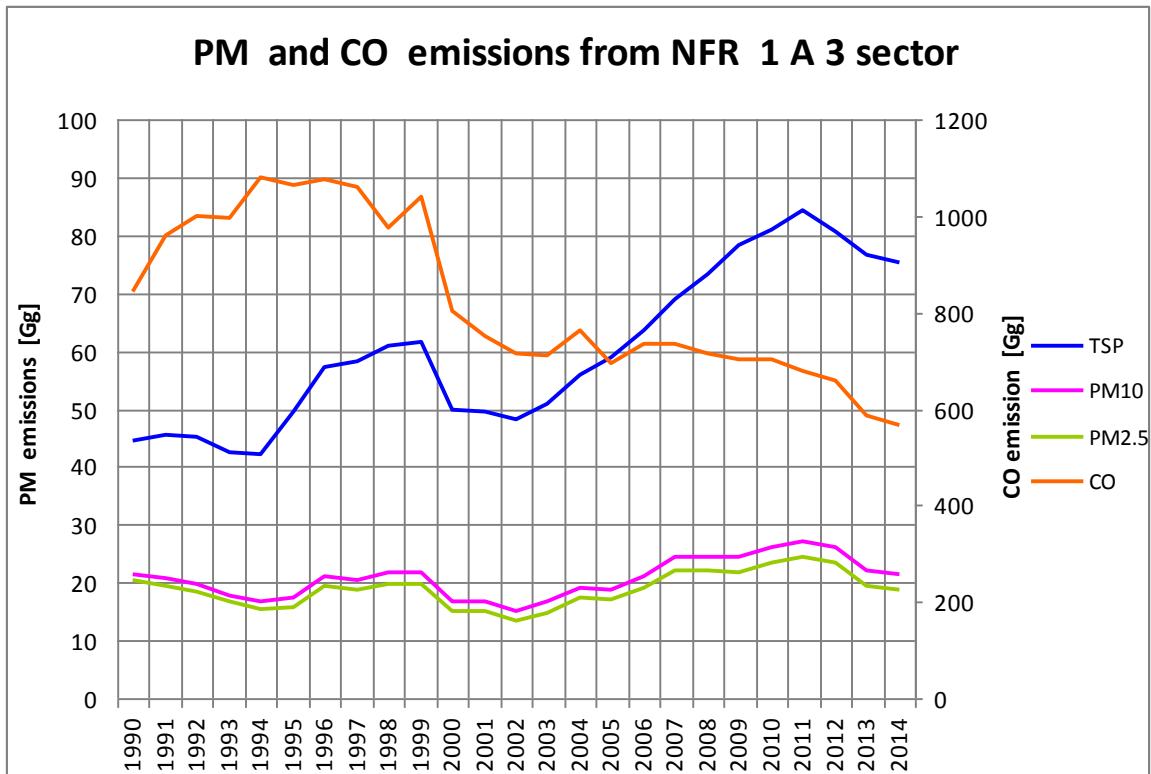


Figure 3.18. Particulates and CO emissions for 1.A.3 category in 1990-2014

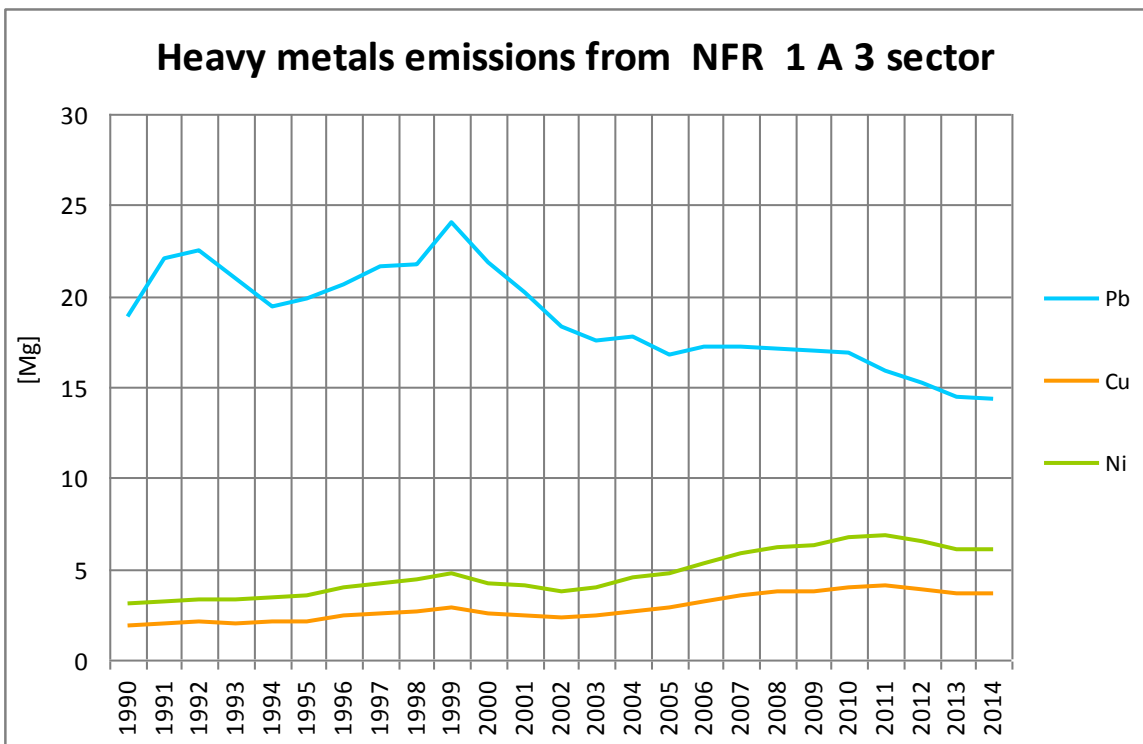


Figure 3.19. Pb, Cu and Ni emissions for 1.A.3 category in 1990-2014

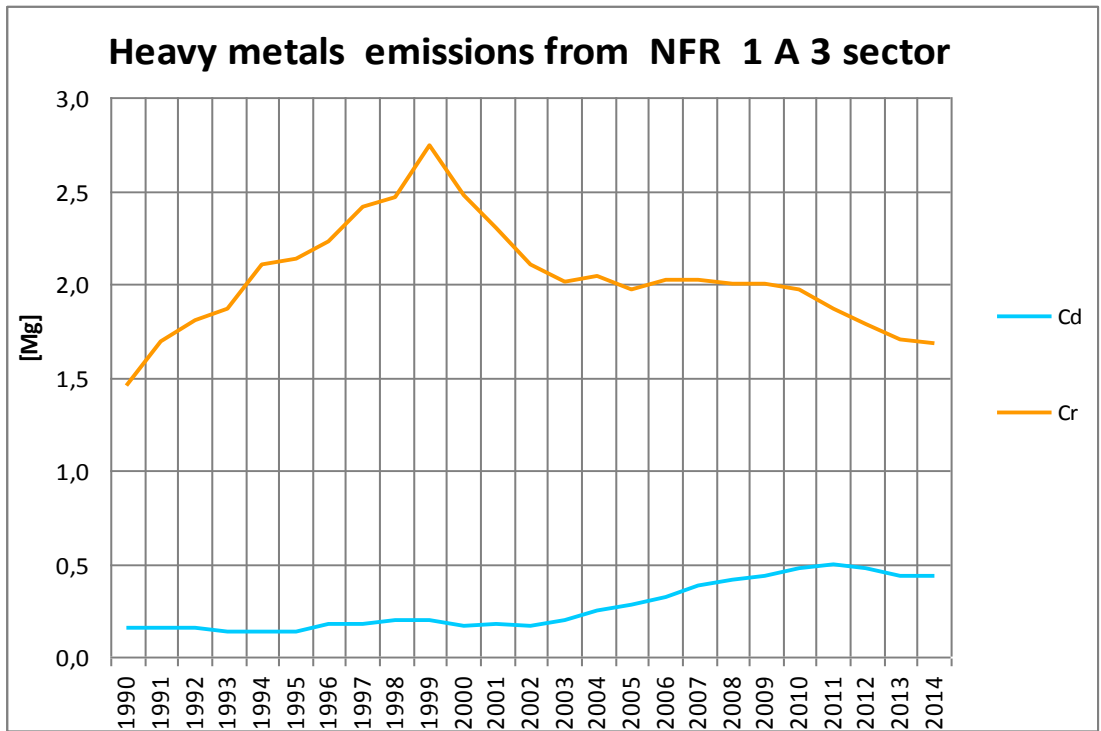


Figure 3.20. Cd and Cr emissions for 1.A.3 category in 1990-2014

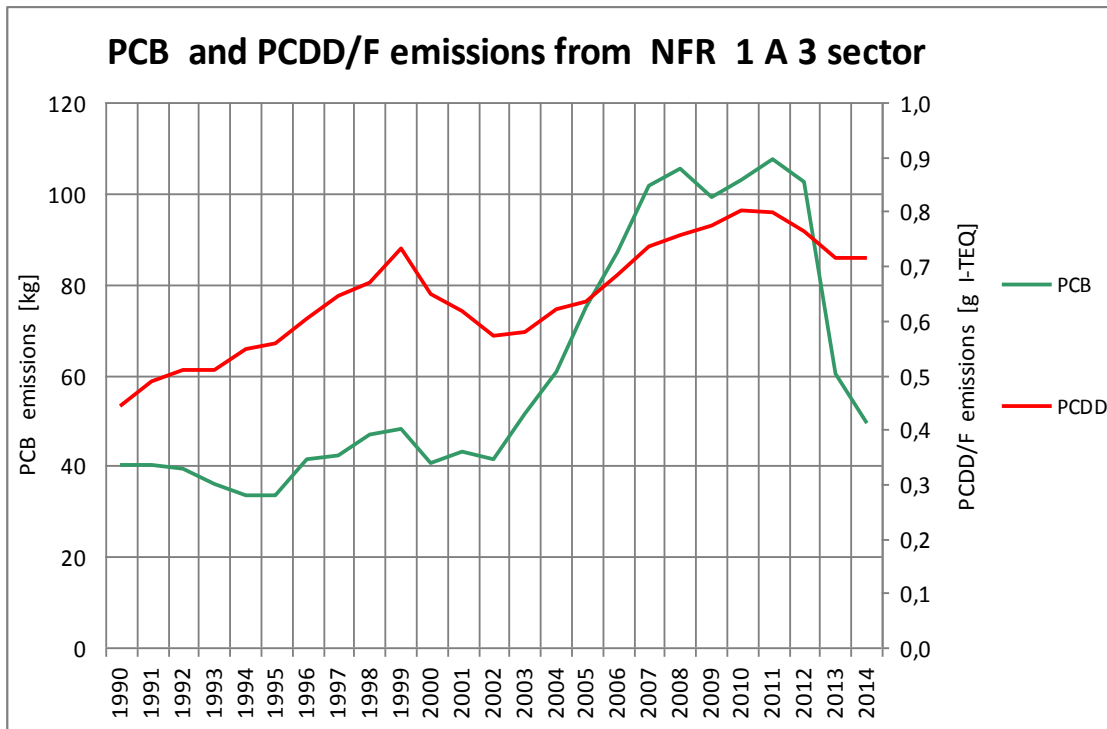


Figure 3.21. PCB and PCDD/F emissions for 1.A.3 category in 1990-2014

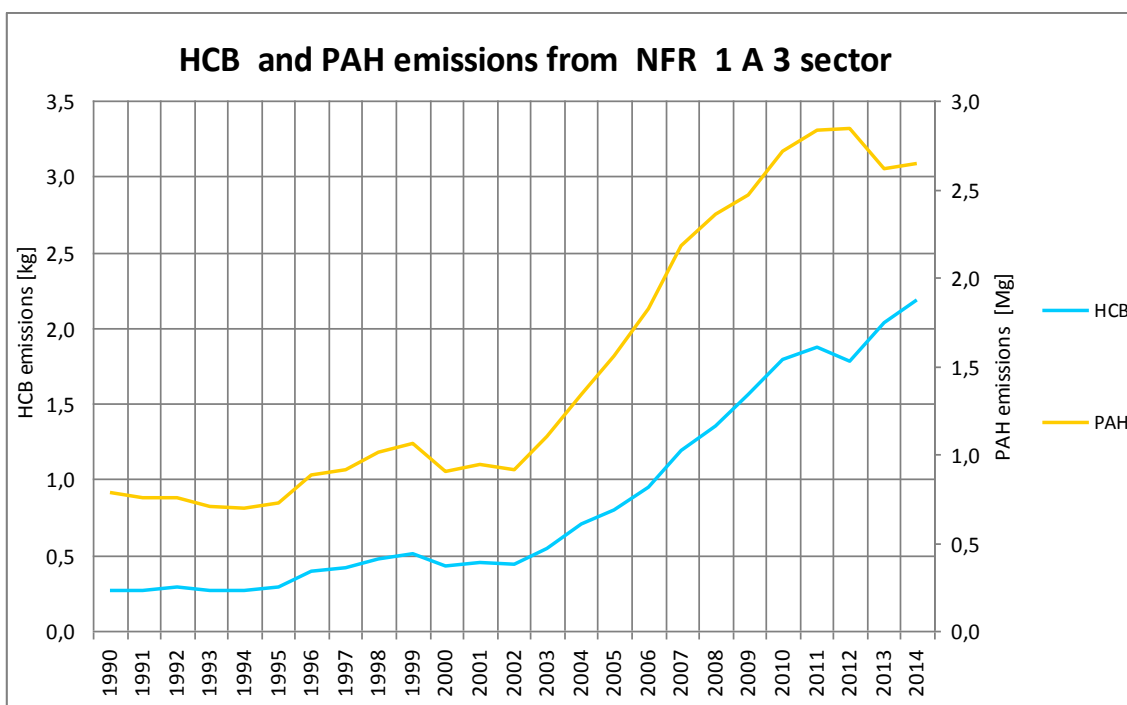


Figure 3.22. HCB and PAH emissions for 1.A.3 category in 1990-2014

#### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector *1.A.3* was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector *1.A.3* are given below.

Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 3.28. Results of the uncertainty analysis for NFR sector *1.A.3*

NFR		NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%	%	%
1A3ai(i)	International aviation LTO (civil)	112	112	86		86	50				
1A3aii(i)	Domestic aviation LTO (civil)	46	98	25		99	85				
1A3bi	Road transport: Passenger cars	14	49	19	83	60	91	95	97		71
1A3bii	Road transport: Light duty vehicles	19	46	22	66	53	86	93	97		79
1A3biii	Road transport: Heavy duty vehicles and buses	17	59	20	66	52	54		56		64
1A3biv	Road transport: Mopeds & motorcycles	27	73	23	78	75	76	76			76
1A3bv	Road transport: Gasoline evaporation		90								
1A3c	Railways	50	100	30	50	100	100		50		100
1A3dii	National navigation (shipping)	39	78	27		92	81	100	45	100	91
1A3ei	Pipeline transport	50		70							

#### Source-specific recalculations

Fuel consumption in 1990-2013 was corrected based on updated Eurostat database.

### 3.6. Other sectors (NFR sector 1.A.4)

#### Source category description

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

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

Shares of emissions from the 1.A.4 category in the country total for the particular pollutants in 2014 are shown on the figure 3.23. Subsector 1.A.4.b *Residential* is by far the largest contributor to emissions from this category.

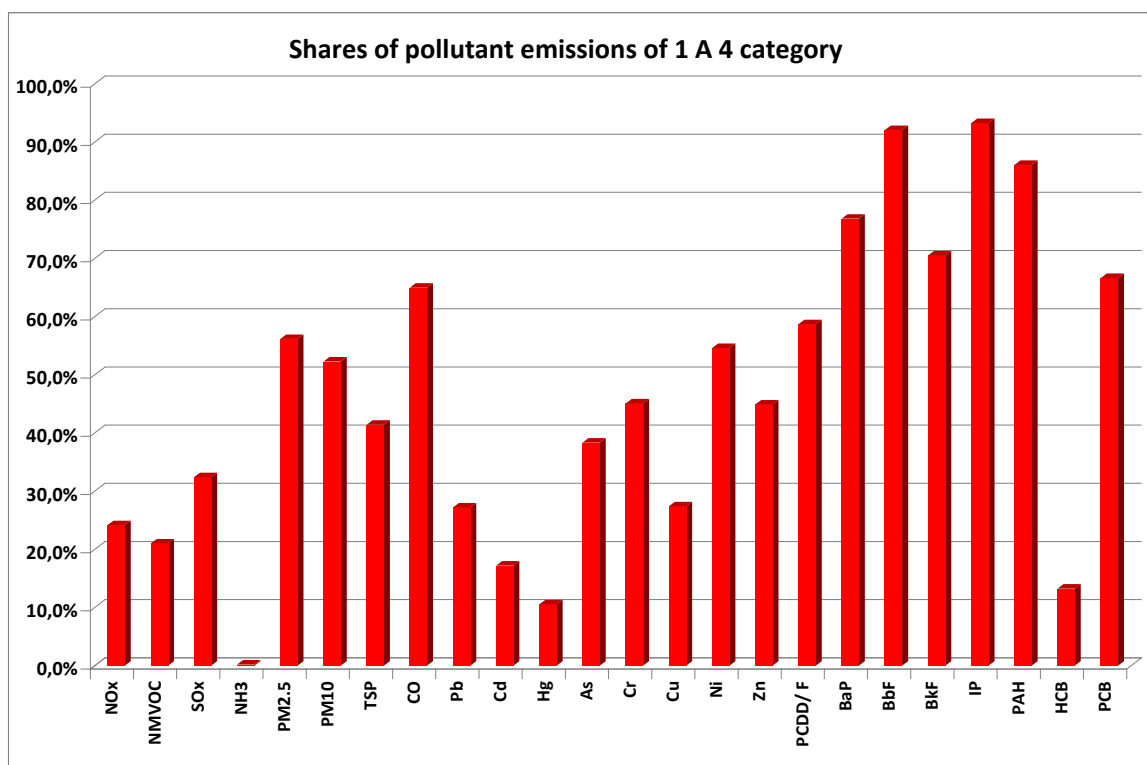


Figure 3.23. Shares of emissions from the 1.A.4 category in the country total

#### Methodological issues

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

### 3.6.1. Other Sectors – Commercial/Institutional (1.A.4.a i)

The data on main fuels use in stationary sources in the sub-category 1.A.4.a i *Other Sectors – Commercial/Institutional* over the 1990-2014 period are presented in table 3.29. Detailed data concerning fuel consumption in 1.A.4.a i subcategory was tabulated in Appendix 1. Applied emission factors are presented in Appendix 2.

Table 3.29. Fuel consumption in 1990-2014 in 1.A.4.a i subcategory [PJ]

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998
Hard coal	54.547	62.166	54.214	50.334	34.666	34.267	25.608	18.696	16.200
Natural gas	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769
Fuel wood and wood waste	4.501	2.945		12.312	11.719	11.560	10.046	9.028	8.437
Coke	34.712	28.264	40.068	33.402	27.332	25.878	26.220	28.642	13.480
Liquid petroleum gas (LPG)					1.334	0.782	0.782	1.748	1.564
Diesel oil							0.987	4.290	6.220

Fuels	1999	2000	2001	2002	2003	2004	2005	2006	2007
Hard coal	15.104	13.354	13.460	21.677	21.539	22.502	25.405	29.320	25.291
Natural gas	37.696	38.567	49.971	61.001	67.057	69.570	68.410	63.517	65.488
Fuel wood and wood waste	8.553	8.514	5.736	5.747	5.752	6.028	6.171	4.580	5.482
Coke	12.226	8.265	3.819	8.122	8.180	5.928	2.679	2.878	2.594
Liquid petroleum gas (LPG)	2.070	2.300	3.266	3.358	5.520	5.014	4.600	5.244	4.922
Diesel oil	7.636	13.342	15.015	19.090	16.774	14.286	13.213	23.252	22.866

Fuels	2008	2009	2010	2011	2012	2013	2014
Hard coal	28.763	31.393	36.517	31.093	32.855	30.116	26.785
Natural gas	71.250	75.746	83.433	78.278	80.888	76.501	60.684
Fuel wood and wood waste	5.012	7.098	7.929	7.818	6.833	7.433	6.556
Coke	2.080	2.138	2.109	1.824	0.741	1.083	0.601
Liquid petroleum gas (LPG)	4.462	3.772	3.404	3.312	4.048	2.852	3.576
Diesel oil	22.866	21.910	27.409	25.634	18.402	15.155	14.735

### 3.6.2. Other Sectors – Residential (NFR sector 1.A.4.b i)

The data on main fuels use in stationary sources in the sub-category 1.A.4.b i *Residential* over the 1990-2014 period are presented in table 3.30. Detailed information on fuel consumption for 1.A.4.b i subcategory are presented in Appendix 1. Applied emission factors are presented in Appendix 2.

Table 3.30. Fuel consumption in 1995-2013 in 1.A.4.b I subcategory [PJ]

Fuels	1990	1991	1992	1993	1994	1995	1996	1997
Hard coal	272.689	358.521	351.542	372.347	309.920	305.701	326.681	271.980
Natural gas	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022
Fuel wood and wood waste	34.335	27.721	33.969	106.000	104.715	105.000	101.000	100.000
Coke	14.866	12.110	26.732	30.752	27.788	27.502	28.044	32.775
Liquid petroleum gas (LPG)	1.702	1.012	1.840	6.072	8.970	12.834	16.100	18.400

Fuels	1998	1999	2000	2001	2002	2003	2004	2005
Hard coal	213.584	223.330	166.012	184.730	209.771	207.214	219.654	249.994
Natural gas	138.268	135.995	127.611	133.737	127.093	127.629	126.376	135.111
Fuel wood and wood waste	100.700	95.000	95.000	104.500	104.500	103.075	103.360	100.700
Coke	19.950	18.525	11.685	11.970	8.550	8.550	7.125	2.992
Liquid petroleum gas (LPG)	18.400	19.320	20.240	20.700	21.390	25.300	23.920	23.000

Fuels	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	284.628	257.388	276.073	279.808	342.161	275.817	291.964	280.043	257.400
Natural gas	138.686	132.622	131.450	134.857	148.427	135.471	141.397	143.187	118.438
Fuel wood and wood waste	104.500	102.000	102.500	102.500	112.746	115.000	116.850	116.850	105.450
Coke	3.278	1.425	1.140	5.928	6.526	5.700	5.415	5.700	4.760
Liquid petroleum gas (LPG)	23.000	23.920	24.380	25.254	24.840	23.000	23.000	21.620	22.546

### 3.6.3. Other Sectors – Agriculture/Forestry/Fishing – stationary (NFR sector 1.A.4.c i)

The data on main fuels use in stationary sources in the sub-category 1.A.4.c.i Agriculture/Forestry/ Fishing over the 1990-2014 period are presented in table 3.31. Detailed data concerning total fuel consumption in 1.A.4.c i subcategory (including fuel consumption related to off-road vehicles and other machinery in agriculture and fuel use in fishing) was tabulated in Appendix 1. Applied emission factors are presented in Appendix 2.

Table 3.31. Fuel consumption in stationary sources in 1.A.4.c I subcategory [PJ]

Fuels	1990	1991	1992	1993	1994	1995	1996	1997
Hard coal	36.365	57.356	62.959	62.501	60.542	58.583	62.611	52.483
Fuel wood and wood waste	0.039	0.278	0.583	20.057	18.367	18.500	17.567	17.000
Coke	1.568	1.168	0.684	0.570	4.018	4.018	4.104	5.130
Liquid petroleum gas (LPG)					0.460	0.690	1.150	1.380
Fuel oil	3.560	2.720	1.440	13.400	16.720	8.720	4.000	6.560

Fuels	1998	1999	2000	2001	2002	2003	2004	2005
Hard coal	46.050	49.162	33.231	36.975	30.820	29.693	31.728	35.673
Fuel wood and wood waste	17.100	17.100	17.100	19.043	19.010	19.017	19.878	19.038
Coke	5.700	5.130	3.420	3.705	2.850	2.850	1.995	1.140
Liquid petroleum gas (LPG)	1.380	1.610	1.840	2.300	2.760	3.220	3.220	3.220
Fuel oil	5.680	5.480	5.600	5.240	3.880	5.840	5.960	7.200

Fuels	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	42.074	37.748	41.640	41.538	50.605	41.488	43.715	41.611	39.000
Fuel wood and wood waste	19.977	19.060	19.024	19.030	21.088	23.931	20.948	20.937	19.310
Coke	1.425	0.855	0.826	0.855	0.940	0.998	0.285	0.570	0.560
Liquid petroleum gas (LPG)	2.300	2.300	2.346	2.070	2.300	2.346	2.300	2.300	2.300
Fuel oil	1.720	1.200	1.360	1.200	0.920	1.280	1.360	0.560	0.447

### 3.6.4. Other Sectors – Agriculture/Forestry/Fishing – mobile sources

Mobile sources included in the national inventory in category 1.A.4 include:

- machinery and off-road transport in agriculture (sub-category 1.A.4.c.ii)
- fishing (sub-category 1.A.4.c.iii).

The amounts of fuels used in the above listed sub-categories in the 1991-2014 period are presented in table 3.32. Applied emission factors are presented in Appendix 2.

Table 3.32. Fuel consumption [Gg] in 1991-2014 in mobile sources in NFR 1.A.4

Category / Fuels	1991	1992	1993	1994	1995	1996	1997	1998
Off-road transport in agriculture - ON	1 021.30	1 200.13	1 513.80	1 639.43	1 726.14	1 926.00	2 240.61	2 038.49
Machinery in agriculture - ON	113.48	133.35	168.20	182.16	191.79	214.00	248.96	226.50
Fishery – ON	77.22	80.52	66.00	75.41	74.07	60.00	62.43	45.01
Fishery – OP	135.13	140.91	115.49	131.97	129.62	105.00	109.25	78.76

Category / Fuels	1999	2000	2001	2002	2003	2004	2005	2006
Off-road transport in agriculture - ON	2 087.84	2 313.00	2 156.26	2 149.76	2 175.02	2 215.42	2 266.30	1 682.94
Machinery in agriculture - ON	231.98	257.00	239.58	238.86	241.67	246.16	251.81	186.99
Fishery – ON	45.18	40.00	42.16	41.37	33.32	37.42	31.89	30.07
Fishery – OP	79.06	70.00	73.78	72.40	58.30	65.49	55.81	52.62

Category / Fuels	2007	2008	2009	2010	2011	2012	2013	2014
Off-road transport in agriculture - ON	1 547.04	1 548.09	1 490.01	1 494.25	1 506.77	1 518.01	1 483.94	1 433.56
Machinery in agriculture - ON	171.89	172.01	165.56	166.03	167.42	168.67	164.88	159.28
Fishery - ON	31.07	29.90	44.44	36.72	37.81	38.27	41.17	37.09
Fishery - OP	54.38	52.32	77.77	64.25	66.16	66.98	72.05	64.90

Note: ON - diesel oil, OP - fuel oil

Emission trends for the NFR sector 1.A.4

Volumes and trend of pollutant emissions for 1.A.4 sector are shown below on figures 3.24 ÷ 3.29.

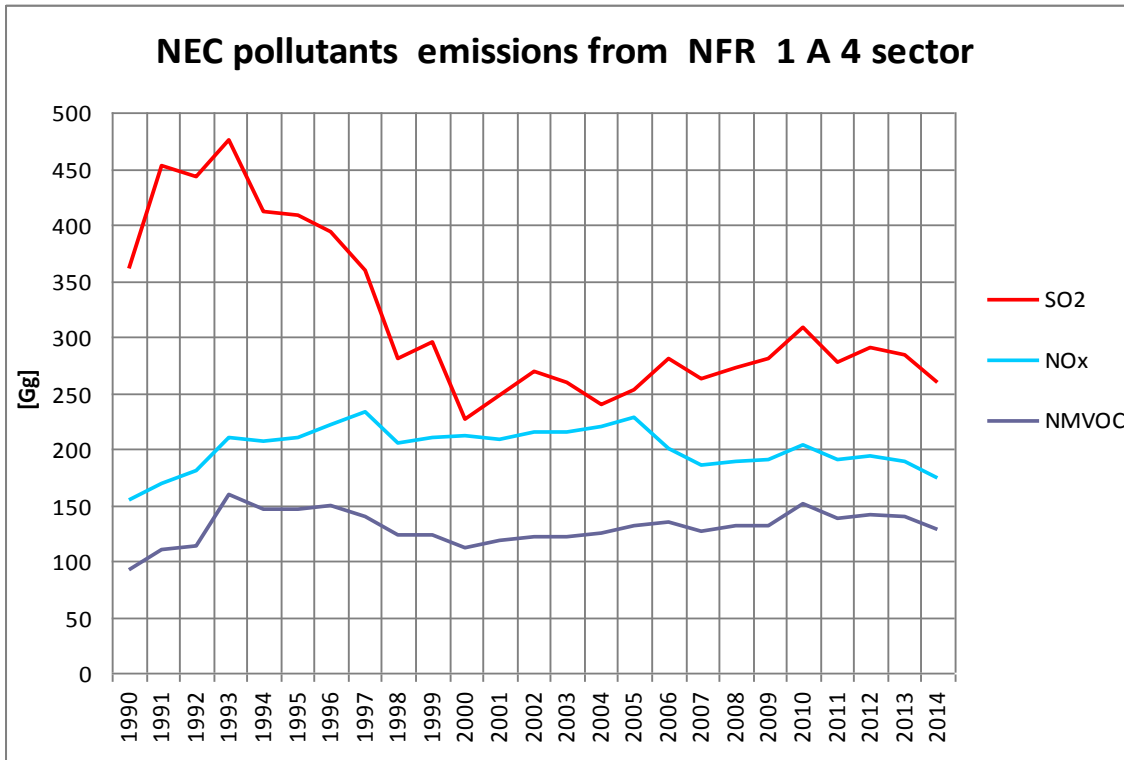


Figure 3-24. SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> and NMVOC emissions for 1.A.4 category in 1990-2014

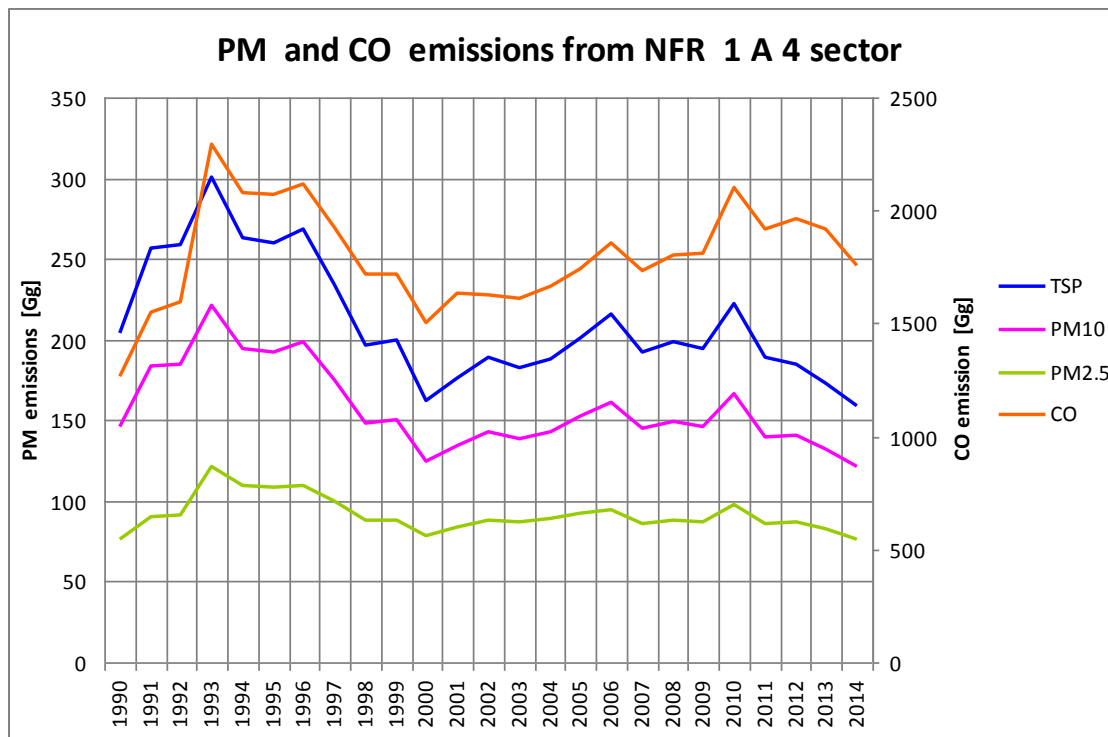


Figure 3-25. CO and particulates emissions for 1.A.4 category in 1990-2014



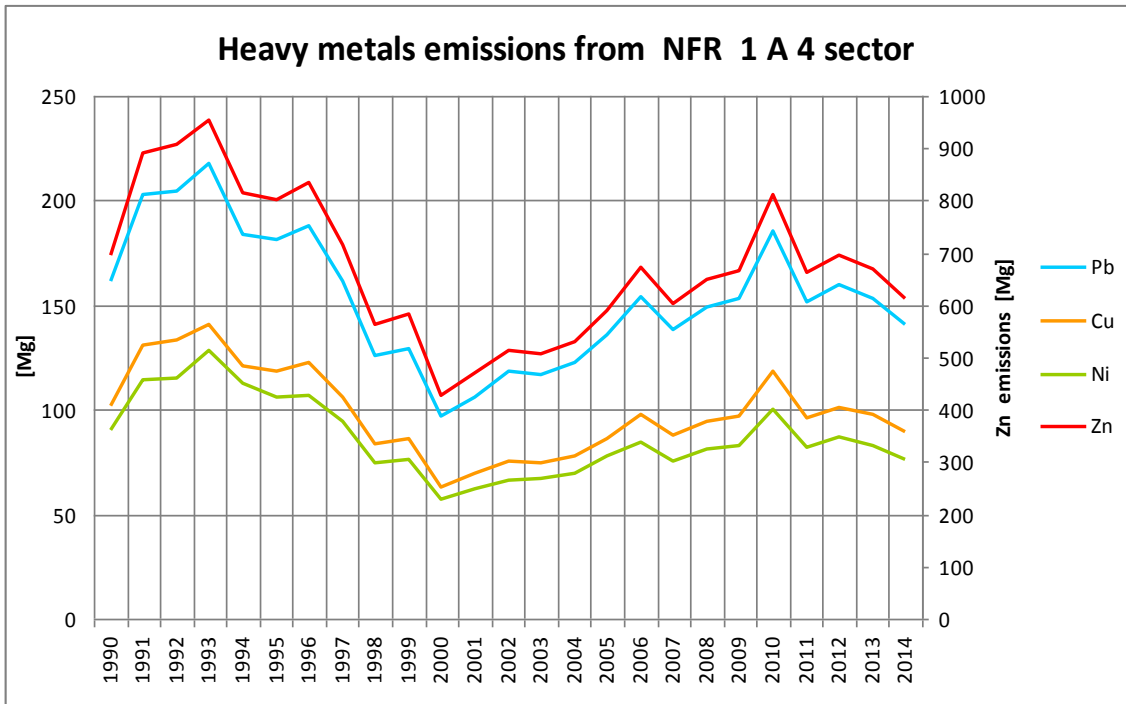


Figure 3-26. Pb, Cu, Zn and Ni emissions for 1.A.4 category in 1990-2014

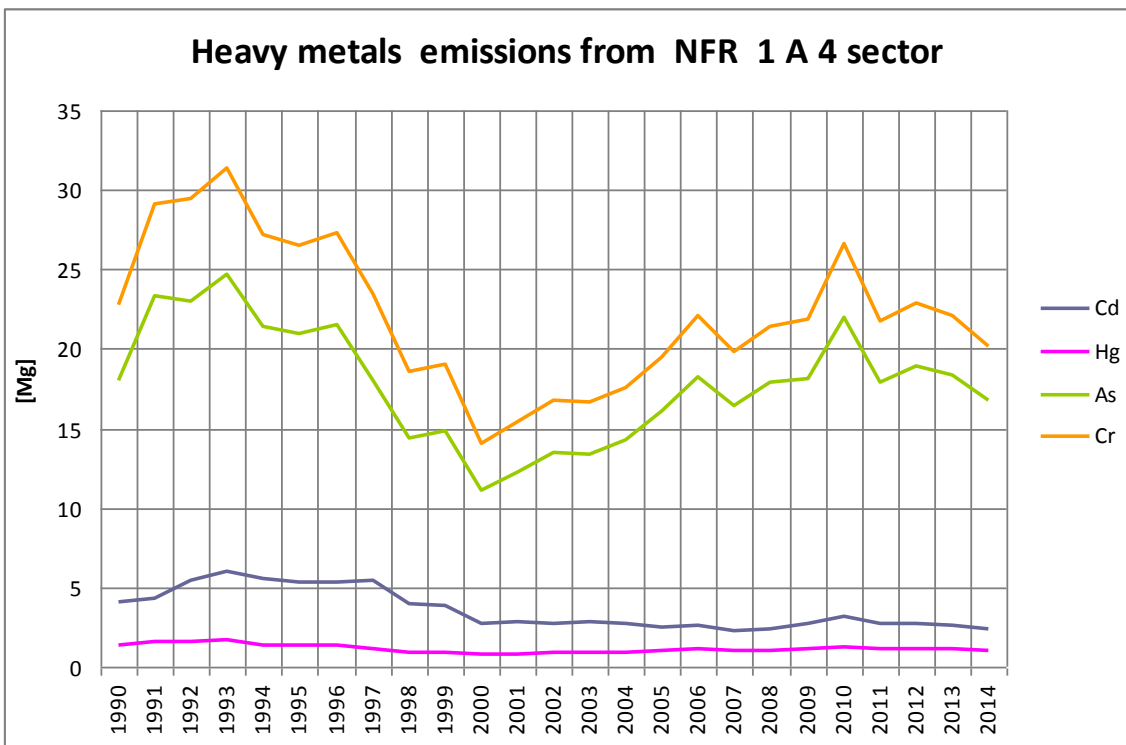


Figure 3-27. Cd, As, Hg and Cr emissions for 1.A.4 category in 1990-2014

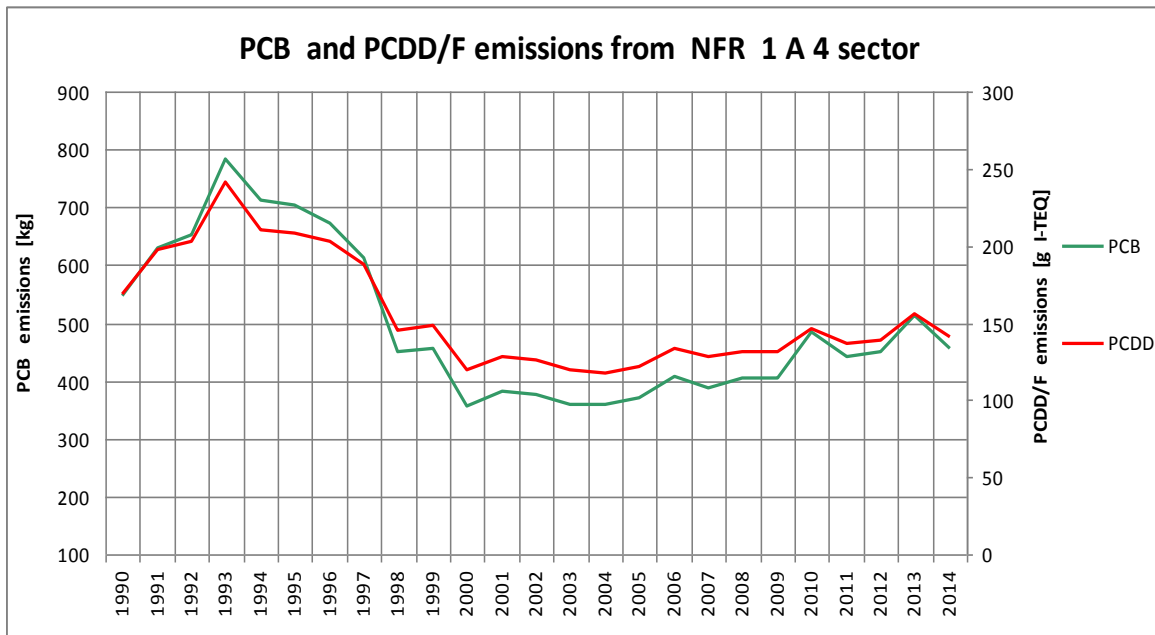


Figure 3-28. PCB and PCDD/F emissions for 1.A.4 category in 1990-2014

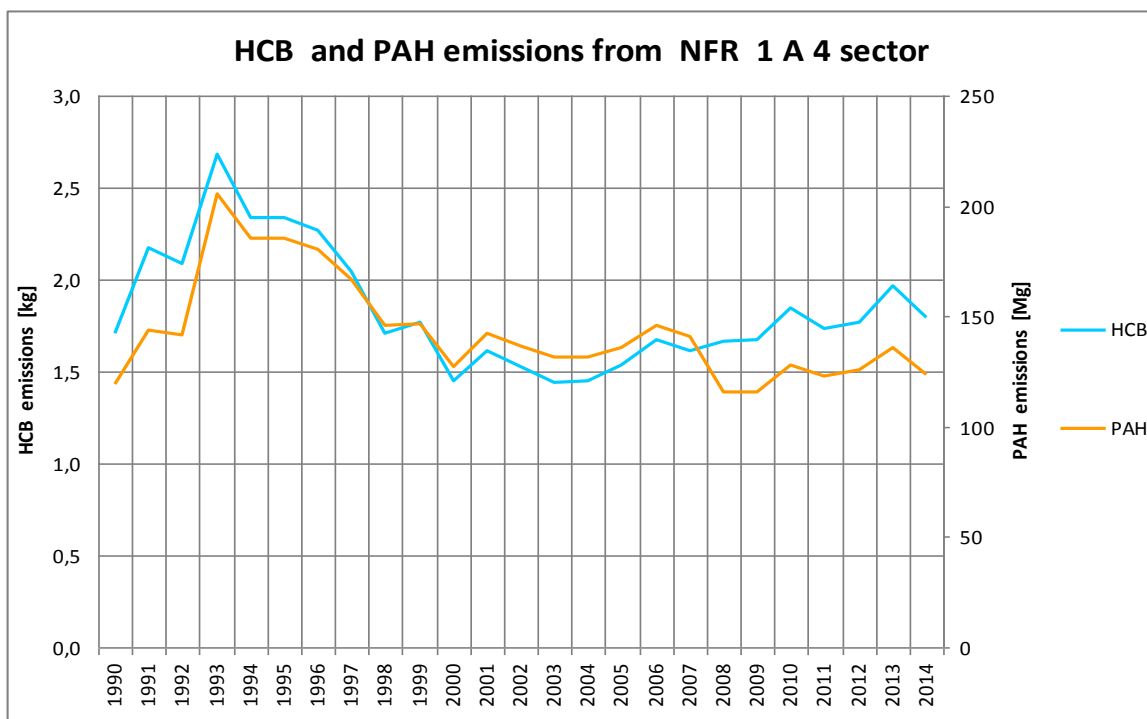


Figure 3-29. HCB and PAH emissions for 1.A.4 category in 1990-2014

#### Uncertainties and time-series consistency for 1.A.4

Uncertainty analysis for the 2014 for NFR sector 1.A.4 was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 1.A.4 are given below. Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 3.33. Results of the uncertainty analysis for NFR sector 1.A.4

NFR		NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	NH <sub>3</sub>	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%	%	%
1A4ai	Commercial/institutional: Stationary	17	32	26		36	42	68	51	65	61
1A4bi	Residential: Stationary	20	35	29	43	35	39	66	52	64	76
1A4ci	Agriculture/Forestry/Fishing: Stationary	24	34	26		40	41	57	52	62	92
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	45	86	28	46	90	91		46		91
1A4ciii	Agriculture/Forestry/Fishing: National fishing	37	73	28		73	73		37		100

### Source-specific recalculations

Activity data on fuel consumption for years 1990-2013 were updated due to changes made in EUROSTAT database.

### Source-specific planned improvements

Further developing of cooperation with institutions responsible for compilation of Polish energy balances in order to explain and verify time-trends of activity data in 1.A.4 category.

## **3.7. Fugitive emissions (NFR sector 1.B)**

### Overview of a sector

The Fugitive emissions sector consists of the following main subcategories:

- fugitive emission from solid fuels (NFR 1.B.1)
- fugitive emission from oil and natural gas (NFR 1.B.2).

Shares of emissions from the 1 B category in the country total for the particular pollutants in 2014 are shown on the figure 3.30.

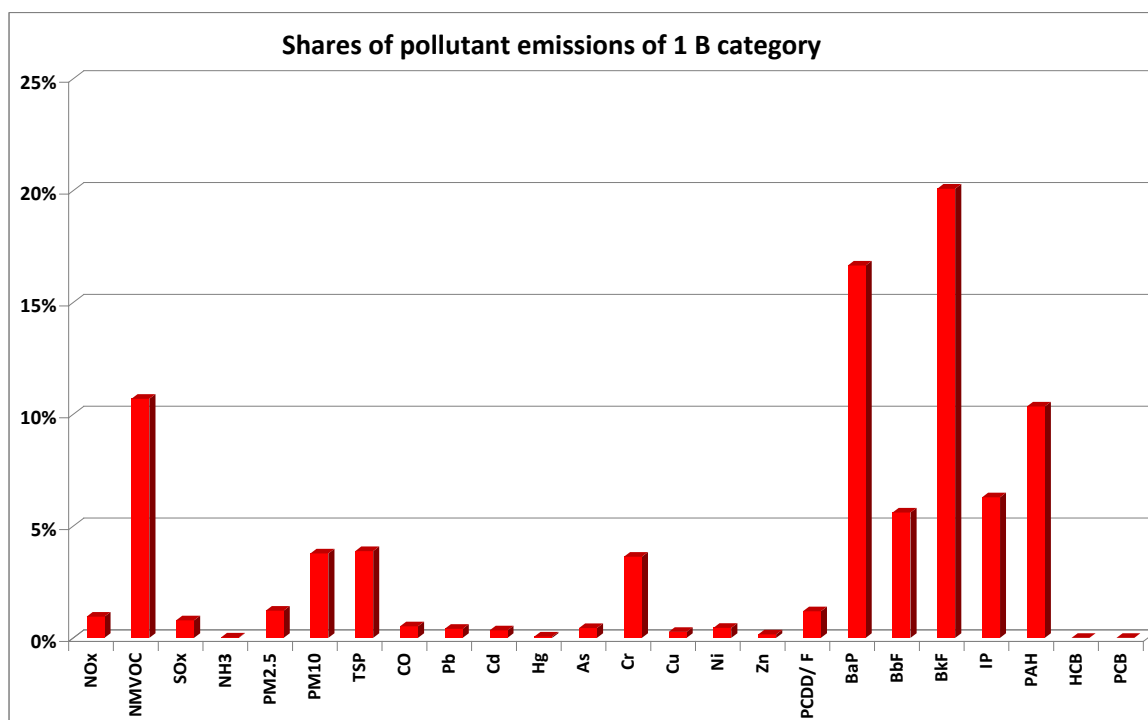


Figure 3.30. Shares of emissions from the 1 B category in the country total

### 3.7.1. Fugitive emission from solid fuels (NFR sector 1.B.1)

#### Source category description

Fugitive emission from solid fuels involves emissions from

- coal mining and handling (NFR 1.B.1.a.)
- solid fuel transformation (NFR 1.B.1.b.).

Activity data used in the sub-category 1.B.1 for the years 1991-2014 are presented in Table 3.34. Applied emission factors are presented in Appendix 2.

Table 3.34. Activity data used in the category 1.B.1 - *Fugitive emission from solid fuels* [Gg]

Industrial process	1991	1992	1993	1994	1995	1996	1997	1998
Lignite extraction	69 359.1	66 852.1	68 104.9	66 770.2	63 500.0	63 800.0	63 200.0	62 800.0
Hard coal extraction	140 269.9	131 530.6	130 479.2	133 933.1	137 000.0	138 000.0	138 000.0	116 000.0
Coke production	11 468.1	11 128.4	10 281.7	11 456.1	11 579.0	10 340.0	10 536.0	9 847.0

Industrial process	1999	2000	2001	2002	2003	2004	2005	2006
Lignite extraction	60 800.0	59 484.1	59 557.4	58 209.6	60 919.1	61 197.5	61 636.4	60 844.3
Hard coal extraction	112 000.0	103 330.6	103 991.7	103 704.8	103 016.4	100 087.1	97 902.9	95 220.8
Coke production	8 476.0	8 972.2	8 954.3	8 787.9	10 231.9	10 213.9	8 404.1	9 613.3

Industrial process	2007	2008	2009	2010	2011	2012	2013	2014
Lignite extraction	57 537.7	59 668.2	57 108.3	56 510.1	62 841.3	64 279.8	65 848.7	63 877.4
Hard coal extraction	88 312.9	84 345.1	78 064.5	76 727.8	76 447.6	79 812.8	77 056.2	73 270.8
Coke production	10 167.7	10 075.4	7 091.3	9 738.0	9 376.8	8 891.0	9 359.6	9 568.1

### 3.7.2. Fugitive emissions from oil and natural gas (NFR sector 1.B.2)

#### Source category description

Fugitive emission from oil and gas include fugitive emissions from:

- production, transport and refining of oil
- production, processing, transmission, distribution and underground storage of gas
- flaring in gas subsystem.

#### Fugitive emissions from fuels – oil (NFR sector 1.B.2.a)

Fugitive emission from oil include fugitive emissions from production, refining and transport of oil. Activity data used in the sub-category 1.B.2 a for the years 1995-2013 are presented in Table 3.35.

Applied emission factors are presented in Appendix 2.

Table 3.35. Activity data used in the sub-category 1.B.2 a - *Fugitive emission from oil* [Mg]

Category	1990	1991	1992	1993	1994	1995	1996
Extraction of crude oil	160 000	158 000	200 000	235 000	284 000	292 000	317 000
Liquid fuel distribution (except gasoline)							
<i>Marine terminals</i>	13 126 000	11 454 000	12 769 000	13 674 000	12 721 000	12 957 000	14 026 000
Handling and storage - diesel oil	5 297 000	4 922 000	5 135 000	5 572 000	5 781 000	5 350 000	6 103 000
<i>Petrol distribution</i>							
Refinery dispatch station	2 414 000	2 400 000	3 201 000	3 486 000	3 773 000	3 037 000	3 481 000
Transport and depots	3 773 000	4 100 000	4 750 000	4 350 000	4 746 000	5 454 000	4 836 000
Service stations (including refuelling of cars)	3 773 000	4 100 000	4 750 000	4 350 000	4 746 000	4 777 000	4 615 000

Category	1997	1998	1999	2000	2001	2002	2003
Extraction of crude oil	289 000	357 000	425 000	652 696	767 004	727 973	764 806
Liquid fuel distribution (except gasoline)							
<i>Marine terminals</i>	14 713 000	15 367 000	16 022 000	18 001 600	17 558 000	17 942 200	17 448 300
Handling and storage - diesel oil	6 096 000	5 808 000	6 343 000	6 004 000	5 739 000	5 070 000	5 908 000
<i>Petrol distribution</i>							
Refinery dispatch station	3 413 000	3 465 000	4 287 000	4 412 000	4 294 000	4 019 000	4 038 000
Transport and depots	5 085 000	5 020 000	5 743 000	5 174 000	4 746 000	4 314 000	4 212 000
Service stations (including refuelling of cars)	4 966 000	5 020 000	5 743 000	4 999 000	4 629 000	4 203 000	4 212 000

Category	2004	2005	2006	2007	2008	2009	2010
Extraction of crude oil	886 188	847 844	795 742	720 603	754 907	686 992	688 487
Liquid fuel distribution (except gasoline)							
<i>Marine terminals</i>	17 316 100	17 912 300	19 813 000	20 885 100	20 786 950	20 097 683	22 688 120
Handling and storage - diesel oil	6 748 000	7 405 000	8 224 000	9 510 000	10 430 853	10 800 000	12 006 000
<i>Petrol distribution</i>							
Refinery dispatch station	4 081 000	4 203 000	4 255 000	3 969 000	4 081 000	4 271 000	4 221 590
Transport and depots	4 198 000	4 065 000	4 158 000	4 144 000	4 416 000	4 242 000	4 145 000
Service stations (including refuelling of cars)	4 115 000	4 008 000	4 135 000	4 139 000	4 166 000	4 242 000	4 145 000

Category	2011	2012	2013	2014
Extraction of crude oil	616 704	677 664	960 672	984 216
Liquid fuel distribution (except gasoline)				
<i>Marine terminals</i>	23 792 000	24 633 000	23 347 000	23 713 000
Handling and storage - diesel oil	12 295 000	12 093 000	11 252 000	11 260 000
<i>Petrol distribution</i>				
Refinery dispatch station	3 921 000	4 027 000	4 040 000	3 849 000
Transport and depots	3 951 000	3 872 000	3 669 000	3 583 000
Service stations (including refuelling of cars)	3 951 000	3 872 000	3 669 000	3 583 000

### Fugitive emissions from fuels – natural gas (NFR sector 1.B.2.b).

Fugitive emission from gas include fugitive emissions from production and transport of gas. Table 3.36 presents the activity data used in the sub-category 1.B.2 b for the years 1991-2014. Emission factors used in the sub-category 1.B.2 b are presented in Appendix 2.

Table 3.36. Activity data used in the category 1.B.2 b - *Fugitive emission from gas* [mln m<sup>3</sup>]

Category	1991	1992	1993	1994	1995	1996	1997	1998
Extraction of high - methane natural gas	1 644	1 509	2 129	1 997	1 642	1 952	1 988	2 101
Extraction of nitrogenous natural gas	2 504	2 519	2 821	2 638	2 831	2 802	2 848	2 751
<i>Gas distribution networks</i>								
High - methane natural gas	8 837	8 193	8 561	8 640	9 515	9 999	9 938	9 278
Nitrogenous natural gas	2 716	2 684	2 927	2 719	2 938	2 956	2 982	1 784
Coke oven gas	5 056	4 881	4 435	4 911	4 873	4 229	4 501	3 426

Category	1999	2000	2001	2002	2003	2004	2005	2006
Extraction of high - methane natural gas	2 004	2 035	2 088	2 016	2 075	2 297	2 232	2 239
Extraction of nitrogenous natural gas	2 712	2 917	3 090	3 247	3 259	3 333	3 510	3 444
<i>Gas distribution networks</i>								
High - methane natural gas	8 990	8 974	9 195	9 024	9 786	10 273	10 913	11 023
Nitrogenous natural gas	1 461	1 445	1 651	1 587	1 499	1 343	1 289	1 388
Coke oven gas	2 694	2 910	2 956	2 804	3 277	3 260	2 757	2 970

Category	2007	2008	2009	2010	2011	2012	2013	2014
Extraction of high - methane natural gas	2 243	2 116	2 047	2 010	2 025	2 016	1 976	1 969
Extraction of nitrogenous natural gas	3 494	3 335	3 511	3 753	3 896	3 972	3 907	3 795
<i>Gas distribution networks</i>								
High - methane natural gas	10 843	11 094	11 366	14 010	13 970	14 819	14 762	14 484
Nitrogenous natural gas	1 503	1 436	1 455	3 771	3 853	3 870	3 942	3 864
Coke oven gas	3 250	3 001	2 068	1 284	1 283	1 178	1 256	1 316

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

Pollutant emissions from flaring in *Flaring in oil refinery* and *Flaring in gas and oil extraction* were not estimated separately due to a lack of activity data however they may be considered as included elsewhere assuming the combusted fuels have been included in the energy balance of categories 1 A 1 b and 1 A 1 c.

#### Source-specific planned improvements

Gathering complete activity data for flaring.

#### Emission trends for the NFR sector 1.B

Volumes and trend of pollutant emissions for 1.B sector are shown below on figures 3.31 ÷ 3.34.

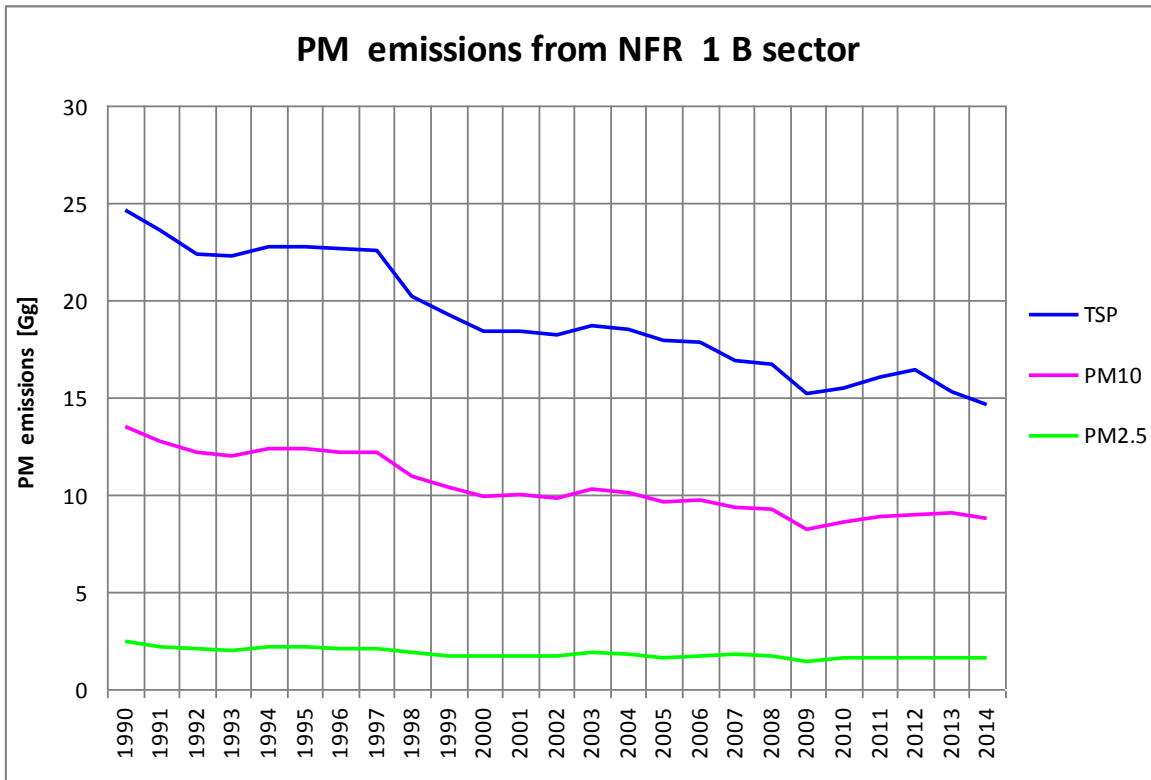


Figure 3-31. Particulates emissions for 1.B category in 1990-2014

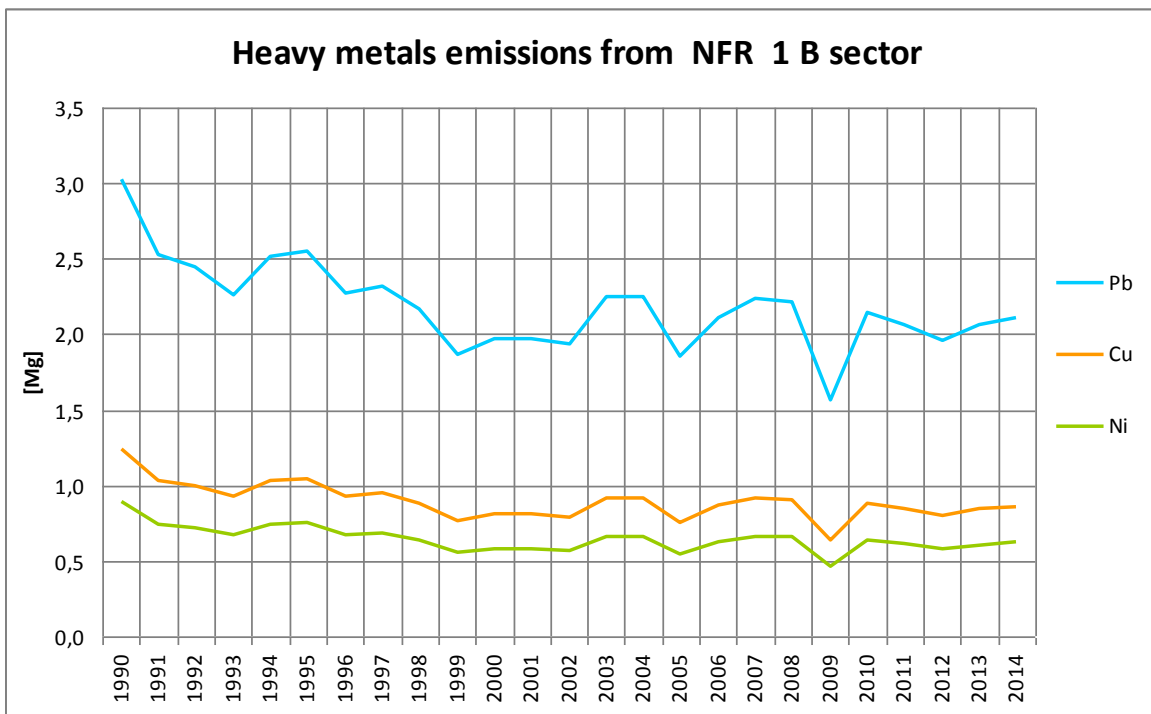


Figure 3-32. Pb, Cu and Ni emissions for 1.B category in 1990-2014

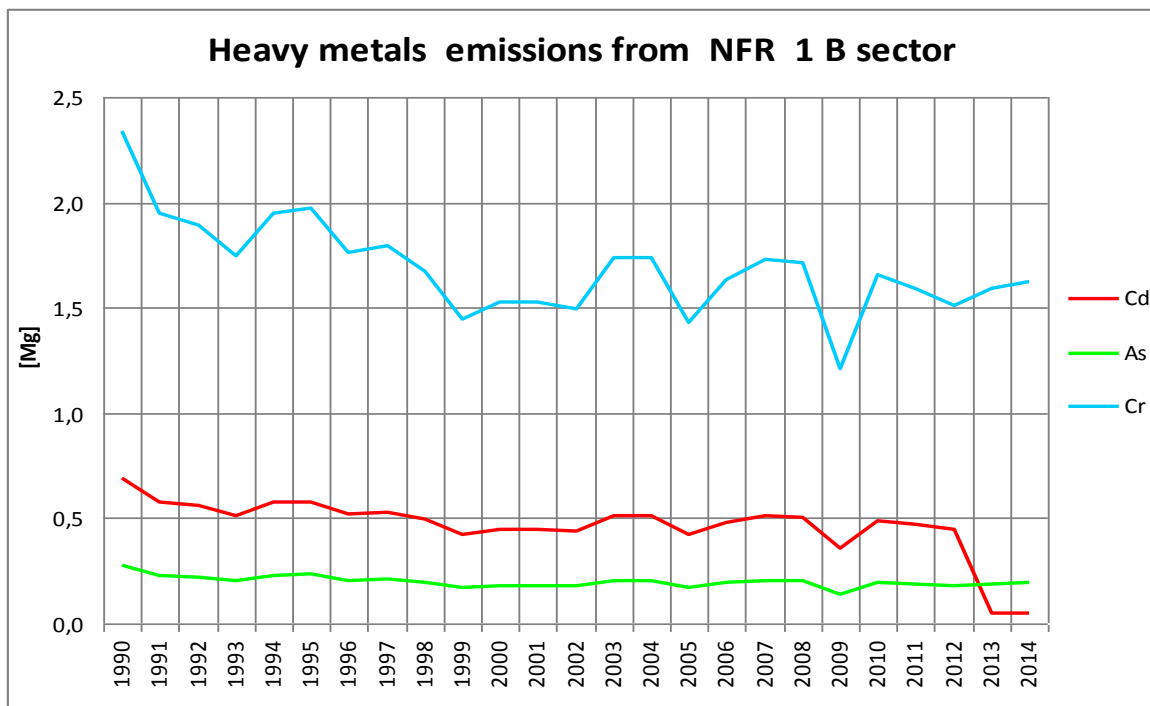


Figure 3-33. Cd, As and Cr emissions for 1.B category in 1990-2014

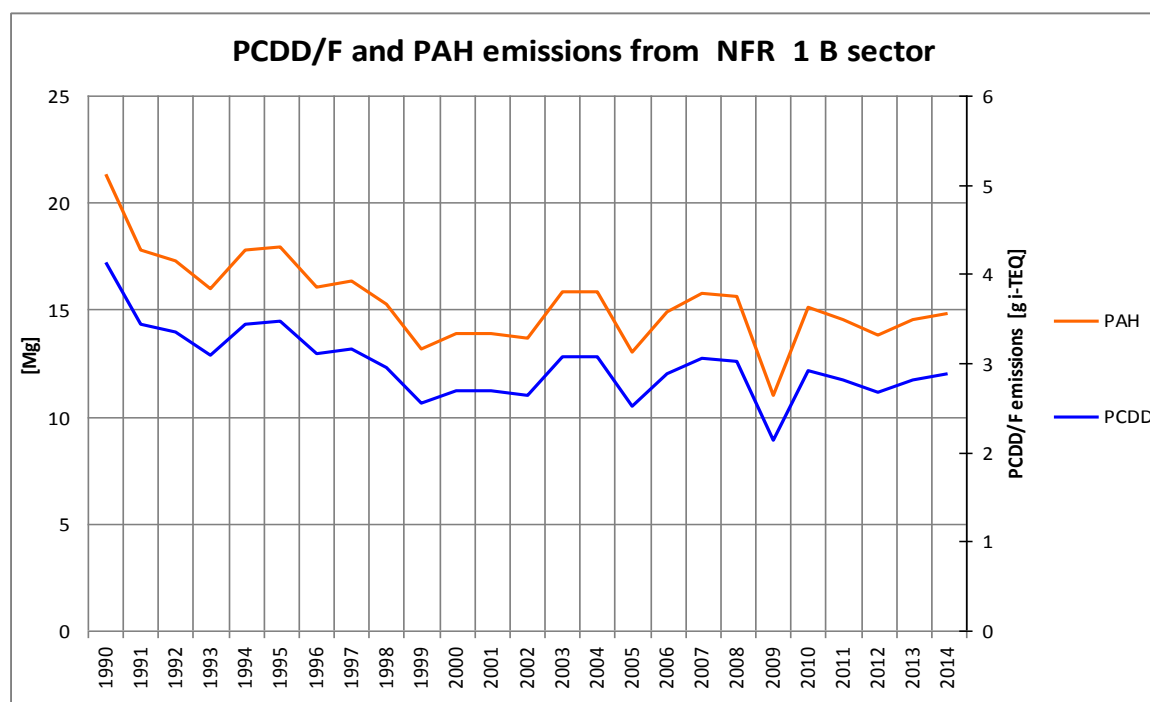


Figure 3-34. PCDD/F and PAH emissions for 1.B category in 1990-2014

### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 1.B was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 1.B are given below.



Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 3.37. Results of the emission uncertainty analysis for NFR sector *I.B*

NFR		<b>NO<sub>x</sub></b>	<b>NMVOC</b>	<b>SO<sub>x</sub></b>	<b>NH<sub>3</sub></b>	<b>Pb</b>	<b>Cd</b>
		%	%	%	%	%	%
1B1a	Fugitive emission from solid fuels: Coal mining and handling		50				
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	30	50	70	50	70	70
1B2ai	Fugitive emissions oil: Exploration, production, transport		50				
1B2aiv	Fugitive emissions oil: Refining / storage	30	39	70			
1B2av	Distribution of oil products		38				
1B2b	Fugitive emissions from natural gas (exploration, production and other)		32				

## 4. Industrial processes (NFR sector 2)

### Source category description

The following subcategories from sector 2 have been included in the pollutant inventory:

- 2.A. Mineral Products
- 2.B. Chemical Industry
- 2.C. Metal Production
- 2.D. Solvent use
- 2.G. Other product use
- 2.H1. Pulp and paper industry
- 2.H2. Food and beverages industry
- 2.I. Wood processing
- 2.L. Other – bulk products.

Shares of emissions from the NFR 2 category in the country total for the particular pollutants in 2014 are shown on the figure 4.1.

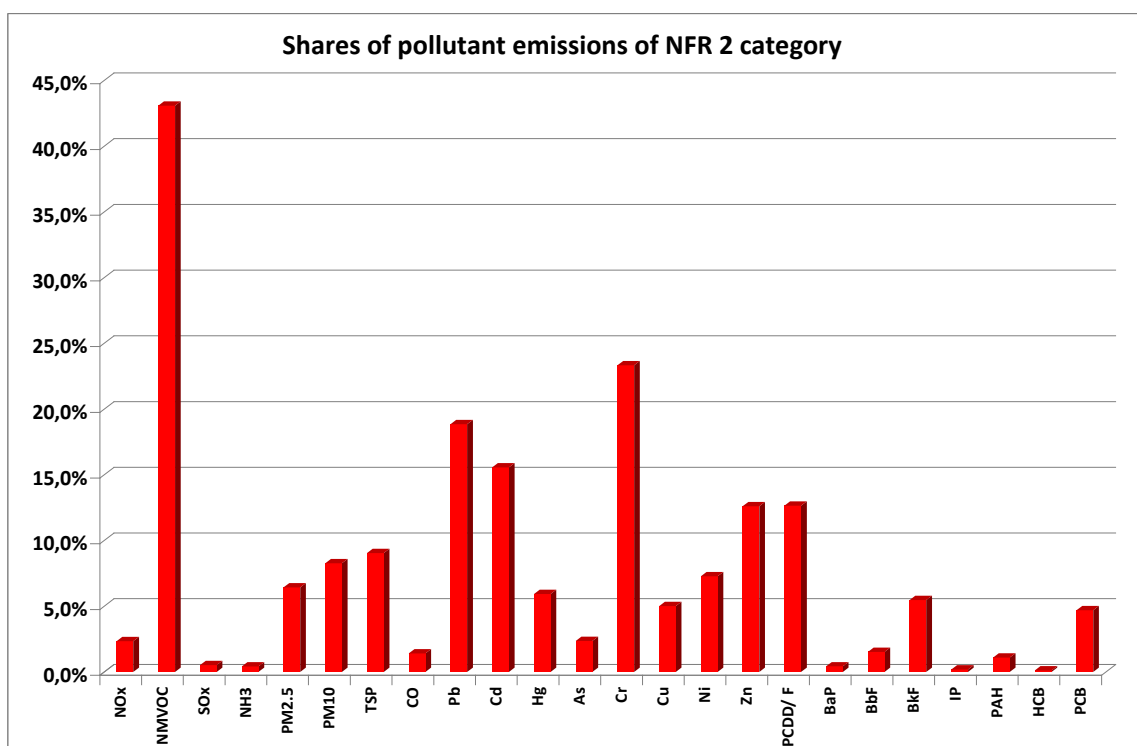


Figure 4.1. Shares of emissions from the NFR 2 category in the country total

### 4.1. Mineral Products (NFR sector 2.A)

#### Source category description

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

- *Cement Production (2.A.1)*
- *Lime Production (2.A.2)*
- *Gypsum Production (2.A.2)*
- *Glass production (2.A.3)*

- Quarrying and mining of minerals other than coal (2.A.5 a)
- Construction and demolition (2.A.5 b).

Shares of emissions from the NFR 2 A category in the country total for the particular pollutants in 2014 are shown on the figure 4.2.

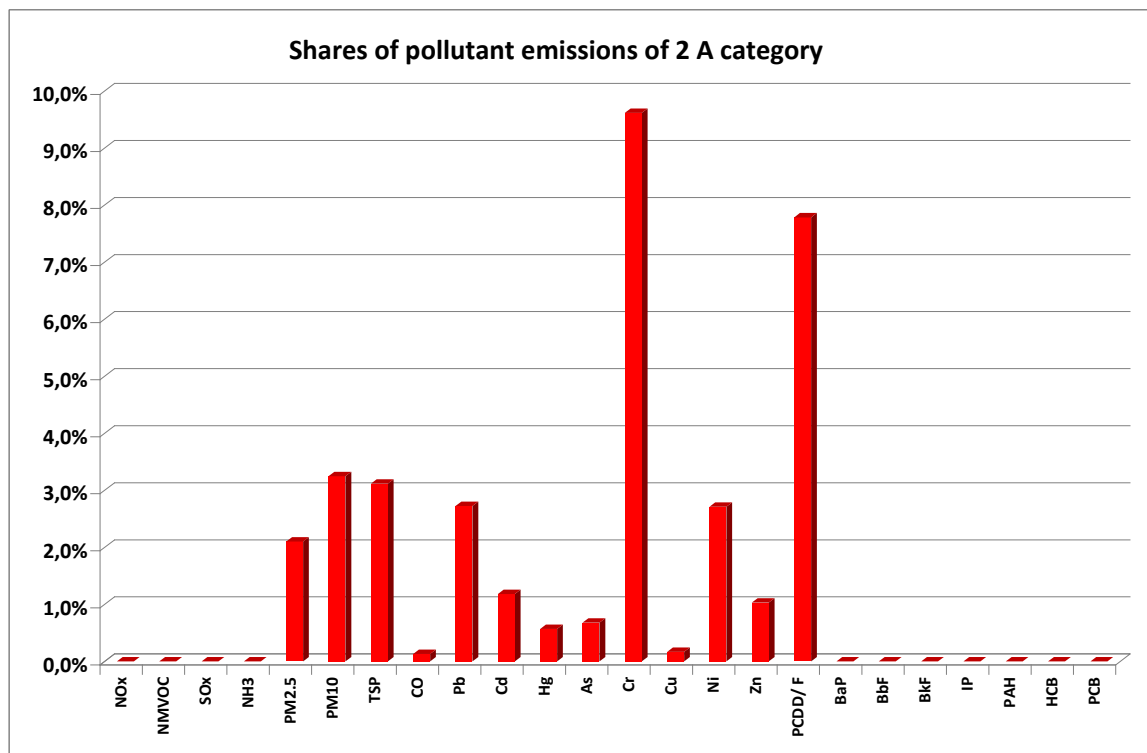


Figure 4.2. Shares of emissions from the NFR 2 A category in the country total

This category corresponds to part of category SNAP 0406.

Activity data for this sector come from GUS statistical yearbooks. Table 4.1 presents the activity data used in the sub-category 2.A - *Mineral Products* for the years 1990-2014.

To estimate emissions default emission factors are used. Applied emission factors for subcategory 2.A are presented in Appendix 2.

Table 4.1. Activity data for the years 1995-2013 in NFR 2.A [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Cement production	12 518 000	12 012 000	11 908 000	12 200 000	13 834 000	13 914 000	13 959 000
Lime production	3 200 000	2 413 000	2 526 000	2 584 000	2 516 000	2 526 000	2 461 000
Gypsum production	191 700	246 600	222 100	290 000	357 000	407 000	450 000
Quarrying and mining of minerals	375 115 300	379 152 900	383 190 500	390 807 900	396 977 900	81 438 700	79 775 700
Extraction of mineral ores - copper	24 358 600	25 702 000	24 114 500	27 113 300	26 135 600	26 463 000	27 427 000
Extraction of mineral ores - zinc and lead	4 875 100	4 848 600	5 017 200	4 819 000	4 871 000	5 040 000	5 030 000
Construction and demolition [m2]	10 361 398	10 259 250	9 972 675	7 659 814	6 733 080	6 009 651	5 722 173

	1997	1998	1999	2000	2001	2002	2003
Cement production	15 003 000	14 970 000	15 555 000	15 046 400	12 074 300	11 206 400	11 653 400
Lime production	2 516 000	2 406 000	2 299 000	2 376 000	2 074 000	1 960 400	2 053 400
Gypsum production	504 000	511 000	459 000	444 700	1 034 500	1 243 600	1 442 800
Quarrying and mining of minerals	72 442 200	73 346 900	70 332 700	102 945 827	87 309 814	86 388 504	95 821 761
Extraction of mineral ores - copper	26 165 000	27 594 000	28 395 000	28 503 400	30 227 300	29 704 700	29 992 100
Extraction of mineral ores - zinc and lead	4 939 000	5 052 000	5 068 000	4 856 995	4 665 761	4 804 929	4 754 424
Construction and demolition [m2]	6 876 770	7 527 480	7 156 767	7 872 700	9 118 237	9 691 798	18 838 485

Industrial process	2004	2005	2006	2007	2008	2009	2010
Cement production	12 566 300	12 646 200	14 688 400	17 119 900	17 206 700	15 422 000	15 812 100
Lime production	2 167 600	1 748 500	1 936 000	2 142 800	1 951 600	1 703 500	1 798 900
Gypsum production	557 000	771 000	1 190 100	1 422 200	1 578 700	1 317 400	1 346 800
Quarrying and mining of minerals	99 582 295	109 421 240	120 749 232	138 097 208	142 790 779	150 946 869	160 437 485
Extraction of mineral ores - copper	31 880 200	32 018 700	32 874 700	31 808 600	30 920 300	31 252 600	30 805 200
Extraction of mineral ores - zinc and lead	4 668 811	4 444 656	4 088 997	4 003 141	3 890 750	3 197 715	2 450 278
Construction and demolition [m2]	11 619 777	12 010 635	11 721 159	14 117 500	17 185 370	15 942 523	14 410 837

Industrial process	2011	2012	2013	2014			
Cement production	18 992 900	15 918 600	14 831 300	15 814 500			
Lime production	2 036 300	1 798 800	1 709 500	1 817 300			
Gypsum production	1 349 300	1 220 300	1 263 700	1 072 700			
Quarrying and mining of minerals	216 614 772	168 196 741	157 053 558	159 307 400			
Extraction of mineral ores - copper	31 240 900	31 725 400	32 215 300	32 613 200			
Extraction of mineral ores - zinc and lead	2 344 862	2 328 582	2 327 840	2 296 948			
Construction and demolition [m2]	14 028 000	15 657 370	15 181 226	14 445 449			

### Emission trends for the NFR sector 2.A

Volumes and trend of pollutant emissions for *Mineral Products* is shown below on figure 4.3.

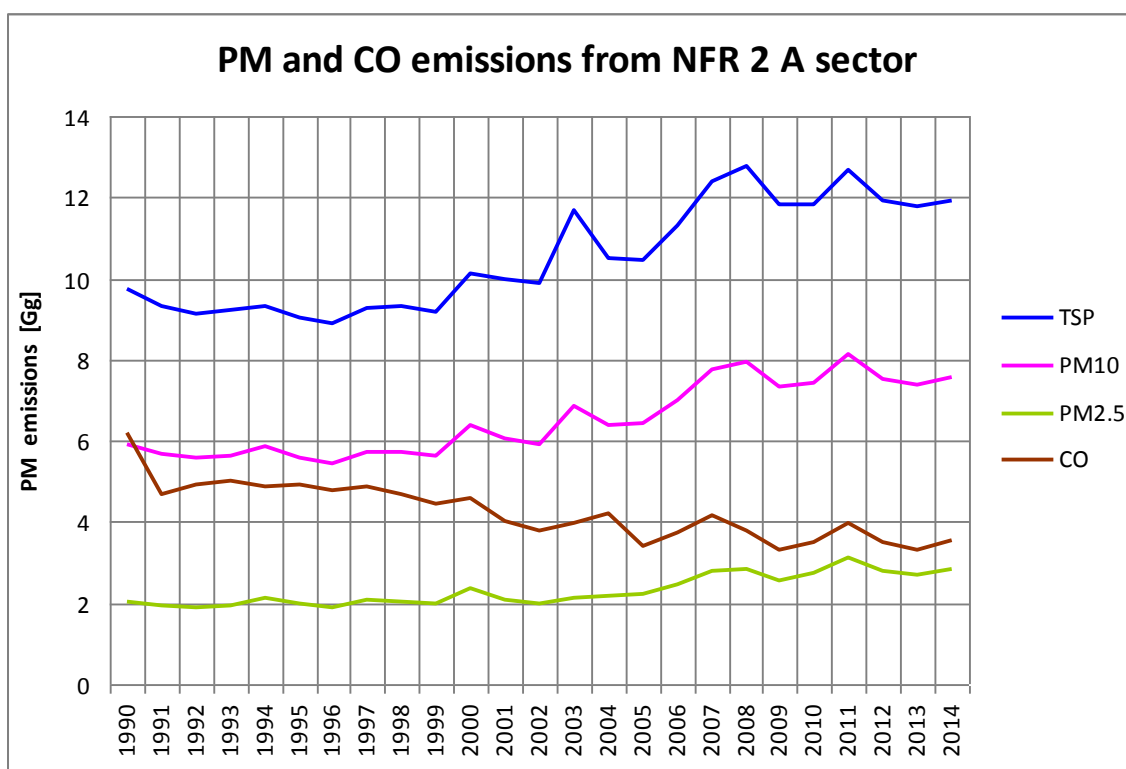


Figure 4.3. Particulates and CO emissions for 2.A category in 1990-2014

### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 2.A was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 2.A are given below.

Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 4.2. Results of the emission uncertainty analysis for NFR 2.A

NFR		CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%
2A1	Cement production			70	70	70	
2A2	Lime production	50	50				100
2A3	Glass production	36	50	70	70	70	73

## 4.2. Chemical Industry (NFR sector 2.B)

### Source category description

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

- *Ammonia Production (2.B.1)*
- *Nitric Acid Production (2.B.2)*
- *Carbide Production (2.B.5)*
- *Titanium dioxide production (2.B.6)*
- *Soda Ash Production and Use (2.B.7)*
- *Chemical industry: Other (2.B 10 a):*  
Production of: sulfuric acid, NPK fertilisers, Carbon black, Titanium dioxide, Phosphate fertilizers, Ethylene, Caprolactam, Propylene, Polyethylene, Polyvinylchloride, Polypropylene, Polystyrene, Formaldehyde, chlorine production (Mercury cell)
- *Storage, handling and transport of chemical products (2.B 10 b).*

This category corresponds to categories SNAP 0404, SNAP 0405 and SNAP 040617.

Shares of emissions from the 2 B category in the country total for the particular pollutants in 2014 are shown on the figure 4.4.

Activity data for this sector come from GUS statistical yearbooks [GUS 2015e]. Table 4.3 presents the activity data used in the sub-category 2.B - *Chemical Industry* for the years 1991-2014.

To estimate emissions domestic and default emission factors are used. Applied emission factors for subcategory 2.B are presented in Appendix 2. Data on mercury emissions from Chlorine production (mercury cell) are taken from producer's report.

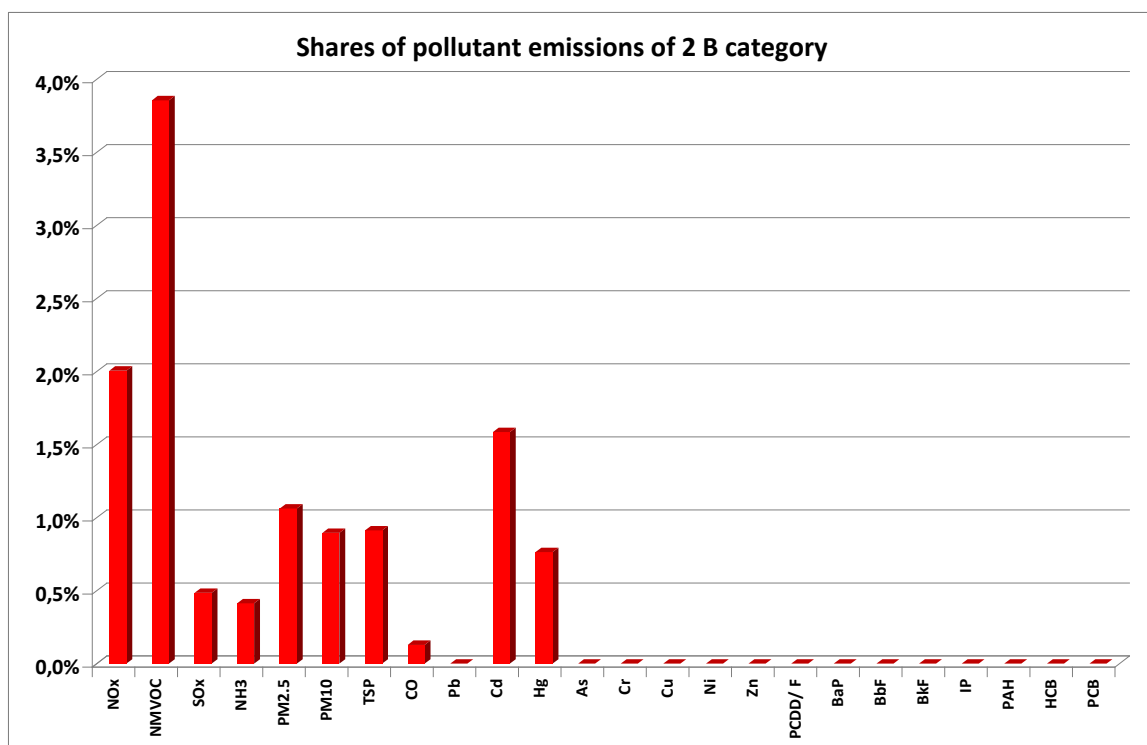


Figure 4.4. Shares of emissions from the 2 B category in the country total

Table 4.3. Activity data for the years 1991-2014 in 2.B Chemical Industry [Gg]

Industrial process	1991	1992	1993	1994	1995	1996	1997	1998
Sulfuric acid	1 088 400	1 244 300	1 144 800	1 451 900	1 861 000	1 761 000	1 791 000	1 707 000
Nitric acid production	1 438 200	1 388 300	1 607 600	1 700 500	1 930 500	1 929 000	1 808 000	1 671 000
Ammonia production	1 560 883	1 480 798	1 630 946	1 945 470	2 248 317	2 185 188	2 251 616	2 047 948
Carbide production	283 000	220 800	180 400	173 700	178 000	145 000	120 600	69 600
Soda ash production and use	1 124 761	1 103 430	1 007 100	1 369 166	1 019 000	909 000	950 000	1 000 000
NPK fertilisers	4 287 900	4 547 300	4 707 100	5 539 700	6 491 000	6 625 000	6 558 000	5 983 000
NPK fertilisers - nitrogenous	3 332 600	3 278 200	3 513 500	3 813 900	4 389 000	4 378 000	4 271 000	3 739 000
Carbon black	17 141	25 877	26 433	25 537	23 256	24 800	25 000	22 600
Titanium dioxide	27 107	27 972	24 460	33 515	34 879	34 616	32 419	34 758
Phosphate fertilizers	563 700	474 300	289 200	364 400	411 000	411 000	361 000	337 000
Ethylene	448 219	472 768	476 602	398 537	436 000	493 000	510 000	519 000
Caprolactam	103 652	104 681	103 169	106 274	126 276	127 769	130 294	131 310
Propylene	176 862	189 641	187 526	163 518	176 000	194 000	202 000	189 000
Polyethylene	149 865	163 088	162 178	141 898	155 031	163 000	160 000	173 000
Polyvinylchloride	194 808	219 963	212 143	202 273	225 267	254 000	285 000	266 000
Polypropylene	88 585	85 666	75 191	75 781	76 445	45 400	35 300	38 200
Polystyrene	20 826	25 750	31 509	33 822	46 243	46 500	48 900	51 200
Polystyrene - EPS	12 913	15 966	19 537	20 971	28 673	28 832	30 320	31 746
Polystyrene - GPPS/HIPS	4 502	5 567	6 812	7 312	9 997	10 053	10 571	11 069
Formaldehyde	70 000	75 000	80 000	85 000	90 000	95 000	100 000	105 000

Industrial process	1999	2000	2001	2002	2003	2004	2005	2006
Sulfuric acid	1 505 000	1 763 000	1 690 000	1 648 000	1 764 000	1 811 000	1 807 000	1 907 000
Nitric acid production	1 635 000	2 007 363	2 060 012	1 688 879	2 030 445	2 084 560	2 219 374	2 200 804
Ammonia production	1 784 726	2 243 108	2 103 805	1 594 797	2 246 505	2 451 557	2 523 790	2 326 621
Carbide production	53 200	39 368	38 351	27 796	29 281	27 516	24 740	21 072
Soda ash production and use	926 000	902 418	925 744	906 000	917 100	975 435	996 245	1 026 309
NPK fertilisers	5 634 000	6 868 720	6 441 333	5 923 667	6 974 761	7 384 802	7 463 901	7 347 359
NPK fertilisers - nitrogenous	3 433 000	4 401 118	4 280 696	3 650 044	4 641 510	4 662 097	4 908 027	4 850 113
Carbon black	18 700	13 016	14 713	15 820	17 700	34 956	28 510	31 971
Titanium dioxide	37 191	35 235	38 099	37 807	42 300	41 008	41 201	41 003
Phosphate fertilizers	294 000	323 484	348 997	357 407	401 015	453 080	409 930	358 576
Ethylene	494 000	508 341	431 330	522 686	492 482	489 356	446 633	878 300
Caprolactam	139 588	146 900	148 600	152 900	152 373	149 490	159 733	159 708

Industrial process	1999	2000	2001	2002	2003	2004	2005	2006
Propylene	198 000	249 142	227 902	256 348	257 480	245 764	248 656	412 603
Polyethylene	134 000	146 982	155 353	170 005	160 528	153 387	161 566	373 598
Polyvinylchloride	259 000	273 930	225 608	248 541	255 762	268 454	216 775	277 798
Polypropylene	104 000	122 924	122 915	144 363	145 397	143 405	157 490	215 383
Polystyrene	70 600	94 335	92 540	87 228	82 369	97 488	92 667	101 179
Polystyrene - EPS	43 775	56 182	50 153	53 296	60 150	57 638	59 319	70 446
Polystyrene - GPPS/HIPS	15 263	16 945	19 986	16 079	10 230	20 086	16 729	13 036
Formaldehyde	110 000	101 396	94 157	211 081	221 125	232 450	221 012	232 690

Industrial process	2007	2008	2009	2010	2011	2012	2013	2014
Sulfuric acid	2 010 000	1 813 000	1 243 000	1 686 000	1 889 000	1 693 000	1 462 000	1 550 000
Nitric acid production	2 269 876	2 267 371	2 139 417	2 209 363	2 168 123	2 322 586	2 279 669	2 365 877
Ammonia production	2 417 543	2 485 148	2 010 891	2 059 437	2 321 849	2 526 174	2 482 151	2 651 068
Carbide production	16 141							
Soda ash production and use	1 191 665	1 424 841	889 857	1 050 952	1 083 222	1 161 736	1 183 310	1 186 661
NPK fertilisers	7 896 433	7 290 428	5 759 166	6 966 582	7 389 434	7 719 324	7 340 802	7 744 006
NPK fertilisers - nitrogenous	5 087 104	4 824 952	4 472 445	4 708 955	4 986 790	5 454 509	5 406 997	5 697 547
Carbon black	38 163	33 349	25 806	32 560	42 148	20 065	27 947	35 431
Titanium dioxide	39 400	40 379	36 363	39 773	38 020	36 788	35 785	36 207
Phosphate fertilizers	465 562	458 009	145 795	310 421	392 182	375 835	311 122	366 249
Ethylene	924 102	798 038	758 595	737 808	813 052	753 229	487 088	471 831
Caprolactam	157 602	144 852	144 974	159 307	164 000	162 995	159 916	167 601
Propylene	408 522	365 336	358 192	337 070	358 842	325 518	351 615	340 441
Polyethylene	397 210	359 762	340 474	364 603	371 009	337 641	347 110	348 168
Polyvinylchloride	302 716	251 380	258 086	195 836	282 952	261 339	306 129	275 159
Polypropylene	270 777	280 678	267 001	243 444	255 134	248 245	256 608	230 621
Polystyrene	107 815	119 973	127 281	142 051	145 099	143 160	135 731	128 352
Polystyrene - EPS	63 948	78 625	82 593	82 324	85 201	86 238	77 655	75 058
Polystyrene - GPPS/HIPS	21 308	25 561	32 058	42 030	44 836	45 855	47 634	44 435
Formaldehyde	224 060	115 701	96 289	97 837	218 535	221 096	218 535	258 424

### Emission trends for the NFR sector 2.B

Volumes and trend of pollutant emissions for *Chemical Industry* are shown below on figures 4.5 ÷ 4.7.

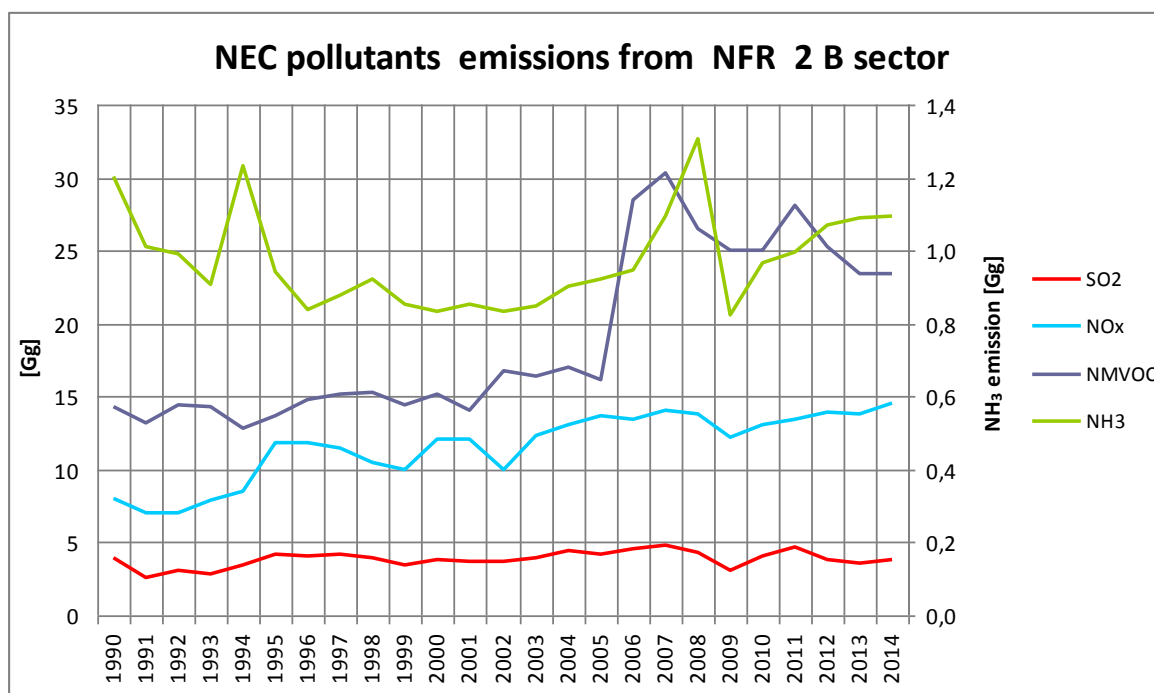


Figure 4.5. SO<sub>2</sub>, NO<sub>x</sub>, NH<sub>3</sub> and NMVOC emissions for 2.B category in 1990-2014

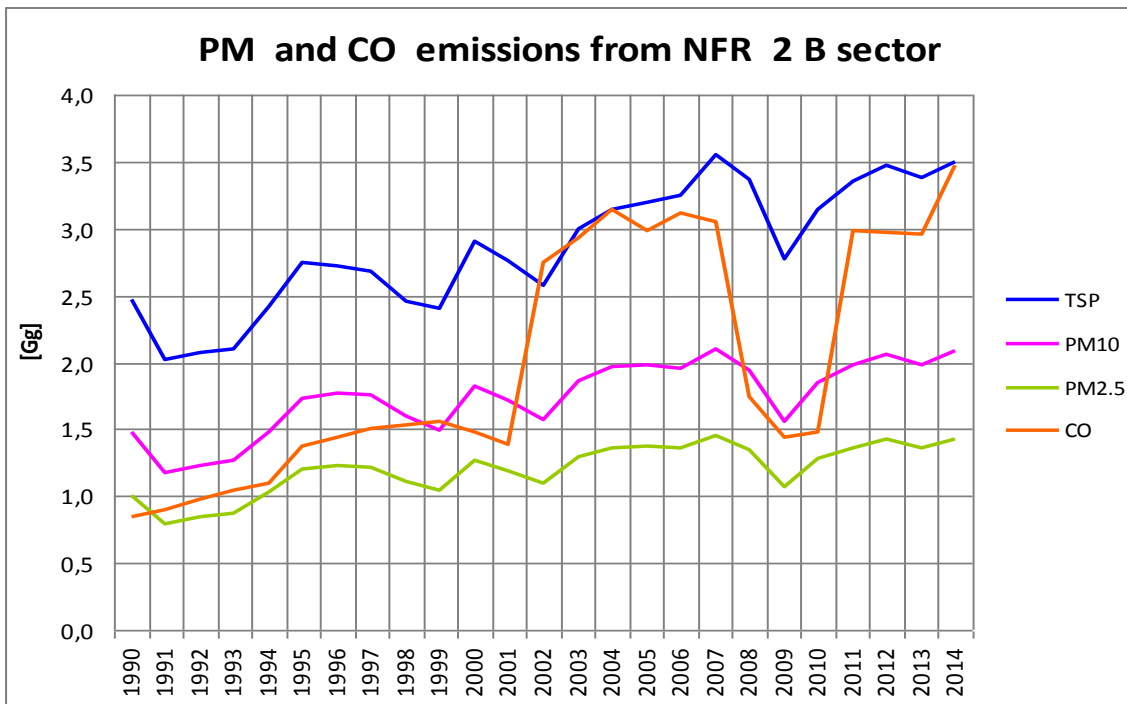


Figure 4.6. CO and particulates emissions for 2.B category in 1990-2014

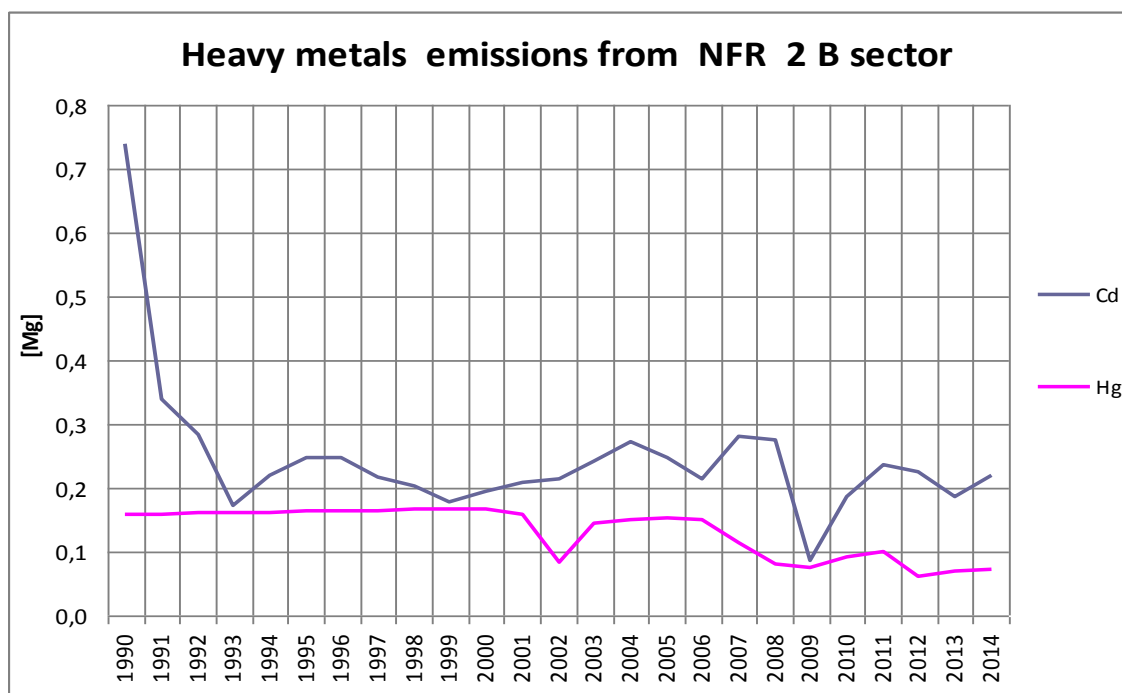


Figure 4.7. Cd and Hg emissions for 2.B category in 1990-2014

### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 2.B was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 2.B are given below. Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.



Table 4.4. Results of the emission uncertainty analysis for NFR sector 2.B

NFR		NO <sub>x</sub>	NM <sub>10</sub> VOC	SO <sub>x</sub>	NH <sub>3</sub>	CO	TSP	Cd	Hg
		%	%	%	%	%	%	%	%
2B1	Ammonia production	30			50	50			
2B2	Nitric acid production	30							
2B6	Titanium dioxide production	30							
2B7	Soda ash production				50				
2B10a	Chemical industry: Other	26	25	25		49	8	70	10

### 4.3. Metal Production (NFR sector 2.C)

#### Source category description

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

- Iron and Steel Production (2.C.1)
- Ferroalloys Production (2.C.2)
- Aluminium Production (2.C.3)
- Lead production, including batteries (2.C.5)
- Zinc production (2.C.6)
- Copper production (2.C.7 a).

This category corresponds to categories SNAP 0402 and SNAP 0403.

Shares of emissions from the 2 C category in the country total for the particular pollutants in 2014 are shown on the figure 4.8.

Emissions from Zinc production (2.C.6) and Copper production (2.C.7 a) are temporally included in 1 A 2 b category.

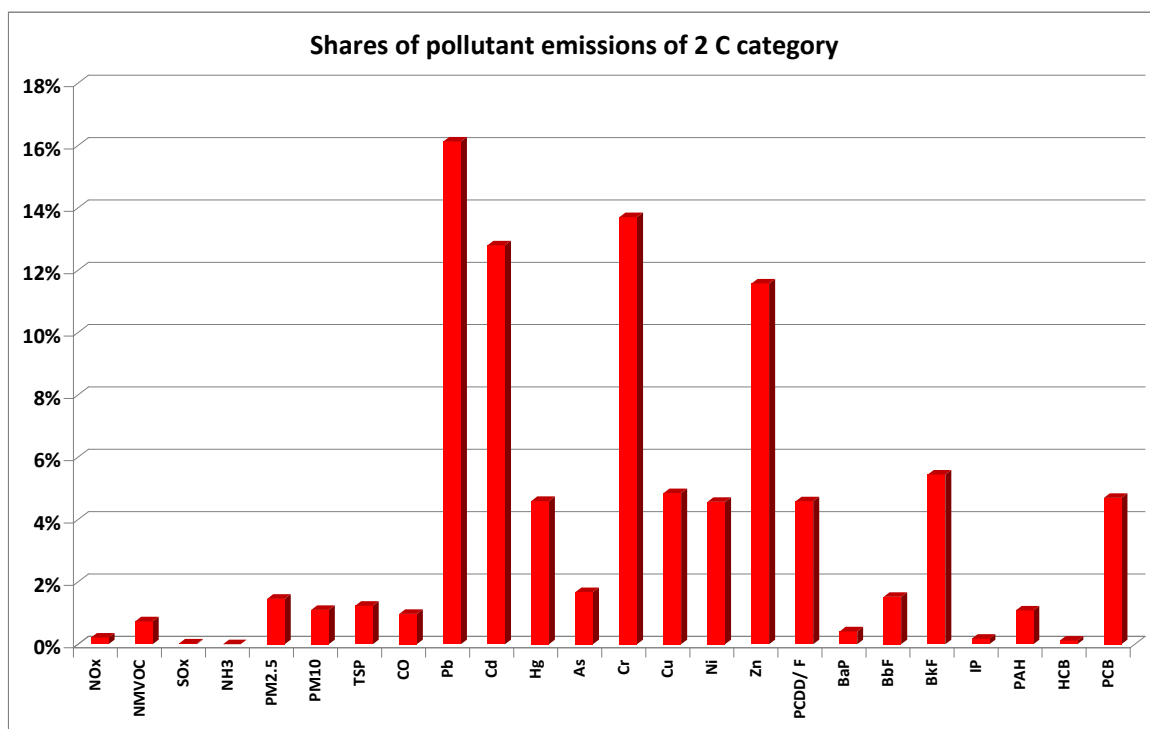


Figure 4.8. Shares of emissions from the 2 C category in the country total

Activity data for this sector come from statistical yearbooks [GUS 2015e].

Table 4.5 presents the activity data used in the sub-category 2.C - *Metal Production* for the years 1990-2014.

To estimate emissions domestic and default emission factors are used. Applied emission factors for subcategory 2.C are presented in Appendix 2.

Table 4.5. Activity data for the years 1990-2014 in 2.C *Metal Production* [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Pig iron tapping	8 656 711	6 501 541	6 462 033	6 292 896	7 081 233	7 420 000	6 600 000
Open hearth furnace steel plant	3 964 700	2 637 700	1 820 400	1 660 300	1 631 000	1 544 653	1 063 029
Basic oxygen furnace steel plant	7 210 000	5 745 500	6 247 700	6 162 000	7 033 500	7 685 488	6 757 479
Electric furnace steel plant	2 446 900	2 047 500	1 797 400	2 114 500	2 446 600	2 581 861	2 648 398
Hot rolling mills	9 835 600	8 036 400	7 549 800	7 631 600	8 594 800	9 542 360	9 064 041
Cold rolling mills	1 200 531	795 588	793 272	857 132	964 433	1 115 993	1 383 377
Sinter and pelletizing plant	11 779 441	8 612 668	8 621 683	7 628 228	8 787 422	8 646 567	8 318 575
Aluminium production (electrolysis)	45 974	45 793	43 628	46 942	49 509	55 728	51 900
Ferroalloys production	88 600	60 100	36 100	43 100	54 200	70 400	71 800
Batteries manufacturing	38 692	34 079	32 055	32 603	34 817	39 200	36 200
Secondary lead production	10 836	10 836	14 825	10 474	11 854	14 235	22 375

	1997	1998	1999	2000	2001	2002	2003
Pig iron tapping	7 343 000	6 179 000	5 233 000	6 491 867	5 440 047	5 296 410	5 631 830
Open hearth furnace steel plant	1 034 482	495 860	378 389	375 750	177 615	7 271	
Basic oxygen furnace steel plant	7 531 274	6 222 532	5 452 751	6 799 681	5 822 518	5 799 042	6 069 988
Electric furnace steel plant	2 906 324	3 116 918	2 825 084	3 289 965	2 809 078	2 561 171	3 037 396
Hot rolling mills	9 834 131	11 710 103	9 849 381	11 477 797	10 161 226	8 010 784	8 087 541
Cold rolling mills	1 449 947	1 279 267	1 187 535	1 355 819	1 167 569	1 363 179	1 433 451
Sinter and pelletizing plant	8 980 785	6 882 149	6 475 927	8 078 720	7 352 758	7 616 887	7 732 206
Aluminium production (electrolysis)	53 600	54 200	51 000	52 335	54 606	58 777	57 237
Ferroalloys production	77 300	75 000	62 500	55 969	48 608	41 759	92 700
Batteries manufacturing	39 900	40 600	45 200	50 269	53 280	74 179	84 027
Secondary lead production	30 710	39 259	17 416	32 261	32 261	66 500	66 979

Industrial process	2004	2005	2006	2007	2008	2009	2010
Pig iron tapping	6 400 007	4 476 622	5 543 350	5 804 418	4 933 781	2 983 500	3 638 000
Open hearth furnace steel plant							
Basic oxygen furnace steel plant	6 857 583	4 892 671	5 766 385	6 187 910	5 225 075	3 235 666	3 994 650
Electric furnace steel plant	3 720 889	3 443 227	4 225 253	4 432 806	4 502 250	3 892 816	4 001 427
Hot rolling mills	10 368 737	7 877 168	9 464 920	9 640 042	8 588 582	6 455 376	7 182 091
Cold rolling mills	1 612 251	1 158 969	1 326 434	1 397 755	1 322 845	1 107 456	1 539 529
Sinter and pelletizing plant	8 590 558	6 168 357	6 907 824	6 953 950	6 306 368	4 362 554	5 837 251
Aluminium production (electrolysis)	58 931	53 582	55 939	62 508	46 730	15 628	15 953
Ferroalloys production	83 552	65 118	13 034	58 538	56 031	9 673	53 206
Batteries manufacturing	92 461	110 072	124 771	124 340	122 403	117 652	147 829
Secondary lead production	39 414	39 414	38 658	40 600	39 609	40 783	45 644

Industrial process	2011	2012	2013	2014
Pig iron tapping	3 974 922	3 941 428	4 011 968	4 637 478
Open hearth furnace steel plant				
Basic oxygen furnace steel plant	4 423 604	4 333 168	4 520 358	5 182 371
Electric furnace steel plant	4 352 854	4 209 346	3 678 994	3 617 102
Hot rolling mills	8 261 158	7 948 503	8 382 473	8 732 852
Cold rolling mills	1 666 144	1 261 491	1 622 662	1 705 887
Sinter and pelletizing plant	6 512 751	6 672 473	6 854 234	7 389 438
Aluminium production (electrolysis)	13 869	11 087	16 014	16 143
Ferroalloys production	72 668	78 115	73 589	62 878
Batteries manufacturing	151 001	178 462	179 459	177 185
Secondary lead production	50 435	56 048	57 894	88 555

Emission trends for the NFR sector 2.C

Volumes and trend of pollutant emissions for *Metal Production* are shown below on figures 4.9 ÷ 4.14.

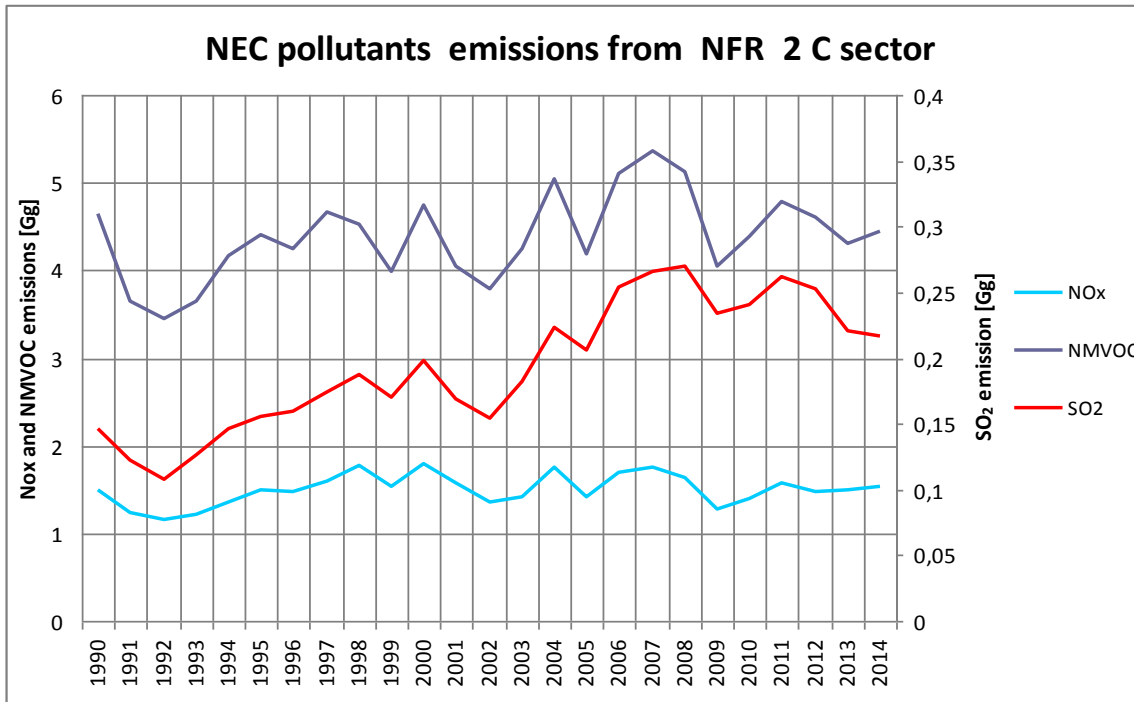


Figure 4.9. SO<sub>2</sub>, NO<sub>x</sub> and NMVOC emissions for 2.C category in 1990-2014

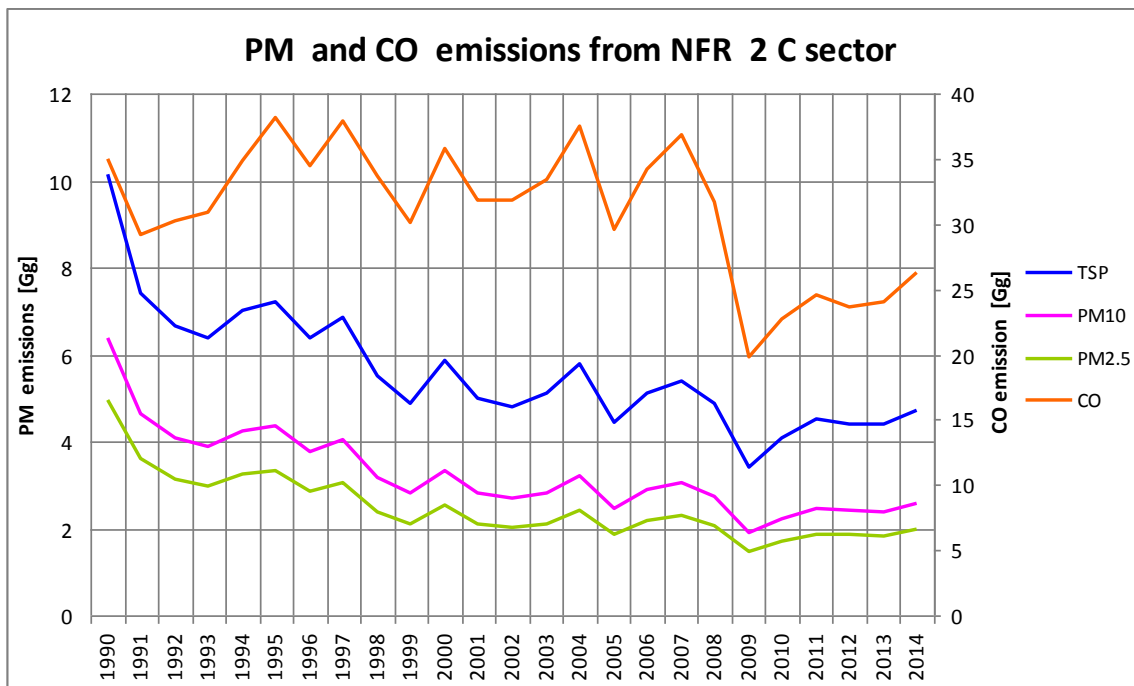


Figure 4.10. CO and particulates emissions for 2.C category in 1990-2014

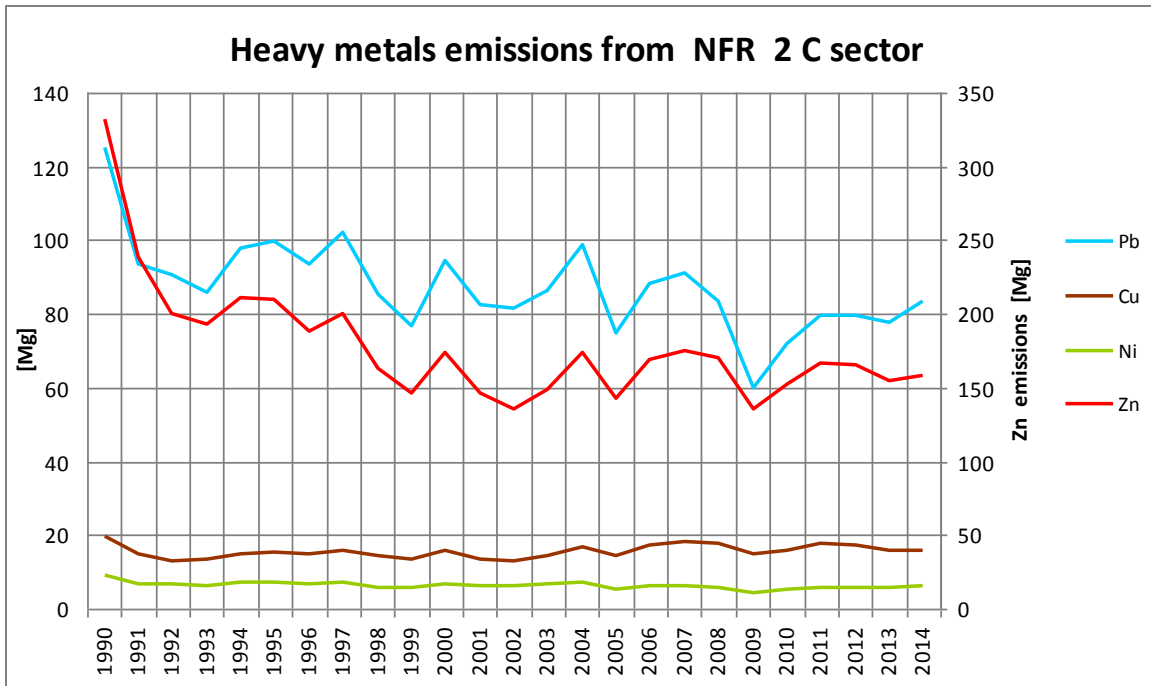


Figure 4.11. Pb, Cu, Ni and Zn emissions for 2.C category in 1990-2014

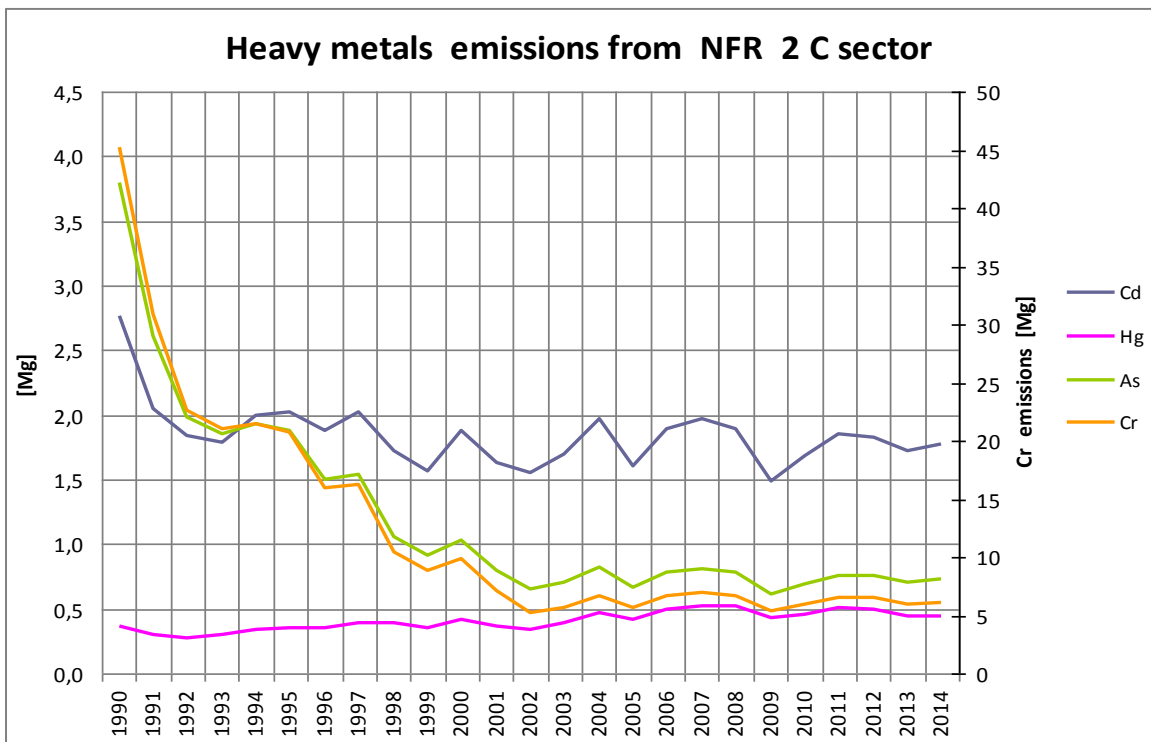


Figure 4.13. Cd, Hg, As and Cr emissions for 2.C category in 1990-2014

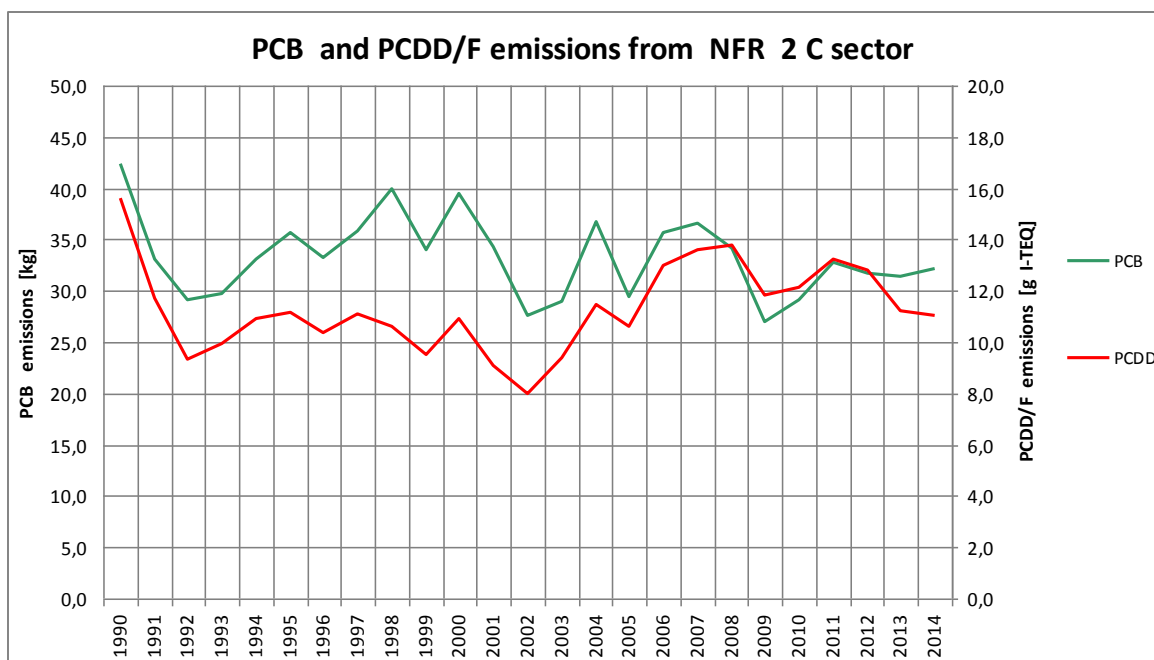


Figure 4.14. PCB and PCDD/F emissions for 2.C category in 1990-2014

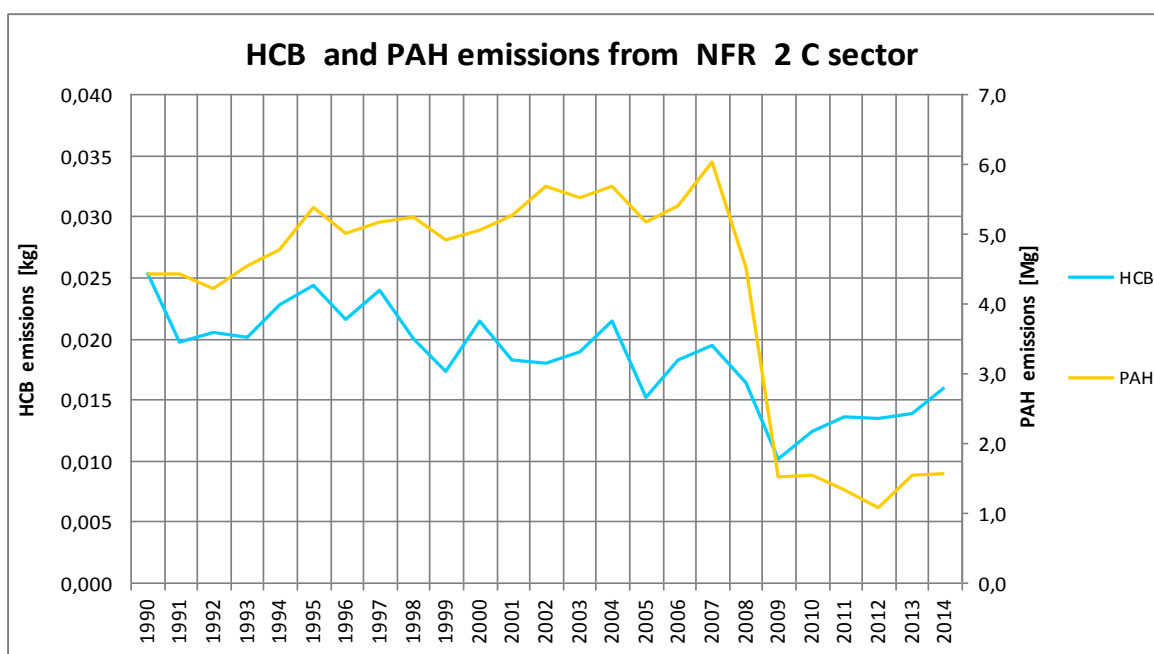


Figure 4.15. HCB and PAH emissions for 2.C category in 1990-2014

### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 2.C was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 2.C are given below. Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 4.6. Results of the emission uncertainty analysis for NFR sector 2.C

NFR		NO <sub>x</sub>	NMVOC	SO <sub>x</sub>	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%	%
2C1	Iron and steel production	20	34	30	39	21	25	37	58	99
2C2	Ferroalloys production						70			
2C3	Aluminium production	30			50	50		30		100
2C4	Magnesium production									
2C5	Lead production						70			

#### 4.4. Solvents Use (NFR sector 2.D)

##### Source category description

The use of solvents is one of the main sources of NMVOC emissions and includes the following subcategories:

- Domestic solvent use including fungicides (2.D.3.a)
- Road paving with asphalt (2.D.3.b)
- Asphalt roofing (2.D.3.c)
- Coating applications (2.D.3.d)
- Degreasing (2.D.3.e)
- Dry cleaning (2.D.3.f)
- Chemical Products (2.D.3.g)
- Other Solvent use (2.D.3.i).

Shares of emissions from the 2 D category in the country total for the particular pollutants in 2014 are shown on the figure 4.16.

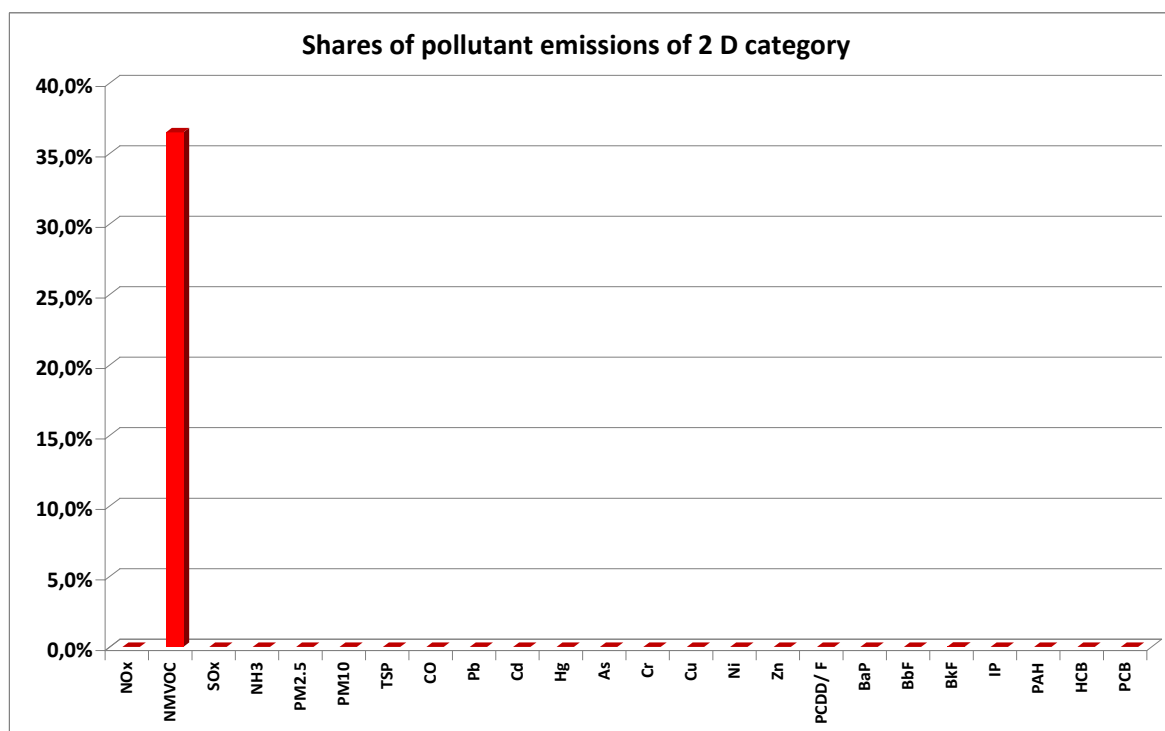


Figure 4.16. Shares of emissions from the 2.D category in the country total

This category corresponds to categories SNAP 06 and SNAP 040610.

Activity data for this sector come from statistical yearbook [GUS 2015e] and import-export balances. Tables 4.7 – 4.12 present the activity data used in the sub-category 2.D for the years 1990-2014. NMVOC emission factors have been developed by the Institute for Ecology of Industrial Areas (IETU). Applied emission factors for subcategory 2.D are presented in Appendix 2.

### Domestic solvent use

In this category domestic solvent use (except paints) was included.

Table 4.7. Activity data for the years 1990-2014 in NFR 2.D.3.a

Process	1990	1991	1992	1993	1994	1995	1996
Domestic solvent use including fungicides [thous. inhab]	38 073	38 144	38 203	38 239	38 265	38 284	38 294
	1997	1998	1999	2000	2001	2002	2003
Domestic solvent use including fungicides [thous. inhab]	38 290	38 277	38 263	38 254	38 242	38 219	38 191
process	2004	2005	2006	2007	2008	2009	2010
Domestic solvent use including fungicides [thous. inhab]	38 174	38 157	38 125	38 116	38 136	38 167	38 200
process	2011	2012	2013	2014			
Domestic solvent use including fungicides [thous. inhab]	38 501	38 538	38 496	38 496			

### Road paving with asphalt and Asphalt roofing

Table 4.8. Activity data for the years 1990-2014 in NFR 2.D.3.b and 2.D.3.c [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Road paving with asphalt	721 900	548 000	578 200	527 100	652 000	615 000	695 000
Asphalt roofing	85 144	100 580	103 197	108 392	128 323	114 000	102 000
	1997	1998	1999	2000	2001	2002	2003
Road paving with asphalt	710 000	714 000	828 000	1 041 600	782 000	924 200	1 001 500
Asphalt roofing	109 000	93 400	98 000	92 957	73 845	76 621	80 155
Industrial process	2004	2005	2006	2007	2008	2009	2010
Road paving with asphalt	1 097 200	1 311 500	1 605 500	1 721 000	1 578 200	2 234 200	1 855 000
Asphalt roofing	90 636	89 339	92 508	98 379	88 734	84 601	91 688
Industrial process	2011	2012	2013	2014			
Road paving with asphalt	2 000 900	1 700 900	1 374 800	1 326 800			
Asphalt roofing	91 372	87 197	74 529	75 596			

### Coating applications

Table 4.9. Activity data for the years 1991-2014 in NFR 2.D.3.d [Mg]

process	1991	1992	1993	1994	1995	1996	1997	1998
Decorative coating application	20 000	30 000	38 000	51 000	66 180	86 948	105 500	158 041
Industrial coating application	80 000	100 000	128 000	155 000	120 400	123 249	126 000	116 394
process	1999	2000	2001	2002	2003	2004	2005	2006
Decorative coating application	181 361	176 183	198 034	228 430	254 430	262 267	360 749	315 124
Industrial coating application	101 569	138 300	145 141	160 563	136 656	142 095	143 986	186 496
process	2007	2008	2009	2010	2011	2012	2013	2014
Decorative coating application	379 183	380 611	354 658	373 483	372 637	355 148	339 813	358 309
Industrial coating application	153 978	186 473	179 294	199 082	198 716	194 132	204 967	218 711

## Degreasing and dry Cleaning

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

Table 4.10. Activity data for the years 1990-2014 in NFR 2.D.3.d and 2.D.3.e

Process	1990	1991	1992	1993	1994	1995	1996
Degreasing [Mg]	4 000	5 500	7 000	8 500	9 500	11 348	9 790
Dry cleaning [thous. inhab.]	38 073	38 144	38 203	38 239	38 265	38284	38294

Process	1997	1998	1999	2000	2001	2002	2003
Degreasing [Mg]	7 191	9 746	12 128	14 564	11 710	12 566	18 388
Dry cleaning [thous. inhab.]	38290	38 277	38 263	38 254	38 242	38 219	38 191

Process	2004	2005	2006	2007	2008	2009	2010
Degreasing [Mg]	24 236	22 580	24 236	23 227	29 613	20 519	16 963
Dry cleaning [thous. inhab.]	38 174	38 157	38 125	38 116	38 136	38 167	38 200

Process	2011	2012	2013	2014
Degreasing [Mg]	16 343	11 903	10 310	10 441
Dry cleaning [thous. inhab.]	38 500	38 538	38 496	38 496

## Chemical products

The emission inventory for Chemical products includes emissions from the following processes:

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

Table 4.11. Activity data for the years 1990-2014 in 2D.3.g *Chemical products* [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Polyvinylchloride processing	203 405	211 684	219 963	212 143	202 273	225 267	254 000
Polystyrene foam processing	19 096	22 423	25 750	31 509	33 822	46 243	46 500
Rubber processing	203 989	161 488	171 362	184 317	210 085	249 000	266 000
Pharmaceutical products manufacturing [thous. inhab.]	38 073	38 144	38 203	38 239	38 265	38284	38294
Paints manufacturing	310 000	320 000	330 000	350 000	377 000	453 167	539 208
Leather tanning	26 400	26 000	25 600	25 200	24 800	24 400	24 000

Industrial process	1997	1998	1999	2000	2001	2002	2003
Polyvinylchloride processing	285 000	266 000	259 000	273 930	225 608	248 541	255 762
Polystyrene foam processing	48 900	51 200	70 600	94 335	92 540	87 228	82 369
Rubber processing	271 000	288 000	290 000	353 773	383 251	399 487	449 821
Pharmaceutical products manufacturing [thous. inhab.]	38290	38 277	38 263	38 254	38 242	38 219	38 191
Paints manufacturing	247000	367 391	334 266	280 231	295 981	330 989	361 884
Leather tanning	23 600	23 200	22 800	23 314	20 343	19 118	17 760

Industrial process	2004	2005	2006	2007	2008	2009	2010
Polyvinylchloride processing	268 454	216 775	277 798	302 716	251 380	258 086	195 836
Polystyrene foam processing	87 228	92 667	101 179	107 815	119 973	127 281	142 051
Rubber processing	519 118	556 990	625 632	679 590	714 446	621 829	790 196
Pharmaceutical products manufacturing [thous. inhab.]	38 174	38 157	38 125	38 116	38 136	38 167	38 200
Paints manufacturing	375 160	429 262	388 989	485 847	456 322	418 262	449 559
Leather tanning	19 038	16 148	12 382	11 253	13 652	14 721	14 952



Industrial process	2011	2012	2013	2014
Polyvinylchloride processing	282 952	261 339	306 129	275 159
Polystyrene foam processing	145 099	143 160	135 731	128 352
Rubber processing	897 851	857 201	915 888	978 359
Pharmaceutical products manufacturing [thous. inhab.]	38 501	38 538	38 496	38 496
Paints manufacturing	458 440	458 423	456 940	509 664
Leather tanning	16 197	14 438	13 898	16 416

### Other solvent use

In the category 2.d.3.i the following processes were included:

- oil extraction (production of fats and oils),
- preservation of wood.

Table 4.12. Activity data for the years 1990-2014 in 2.D.3.i *Other solvent use* [Mg]

process	1990	1991	1992	1993	1994	1995	1996
Fat. edible and non edible oil extraction	260 363	221 645	200 383	227 069	227 452	298 538	303700

process	1997	1998	1999	2000	2001	2002	2003
Fat. edible and non edible oil extraction	317375	319 674	367 700	464 800	461 700	432 500	396 100

process	2004	2005	2006	2007	2008	2009	2010
Fat. edible and non edible oil extraction	395 300	427 400	452 100	502 600	567 100	565 800	488 700

process	2011	2012	2013	2014
Fat. edible and non edible oil extraction	509 523	470 154	519 058	543 425

For *Preservation of wood* (NFR 2.D.3.i) resulting in PAH emissions there was a temporary expert estimate of 8,5 Gg activity every year.

### Source-specific QA/QC and verification

Activity data used in the pollutant emission inventory concerning industry sector come from yearbooks published by the Central Statistical Office (GUS). GUS is responsible for QA/QC of collected and published data.

### Source-specific planned improvements

Development and update of NMVOCs emissions methodology.

### Emission trends for the NFR sector 2.D

Volumes and trend of pollutant emissions for *Solvent use* is shown below on figure 4.17.

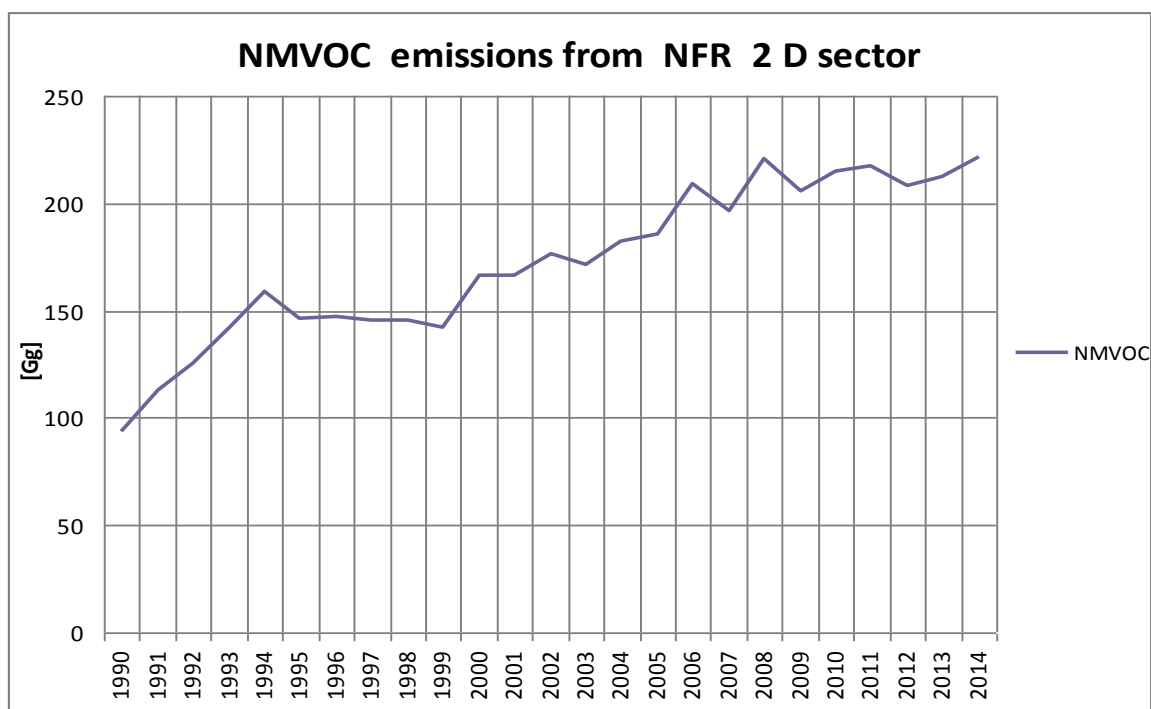


Figure 4.17. NMVOC emissions for NFR 2.D category in 1990-2014

Uncertainties and time-series consistency for NFR 2.D.

Uncertainty analysis for the 2014 for NFR sector 2.D was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 2.D are given below.

Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 4.13 Results of the emission uncertainty analysis for NFR sector 2.D

NFR		NMVOC	NH <sub>3</sub>
		%	%
2D3a	Domestic solvent use including fungicides	30	
2D3c	Asphalt roofing	50	
2D3d	Coating applications	28	
2D3e	Degreasing	30	
2D3f	Dry cleaning	30	
2D3g	Chemical products	19	50
2D3i	Other solvent use	30	

#### 4.5. Other products (NFR 2.G, 2.H, 2.I and 2.L)

##### Source category description

Estimation of emissions in *Other Products* carried out in sub-categories listed below:

- Use of tobacco (NFR 2.G)
- Pulp and paper (NFR 2.H.1)
- Food and drink (NFR 2.H.2)
- Wood processing (NFR 2.I)
- Other production, consumption, storage, transportation or handling of bulk products (2.L).

This category corresponds to categories SNAP 040601 ÷ SNAP 040608, 040617 (smoke houses; storage and handling) and SNAP 060602 (use of tobacco).

Category 2.L consists of the storage and handling of cement, coal and coke.

Shares of emissions from the 2 D category in the country total for the particular pollutants in 2014 are shown on the figure 4.18.

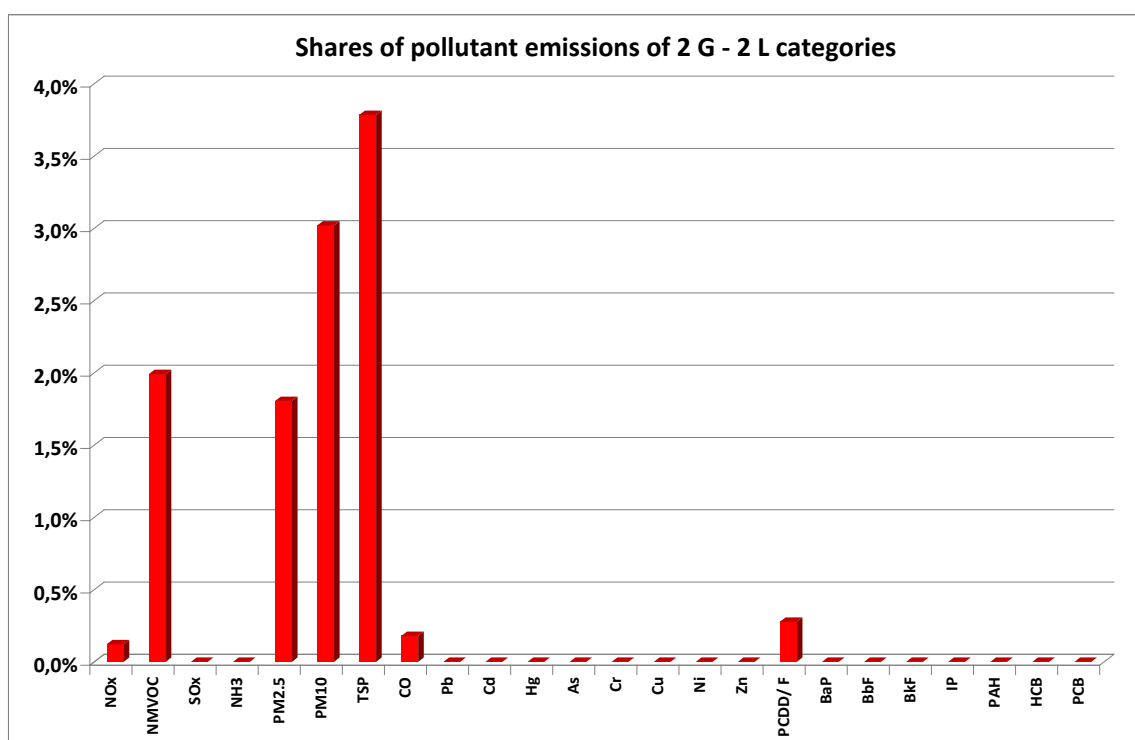


Figure 4.18. Shares of emissions from the 2.G, 2.H, 2.I and 2.L categories in the country total

Activity data for this sector come from GUS statistical yearbooks [GUS 2014e].

Table 4.14 presents the activity data used in the sub-category *Other Products* for the years 1990-2014. To estimate emissions domestic and default emission factors are used. Applied emission factors for subcategories 2.G, 2.H, 2.I and 2.L are presented in Appendix 2.

Table 4.14. Activity data for the years 1990-2014 in category *Other Products* [Gg]

Industrial process	1990	1991	1992	1994	1994	1995	1996
Tobacco combustion [Mg]	70 572	69 502	66 855	70 666	67 205	68 573	69 925
Tobacco combustion [mln pcs]	100 817	99 289	95 508	100 951	96 007	97 961	99 893
Chipboard [m3]	923 600	1 136 600	1 201 000	1 329 000	2 014 200	1 538 000	1 747 000
Paper pulp (kraft process)	522 600	508 800	566 600	597 100	644 400	671 200	644 000
Bread	3 129 100	2 775 000	2 633 600	2 707 300	2 750 300	2 750 000	2 915 000
Wine [MI]	2 113 921	2 970 381	2 285 079	2 468 887	2 498 055	2 470 000	3 480 000
Beer [MI]	11 294 200	13 633 300	14 138 800	12 584 900	14 098 600	15 200 000	16 700 000
Spirits [MI 100%]	151 005	143 331	135 656	149 518	156 621	153 947	665 041
Smoke houses - no flue gas burn out	187 607	180 595	180 707	181 667	187 333	195 633	217 717
Smoke houses - flue gas burn out	375 215	361 191	361 413	363 333	374 667	391 267	435 433
Storage and handling - cement	12 518 000	12 012 000	11 908 000	12 200 000	13 834 000	13 914 000	13 959 000
Storage and handling - coal	147 674 200	140 269 900	131 530 600	130 479 200	133 933 100	137 000 000	138 000 000
Storage and handling - coke	13 738 730	11 468 071	11 128 385	10 281 729	11 456 120	11 579 000	10 340 000

Industrial process	1997	1998	1999	2000	2001	2002	2003
Tobacco combustion [Mg]	63 301	64 353	65 067	62 503	52 324	52 361	53 773
Tobacco combustion [mln pcs]	90 430	91 933	92 953	89 290	74 748	74 802	76 819
Chipboard [m3]	2 072 000	2 452 000	2 599 000	3 031 000	2 937 000	3 111 500	3 748 000
Paper pulp (kraft process)	664 000	722 000	798 000	750 900	753 100	783 400	810 800
Bread	3 194 000	3 449 000	3 674 000	1 619 800	1 653 300	1 547 000	1 556 400
Wine [MI]	4 280 000	4 500 000	4 490 000	3 855 586	3 315 476	3 549 022	3 558 239
Beer [MI]	19 300 000	21 000 000	23 400 000	25 231 000	25 162 900	26 874 900	28 621 700
Spirits [MI 100%]	665 041	665 041	665 041	665 041	574 023	607 484	795 615
Smoke houses - no flue gas burn out	243 817	229 733	226 517	243 705	232 514	239 935	236 609
Smoke houses - flue gas burn out	487 633	459 467	453 033	487 410	465 028	479 869	473 217
Storage and handling - cement	15 003 000	14 970 000	15 555 000	15 046 400	12 074 300	11 206 400	11 653 400
Storage and handling - coal	138 000 000	116 000 000	112 000 000	103 330 600	103 991 700	103 704 800	103 016 400
Storage and handling - coke	10 536 000	9 847 000	8 476 000	8 972 173	8 954 325	8 787 899	10 231 932

Industrial process	2004	2005	2006	2007	2008	2009	2010
Tobacco combustion [Mg]	51 328	51 493	52 725	50 294	55 790	46 728	48 694
Tobacco combustion [mln pcs]	73 326	73 561	75 322	71 849	79 701	66 754	69 562
Chipboard [m3]	4 101 200	3 939 600	4 485 900	5 330 400	5 081 400	4 703 800	4 684 100
Paper pulp (kraft process)	790 600	802 300	824 600	813 800	819 900	826 300	881 000
Bread	1 532 000	1 548 700	1 551 500	1 523 000	1 683 800	1 663 000	1 674 900
Wine [MI]	3 236 412	2 764 698	2 679 669	2 456 338	2 230 163	1 881 311	1 816 152
Beer [MI]	31 850 600	31 572 200	33 953 300	36 895 500	37 107 500	36 235 800	36 800 400
Spirits [MI 100%]	868 605	790 175	833 375	927 524	1 081 306	1 043 402	1 070 126
Smoke houses - no flue gas burn out	257 802	242 475	258 388	271 152	261 014	244 759	252 850
Smoke houses - flue gas burn out	515 604	484 951	516 775	542 304	522 027	489 519	505 700
Storage and handling - cement	12 837 100	1 311 500	1 605 500	1 721 000	1 578 200	2 234 200	15 812 100
Storage and handling - coal	100 087 100	97 902 900	95 220 800	88 312 900	84 345 100	78 064 500	76 727 800
Storage and handling - coke	10 213 919	8 404 145	9 613 323	10 167 732	10 075 393	7 091 326	9 738 013

Industrial process	2011	2012	2013	2014
Tobacco combustion [Mg]	48 808	46 616	41 849	35 435
Tobacco combustion [mln pcs]	69 725	66 594	59 784	50 622
Chipboard [m3]	4 917 500	4 879 400	4 785 800	4 809 500
Paper pulp (kraft process)	894 300	847 600	881 300	880 700
Bread	1 600 900	1 675 000	1 733 000	1 613 300
Wine [MI]	1 666 663	1 483 883	1 531 133	1 526 271
Beer [MI]	38 066 600	39 605 100	40 001 200	40 075 300
Spirits [MI 100%]	1 035 802	1 032 199	1 156 615	881 248
Smoke houses - no flue gas burn out	277 671	281 814	283 294	276 274
Smoke houses - flue gas burn out	555 343	563 629	566 587	552 549
Storage and handling - cement	18 992 900	15 918 600	14 831 300	15 814 500
Storage and handling - coal	76 447 600	79 812 800	77 056 200	73 270 800
Storage and handling - coke	9 376 781	8 891 044	9 359 627	9 568 135

### Emission trends for the NFR sectors 2.G – 2.L

Volumes and trend of pollutant emissions for *Other Products* are shown below on figures 4.19 ÷ 4.20.

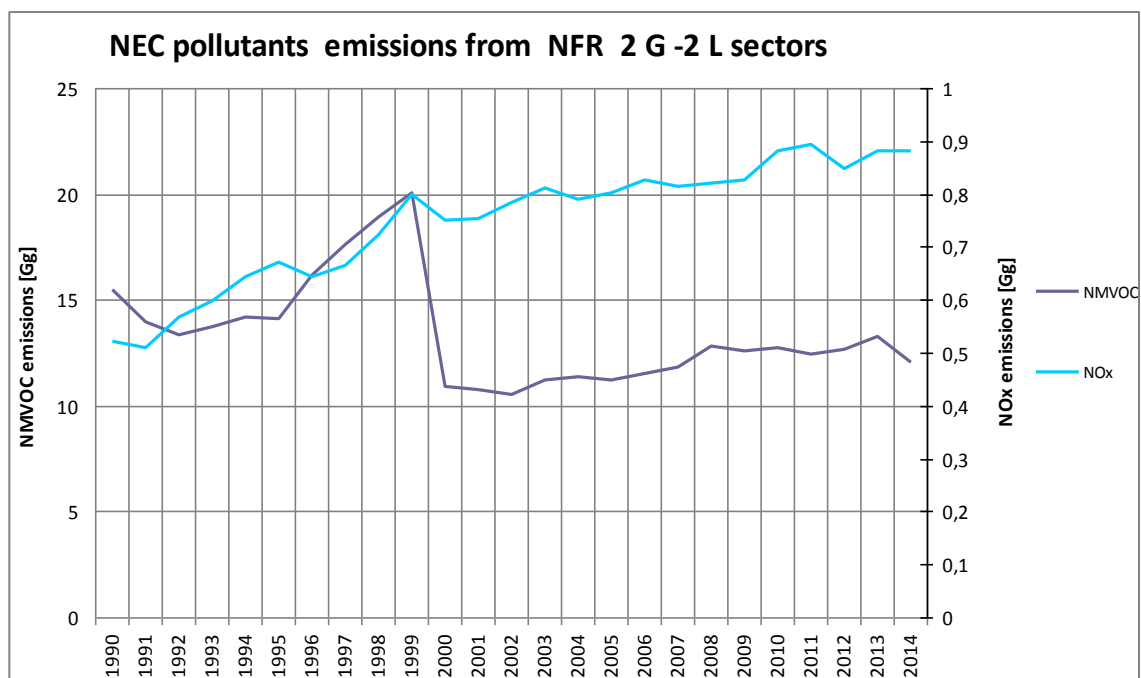


Figure 4.19. NOx and NMVOC emissions for 2.G – 2.L categories in 1990-2014

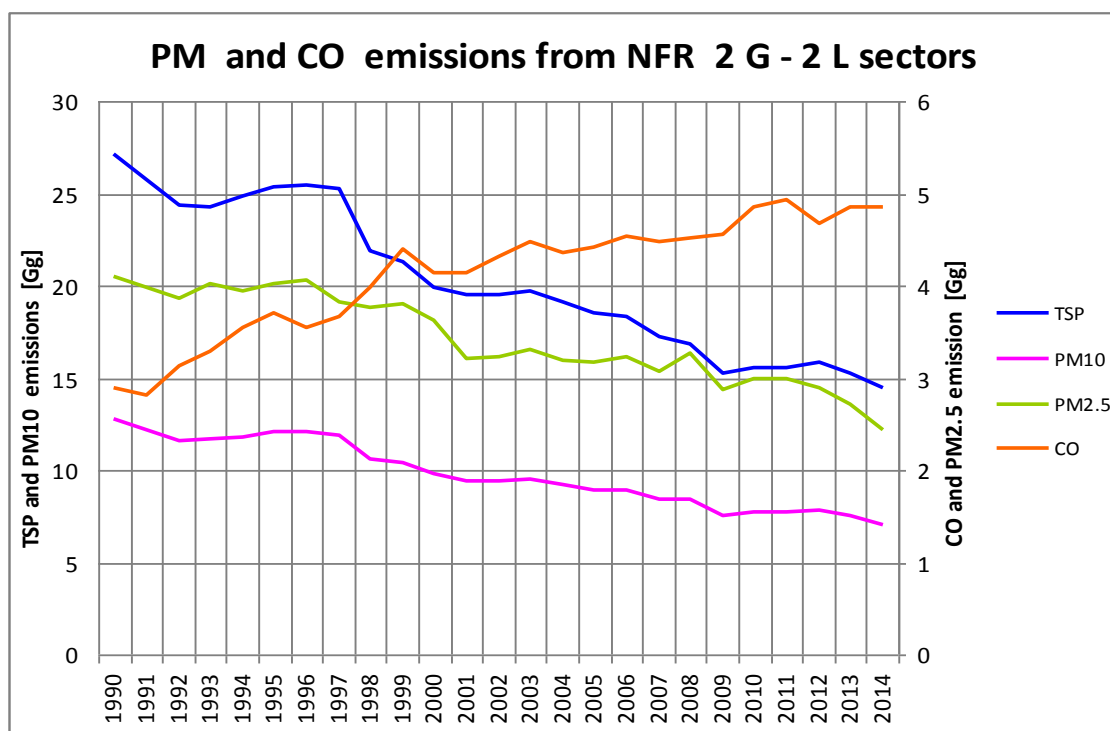


Figure 4.20. Particulates and CO emissions for 2.G – 2.L categories in 1990-2014

#### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for sector *Other Products* was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis are given below. Performed recalculations (period 1990-2013) of data ensured consistency for whole time-series.

Table 4.15. Results of the uncertainty analysis for NFR sector 2.G – 2.I

NFR		NO <sub>x</sub>	NMVOC	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%
2G	Other product use	71	71	71	50	71	71	71	100
2H1	Pulp and paper industry	30	50	50	50				
2H2	Food and beverages industry		36						
2I	Wood processing		50						

## 5. Agriculture (NFR sector 3)

### Overview of sector

The pollutant emission sources in agricultural sector involve: manure related to livestock management (NH<sub>3</sub>, PM<sub>10</sub>, PM<sub>2.5</sub>, TSP), agricultural soils (NH<sub>3</sub>, NO<sub>x</sub> and NMVOC) and agricultural residue burning (CO, NMVOC, TSP, PM<sub>10</sub>, PM<sub>2.5</sub>). Emission categories like: rice cultivation and prescribed burning of savannas were skipped as do not occur in Poland.

The agriculture sector is main source of ammonia emissions (98%), driven by a number of animals and volume of N fertilizers applied. Therefore main influence on interannual emissions change has the fluctuations of animal population and amount of nitrogen fertilizers used.

Shares of emissions from the NFR 3 category in the country total for the particular pollutants in 2014 are shown on the figure 5.1.

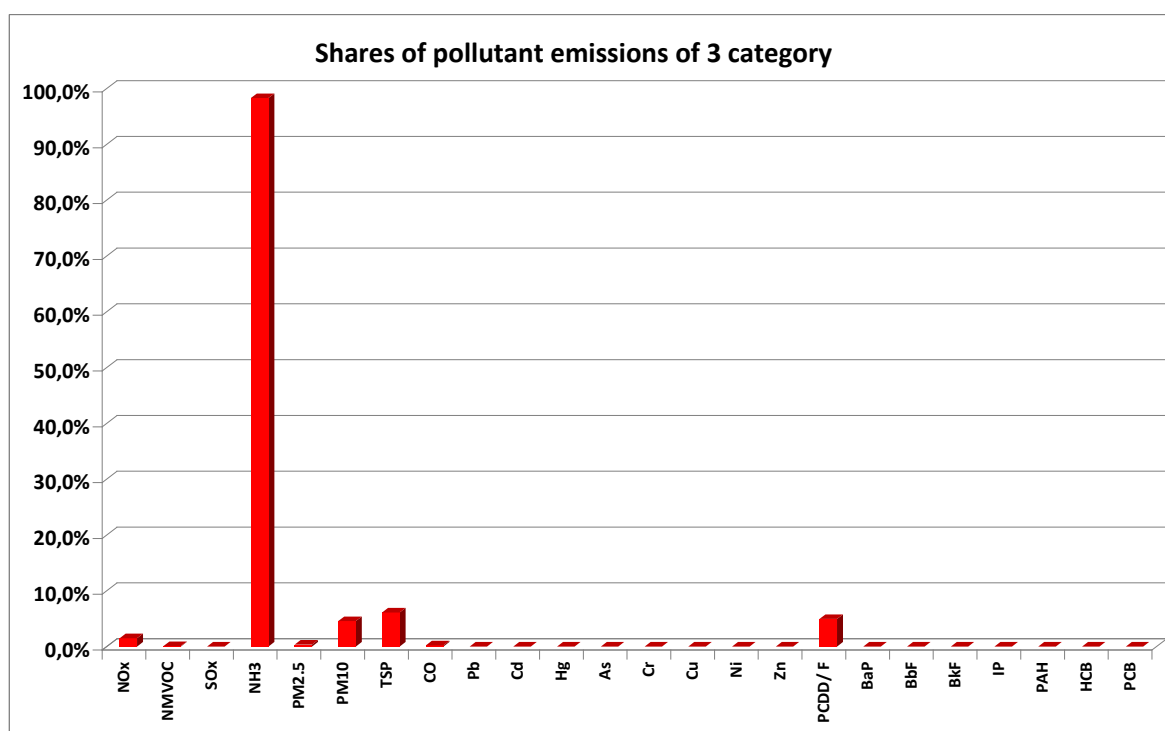


Figure 5.1. Shares of emissions from the NFR 3 category in the country total

### 5.1. Manure Management (NFR sector 3.B)

The pollutant emission sources in manure related to livestock management cover: NH<sub>3</sub>, PM<sub>10</sub>, PM<sub>2.5</sub> and TSP. Shares of emissions from the NFR 3.B category in the country total for the particular pollutants in 2014 are shown on the figure 6.2.

The key activity data applied in this category covers livestock population which comes from national statistics [GUS 2015] and are compiled on the basis of:

- generalized results of sample surveys<sup>1</sup> on cattle, sheep, poultry and pigs, as well as, the animal output in private farms,
- statistical reports in the scope of livestock in state and cooperative farms and companies with public and private property share,
- statistical reports from slaughter houses of farm animals,

- statistical reports from poultry hatcheries,
- information on the livestock of poultry from voivodship experts,
- own estimates.

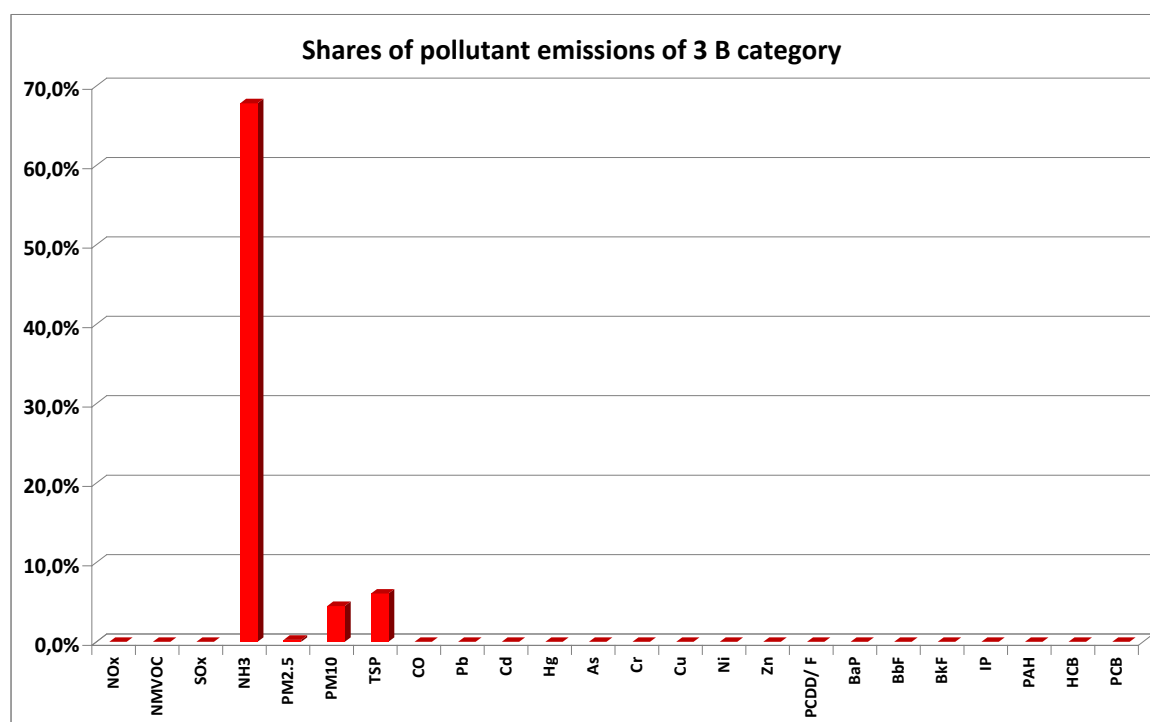


Figure 5.2. Shares of emissions from the 3.B category in the country total

Generally activity data for entire inventoried period since 1990 comes from the Central Statistical Office from analogous publications like for 2014. Trend of animal population in 1990–2014 is given in table 5.1.

Table 5.1. Trends of livestock population in 1990-2014

Years	Livestock population [thousands]								
	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry		
							Laying hens	Broilers	Other poultry
1990	4919	5130	4 159	179	941	19 464	55686	132485	36694
1991	4577	4267	3 234	179	939	21 868	53427	128193	34473
1992	4257	3964	1 870	179	900	22 086	49418	115636	34081
1993	3983	3660	1 268	179	841	18 860	47819	112420	34467
1994	3863	3833	870	179	622	19 466	51278	116569	33549
1995	3 579	3 727	713	179	636	20 418	48799	110300	30885
1996	3 461	3 675	552	179	569	17 964	56302	136471	14707
1997	3 490	3 817	491	182	558	18 135	54746	130195	16300
1998	3 542	3 413	453	186	561	19 168	53241	127709	20413
1999	3 418	3 137	392	181	551	18 538	53245	125929	23333
2000	3 098	2 985	362	177	550	17 122	52337	122307	23692
2001	3 005	2 729	343	172	546	17 105	55314	128085	22810
2002	2 873	2 660	345	193	330	18 629	51759	123316	23708
2003	2 897	2 592	338	192	333	18 605	44549	88846	12926
2004	2 796	2 557	318	176	321	16 988	43001	76810	10478
2005	2 795	2 688	316	142	312	18 112	45201	68287	11585
2006	2 824	2 782	301	130	307	18 881	47746	77124	16938
2007	2 787	2 909	332	144	329	18 129	49509	83563	17548
2008	2 806	2 950	324	136	325	15 425	50725	78063	16708
2009	2 688	3 012	286	119	298	14 279	49396	74733	16697
2010	2 656	3 068	258	108	264	14 865	50659	80300	11502
2011	2 626	3 136	251	112	254	13 509	47059	80482	16016



Years	Livestock population [thousands]								
	Dairy cattle	Non-dairy cattle	Sheep	Goats	Horses	Swine	Poultry		
							Laying hens	Broilers	Other poultry
2012	2578	3199	267	90	222	11581	52455	60969	17172
2013	2531	3329	249	82	207	11163	49893	73619	17179
2014	2479	3448	223	82	207	11724	41769	88092	16910

NH<sub>3</sub> emission factors from manure management are country specific and come from publications [Pietrzak 2006] (for all livestock except broilers) and [Atmoterm IS 2009] (for broilers). Generally EFs were assessed based on country data on animal waste management systems and livestock breeding schemes considering: given N-excretion rates, ammonia losses from manure in farm buildings, losses during manure storage and use as fertilizers as well as losses from manure left on pastures.

Nitrogen excretion rates (N<sub>ex</sub>) used in Ammonia EFs calculations for cattle, horses and swine were based on standard amount of animals manure. These were determined for specific livestock categories and utility sub-groups based on quantity, sort and digestibility of fodder applied. Then the nitrogen content in livestock manure was assessed based on manure management systems of collection and storage used [Jadczyzyn 2000]. Country specific N<sub>ex</sub> values are given in Appendix 2 and they are in line with parameters published in [UNECE 2001]. Further analysis is planned for updating ammonia emission factors from manure management.

Particulate matters emitted during livestock manure management are estimated based on emission factors taken from CEPMEIP. All applied emission factors are shown in Appendix 2.

## 5.2. Agricultural Soils (NFR sector 3.D)

### Source category description

The pollutant emissions in agricultural soils involve: NH<sub>3</sub>, NO<sub>x</sub> and NMVOCs from the application of synthetic nitrogen fertilizers. Shares of emissions from the NFR 3.D category in the country total for the particular pollutants in 2014 are shown on the figure 5.3.

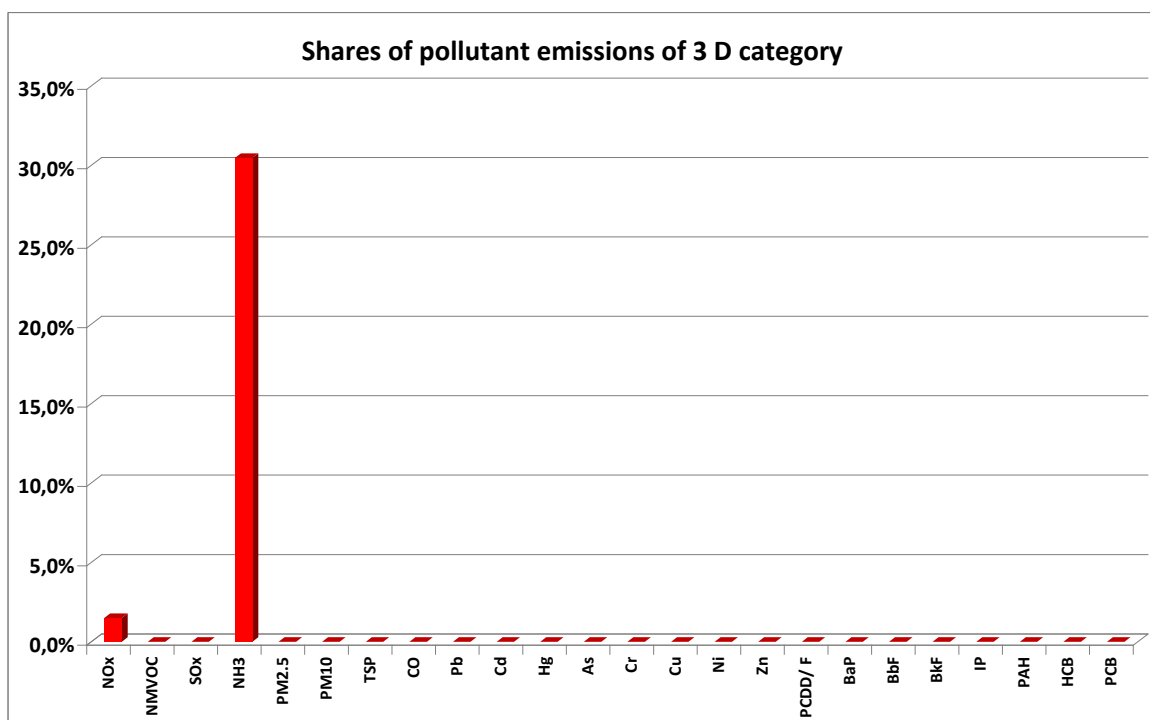


Figure 5.3. Shares of emissions from the 3.D category in the country total

### Methodological issues

NH<sub>3</sub>, NO<sub>x</sub> and NMVOC emissions from synthetic fertilizers were estimated based on the amount of nitrogen synthetic fertilizer applied to agricultural fields published in *Statistical yearbook* [GUS 2015g]. Data regarding consumption of mineral fertilizers are elaborated on the basis of reporting from production and trade units, statistical reports of agricultural farms: state-owned, co-operatives and companies with share of public and private sector, expert's estimates as well as Central Statistical Office estimates. The recommendations following agricultural good practice elaborated by the Ministry of Agriculture and Rural Development contain the rules for rational use of fertilisers, free consultancy system for farmers in this area, while the large-scale farms are obliged to elaborate fertilizing plans.

Table 5.2. Nitrogen fertilizers use in 1990–2014 in Poland [Gg N]

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	
1274	735	619	683	758	836	852	890	891	862	861	895	
2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
862	832	895	895	996	1 056	1 142	1095	1028	1091	1095	1179	1098

Ammonia emissions from fertilizers use for crop cultivation was estimated on the basis of country specific factor elaborated on domestic structure of nitrogen fertilizers application in the years 1995–1997 [Grześkowiak 2001] and in 2000 [Pietrzak 2006] as well as using default ammonia loss factors characteristic for region B (mean air temperature for Spring season 6 – 13°C) [EMEP/CORINAIR Emission Inventory Guidebook - 2006]. The highest share in nitrogen fertilizers applied in Poland in 2000 had ammonium nitrate (45 %) and urea (25 %). Emission factors for the particular pollutants with their source are presented in Appendix 2.

### 5.3. Field Burning of Agricultural Residues (NFR sector 3.F)

#### Source category description

The pollutant emissions related to on-field burning of stubble include PCDD/F, CO, NMVOC, TSP, PM10 and PM2.5. Shares of emissions from the NFR 3.F category in the country total for the particular pollutants in 2014 are shown on the figure 5.4. This category corresponds to SNAP 1003 category.

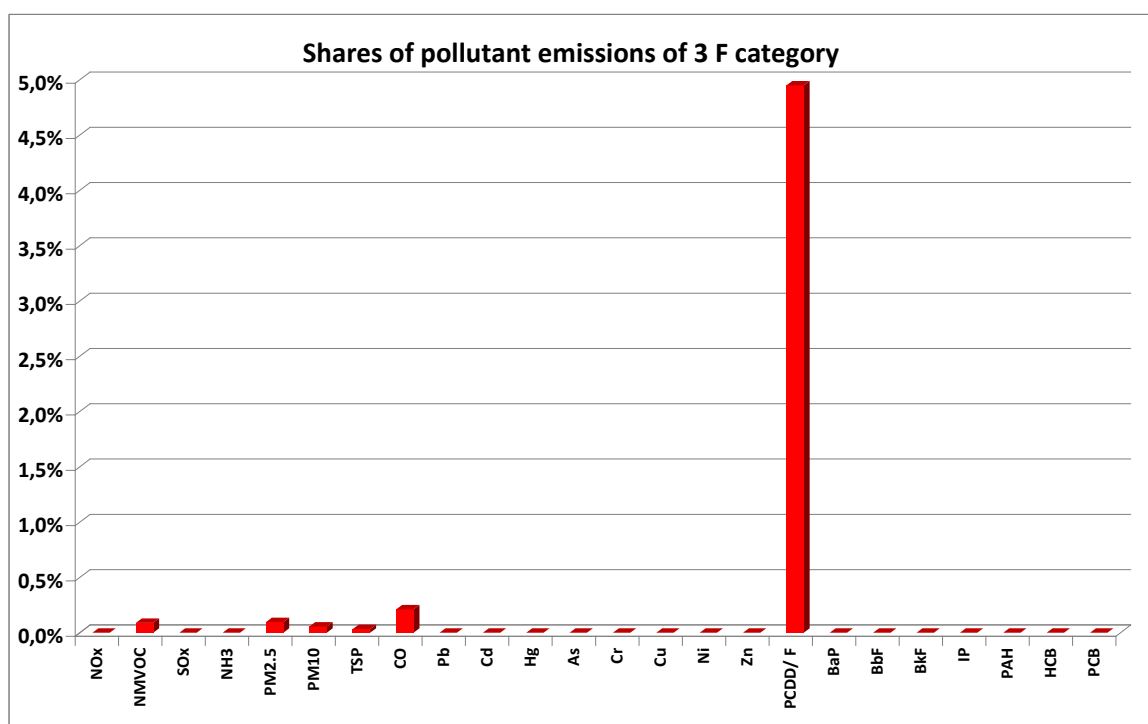


Figure 5.4. Shares of emissions from the 3.F category in the country total

#### Methodological issues

Estimation of pollutant emissions related to on-field stubble burning is based on the area of agricultural crops, meadows and stubbles burned in a given year. The amount of biomass burned resulting in emissions is calculated based on assumption that on average 3.6 Mg of biomass occurs on 1 ha of area.

Activity data for 2014 come from Central Statistical Office's yearbook on environment [GUS 2015c] and for previous years – from analogous publications (table 5.3).

Table 5.3. Activity data for On-field burning of stubble (3.F)

<b>process</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>
On-field burning of stubble [ha]	42991	42991	42991	42991	37208	39 275	53 919
<b>process</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
On-field burning of stubble [ha]	54 369	32 795	40 380	28 943	34 038	35 435	109 624
<b>process</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
On-field burning of stubble [ha]	39 331	36 149	28 998	16 652	19 696	13 031	9 855
<b>process</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>			
On-field burning of stubble [ha]	15 691	39 639	10 640	23817			

The corresponding emission factors for pollutants accompanying on-field burning of stubble are given in Appendix 2.

### Source-specific QA/QC and verification

Activity data related to livestock population come from national statistics prepared by the Central Statistical Office. Also activity data related to mineral fertilisers use or crop production come from national statistics prepared by the Central Statistical Office.

Emphasis was put on data consistency between sub-categories and between sectors using agricultural data. Emission factors and methodology is compared with international literature and other countries methods/EF applied. Calculations were examined with focus on formulas, units and trends consistency.

### Source-specific recalculations

Recalculations were made for 3.B and 3.D categories related to update of activity data for livestock population and nitrogen fertilizers use based on GUS publications.

### Source-specific planned improvements

Update of ammonia emission factors for livestock manure is planned.

### Emission trends for the NFR sector 3

Volumes and trend of pollutant emissions for *Agriculture* are shown below on figures 5.5 ÷ 5.6.

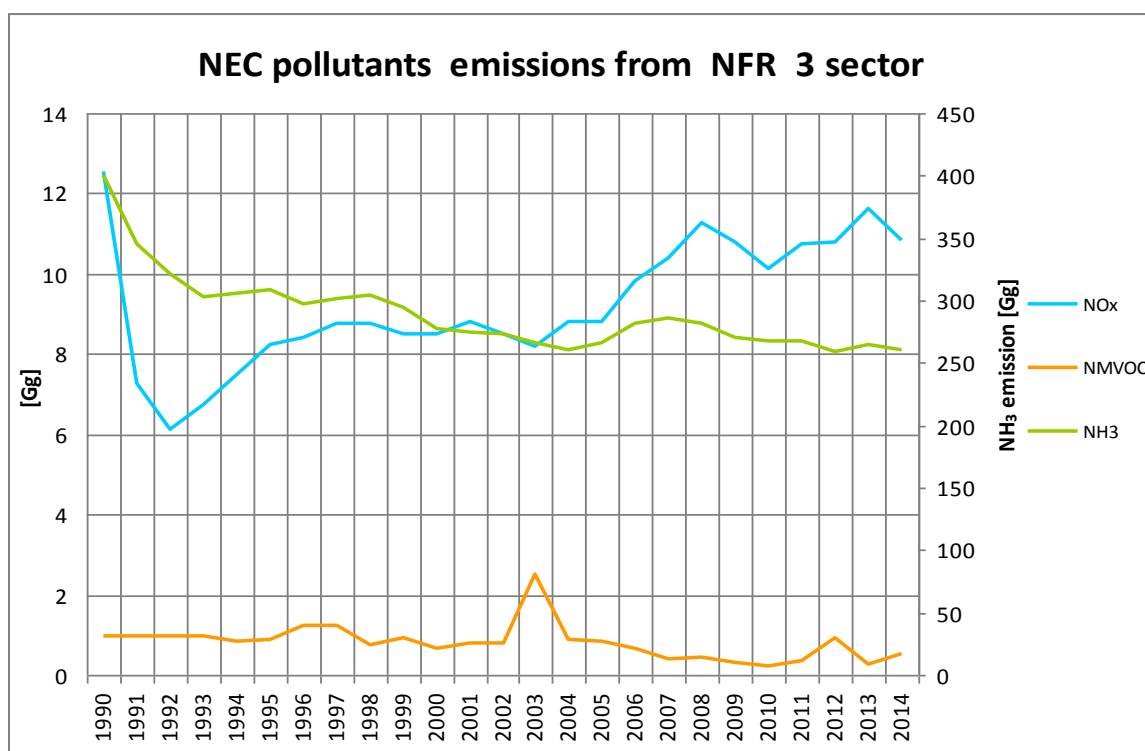


Figure 5.5. NH<sub>3</sub>, NO<sub>x</sub> and NMVOC emissions for NFR 3 category in 1990-2014

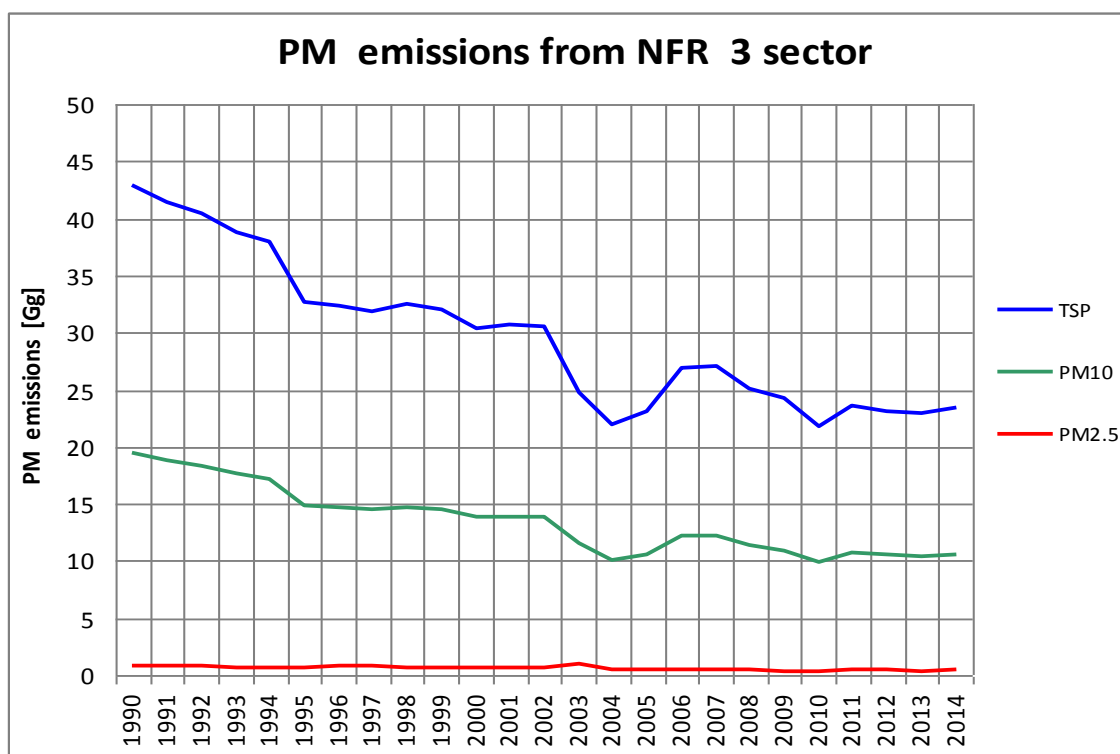


Figure 5.6. Particulates emissions for NFR 3 category in 1990-2014

#### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 3 was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 3 are given below.

Table 5.4. Results of the uncertainty analysis for NFR sector 3

NFR		NO <sub>x</sub>	NM VOC	NH <sub>3</sub>
		%	%	%
3B1a	Manure management - Dairy cattle			100
3B1b	Manure management - Non-dairy cattle			100
3B2	Manure management - Sheep			100
3B3	Manure management - Swine			86
3B4d	Manure management - Goats			100
3B4e	Manure management - Horses			100
3B4gi	Manure management - Laying hens			100
3B4gii	Manure management - Broilers			100
3B4giv	Manure management - Other poultry			100
3Da1	Inorganic N-fertilizers (includes also urea application)	30	150	100
3F	Field burning of agricultural residues		150	

## 6. NFR SECTOR 5 - Waste

### Source category description

Following subcategories from sector 6 have been included in the pollutant inventory:

- 5.A. Solid waste disposal on land
- 5.C. Waste incineration
  - o 5.C.1.a Municipal waste incineration
  - o 5.C.1.b Industrial waste incineration (including sludges)
  - o 5.C.1.b.iii Clinical waste incineration
  - o 5.C..1.b.v Cremations
  - o 5.C.2 Open burning of agricultural wastes
- 5.D. Wastewater handling (including latrines).

Shares of emissions from the major NFR 5 C category in the country total for the particular pollutants in 2014 are shown on the figure 6.1.

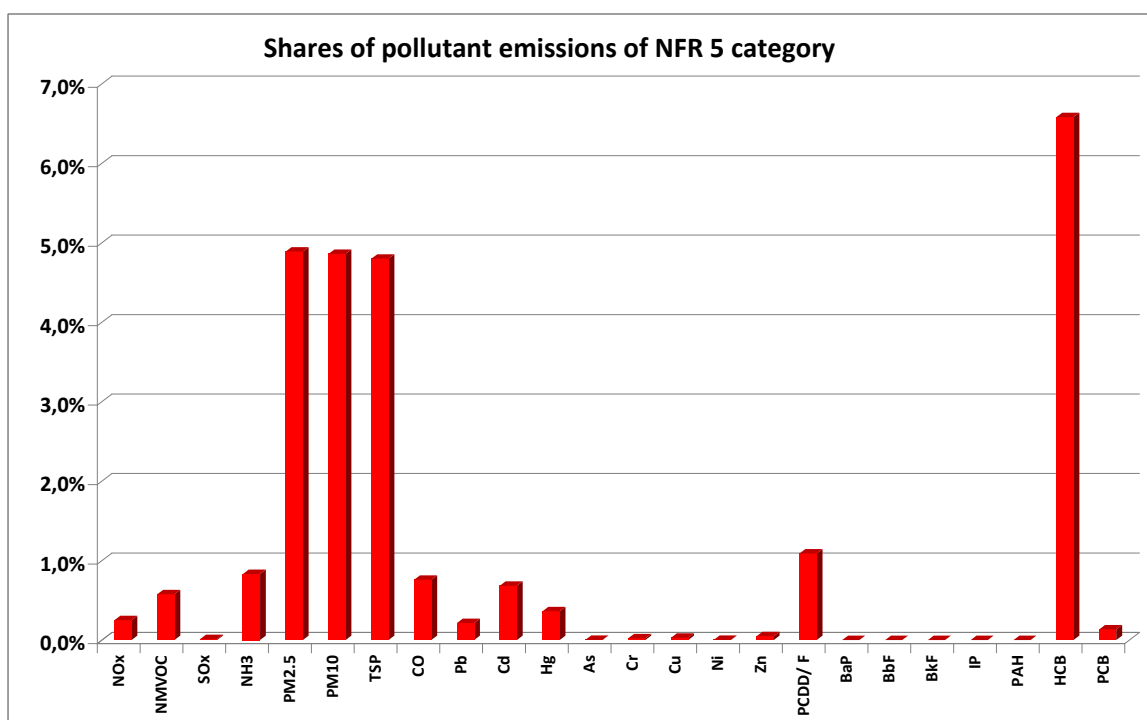


Figure 6.1. Shares of emissions from the NFR 5 category in the country total

### Activity data

Activity data, applied for current Polish emission inventory come from various sources. Majority of data is derived from national statistics made by GUS (Central Statistical Office). All used activity data are presented by NFR codes in tables below.

## Solid waste disposal on land (NFR 5 A)

Table 6.1. Activity data for the years 1990-2014 in *Municipal solid waste disposal* [Gg]

process	1990	1991	1992	1993	1994	1995	1996
Municipal solid waste disposal on land	11 087.2	10 627.3	10 610.4	10 551.8	10 900.0	13 124.1	13 922.2
process	1997	1998	1999	2000	2001	2002	2003
Municipal solid waste disposal on land	14 089.7	14 454.4	14 731.6	13 894.4	12 194.0	11 717.2	11 003.7
process	2004	2005	2006	2007	2008	2009	2010
Municipal solid waste disposal on land	10 276.7	12 384.6	12 088.6	11 941.0	11 308.4	10 242.9	9 894.5
process	2011	2012	2013	2014			
Municipal solid waste disposal on land	9 650.3	9 997.9	8 081.7	5 660.4			

## Waste incineration (NFR 5 C)

### - 5.C.1.a Municipal waste incineration

Table 6.2. Activity data for the years 1990-2014 in *Municipal waste incineration* [Mg]

process	1990	1991	1992	1993	1994	1995	1996
Municipal waste incineration							
process	1997	1998	1999	2000	2001	2002	2003
Municipal waste incineration				2 900.0	26 000.0	36 000.0	41 600.0
process	2004	2005	2006	2007	2008	2009	2010
Municipal waste incineration	43 000.0	44 381.0	41 274.0	43 800.0	40 815.0	40 300.0	40 898.5
process	2011	2012	2013	2014			
Municipal waste incineration	39 392.8	50 700.0	50 073.7	31 610.9			

### - 5.C.1.b Industrial waste incineration (including sludges)

Table 6.3. Activity data for the years 1990-2014 in *Industrial waste incineration* [Mg]

Industrial process	1990	1991	1992	1993	1994	1995	1996
Incineration of industrial wastes (no APCs)	7 893.7	6 593.5	5 832.8	5 349.5	4 945.7	4 590.4	4 226.6
Incineration of industrial wastes (minimal APCs)	54 269.7	47 960.3	45 092.5	44 184.0	43 909.6	44 125.6	44 369.0
Incineration of industrial wastes (good APCs)	131 597.1	117 830.7	112 253.4	111 458.1	112 251.0	114 324.5	116 514.8
Incineration of industrial wastes (very good APCs)	57 151.3	51 425.9	49 231.1	49 118.2	49 703.5	50 860.0	52 075.5
Incineration of sludges from waste water treatment (good APCs)	4 950.0	5 280.0	5 610.0	6 270.0	6 600.0	7 920.0	9 240.0
Incineration of sludges from waste water treatment (very good APCs)	10 050.0	10 720.0	11 390.0	12 730.0	13 400.0	16 080.0	18 760.0
Industrial process	1997	1998	1999	2000	2001	2002	2003
Incineration of industrial wastes (no APCs)	3 789.9	3 588.6	2 581.9	2 829.8	2 726.7	2 843.9	2 852.5
Incineration of industrial wastes (minimal APCs)	43 907.7	46 489.6	38 033.9	48 465.8	46 699.1	48 706.3	48 853.5
Incineration of industrial wastes (good APCs)	116 877.5	125 450.1	104 051.5	134 426.2	129 526.1	135 093.2	135 501.5
Incineration of industrial wastes (very good APCs)	52 477.7	56 582.5	47 141.6	61 178.1	58 948.1	61 481.7	61 667.5
Incineration of sludges from waste water treatment (good APCs)	11 220.0	13 655.7	10 540.9	11 412.0	29 082.1	29 082.1	29 082.1
Incineration of sludges from waste water treatment (very good APCs)	22 780.0	27 725.3	21 401.1	22 688.0	57 817.9	57 817.9	57 817.9

<b>Industrial process</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Incineration of industrial wastes (no APCs)	1 674.0	3 407.5	16 700.0	1 000.0			
Incineration of industrial wastes (minimal APCs)	28 670.0	58 359.2	16 500.0	29 200.0	36 769.7	35 950.0	34 325.5
Incineration of industrial wastes (good APCs)	79 520.0	161 866.8	63 650.0	65 200.0	3 748.0	4 400.0	4 201.2
Incineration of industrial wastes (very good APCs)	36 190.0	73 666.5	62 700.0	62 800.0	83 299.8	79 120.0	75 544.8
Incineration of sludges from waste water treatment (good APCs)	30 755.4	10 016.8	25 200.0	24 450.0	3 166.1	1 020.0	1 343.8
Incineration of sludges from waste water treatment (very good APCs)	61 144.6	21 726.1	50 100.0	48 700.0	4 655.0	25 130.0	33 107.8

<b>Industrial process</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Incineration of industrial wastes (no APCs)				
Incineration of industrial wastes (minimal APCs)	34 726.1	43 260.2	45 051.5	42 592.6
Incineration of industrial wastes (good APCs)	4 250.2	5 294.7	5 514.0	5 213.0
Incineration of industrial wastes (very good APCs)	76 426.3	95 208.5	99 151.0	93 739.2
Incineration of sludges from waste water treatment (good APCs)	1 724.3	2 098.2	5 952.0	6 576.0
Incineration of sludges from waste water treatment (very good APCs)	42 481.7	50 357.4	142 848.0	157 824.0

- 5.C.1. b.iii Clinical waste incineration

Table 6.4. Activity data for the years 1990-2014 in *Clinical waste incineration* [Mg]

<b>process</b>	<b>1990</b>	<b>1991</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>
Incineration of clinical wastes (compliance with EU Directive)	45 247.1	45 067.2	44 259.5	45 426.6	46 211.1	45 981.9	46 253.2
Incineration of clinical wastes (minimal APCs)	10 774.2	10 048.9	9 214.8	8 802.6	8 303.9	7 630.2	7 053.7
Incineration of clinical wastes (no APCs)							

<b>process</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Incineration of clinical wastes (compliance with EU Directive)	45 818.9	46 000.3	44 689.3	46 256.4	24 685.5	16 883.7	19 222.4
Incineration of clinical wastes (minimal APCs)	6 385.8	5 820.7	5 093.9	4 704.9	2 214.5	1 316.3	1 277.6
Incineration of clinical wastes (no APCs)							

<b>process</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>
Incineration of clinical wastes (compliance with EU Directive)	25 397.8	28 189.2	21 176.2	24 248.4	23 473.3	27 380.0	26 553.2
Incineration of clinical wastes (minimal APCs)	1 402.2	1 245.8	935.8	1 071.6	1 037.4	1 210.0	1 173.5
Incineration of clinical wastes (no APCs)		1 295.7			208.1		

<b>process</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
Incineration of clinical wastes (compliance with EU Directive)	31 944.5	32 716.2	33 410.0	39 963.9
Incineration of clinical wastes (minimal APCs)	1 411.7	1 445.8	1 476.5	1 766.1
Incineration of clinical wastes (no APCs)				



- 5.C.1.b.v Cremations

Table 6.5. Activity data for the years 1990-2014 in *Cremations* [thous.]

process	1990	1991	1992	1993	1994	1995	1996
Cremations	0.2	0.4	0.6	0.8	1.0	2.0	2.5
process	1997	1998	1999	2000	2001	2002	2003
Cremations	3.0	3.4	4.7	6.0	7.7	9.4	11.5
process	2004	2005	2006	2007	2008	2009	2010
Cremations	14.6	16.3	19.5	22.4	25.4	27.9	20.7
process	2011	2012	2013	2014			
Cremations	24.4	30.8	31.0	30.1			

- 5.C.2 Open burning of agricultural wastes

Table 6.6. Activity data for the years 1990-2014 in *Open burning of agricultural wastes* [Mg]

process	1990	1991	1992	1993	1994	1995	1996
Open burning of agricultural wastes	265 100.5	256 812.6	224 187.8	268 498.0	224 327.5	262 023.2	255 261.6
process	1997	1998	1999	2000	2001	2002	2003
Open burning of agricultural wastes	245 306.7	271 502.5	248 016.1	233 570.6	272 988.1	248 525.0	237 425.5
process	2004	2005	2006	2007	2008	2009	2010
Open burning of agricultural wastes	292 119.9	251 755.4	244 966.8	240 810.1	299 748.8	322 210.8	277 837.7
process	2011	2012	2013	2014			
Open burning of agricultural wastes	275 106.7	289 517.9	317 865.6	346 606.7			

Wastewater handling (NFR 5 D)

Table 6.7. Activity data for the years 1990-2014 in *Municipal Waste water treatment*

process	1990	1991	1992	1993	1994	1995	1996
Municipal Waste water treatment [mln m <sup>3</sup> ]	1 391.0	1 362.6	1 329.9	1 281.5	1 275.6	1 257.6	1 244.5
Latrines [mln inhabitants]	6.5	6.3	6.1	5.9	5.7	5.5	5.2
process	1997	1998	1999	2000	2001	2002	2003
Municipal Waste water treatment [mln m <sup>3</sup> ]	1 274.3	1 311.4	1 292.7	1 243.4	1 227.4	1 190.9	1 159.1
Latrines [mln inhabitants]	5.0	4.8	4.6	4.4	4.2	4.0	3.7
process	2004	2005	2006	2007	2008	2009	2010
Municipal Waste water treatment [mln m <sup>3</sup> ]	1 152.3	1 140.0	1 155.5	1 174.1	1 169.4	1 181.0	1 242.4
Latrines [mln inhabitants]	3.5	3.3	3.1	2.9	2.7	2.5	2.2
process	2011	2012	2013	2014			
Municipal Waste water treatment [mln m <sup>3</sup> ]	1 203.1	1 220.8	1 244.3	1 236.5			
Latrines [mln inhabitants]	2.0	1.8	1.6	1.4			

Tables with applied emission factors are presented in Appendix 2.

Source-specific QA/QC and verification

Activity data related to: solid waste disposal, wastewater handling, latrines and incineration of wastewater sludge comes from national statistics prepared by the Main Statistical Office of Poland. The rest of data applied for calculations is derived from various sources. Description of them is provided in Appendix 5.

### Emission trends for the NFR sector 5

Volumes and trend of pollutant emissions for *Waste treatment and disposal* are shown below on figures 6.2 ÷ 6.5.

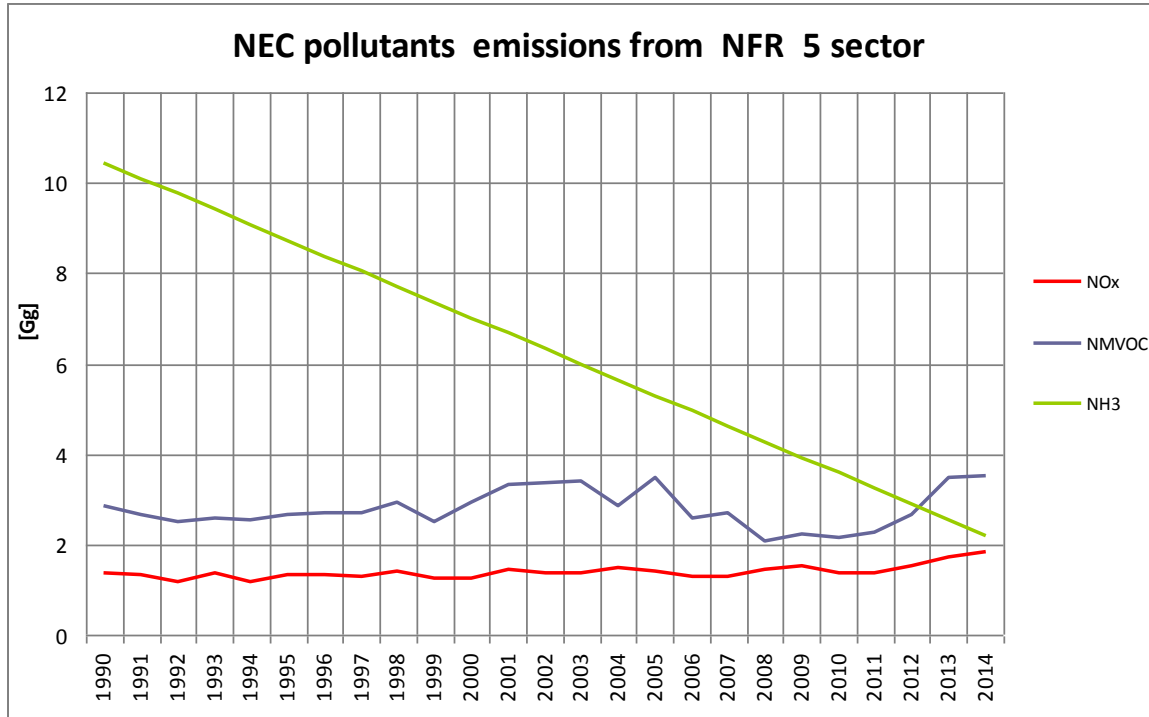


Figure 6.2. NO<sub>x</sub>, NMVOC and NH<sub>3</sub> emissions for NFR 5 category in 1990-2014

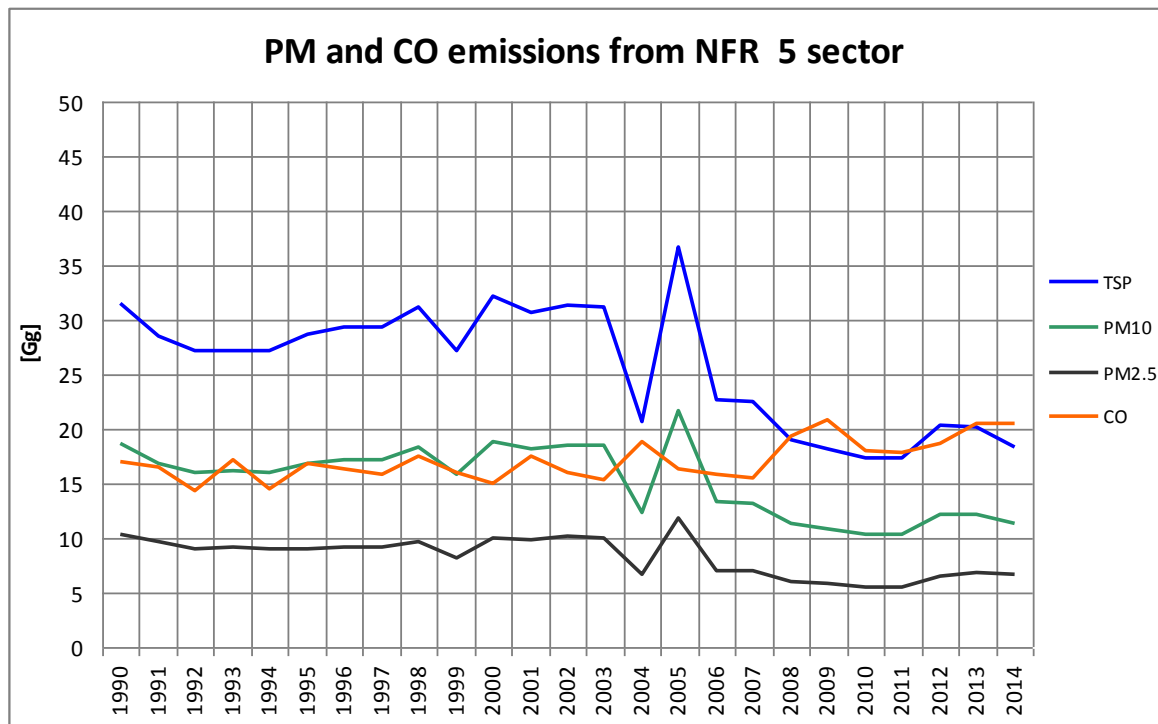


Figure 6.3. CO and PM emissions for NFR 5 category in 1990-2014

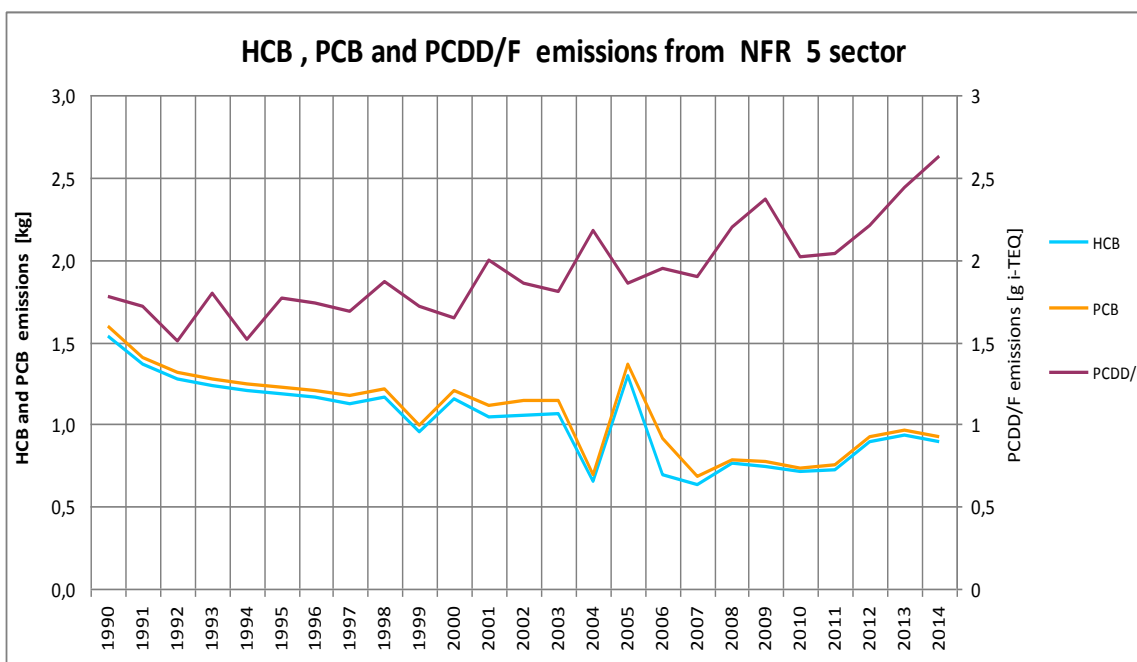


Figure 6.4. PCDD/F emissions for NFR 5 category in 1990-2014

### Uncertainties and time-series consistency

Uncertainty analysis for the 2014 for NFR sector 5 was developed with use of methodology, described in Appendix 5. For the most of pollutants there is applied simplified approach described in EMEP/EEA Guidebook (Chapter 5). Results of the sectoral uncertainty analysis for NFR sector 5 are given below.

Table 6.8. Results of the uncertainty analysis for NFR sector 5

	NFR	NO <sub>x</sub>	NM VOC	SO <sub>x</sub>	NH <sub>3</sub>	CO	TSP	Pb	Cd	Hg	PCDD/F
		%	%	%	%	%	%	%	%	%	%
5A	Biological treatment of waste - Solid waste disposal on land		30								
5C1a	Municipal waste incineration	50	50	30		50	50	100	100	100	100
5C1bi	Industrial waste incineration	37	37	22		37	37				99
5C1biii	Clinical waste incineration	48	48	29		48					76
5C1bv	Cremation	71	51	32		51		71	71	71	100
5C2	Open burning of waste	50	50			50	50				100
5D1	Domestic wastewater handling				30						

## 7. Other and Natural emissions

The category *Other and Natural emissions* includes emissions that have not been included in the national totals.

### 7.1 Forest fires (NFR 11.B)

Estimated emissions from Forest fires include NMVOC and PCDD/F.

Activity data were derived from national statistics made by GUS and are listed in table 7.1. Tables with applied emission factors are presented in Appendix 2.

Table 7.1. Activity data for the years 1990-2014 in NFR 11.B *Forest fires* [Gg]

process	1990	1991	1992	1993	1994	1995	1996
Forest fires	240.3	86.5	1 455.7	257.3	273.6	160.4	431.7
process	1997	1998	1999	2000	2001	2002	2003
Forest fires	199.6	122.4	244.8	208.4	100.7	153.7	630.3
process	2004	2005	2006	2007	2008	2009	2010
Forest fires	112.7	171.3	174.1	103.6	89.4	130.6	66.5
process	2011	2012	2013	2014			
Forest fires	87.7	226.6	46.6	90.5			

### 7.2 Other natural sources (NFR 11.C)

#### Unintentional fires

Estimated emissions from *Unintentional fires* include PCDD/F.

Activity data were derived from fire statistics made by National Headquarters of the State Fire Service and own estimates; they are listed in table 7.2. Tables with applied emission factors are presented in Appendix 2.

Table 7.2. Activity data for the years 1990-2014 for category Unintentional fires

process	1990	1991	1992	1993	1994	1995	1996
car fires	3 500	4 000	4 600	5 091	5 237	5 277	5 540
house fires [Gg]	21.5	23.5	25.0	25.9	28.0	28.2	29.9
landfill fires - surface	353	353	353	353	353	481	465
landfill fires - deep	40	40	40	40	40	53	52
	1997	1998	1999	2000	2001	2002	2003
car fires	6 135	6 701	7 243	7 100	6 851	7 212	6 916
house fires [Gg]	32.1	32.7	32.3	32.4	30.4	32.6	34.6
landfill fires - surface	451	435	420	395	382	369	357
landfill fires - deep	50	49	47	45	43	42	40
	2004	2005	2006	2007	2008	2009	2010
car fires	6 700	7 307	7 835	7 463	7 552	8 131	8 667
house fires [Gg]	33.2	34.2	34.5	34.1	35.5	34.7	34.8
landfill fires - surface	345	332	320	306	294	282	283
landfill fires - deep	38	37	35	34	32	30	29
	2011	2012	2013	2014			
car fires	8 436	8 126	7 815	8 201			
house fires [Gg]	35.2	36.7	33.4	33.8			
landfill fires - surface	285	287	209	193			
landfill fires - deep	27	25	23	22			

PCDD/F emissions from this subcategory will be moved to NFR 5.E in the next submission.

## Non-managed broadleaf and coniferous forests

Estimated emissions from Non-managed forests include NMVOC.

Activity data were derived from national statistics made by GUS and are listed in table 7.3.

Tables with applied emission factors are presented in Appendix 2.

Table 7.3. Activity data for the years 1990-2014 for Non-managed forests [thous. ha]

process	1990	1991	1992	1993	1994	1995	1996
Non-managed broadleaf forests	1 805.5	1 815.0	1 818.1	1 830.5	1 798.3	1 816.3	1 828.9
Non-managed coniferous forests	6 888.4	6 891.3	6 900.1	6 884.5	6 737.9	6 735.2	6 756.8

process	1997	1998	1999	2000	2001	2002	2003
Non-managed broadleaf forests	1 860.6	1 893.0	1 908.2	1 947.9	1 981.2	2 018.9	2 049.5
Non-managed coniferous forests	6 754.9	6 771.2	6 771.9	6 761.1	6 740.4	6 754.3	6 784.5

process	2004	2005	2006	2007	2008	2009	2010
Non-managed broadleaf forests	2 079.0	2 103.8	2 111.5	2 122.2	2 641.1	2 648.1	2 665.5
Non-managed coniferous forests	6 829.0	6 849.1	6 849.3	6 895.7	6 403.7	6 420.6	6 431.7

process	2011	2012	2013	2014
Non-managed broadleaf forests	2 672.7	2 753.4	2 785.7	2 835.8
Non-managed coniferous forests	6 449.1	6 394.1	6 377.9	6 341.6

## 8. Recalculations and Improvements

In 2015 recalculations of data from 1990 have been completed – therefore completeness and consistency of emission inventory have been much improved. Emission inventory of air pollutants - though generally complete - still needs improvements of the elements described below in paragraph 8.2.

### 8.1 Recalculations

In 2015 update of energy data from 1990 has been performed which changed inventory data for combustion processes for the whole trend 1990-2013.

Volumes of emissions reported under the Directive 2001/81/EC of the European Parliament and the Council on National Emissions Ceilings (NECD) in December 2015 slightly differ from the data submitted to the LRTAP Convention in February 2016 due to corrections of statistical activity data - therefore NECD report will be updated in March 2016.

As compared to the previous CLRTAP submissions there has been some methodology changes introduced into the Polish emission inventory of air pollutants.

1990-1994 data (activities; emissions) has been recalculated to ensure consistent 1990-2014 trend. Due to the lack of direct statistical data for historical years some activity data were approximated based on interpolated data or those available for other years and may be subject to recalculation.

The major improvements of the inventory are enumerated below:

#### General improvements

Current LRTAP emission inventory is submitted according to new NFR-2014 classification. Activity data are listed in reporting sheets for the whole trend (1990-2014).

For the first time in 2016 there will be submitted:  
emission data for Large Point Sources (LPS) on an individual basis  
gridded emission data (in the 0.1° x 0.1° format)  
based on data reported to the National Database.

#### Sectoral improvements for NFR 1 “Energy” - activities:

- NFR 1A2b (Non ferrous metals production)

Total of secondary copper production was determined using official statistics on:  
- self consumption (Central Statistical Office, Materials Management, ISSN 1506-6886);  
- copper from converters (Central Statistical Office, Production of Industrial Products);  
- copper melted from other furnaces (Central Statistical Office, Production of Industrial Products).

- NFR 1B2aiv (Refineries)

Refineries’ input derived from the National Database.

Sectoral improvements for NFR 1 “Energy” - methodology:

- NFR 1A3ei (Pipeline transport)

NO<sub>x</sub>, SO<sub>x</sub> and TSP: data on emissions from gas turbines (pumping stations) derived from the National Database.

- NFR 1A4bi (Residential: Stationary)

Estimation based on study: Hlawiczka et al. (2003), with assumption only  $\kappa = 0.52$  (52%) of Hg concentrated in coal is released directly to air.

Sectoral improvements for NFR 2 “Industrial processes and product use” - activities:

- NFR 2A3 (Glass production)

Activities for container glass and glass for domestic purposes: derived from the National Database.

Sectoral improvements for NFR 5 “Waste” - activities:

- NFR 5C1a (Municipal waste incineration)

Data derived from Central Waste System (CWS) - waste of code 20 (according to ‘Polish waste catalogue’).

- NFR 5C1biii (Clinical waste incineration)

Data derived from CWS - waste of code 18.

- NFR 5A (Solid waste disposal on land)

Data derived from Central Statistical Office; consistent with GHG data.

## **8.2 Planned improvements**

Even after performed recalculations there is still scope for inventory improvement; planned programme of improvement is focused on the following tasks:

- verification of NMVOC emissions from the solvents use,
- gathering additional activity data to include new emission sources (eg. Venting and flaring),
- further methodology development by applying higher tier of estimation methodology, especially for key categories.

## 9. Projections

Description by source sector of general methods, data sources and assumptions used for previously estimated emissions and activity data for 2010 have been included in the Report on the Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants (NEC), submitted in December 2010.

In 2012 reported projections for 2010 has been substituted by 2010 data, following EU recommendation that the latter fulfill also, de facto, the 2010 emission projections reporting requirements.

In the course of Gothenburg Protocol revision negotiations the emission levels for some air pollutants emissions (through emission reductions) have been set for 2020 in Poland (as in the table 9.1 below).

Future projections and reduction measures taken will take these emission levels into account.

Table 9.1. 2005 emission levels and national emission reduction commitments in 2020 and beyond for Poland

SO <sub>2</sub>		NO <sub>x</sub>		NH <sub>3</sub>		VOC		PM2.5	
Emission levels 2005 *	Reduction from 2005 level	Emission levels 2005 *	Reduction from 2005 level	Emission levels 2005 *	Reduction from 2005 level	Emission levels 2005 *	Reduction from 2005 level	Emission levels 2005 *	Reduction from 2005 level
Gg	%	Gg	%	Gg	%	Gg	%	Gg	%
1,224	59	866	30	270	1	593	25	133	16

\* as reported in 2012

## 10. Gridded emissions

Due to steps undertaken to develop estimates in the new EMEP grid resolution in 2016 for the first time there will be submitted gridded emission data (in the new 0.1° x 0.1° format) based on individual data reported to the National Database.



## Abbreviations

ARE	Energy Market Agency
CEPMEIP	Coordinated European Programme on Particulate Matter Emission Inventories
CORINAIR	EMEP/CORINAIR Emission Inventory Guidebook
EIU	Emission Inventory Unit (of KOBiZE)
EMEP/LRTAP	European Monitoring and Evaluation Programme under the Convention on Long-range Transboundary Air Pollution
EPA	U.S. Environmental Protection Agency
EU	European Union
EUROSTAT	EUROSTAT database
GUS	Central Statistical Office (CSO)
HCB	Hexachlorobenzene
HM	Heavy metals
IChPW	Institute for Chemical Processing of Coal
IETU	Institute of Ecology of Industrial Areas in Katowice
IMUZ	Institute for Land Reclamation and Grassland Farming
IOS	Institute of Environmental Protection - National Research Institute
ITS	Motor Transport Institute in Warsaw
KOBiZE	National Centre for Emissions Management
MoE	Ministry of the Environment
NED	National Database of Emissions
NCEM	National Centre for Emissions Management
NFR	Nomenclature for Reporting
NH <sub>3</sub>	Ammonia
NM VOC	Non-methane volatile organic compounds
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Nitrogen oxides
OECD	Organization for Economic Cooperation and Development
PAHs	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyl
PCDD/F	Dioxins and furans
PM <sub>10</sub>	particulate matter - particles of 10 µm or less in aerodynamic diameter
PM <sub>2.5</sub>	particulate matter - particles of 2.5 µm or less in aerodynamic diameter
POP	Persistent organic pollutants
SNAP	Selected nomenclature for air pollution
SO <sub>2</sub>	Sulphur dioxide
TSP	Total suspended particulates
UN ECE	United Nations Economic Commission for Europe

## References

1. EMEP/EEA (2009): EMEP/EEA Emission Inventory Guidebook, European Environment Agency, Copenhagen 2009; 2013.
2. GUS (2015a): Energy statistics 2013, 2014. GUS. Warsaw, 2015.
3. GUS (2015b): Municipal infrastructure in 2014. GUS. Warsaw, 2015.
4. GUS (2015c): Environment 2013. GUS. Warsaw, 2015.
5. GUS (2015d): Transport in 2013. GUS, Warsaw, 2015.
6. GUS (2015e): Production of industrial products. GUS. Warsaw, 2015.
7. GUS (2015f): Statistical Yearbook of Industry. GUS. Warsaw, 2015.
8. GUS (2015g): Statistical Yearbook of The Republic of Poland 2015. GUS, Warsaw, 2015.
9. GUS (2015h): Materials management in 2013. GUS. Warsaw, 2015.
10. GUS (2015i): Production of agricultural and horticultural crops in 2014 r. Source materials. GUS, Warsaw, 2015.
11. GUS (2015j): Livestock in 2014. GUS. Warsaw, 2015.
12. GUS (2013): Results of Agricultural Census. GUS. Warsaw, 2013.
13. ARE (2014). Emitter. Emission of pollutants from public power plants. Energy Market Agency, Warsaw 2014.
14. CEPMEIP. Antoon Visschedijk et al. Coordinated European Programme on Particulate Matter Emission Inventories (CEPMEIP); <http://www.air.sk/tno/cepmeip/>
15. Czarnomski (2009). Czarnomski K., Izak E.: Prowadzenie zbiorczych danych dla kraju dotyczących urządzeń z PCB (the inventory of equipments containing PCBs), Institute of Environmental Protection, 2009
16. Grochowalski A.(2002): Estimation and analysis of emission factors of PCDD/F and PAH from selected sources for the national emission inventory purpose.
17. Grześkowiak A. 2001. Trends in mineral fertilizers selection. (in Polish) Zakłady Chemiczne Police SA. <http://www.ppr.pl/artukul.php?id=2905>.
18. Hławiczka S.: “Updating of emission factors used in national inventory heavy metals emission and comparison with emission factors from other European countries for LRTAP Convention”, IETU, Katowice 2001.
19. Taubert S.: “Balance of fuels for road transport in 2009-2010”, Motor Transport Institute (ITS), Warsaw 2011.
20. Report on measurements and estimation of concentration of PCDD/PCDFs, PCBs and HCB, Cracow University of Technology, Kraków 2002.
21. UNEP Chemicals (2003): Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, Geneva 2003.
22. Pietrzak S.: Inventory methodology for ammonia emissions from agriculture sources in Poland and its practical use. (in Polish) Woda – Środowisko – Obszary Wiejskie. IMUZ Institute for Land Reclamation and Grassland Farming, 2006: t.6 z.1 (16), pp. 319-334.
23. Wielgoński G. (2009). Information on waste incinerated in Poland in 2008, Łódź, 2009.
24. “Update of NMVOC and heavy metals LRTAP emissions inventory in 2008-2009”. IETU, Katowice 2001.
25. Database of Central Waste Management System. Ministry of the Environment 2014.

26. Survey of PGE Polish Energy Group (Polska Grupa Energetyczna S.A.) and KOBIZE on mercury emission factors from combustion installations. 2012.
27. National Database. Institute of Environmental Protection-National Research Institute IOŚ-PIB, KOBiZE, 2014.
28. Kristin Aasestad (ed.):The Norwegian Emission Inventory 2007. Documentation of methodologies for estimating emissions of greenhouse gases and long-range transboundary air pollutants. Statistics Norway. Oslo–Kongsvinger, 2007. ISBN 978-82-537-7262-2 Elektronisk versjon.
29. Jadczyż T., Maćkowiak Cz., Kopiński J. (2000). Model SFOM – a tool for simulating quantity and quality of organic fertilizers produced at the farm (in Polish, English description of tables and figures). Pam. Puł. Z. 120/I s. 168-175.
30. UNECE 2001. UNECE Framework code for good agricultural practice for reducing ammonia. EB.AIR/WG.5/2001/7 published 17 July 2001.
31. Kubica K. and Kubica R. (2014). Oszacowanie trendu wskaźników emisji TSP oraz PM10 i PM2.5 ze spalania paliw stałych w sektorach mieszkalnictwa i usług w latach 2000-2013 (in Polish). Katowice 2014.
32. Fire statistics: National Headquarters of the State Fire Service of Poland <http://www.straz.gov.pl/page/index.php?str=2379>
33. Atmoterm IŚ 2009. PRTR methodological guidelines for installations of intensive poultry breeding and husbandry (in Polish). Atmoterm Inżynieria Środowiska Sp. z o.o. Warszawa, 2009
34. I. Bojakowska, 2009. Cadmium in mineral resources of Poland and its potential emission in the environment. Ochrona Środowiska i Zasobów Naturalnych 40 (2009) 22-30, [http://www.ios.edu.pl/pol/pliki/nr40/nr40\\_2.pdf](http://www.ios.edu.pl/pol/pliki/nr40/nr40_2.pdf) [in Polish, with English abstract].
35. S. Hławiczka, K. Kubica and U. Zielonka, 2003. Partitioning factor of mercury during coal combustion in low capacity domestic heating units The Science of the Total Environment 312 (2003) 261–265, [http://dx.doi.org/10.1016/S0048-9697\(03\)00252-3](http://dx.doi.org/10.1016/S0048-9697(03)00252-3)
36. ITS (2001). Preparation of database regarding to emissions of pollutants introduced to the atmosphere from transport in 2000. Motor Transport Institute. Warszawa, 2001.
37. ITS (2014). Estimation of road transport emissions in 2013. Motor Transport Institute. Warszawa 2014

## Appendix 1. Activity data - fuels consumption in NFR 1 A

Table A1.1. Fuel consumption [PJ] in 1.A.1.a category - Public power SNAP0101

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	908.174	879.953	855.928	842.875	859.577	899.258	934.573	921.518	892.435	885.198	907.060	900.562
Lignite	550.804	557.422	545.139	548.823	537.834	528.123	531.967	529.899	534.764	520.692	504.805	511.871
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas	0.270	0.268	0.279	0.276	0.257	0.333	1.733	1.803	2.082	5.949	10.399	14.430
Fuel wood and wood waste	0.006		0.004	0.008	0.011	0.003	1.162	1.150	1.384	1.259	1.301	1.217
Biogas						0.001	0.011	0.028	0.023	0.022	0.027	0.012
Industrial wastes	0.167	1.477	1.173	0.507	0.248	0.468	0.155	0.229			0.511	0.653
Municipal waste - non-biogenic fraction											0.004	
Municipal waste – biogenic fraction											0.004	0.001
Other petroleum products											0.040	
Petroleum coke												
Coke	0.086	0.142	0.114	0.256	0.684	0.627	0.114	0.057	0.057	0.028	0.028	0.028
Liquid petroleum gas (LPG)									0.046			
Motor gasoline	0.045	0.045	0.045	0.090	0.179	0.134		0.045	0.045	0.045	0.045	0.045
Jet kerosene												
Diesel oil												
Fuel oil	0.430	0.472	0.472	0.472	0.773	0.944	0.558	0.516	0.387	0.473	0.600	0.514
Light fuel oil	7.040	7.360	6.280	6.400	7.240	6.680	6.840	7.320	7.640	7.400	7.120	7.040
Feedstocks												
Refinery gas												
Petroleum coke oven gas	0.008	0.006	0.001		0.239	2.614	5.571	7.186	8.841	9.255	9.354	9.448
Blast furnace gas												
Gas works gas		0.005							0.219	0.082	0.011	0.028

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	879.153	917.776	930.264	917.143	970.093	911.353	845.778	776.249	879.153	917.776	930.264	917.143	970.093
Lignite	494.449	518.326	514.306	533.690	525.529	518.202	539.384	513.090	494.449	518.326	514.306	533.690	525.529
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	22.928	28.959	36.403	40.048	36.167	41.348	31.498	29.214	22.928	28.959	36.403	40.048	36.167
Fuel wood and wood waste	1.134	2.008	3.841	9.643	13.440	65.643	73.215	84.159	1.134	2.008	3.841	9.643	13.440
Biogas	0.018	0.018	0.073	0.033	0.033				0.018	0.018	0.073	0.033	0.033
Industrial wastes	1.210	0.017	0.004					0.001	0.001	1.210	0.017	0.004	
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction							0.099						
Other petroleum products							0.030						
Petroleum coke													
Coke								0.001					
Liquid petroleum gas (LPG)								0.002					
Motor gasoline	0.045							0.015	0.045				
Jet kerosene													
Diesel oil													
Fuel oil	0.686	0.558	0.386	0.429	0.472	1.517	0.779	0.755	0.686	0.558	0.386	0.429	0.472
Light fuel oil	6.680	6.400	6.640	6.200	6.000	6.160	5.200	4.222	6.680	6.400	6.640	6.200	6.000
Feedstocks													
Refinery gas													
Petroleum coke oven gas	8.508	9.199	8.929	7.637	9.424	11.001	11.696	10.448	8.508	9.199	8.929	7.637	9.424
Blast furnace gas						9.166	8.689	11.257					
Gas works gas	0.021					4.772	4.955	4.271	0.021				

Table A1.2. Fuel consumption [PJ] in 1.A.1.a category - District heating plants SNAP0102

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	385.339	403.578	372.244	250.756	214.596	230.966	259.833	227.883	198.459	177.661	155.463	171.164
Lignite	3.352	2.820	2.480	0.848	0.348	0.584	0.610	0.475	0.394	0.347	0.337	0.357
Hard coal briquettes (patent fuels)	2.520	0.322	0.117	0.059	0.059			0.059				
Brown coal briquettes	0.140	0.060	0.200									
Crude oil												
Natural gas	18.676	13.989	7.672	0.824	1.221	2.098	3.636	5.225	6.684	8.062	9.104	11.269
Fuel wood and wood waste	4.163	3.279	4.224	0.460	0.302	0.398	0.278	0.647	0.503	0.528	0.535	0.647
Biogas	0.014	0.003	0.024		0.006	0.008	0.007	0.007	0.035	0.049	0.047	0.031
Industrial wastes	0.093	0.059	0.294	0.050	0.226	0.164	0.095	0.136	0.283	0.308	0.005	0.007
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke	12.626	12.939	10.944	8.864	7.524	7.239	6.954	5.301	4.076	2.850	1.995	1.710
Liquid petroleum gas (LPG)								0.046	0.184	0.230	0.184	0.184
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil	0.343	0.343	0.300	0.214	0.172	0.214	1.072	1.459	1.416	1.416	1.716	1.802
Light fuel oil	14.880	14.560	11.640	9.040	8.040	9.080	11.400	9.160	7.480	6.200	4.400	5.720
Feedstocks												
Refinery gas												
Petroleum coke oven gas	1.825	1.966	1.708	0.429	0.909	0.907	0.889	0.897	0.881	0.914	0.965	1.066
Blast furnace gas	2.461	1.627	1.271	0.140	0.167	0.051	0.242	0.404	0.458	0.250	0.174	0.072
Gas works gas	0.167	0.129	0.335	0.085	0.037	0.021	0.004	0.002	0.002	0.002	0.035	0.020

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	153.122	149.953	132.096	127.145	125.967	112.522	115.726	108.302	153.122	149.953	132.096	127.145	125.967
Lignite	0.310	0.301	0.290	0.289	0.289	0.259	0.301	0.350	0.310	0.301	0.290	0.289	0.289
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	12.306	12.532	13.067	12.282	12.435	10.174	10.768	8.150	12.306	12.532	13.067	12.282	12.435
Fuel wood and wood waste	0.805	1.056	1.470	1.665	1.796	1.772	1.995	1.712	0.805	1.056	1.470	1.665	1.796
Biogas	0.006	0.020		0.001	0.002	0.016	0.015	0.014	0.006	0.020		0.001	0.002
Industrial wastes	0.014	0.063	0.056	0.008	0.024	0.114	0.089	0.093	0.014	0.063	0.056	0.008	0.024
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction								0.016					
Other petroleum products						0.030							
Petroleum coke													
Coke	1.197	0.912	0.598	0.342	0.171	0.028	0.028	0.017	1.197	0.912	0.598	0.342	0.171
Liquid petroleum gas (LPG)	0.184	0.046						0.002	0.184	0.046			
Motor gasoline													
Jet kerosene													
Diesel oil													
Fuel oil	1.888	1.759	1.330	1.072	1.030	0.390	0.433	0.444	1.888	1.759	1.330	1.072	1.030
Light fuel oil	4.800	4.240	1.720	1.080	1.040	0.640	0.320	0.286	4.800	4.240	1.720	1.080	1.040
Feedstocks													
Refinery gas													
Petroleum coke oven gas	0.780	1.025	1.072	1.167	1.143	0.478	0.398	0.358	0.780	1.025	1.072	1.167	1.143
Blast furnace gas			0.017	0.005							0.017	0.005	
Gas works gas		0.003	0.015	0.014	0.008	0.025	0.060	0.011		0.003	0.015	0.014	0.008

Table A1.3. Fuel consumption [PJ] in 1.A.1.a category – Industrial power SNAP0301

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	310.328	293.377	279.161	273.625	247.872	80.485	76.263	74.315	67.850	65.730	57.975	58.314
Lignite	1.431	1.260	1.004	1.089	1.095	0.417	0.500	0.296	0.082	0.039	0.019	
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas	2.705	2.087	1.639	2.081	2.733	2.537	1.860	1.034	2.070	2.271	2.187	2.709
Fuel wood and wood waste	10.408	11.105	13.041	13.323	13.749	0.924	1.219	1.499	1.789	1.614	1.628	3.058
Biogas						0.117	0.130	0.081	0.169	0.300	0.396	0.532
Industrial wastes	5.005	7.378	5.887	6.103	6.404	3.246	3.144	2.902	0.267	0.267	0.375	0.379
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke		0.028										
Liquid petroleum gas (LPG)												
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil	0.129	0.129	0.129	0.086	0.129	0.043		0.086	0.043	0.043	0.043	0.043
Light fuel oil	43.480	39.400	38.560	4	40.560	10.200	9.640	10.880	3.000	3.280	2.400	2.000
Feedstocks												
Refinery gas	0.990	0.742	0.644	0.842	1.238	0.050						
Petroleum coke oven gas	5.296	5.586	7.154	7.715	11.999	9.309	7.515	8.367	3.975	5.908	6.779	6.710
Blast furnace gas	19.916	11.170	12.107	10.099	13.023	5.854	2.976	2.902	2.602	3.036	4.143	4.904
Gas works gas									3.041	2.425	2.344	2.290

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	61.537	79.319	62.109	65.294	65.685	31.253	32.262	31.910	61.537	79.319	62.109	65.294	65.685
Lignite													
Hard coal briquettes (patent fuels)	0.029								0.029				
Brown coal briquettes													
Crude oil													
Natural gas	3.804	4.658	4.687	4.873	4.355	6.648	11.152	9.476	3.804	4.658	4.687	4.873	4.355
Fuel wood and wood waste	2.878	2.742	3.598	6.194	5.954	11.297	12.462	11.118	2.878	2.742	3.598	6.194	5.954
Biogas	0.609	0.823	1.236	1.798	2.001	3.312	4.872	5.718	0.609	0.823	1.236	1.798	2.001
Industrial wastes	0.301	0.305	0.347	0.475	0.403	0.344	0.292	0.377	0.301	0.305	0.347	0.475	0.403
Municipal waste - non-biogenic fraction						0.403	0.337	0.208					
Municipal waste – biogenic fraction													
Other petroleum products													
Petroleum coke													
Coke	0.057								0.057				
Liquid petroleum gas (LPG)								0.002					
Motor gasoline													
Jet kerosene													
Diesel oil													
Fuel oil	0.043	0.086	0.043					0.054	0.043	0.086	0.043		
Light fuel oil	2.080	1.520	1.840	1.080	0.960	0.240	0.080	7.038	2.080	1.520	1.840	1.080	0.960
Feedstocks													
Refinery gas								1.290					
Petroleum coke oven gas	7.160	7.821	6.982	5.573	7.758	5.164	5.776	5.207	7.160	7.821	6.982	5.573	7.758
Blast furnace gas	4.783	5.715	6.648	4.141	8.323	1.835	3.040	2.680	4.783	5.715	6.648	4.141	8.323
Gas works gas	3.088	2.589	3.616	4.722	4.770	0.560	0.292	0.281	3.088	2.589	3.616	4.722	4.770

Table A1.4. Fuel consumption [PJ] in 1.A.1.b category - Petroleum refining SNAP0103

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	0.046	0.090	0.069	0.245	0.068	1.302	1.451	1.349	0.629	0.586	0.208	0.070
Lignite												
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas	1.671	1.539	1.508	1.608	1.591	1.562	1.749	2.529	8.244	10.832	12.110	11.354
Fuel wood and wood waste												
Biogas												
Industrial wastes	5.222	0.272	0.682	0.002	0.259	1.919	0.350	0.163		0.310	0.219	0.095
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products							0.520	1.080	0.880	1.720		0.040
Petroleum coke												
Coke		0.028										
Liquid petroleum gas (LPG)								0.046	0.092	0.184	0.276	
Motor gasoline										0.090	0.135	
Jet kerosene												
Diesel oil												
Fuel oil	0.043	0.043		0.086	0.086	0.172	0.172	0.214	0.343	0.086	1.373	0.386
Light fuel oil	11.440	10.560	15.760	12.800	11.960	32.400	40.520	32.200	39.840	35.080	36.160	42.280
Feedstocks												
Refinery gas	7.474	7.623	8.514	9.256	10.444	12.028	8.960	10.197	6.286	6.386	9.058	10.444
Petroleum coke oven gas									0.081	0.051	0.069	0.070
Blast furnace gas												
Gas works gas												

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	0.023					0.091	0.113	0.180	0.023				
Lignite						0.050	0.063	0.016					
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	10.124	12.770	15.454	14.482	14.900	27.399	34.779	31.592	10.124	12.770	15.454	14.482	14.900
Fuel wood and wood waste													
Biogas													
Industrial wastes	0.253	0.176	0.221	0.285	0.224			0.001	0.253	0.176	0.221	0.285	0.224
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products	0.040	0.040	0.360	0.320	0.440	0.600	0.992	1.217	0.040	0.040	0.360	0.320	0.440
Petroleum coke													
Coke													
Liquid petroleum gas (LPG)	0.046	0.092				0.092	0.092	0.166	0.046	0.092			
Motor gasoline		0.135						0.002		0.135			
Jet kerosene													
Diesel oil				0.043								0.043	
Fuel oil	0.858	0.343	0.987	0.300	0.729	0.173	0.043	0.029	0.858	0.343	0.987	0.300	0.729
Light fuel oil	42.560	43.520	42.880	42.560	41.720	39.280	22.200	14.699	42.560	43.520	42.880	42.560	41.720
Feedstocks													
Refinery gas	10.048	10.048	11.632	10.692	12.969	21.532	20.988	14.132	10.048	10.048	11.632	10.692	12.969
Petroleum coke oven gas													
Blast furnace gas													
Gas works gas													

Table A1.5. Fuel consumption [PJ] in 1.A.1.c category - Manufacture of solid fuels SNAP0104

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	0.091	0.068	0.046	0.803	2.156	1.302	1.705	0.280	0.070	0.023		
Lignite												
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas			0.181	0.269	0.462	0.518	0.398	0.570	0.744	0.540	0.424	0.253
Fuel wood and wood waste												
Biogas												
Industrial wastes					0.233	0.184	0.126	0.138				
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke	0.448	0.280	0.028	0.086	0.456	0.170	0.398	0.056				
Liquid petroleum gas (LPG)	0.092	0.092	0.092	0.046	0.046	0.046	0.046					
Motor gasoline				0.045	0.090	0.090	0.045	0.045				
Jet kerosene												
Diesel oil												
Fuel oil			0.043	1.158	1.158	0.858	0.815	0.686	0.343	0.043	0.086	
Light fuel oil												
Feedstocks												
Refinery gas												
Petroleum coke oven gas	43.553	38.485	39.121	34.084	40.237	36.851	34.676	36.572	33.476	29.642	32.403	32.647
Blast furnace gas	3.961	1.995	1.430	2.123	2.488	1.954	1.582	1.893	1.695	0.847	0.840	0.149
Gas works gas	0.005	0.047	0.010	0.004		0.006	0.036	0.019	0.165	0.166	0.004	0.004

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	0.047	0.070	0.046		0.024	1.919	1.529	1.905	0.047	0.070	0.046		0.024
Lignite								0.004					
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	0.065	0.010				0.003	0.003	1.951	0.065	0.010			
Fuel wood and wood waste													
Biogas													
Industrial wastes						0.009							
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products													
Petroleum coke													
Coke		0.114	0.057	0.028		0.057		0.001		0.114	0.057	0.028	
Liquid petroleum gas (LPG)													
Motor gasoline													
Jet kerosene													
Diesel oil													
Fuel oil								0.002					
Light fuel oil													
Feedstocks													
Refinery gas													
Petroleum coke oven gas	31.702	35.822	36.156	32.637	36.291	41.007	40.094	36.159	31.702	35.822	36.156	32.637	36.291
Blast furnace gas	0.086	0.021	0.030	0.042	0.045				0.086	0.021	0.030	0.042	0.045
Gas works gas	0.004	0.004	0.004	0.003	0.004	0.128	0.110	0.098	0.004	0.004	0.004	0.003	0.004



Table A1.6. Fuel consumption [PJ] in 1.A.1.c category - other energy industries (coal-mines) SNAP0105

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	3.734	5.380	3.355	20.145	50.782	51.744	54.960	53.298	50.142	42.346	32.313	29.904
Lignite	0.078	0.132	0.073	0.313	0.303	0.336	0.370	0.324	0.286	0.276	0.258	0.298
Hard coal briquettes (patent fuels)	0.029											
Brown coal briquettes	0.020	0.020		0.040	0.020	0.020	0.040	0.040	0.020	0.020	0.020	
Crude oil							0.080	0.082	0.083	0.083	0.041	
Natural gas	12.360	12.416	14.456	12.010	16.822	14.102	22.798	20.471	16.966	18.847	19.004	12.567
Fuel wood and wood waste											0.003	0.003
Biogas												
Industrial wastes				0.309			0.031				0.002	
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products							0.080	0.080	0.040	0.080	0.040	
Petroleum coke												
Coke	0.086	0.114	0.142	0.171	0.086	0.086	0.086	0.028	0.028		0.142	
Liquid petroleum gas (LPG)										0.046		
Motor gasoline	0.045	0.045	0.045	0.045	0.045	0.045	0.045					
Jet kerosene												
Diesel oil												
Fuel oil	1.544	1.802	1.888	2.917	1.716	2.059	1.973	1.759	1.587	1.415	1.330	1.287
Light fuel oil					0.040	0.040						
Feedstocks												
Refinery gas												
Petroleum coke oven gas				0.520	0.252	0.184	0.429	0.428	0.233	0.230	0.228	0.320
Blast furnace gas												
Gas works gas		0.128		0.116			0.025					

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	14.897	17.269	11.508	8.668	7.751	2.410	0.587	0.717	14.897	17.269	11.508	8.668	7.751
Lignite	0.279	0.248	0.220	0.175	0.204	0.222	0.221	0.203	0.279	0.248	0.220	0.175	0.204
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil	0.041	0.128	0.126					0.004	0.041	0.128	0.126		
Natural gas	12.113	9.078	10.699	9.942	10.213	9.664	11.987	9.536	12.113	9.078	10.699	9.942	10.213
Fuel wood and wood waste	0.021	0.001			0.001	0.039	0.045	0.039	0.021	0.001			0.001
Biogas													
Industrial wastes						0.001	0.001						
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction							0.099						
Other petroleum products	0.040	0.040	0.040	0.080	0.040	0.030	0.032	0.016	0.040	0.040	0.040	0.080	0.040
Petroleum coke													
Coke								0.001					
Liquid petroleum gas (LPG)					0.046			0.010					0.046
Motor gasoline								0.009					
Jet kerosene													
Diesel oil								0.001					
Fuel oil	0.944	1.029	0.901	1.030	0.944	1.212	1.516	1.137	0.944	1.029	0.901	1.030	0.944
Light fuel oil													
Feedstocks													
Refinery gas													
Petroleum coke oven gas	0.298	0.260	0.226	0.155	0.116	0.144	0.123	0.107	0.298	0.260	0.226	0.155	0.116
Blast furnace gas													
Gas works gas													

Table A1.7. Fuel consumption [PJ] in 1.A.2.a category - Stationary combustion in manufacturing industries :  
Iron and steel

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	1.138	1.243	1.494	9.159	8.513	25.320	28.922	23.636	21.085	19.074	18.262	14.701
Lignite		0.019						0.009				
Hard coal briquettes (patent fuels)												0.029
Brown coal briquettes												
Crude oil												
Natural gas	52.851	33.974	26.568	25.562	25.487	24.239	25.898	28.278	23.993	21.440	22.024	18.328
Fuel wood and wood waste				0.016	0.014	0.005	0.006	0.004	0.006	0.004	0.003	0.006
Biogas												
Industrial wastes	4.079	6.756	6.497	4.272	3.757	2.941	0.498					
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke	106.132	87.229	89.783	86.616	99.734	95.330	83.317	91.007	69.691	60.019	77.048	64.276
Liquid petroleum gas (LPG)								0.046		0.046	0.184	0.184
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil	0.172	0.129	0.172	0.343	0.558	0.772	0.901	0.558	0.300	0.343	0.515	0.172
Light fuel oil	11.000	7.800	5.280	4.280	2.960	2.040	0.960	4.720	1.600	1.800	1.040	0.640
Feedstocks												
Refinery gas												
Petroleum coke oven gas	26.038	22.090	22.568	21.604	25.480	27.686	24.404	24.257	24.742	15.875	17.574	16.994
Blast furnace gas	36.484	27.903	25.909	25.676	28.350	37.610	34.205	36.120	29.520	24.034	31.874	26.768
Gas works gas	2.174	1.462	0.718	0.613	0.067	0.068	0.080	0.058	0.007	0.008		0.277

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	12.424	12.593	17.281	11.379	9.636	12.296	4.360	5.482	4.003	4.871	8.276	6.177	2.508
Lignite													
Hard coal briquettes (patent fuels)	0.029	0.029			0.029						0.029		0.001
Brown coal briquettes													
Crude oil													
Natural gas	15.463	14.827	19.969	20.460	21.008	22.724	20.401	16.597	16.922	17.209	16.905	16.242	14.487
Fuel wood and wood waste	0.003	0.004	0.004	0.002	0.001	0.001	0.001	0.001				0.001	0.001
Biogas													
Industrial wastes													
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products													0.001
Petroleum coke													0.068
Coke	58.231	63.248	67.122	44.292	49.584	50.680	42.156	23.147	26.849	32.671	32.821	35.660	45.962
Liquid petroleum gas (LPG)	0.230	0.184	0.138				0.046	0.046	0.046	0.046	0.092	0.046	0.043
Motor gasoline													
Jet kerosene													
Diesel oil													0.001
Fuel oil	0.129	0.129	0.129	0.086	0.129	0.086	0.086	0.086	0.086	0.086	0.043	0.043	0.086
Light fuel oil													
Feedstocks													
Refinery gas													
Petroleum coke oven gas	15.122	16.132	15.368	12.643	12.770	13.885	10.059	5.396	8.488	8.420	8.230	8.518	8.113
Blast furnace gas	23.876	25.282	27.109	19.239	20.580	28.624	18.785	10.160	12.220	11.258	11.352	10.797	11.863
Gas works gas	0.706	1.195	1.654	0.965	1.015	1.313	0.993	0.474	0.187	0.203	0.047	0.028	0.089

Table A1.8. Fuel consumption [PJ] in 1.A.2.b category - Stationary combustion in manufacturing industries :  
Non-Ferrous Metals

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	0.455	0.565	0.850	1.916	1.771	4.172	4.285	3.907	3.331	3.117	3.108	3.790
Lignite												
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas	4.599	4.633	1.213	1.745	5.321	5.447	5.108	5.424	5.638	5.660	5.814	5.700
Fuel wood and wood waste				0.001	0.001		0.149	0.042	0.026	0.010	0.011	0.005
Biogas												
Industrial wastes	0.439	0.483	0.514	0.729	0.823	2.150	2.411	2.361				
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke	6.014	5.216	2.280	2.793	6.412	6.327	6.612	6.584	6.384	5.928	6.070	6.156
Liquid petroleum gas (LPG)							0.046				0.046	0.092
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil	0.043	0.043	0.129	0.086	0.129	0.172	0.214	0.214	0.257	0.172	0.257	0.172
Light fuel oil	0.760	0.800	0.800	0.760	0.800	0.720	0.680	0.640	0.520	0.560	0.560	0.520
Feedstocks												
Refinery gas												
Petroleum coke oven gas	0.397	0.178	0.186	0.043								
Blast furnace gas												
Gas works gas	0.042	0.006							2.164	2.070	2.268	2.551

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	2.560	2.115	1.092	0.024	0.024	0.570				0.250	0.114	0.113	0.108
Lignite													
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	5.589	5.868	6.405	6.468	6.884	6.743	6.542	5.852	6.048	6.670	6.890	6.703	6.254
Fuel wood and wood waste	0.001												
Biogas													
Industrial wastes													
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products			0.040										
Petroleum coke													
Coke	6.156	5.928	5.956	5.814	6.042	6.441	6.640	6.270	6.042	6.214	6.384	6.270	6.449
Liquid petroleum gas (LPG)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.046			0.014
Motor gasoline													
Jet kerosene													
Diesel oil													0.002
Fuel oil	0.172	0.129	0.172	0.172	0.172	0.172	0.172	0.173	0.216	0.173	0.173	0.173	0.171
Light fuel oil	0.400	0.320	0.400	0.400	0.400	0.160	0.160	0.160	0.120	0.120	0.120	0.120	0.083
Feedstocks													
Refinery gas													
Petroleum coke oven gas										0.039	0.043	0.039	0.046
Blast furnace gas													
Gas works gas	2.739	2.539	1.800	1.003	1.004	0.982	1.252	1.119	0.994	0.967	0.928	1.066	1.148

Table A1.9. Fuel consumption [PJ] in 1.A.2.c category - Stationary combustion in manufacturing industries :  
Chemicals

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	7.216	6.623	4.550	13.125	7.945	70.221	71.191	63.913	54.992	50.522	50.115	48.485
Lignite	0.039	0.038	0.027	0.047	0.029	0.428	0.460	0.389	0.429	0.138		
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas	5.289	4.340	4.432	10.075	4.507	6.356	6.191	11.024	9.408	9.041	9.464	8.481
Fuel wood and wood waste	0.118	0.039	0.010	0.003	0.035	0.007						
Biogas									0.001			
Industrial wastes	16.712	18.586	17.039	18.003	22.591	21.546	17.374	14.356	0.672	0.582	0.607	0.618
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products							2.600	2.880	3.440	2.520	0.480	0.480
Petroleum coke												
Coke	2.679	1.966	1.852	1.881	1.938	3.477	2.964	1.454	1.539	1.624	1.596	1.710
Liquid petroleum gas (LPG)				0.046								
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil	0.987	0.858	0.772	0.729	0.729	0.944	1.072	1.072	1.416	1.330	1.030	4.762
Light fuel oil	2.720	1.880	2.760	2.480	3.600	8.160	9.320	9.360	17.560	15.680	13.520	7.360
Feedstocks												
Refinery gas	0.396	3.465	5.445	4.455	0.198	1.584	6.584	9.652	18.513	19.602	23.314	20.542
Petroleum coke oven gas	0.701	0.522	0.440	1.548	0.276	0.729	0.784	0.140	0.174	0.130	0.050	0.150
Blast furnace gas	0.047	0.010	0.006	0.011	0.014	0.023	0.004	0.013	0.004	0.007	0.011	0.008
Gas works gas	0.214	0.192	0.133	0.126	0.110	0.070	0.052					

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	45.458	27.959	28.709	30.107	27.683	28.785	46.079	44.061	49.706	47.704	46.768	46.835	42.882
Lignite													
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	7.199	6.457	7.498	8.104	9.053	8.771	8.037	9.762	12.043	13.887	13.568	14.696	13.050
Fuel wood and wood waste	0.001	0.153	0.102	0.165		0.121		0.058	0.058	0.053	0.131	0.050	0.103
Biogas													0.008
Industrial wastes	0.567	0.875	1.122	0.628	0.721	0.761	0.518	0.621	0.777	0.732	0.581	1.092	1.082
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products	0.280	0.240		0.040	0.040								
Petroleum coke													
Coke	1.738	1.568	1.881	1.454	2.964	1.938	1.168	0.884	0.826	1.340	3.164	3.021	2.926
Liquid petroleum gas (LPG)								0.092	0.138	0.138	0.138	0.184	5.485
Motor gasoline								0.090		0.045	0.045	0.045	0.015
Jet kerosene													
Diesel oil													
Fuel oil	4.247	4.333	3.904	3.775	4.076	3.732	3.689	4.590	4.200	3.637	3.334	4.027	2.434
Light fuel oil	7.640	7.080	7.320	3.920	3.920	3.600	0.640	1.120	0.640	0.720	0.560	0.440	0.426
Feedstocks													
Refinery gas	20.740	21.830	22.424	18.266	21.334	22.473	19.156	20.889	17.176	15.890	13.414	17.870	10.313
Petroleum coke oven gas	0.285	0.634	0.606	0.608	0.547	0.658	0.654	0.483	0.627	0.616	0.595	0.639	0.581
Blast furnace gas	0.004	0.013	0.019	0.006									
Gas works gas													

Table A1.10. Fuel consumption [PJ] in 1.A.2.d category - Stationary combustion in manufacturing industries : Pulp, Paper and Print

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	1.548	1.741	1.379	4.524	3.836	22.318	22.233	23.979	18.936	17.528	15.696	15.564
Lignite												
Hard coal briquettes (patent fuels)												
Brown coal briquettes												
Crude oil												
Natural gas	0.101	0.061	0.026	0.061	0.250	0.232	0.455	1.096	0.563	1.007	1.210	1.445
Fuel wood and wood waste	0.001			1.585	1.610	15.437	16.243	16.472	16.476	15.545	15.938	15.138
Biogas												
Industrial wastes												
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke	0.256	0.285	0.256	0.314	0.285	0.285	0.256	0.142	0.086		0.028	0.028
Liquid petroleum gas (LPG)	0.046	0.046	0.046	0.046	0.046	0.046	0.046	0.092	0.184	0.092	0.138	0.092
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil	0.043	0.086	0.043	0.043	0.086	0.129	0.601	0.987	1.115	0.815	0.601	0.472
Light fuel oil	1.280	1.200	1.320	1.560	1.400	2.360	1.040	1.040	1.320	1.320	1.360	1.480
Feedstocks												
Refinery gas												
Petroleum coke oven gas	0.003	0.003	0.002	0.003	0.002	0.002	0.001					
Blast furnace gas												
Gas works gas	0.003	0.014	0.002				0.004					

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	14.317	14.050	13.797	13.430	11.592	9.452	7.850	8.515	9.950	11.096	10.643	11.460	11.279
Lignite													
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	1.461	2.094	2.657	2.288	2.976	4.087	4.822	4.834	5.030	4.587	5.535	6.271	6.295
Fuel wood and wood waste	16.622	17.950	18.957	18.611	19.379	18.644	19.729	19.171	19.117	19.402	20.358	27.152	26.987
Biogas								0.018	0.049	0.073	0.083	0.091	0.105
Industrial wastes												0.037	0.125
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products				0.040	0.040								
Petroleum coke													
Coke	0.028	0.057	0.028	0.028	0.028	0.028	0.028		0.028				
Liquid petroleum gas (LPG)	0.046	0.046	0.092	0.046	0.092	0.184	0.046	0.092	0.092	0.092	0.092	0.092	0.107
Motor gasoline		0.090											0.004
Jet kerosene													
Diesel oil													
Fuel oil	0.429	0.472	0.472	0.343	0.386	0.429	0.300	0.303	0.260	0.216	0.173	0.260	0.142
Light fuel oil	1.560	1.600	1.680	1.600	1.600	1.720	1.640	1.600	1.640	1.680	1.520	1.520	1.281
Feedstocks													
Refinery gas													
Petroleum coke oven gas													
Blast furnace gas													
Gas works gas													

Table A1.11. Fuel consumption [PJ] in 1.A.2.e category - Stationary combustion in manufacturing industries : Food Processing, Beverages and Tobacco

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	31.914	35.940	32.724	55.643	53.801	73.024	88.777	78.207	64.659	46.327	43.417	40.020
Lignite	0.058	0.019	0.018	0.369	0.195	0.265	0.380	0.250	0.317	0.237	0.191	0.149
Hard coal briquettes (patent fuels)				0.205	0.205	0.059	0.029					
Brown coal briquettes												0.020
Crude oil												
Natural gas	1.970	1.984	2.339	3.171	7.180	3.839	15.051	12.927	10.694	9.255	10.494	11.363
Fuel wood and wood waste	0.091	0.094	0.072	0.151	0.056	0.082	0.094	0.075	0.101	0.069	0.049	0.062
Biogas									0.003	0.020	0.063	0.042
Industrial wastes			0.031	0.003	0.003						0.001	0.014
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products							0.080	0.080	0.040			
Petroleum coke												
Coke	3.334	2.936	2.650	3.249	2.708	2.565	3.192	2.850	2.080	1.710	1.624	1.368
Liquid petroleum gas (LPG)	0.046	0.046	0.046	0.046	0.092	0.138	0.184	0.184	0.276	0.460	0.690	0.874
Motor gasoline	0.135	0.090	0.135	0.180	0.135	0.180	0.180	0.045	0.090	0.045	0.135	0.045
Jet kerosene												
Diesel oil												
Fuel oil	1.244	1.030	0.901	1.201	1.072	0.901	5.448	5.191	6.821	7.465	7.336	7.250
Light fuel oil	1.640	1.480	1.320	3.280	3.920	6.120	2.720	2.400	2.680	2.280	2.520	2.720
Feedstocks												
Refinery gas												
Petroleum coke oven gas	0.111	0.125	0.124	0.102	0.003	0.025	0.004					
Blast furnace gas												
Gas works gas	0.051	0.014	0.001	0.001			0.003					

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	41.803	39.030	36.095	35.894	30.864	31.165	26.778	25.814	25.907	25.614	26.172	24.724	25.562
Lignite	0.192	0.175	0.129	0.092	0.074								
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	12.490	15.075	16.164	17.456	18.623	20.614	20.725	20.950	21.610	22.128	23.704	24.475	22.584
Fuel wood and wood waste	0.060	0.323	0.373	0.214	0.239	0.164	0.365	0.192	0.441	0.534	0.436	0.664	0.747
Biogas	0.037	0.063	0.074	0.068	0.072	0.084	0.094	0.109	0.101	0.145	0.199	0.202	0.241
Industrial wastes													
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products													
Petroleum coke													
Coke	1.539	1.340	1.226	0.969	0.855	0.912	0.656	0.656	0.627	0.542	0.314	0.370	0.449
Liquid petroleum gas (LPG)	1.426	1.380	1.564	1.426	1.196	0.920	1.012	0.966	0.828	0.782	0.690	0.828	0.953
Motor gasoline	0.090	0.090		0.045	0.045	0.045	0.045	0.045	0.045				0.010
Jet kerosene													
Diesel oil													0.007
Fuel oil	6.864	6.864	6.178	5.405	4.504	4.076	4.504	3.161	2.901	2.382	2.944	1.992	1.526
Light fuel oil	2.960	3.040	3.280	3.160	2.920	2.760	2.000	1.440	1.240	1.360	1.360	1.080	0.996
Feedstocks													
Refinery gas													
Petroleum coke oven gas													
Blast furnace gas													
Gas works gas													

Table A1.12. Fuel consumption [PJ] in 1.A.2.f category - Stationary combustion in manufacturing industries : Non-metallic minerals and other industries

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	72.637	72.514	68.894	76.924	83.926	79.647	86.930	81.562	66.639	59.965	53.349	41.103
Lignite	0.156	0.150	0.091	0.161	0.117	0.163	0.150	0.185	0.153	0.069	0.057	0.009
Hard coal briquettes (patent fuels)											0.029	
Brown coal briquettes	0.020	0.020						0.040	0.040	0.040	0.040	0.020
Crude oil												
Natural gas	24.574	22.704	22.246	21.986	21.506	25.518	26.650	25.655	27.097	23.917	27.976	31.858
Fuel wood and wood waste	1.155	0.455	0.042	0.033	0.004	0.010	0.010	0.005	0.006	0.002	0.006	0.275
Biogas												
Industrial wastes	0.068	0.023	0.267	0.250	0.145	0.197	0.144	0.047	0.207	0.529	0.472	0.524
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products								1.400	1.200	0.400		
Petroleum coke												
Coke	13.936	11.314	11.115	10.716	11.400	10.118	11.144	8.664	10.089	8.008	6.868	4.874
Liquid petroleum gas (LPG)					0.092	0.138	0.046	0.092	0.230	0.322	0.506	0.736
Motor gasoline								0.135				
Jet kerosene												
Diesel oil												
Fuel oil	0.944	0.815	0.772	0.772	0.944	1.330	1.802	2.788	2.016	1.716	1.630	1.973
Light fuel oil	4.160	2.800	3.560	3.960	4.320	6.080	3.760	4.120	6.680	5.920	3.880	4.320
Feedstocks												
Refinery gas												
Petroleum coke oven gas	2.101	1.821	1.341	1.234	0.482	0.886	0.509	0.353	0.988	0.804	0.413	0.897
Blast furnace gas	0.101	0.106	0.079	0.108	0.120	0.053	0.053	0.036	0.010	0.005	0.011	0.003
Gas works gas	3.270	3.136	2.706	2.392	2.090	1.788	1.033	0.501	0.330	0.304		

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	33.981	30.332	32.332	31.206	31.547	43.869	36.998	26.468	28.048	34.403	26.766	22.808	26.320
Lignite	0.019						0.063		0.224	0.283	0.549	0.347	0.501
Hard coal briquettes (patent fuels)													
Brown coal briquettes	0.020	0.040	0.040	0.040	0.040	0.040	0.040					0.180	
Crude oil													
Natural gas	33.233	35.584	38.233	38.963	41.283	42.473	39.708	41.422	42.894	44.492	42.349	40.911	36.785
Fuel wood and wood waste	0.292	0.102	0.261	0.110	0.139	0.116	0.223	0.285	0.299	0.348	0.407	0.498	0.724
Biogas													
Industrial wastes	0.508	1.471	1.818	2.701	5.043	5.961	7.400	7.715	10.469	11.729	12.170	12.763	15.171
Municipal waste - non-biogenic fraction		0.003	0.013	0.717	1.620	1.776	0.378	4.419	4.512	5.017	3.913	3.752	4.060
Municipal waste – biogenic fraction						0.001	0.001	0.029	0.123	1.338	1.360	1.391	1.528
Other petroleum products													0.002
Petroleum coke		4.416	3.232	7.072	3.584	1.568	1.152	2.752	1.792	0.064	0.064	0.160	
Coke	4.418	4.874	4.674	2.594	3.050	4.503	2.679	2.280	2.536	2.679	2.508	2.366	2.529
Liquid petroleum gas (LPG)	1.610	1.380	1.656	0.874	0.368	0.322	0.368	0.460	0.414	0.368	0.230	0.322	0.401
Motor gasoline								0.045					0.014
Jet kerosene													
Diesel oil													
Fuel oil	2.145	2.274	2.788	2.188	1.888	1.845	2.188	1.992	1.992	2.338	1.862	1.472	1.284
Light fuel oil	4.600	4.520	4.480	4.080	2.880	2.120	2.400	1.960	1.840	1.640	1.400	1.320	0.685
Feedstocks													
Refinery gas													
Petroleum coke oven gas	0.767	0.746	1.505	1.370	1.465	1.614	1.523	1.233	1.614	1.866	1.687	1.552	1.756
Blast furnace gas	0.003							0.001					
Gas works gas													

Table A1.13. Fuel consumption [PJ] in 1.A.4. a i category - Commercial/Institutional: Stationary SNAP0201

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	54.547	62.166	54.214	50.334	34.666	34.267	25.608	18.696	16.200	15.104	13.354	13.460
Lignite				0.017	0.091	0.025	0.026	0.009	0.009	0.009		
Hard coal briquettes (patent fuels)						0.322						
Brown coal briquettes	0.420			1.780	1.820	1.940	0.240	0.540	0.120	0.520	0.380	
Crude oil												
Natural gas	13.787	10.977	11.190	11.548	9.573	13.260	18.771	24.256	32.769	37.696	38.567	49.971
Fuel wood and wood waste	4.501	2.945		12.312	11.719	11.560	10.046	9.028	8.437	8.553	8.514	5.736
Biogas	0.379	0.187	0.206	0.062	0.249	0.423	0.579	0.599	0.648	0.663	0.678	0.860
Industrial wastes	0.504	0.081	0.011	0.352	0.089		0.124		0.003	0.004	0.004	0.091
Municipal waste - non-biogenic fraction											0.020	
Municipal waste – biogenic fraction											0.019	
Other petroleum products										0.640	0.880	3.000
Petroleum coke												
Coke	34.712	28.264	40.068	33.402	27.332	25.878	26.220	28.642	13.480	12.226	8.265	3.819
Liquid petroleum gas (LPG)					1.334	0.782	0.782	1.748	1.564	2.070	2.300	3.266
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil							0.987	4.290	6.220	7.636	13.342	15.015
Light fuel oil								0.080				
Feedstocks												
Refinery gas												
Petroleum coke oven gas	1.224	1.088	0.877	0.428	0.123	0.053	0.034	0.127				
Blast furnace gas												
Gas works gas	0.312	0.554	0.576	0.091	0.014	0.014	0.014	0.072	0.040	0.005	0.005	0.004

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	21.677	21.539	22.502	25.405	29.320	31.093	30.116	26.785	21.677	21.539	22.502	25.405	29.320
Lignite						0.702	0.515	0.402					
Hard coal briquettes (patent fuels)													
Brown coal briquettes	0.020								0.020				
Crude oil													
Natural gas	61.001	67.057	69.570	68.410	63.517	78.278	76.501	60.684	61.001	67.057	69.570	68.410	63.517
Fuel wood and wood waste	5.747	5.752	6.028	6.171	4.580	7.818	7.433	6.556	5.747	5.752	6.028	6.171	4.580
Biogas	0.683	0.700	0.558	0.343	0.505	1.963	2.127	2.258	0.683	0.700	0.558	0.343	0.505
Industrial wastes	0.092	0.060	0.002	0.022		0.011	0.388	0.079	0.092	0.060	0.002	0.022	
Municipal waste - non-biogenic fraction	0.009	0.011				0.035	0.033	0.152	0.009	0.011			
Municipal waste – biogenic fraction	0.010	0.014	0.013	0.030	0.028				0.010	0.014	0.013	0.030	0.028
Other petroleum products	0.360	1.720	2.000						0.360	1.720	2.000		
Petroleum coke								0.042					
Coke	8.122	8.180	5.928	2.679	2.878	1.824	1.083	0.601	8.122	8.180	5.928	2.679	2.878
Liquid petroleum gas (LPG)	3.358	5.520	5.014	4.600	5.244	3.312	2.852	3.576	3.358	5.520	5.014	4.600	5.244
Motor gasoline													
Jet kerosene													
Diesel oil								0.013					
Fuel oil	19.090	16.774	14.286	13.213	23.252	25.634	15.155	14.735	19.090	16.774	14.286	13.213	23.252
Light fuel oil						0.040		0.024					
Feedstocks													
Refinery gas													
Petroleum coke oven gas					0.001	0.001		0.001					0.001
Blast furnace gas													
Gas works gas	0.003	0.004	0.003	0.003	0.003	0.018	0.010	0.001	0.003	0.004	0.003	0.003	0.003



Table A1.14. Fuel consumption [PJ] in 1.A.4. b i category - Residential: Stationary plants SNAP0202

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	272.689	358.521	351.542	372.347	309.920	305.701	326.681	271.980	213.584	223.330	166.012	184.730
Lignite	0.526	0.042		2.956	4.403	4.279	3.420	2.626	1.772	1.286	1.169	1.373
Hard coal briquettes (patent fuels)												
Brown coal briquettes	1.240											
Crude oil												
Natural gas	122.204	133.674	141.212	141.590	151.671	159.559	143.057	150.022	138.268	135.995	127.611	133.737
Fuel wood and wood waste	34.335	27.721	33.969	106.000	104.715	105.000	101.000	10	100.700	95.000	95.000	104.500
Biogas												
Industrial wastes												
Municipal waste - non-biogenic fraction												
Municipal waste – biogenic fraction												
Other petroleum products												
Petroleum coke												
Coke	14.866	12.110	26.732	30.752	27.788	27.502	28.044	32.775	19.950	18.525	11.685	11.970
Liquid petroleum gas (LPG)	1.702	1.012	1.840	6.072	8.970	12.834	16.100	18.400	18.400	19.320	20.240	20.700
Motor gasoline												
Jet kerosene												
Diesel oil												
Fuel oil							2.145	6.435	8.580	9.781	17.160	21.450
Light fuel oil												
Feedstocks												
Refinery gas												
Petroleum coke oven gas	15.155	13.706	11.334	6.779	3.560	1.723	0.226					
Blast furnace gas												
Gas works gas	3.088	1.307	0.739	0.431	0.418	0.258	0.222	0.181	0.164	0.163	0.158	0.151

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	209.771	207.214	219.654	249.994	284.628	275.817	280.043	257.400	209.771	207.214	219.654	249.994	284.628
Lignite	1.482	1.605	1.919	2.006	2.168	3.593	4.022	3.200	1.482	1.605	1.919	2.006	2.168
Hard coal briquettes (patent fuels)													
Brown coal briquettes													
Crude oil													
Natural gas	127.093	127.629	126.376	135.111	138.686	135.471	143.187	118.438	127.093	127.629	126.376	135.111	138.686
Fuel wood and wood waste	104.500	103.075	103.360	100.700	104.500	115.000	116.850	105.450	104.500	103.075	103.360	100.700	104.500
Biogas													
Industrial wastes													
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products													
Petroleum coke													
Coke	8.550	8.550	7.125	2.992	3.278	5.700	5.700	4.760	8.550	8.550	7.125	2.992	3.278
Liquid petroleum gas (LPG)	21.390	25.300	23.920	23.000	23.000	23.000	21.620	22.546	21.390	25.300	23.920	23.000	23.000
Motor gasoline													
Jet kerosene													
Diesel oil													
Fuel oil	22.952	22.952	21.450	19.305	19.305	4.763	3.464	3.030	22.952	22.952	21.450	19.305	19.305
Light fuel oil													
Feedstocks													
Refinery gas													
Petroleum coke oven gas													
Blast furnace gas													
Gas works gas	0.134	0.128	0.113	0.095	0.099	0.059	0.047	0.032	0.134	0.128	0.113	0.095	0.099

Table A1.15. Fuel consumption [PJ] in 1.A.4. c i category - Agriculture/Forestry/Fishing – stationary SNAP0203

Fuels	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hard coal	36.365	57.356	62.959	62.501	60.542	58.583	62.611	52.483	46.050	49.162	33.231	36.975
Lignite	0.844	1.018	0.911	0.814	1.642	1.698	1.299	1.292	1.419	1.097	0.939	1.236
Hard coal briquettes (patent fuels)	0.645	0.146	0.088	0.059	0.059							
Brown coal briquettes	0.040	0.020	0.020									
Crude oil												
Natural gas	0.448	0.275	0.055	0.132	0.212	0.243	0.428	0.571	0.868	0.476	0.536	0.777
Fuel wood and wood waste	0.039	0.278	0.583	20.057	18.367	18.500	17.567	17.000	17.100	17.100	17.100	19.043
Biogas												
Industrial wastes												
Municipal waste - non-biogenic fraction										0.006	0.012	0.011
Municipal waste – biogenic fraction										0.006	0.013	0.010
Other petroleum products												
Petroleum coke												
Coke	1.568	1.168	0.684	0.570	4.018	4.018	4.104	5.130	5.700	5.130	3.420	3.705
Liquid petroleum gas (LPG)					0.460	0.690	1.150	1.380	1.380	1.610	1.840	2.300
Motor gasoline				0.674	1.122	1.122	1.122	1.212	1.122	1.347	1.392	0.943
Jet kerosene												
Diesel oil												
Fuel oil												
Light fuel oil	3.560	2.720	1.440	13.400	16.720	8.720	4.000	6.560	5.680	5.480	5.600	5.240
Feedstocks												
Refinery gas												
Petroleum coke oven gas	0.002	0.002										
Blast furnace gas												
Gas works gas	0.001			0.002					0.001			

Fuels	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Hard coal	30.820	29.693	31.728	35.673	42.074	41.488	41.611	39.000	30.820	29.693	31.728	35.673	42.074
Lignite	1.395	1.528	2.086	2.188	2.489	1.337	1.609	1.280	1.395	1.528	2.086	2.188	2.489
Hard coal briquettes (patent fuels)			0.029			0.059	0.293	0.200			0.029		
Brown coal briquettes					0.040		0.520	1.188					0.040
Crude oil													
Natural gas	0.914	1.197	1.182	1.084	1.492	1.531	1.501	1.295	0.914	1.197	1.182	1.084	1.492
Fuel wood and wood waste	19.010	19.017	19.878	19.038	19.977	23.931	20.937	19.310	19.010	19.017	19.878	19.038	19.977
Biogas						0.223	0.286	0.328					
Industrial wastes													
Municipal waste - non-biogenic fraction													
Municipal waste – biogenic fraction													
Other petroleum products													
Petroleum coke													
Coke	2.850	2.850	1.995	1.140	1.425	0.998	0.570	0.560	2.850	2.850	1.995	1.140	1.425
Liquid petroleum gas (LPG)	2.760	3.220	3.220	3.220	2.300	2.346	2.300	2.761	2.760	3.220	3.220	3.220	2.300
Motor gasoline	0.269	0.314	0.224	0.269	0.314	0.045	0.045	0.035	0.269	0.314	0.224	0.269	0.314
Jet kerosene													
Diesel oil													
Fuel oil													
Light fuel oil	3.880	5.840	5.960	7.200	1.720	1.280	0.560	0.447	3.880	5.840	5.960	7.200	1.720
Feedstocks													
Refinery gas													
Petroleum coke oven gas													
Blast furnace gas													
Gas works gas													

## Appendix 2. Emission factors

### I. NFR SECTOR 1 - ENERGY

Emission factors with their source used for estimation of 2012 emissions of the particular pollutants are presented in the tables below according to NFR categories. These factors are used when the information on emission volume is not available directly.

#### I.1. Public electricity and heat production (NFR 1.A.1.a)

Table A2.1 SO<sub>2</sub> emission factors applied for NFR 1.A.1.a

SO <sub>2</sub> emission source	Emission factor	EF unit
<b>Heating plants</b>		
Hard coal	0.0174	Mg/Mg
Coke	0.016	Mg/Mg
Fuel oils	0.006	Mg/Mg

Note: emission factors applied are country specific, based on sulphur content;

Table A2.2 NO<sub>x</sub> emission factors applied for NFR 1.A.1.a

NO <sub>x</sub> emission source	Emission factor	EF unit
<b>Heating plants</b>		
Hard coal	0.27	Mg/TJ
Fuel oils	0.2	Mg/TJ
Natural gas	0.125	Mg/TJ

Note: emission factors applied come from Corinair

Table A2.3 CO emission factors applied for NFR 1.A.1.a

CO emission source	Emission factor	EF unit
<b>Heating plants</b>		
Hard coal	0.0325	Mg/TJ
Fuel oils	0.015	Mg/TJ
Natural gas	0.019	Mg/TJ
<b>Industrial power</b>		
Hard coal and lignite	0.0058	Mg/TJ
Natural gas	0.02	Mg/TJ
Fuel wood and wood waste	1.5	Mg/TJ
Coke	0.0058	Mg/TJ
Fuel oils	0.0156	Mg/TJ
Industrial gases	0.02	Mg/TJ

Note: emission factors applied for SNAP 0102 come from Corinair;

Table A2.4 PM emission factors applied for NFR 1.A.1.a

PM emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>Public power</b>					
Hard coal	0.01313	0.0088	0.0044	Mg/TJ	PL(ARE) *
Brown coal	0.01064	0.0071	0.0036	Mg/TJ	PL(ARE) *
Fuel oils	0.0400	0.0200	0.0100	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP
<b>Heating plants</b>					
Hard coal and coke	0.14	0.093	0.07	Mg/TJ	CEPMEIP**
Fuel oils	0.0400	0.0200	0.0100	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP
<b>Industrial power</b>					
Hard coal	0.1400	0.0700	0.0170	Mg/TJ	CEPMEIP
Brown coal	0.1600	0.0800	0.0200	Mg/TJ	CEPMEIP
Coke	0.1400	0.0700	0.0170	Mg/TJ	CEPMEIP
Wood and wood waste	0.1600	0.0800	0.0200	Mg/TJ	CEPMEIP
Fuel oils	0.0400	0.0200	0.0100	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP

\* PL(ARE) emission factors come from ARE surveys, updated every year

\*\* emission factors for TSP come from CEPMEIP;

EFs for PM10 and PM2.5 are calculated as a share of PM<sub>10</sub> and PM<sub>2.5</sub> fractions in TSP

Table A2.5 NMVOC emission factors applied for NFR 1.A.1.a

Emission source	EF	EF unit	EF Reference
<b>Public power</b>			
Hard coal, brown coal, coal briquettes	0.008	Mg/TJ	PL (IETU)
Coke	0.01	Mg/TJ	PL (IETU)
Crude oil	0.003	Mg/TJ	CORINAIR
Intermediate from crude oil	0.003	Mg/TJ	PL (IETU)
Gasoline	0.003	Mg/TJ	PL (IETU)
Other petroleum products	0.003	Mg/TJ	PL (IETU)
Wood and wood waste	0.1	Mg/TJ	CORINAIR
Natural gas	0.001	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	PL (IETU)
Biogas	0.0025	Mg/TJ	PL (IETU)
Industrial gases	0.0025	Mg/TJ	CORINAIR
<b>Heating plants</b>			
Hard coal, hard coal briquettes	0.006	Mg/TJ	PL (IETU)
Brown coal, brown coal briquettes, coke	0.01	Mg/TJ	PL (IETU)
Crude oil	0.003	Mg/TJ	CORINAIR
Intermediate from crude oil	0.003	Mg/TJ	PL (IETU)
Gasoline	0.003	Mg/TJ	PL (IETU)
Fuel oils	0.003	Mg/TJ	PL (IETU)
Other petroleum products	0.003	Mg/TJ	PL (IETU)
Wood and wood waste	0.1	Mg/TJ	CORINAIR
Natural gas	0.001	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	PL (IETU)

Emission source	EF	EF unit	EF Reference
Biogas	0.0025	Mg/TJ	PL (IETU)
Industrial gases	0.0025	Mg/TJ	CORINAIR
<b>Industrial power</b>			
Hard coal, brown coal	0.02	Mg/TJ	CORINAIR
Natural gas	0.001	Mg/TJ	CORINAIR
Wood and wood waste	0.1	Mg/TJ	CORINAIR
Biogas	0.0025	Mg/TJ	CORINAIR
Coke	0.01	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	CORINAIR
Diesel oil and fuel oil	0.003	Mg/TJ	PL(IETU)
Industrial gases	0.0025	Mg/TJ	CORINAIR

Note: PL (IETU) emission factors come from IETU surveys

Table A2.6 Main Heavy Metals emission factors applied for NFR 1.A.1.a

Emission source	Emission factors			Unit	EF Reference
	Cd	Hg	Pb		
<b>Public power</b>					
Coke	0.001		0.0086	kg/TJ	PL (IETU)
Wood and wood waste	0.0018		0.021	kg/TJ	PL (IETU)
Fuel oil	0.0024		0.003	kg/TJ	PL (IETU)
Natural gas	0.0005		0.0002	kg/TJ	PL (IETU)
Industrial gases	0.0005			kg/TJ	PL (IETU)
<b>Heating plants</b>					
Hard coal	0.00137	0.0064	0.1024	kg/TJ	PL (IETU)
Brown coal	0.00013	0.004	0.00384	kg/TJ	PL (IETU)
Hard coal briquettes	0.01638	0.0064	0.1024	kg/TJ	PL (IETU)
Brown coal briquettes	0.00013	0.004	0.00384	kg/TJ	PL (IETU)
Coke	0.001	0.0017	0.0086	kg/TJ	PL (IETU)
Wood and wood waste	0.0018	0.0015	0.021	kg/TJ	PL (IETU)
Fuel oil	0.024		0.03	kg/TJ	PL (IETU)
Natural gas	0.0005	0.0001	0.0002	kg/TJ	PL (IETU)
Industrial gases	0.0005	0.0001	0.0002	kg/TJ	PL (IETU)
<b>Industrial power</b>					
Hard coal	0.0052	0.008	0.17	kg/TJ	PL (IETU)
Brown coal	0.0004	0.005	0.022	kg/TJ	PL (IETU)
Hard coal briquettes	0.0052	0.008		kg/TJ	PL (IETU)
Brown coal briquettes	0.0040	0.005		kg/TJ	PL (IETU)
Coke	0.023	0.0006	0.13	kg/TJ	PL (IETU)
Wood and wood waste	0.0018	0.0007	0.025	kg/TJ	PL (IETU)
Fuel oil	0.024		0.03	kg/TJ	PL (IETU)
Natural gas	0.0005	0.0002	0.0002	kg/TJ	PL (IETU)

\* Hg EFs applied have been based on a country study, conducted in 2011-2013 by Polish Energy Group PGE, data from Polish emissions database and own analyses. Note: PL (IETU) emission factors from IETU surveys

Table A2.7 Additional Heavy Metals emission factors applied for NFR 1.A.1.a

Emission source	Unit	Emission factors *				
		As	Cr	Cu	Ni	Zn
<b>Public power</b>						
Hard coal	kg/TJ	0.00134	0.0025	0.00704	0.00576	0.01792
Brown coal	kg/TJ	0.00282	0.00192	0.00384	0.0009	0.01664
Hard coal briquettes	kg/TJ	0.0013	0.0025	0.007	0.00576	0.01792
Brown coal briquettes	kg/TJ	0.0028	0.00192	0.00384	0.0009	0.01664
Coke	kg/TJ	0.0084	0.0053	0.0078	0.0057	0.019
Wood and wood waste	kg/TJ	0.0095	0.009	0.021	0.014	0.181
Fuel oil	kg/TJ	0.0024	0.0029	0.0068	0.0654	0.0024
Natural gas	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014
Industrial gases	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014
<b>Heating plants</b>						
Hard coal	kg/TJ	0.01024	0.01408	0.0576	0.0512	0.416
Brown coal	kg/TJ	0.00282	0.00192	0.00384	0.0009	0.01664
Hard coal briquettes	kg/TJ	0.01024	0.01408	0.0576	0.0512	0.416
Brown coal briquettes	kg/TJ	0.00282	0.00192	0.00384	0.0009	0.01664
Coke	kg/TJ	0.0084	0.0053	0.0078	0.0057	0.019
Wood and wood waste	kg/TJ	0.0095	0.009	0.021	0.001	0.181
Fuel oil	kg/TJ	0.024	0.029	0.068	0.654	0.024
Natural gas	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014
Industrial gases	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014
<b>Industrial power</b>						
Hard coal	kg/TJ	0.017	0.022	0.095	0.085	0.69
Brown coal	kg/TJ	0.018	0.011	0.024	0.005	0.11
Coke	kg/TJ	0.002	0.017	0.086	0.076	0.53
Wood and wood waste	kg/TJ	0.0014	0.0065	0.0046	0.002	0.114
Fuel oil	kg/TJ	0.024	0.029	0.068	0.654	0.024
Natural gas	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014

\* all Additional Heavy Metals emission factors applied for SNAP 01 are country specific – PL (IETU) surveys

Table A2.8 PCDD/F emission factors applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.06	mg TEQ/Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>
Lignite	0.06	mg TEQ/Gg	EF for hard coal was applied
Hard coal briquettes (patent fuels)	0.06	mg TEQ/Gg	EF for hard coal was applied
Brown coal briquettes	0.06	mg TEQ/Gg	EF for hard coal was applied
Fuel wood and wood waste	1	mg TEQ/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oil	1	mg TEQ/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic), 1999</i>
Natural gas	0.0005	ng TEQ/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.0005	ng TEQ/GJ	EMEP/EEA Guidebook (2009)

Table A2.9 Emission factors of PCBs applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.31	g/Gg	EF applied in Bulgaria
Lignite - Public power	1.8	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Brown coal briquettes	1.8	g/Gg	EF for lignite was applied
Fuel wood and wood waste	0.9	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Fuel oils	0.6	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Table A2.10 HCB emission factors applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.013	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>
Fuel wood and wood waste	0.06	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>

Table A2.11 Benzo(a)pyrene emission factors applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.00352	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	0.00352	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.6	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.6	µg/GJ	EMEP/EEA Guidebook (2009)
Fuel wood and wood waste	0.095	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	4.68	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.12 Benzo(b)fluoranthene emission factors applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.00732	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	0.00732	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	3.98	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.13 Benzo(k)fluoranthene emission factors applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.00732	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	0.00732	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Natural gas	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel oil	3.98	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

Table A2.14 Indeno(1.2.3-cd)pyrene emission factors applied for NFR 1.A.1.a

Activity	EF	Unit	EF Reference
Hard coal	0.00703	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	0.00703	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Natural gas	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Fuel wood and wood waste	0.17	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel oils	7.57	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

## I.2. Petroleum refining (NFR 1.A.1.b)

For *Petroleum refining plants* aggregate emission data of SO<sub>2</sub> and NO<sub>x</sub> were included from the National Database. CO emissions have been estimated based on confidential data and volume of production.

Table A2.15 PM emission factors applied for NFR 1.A.1.b

Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>Petroleum refining plants</b>					
Hard coal	0.1400	0.0700	0.0170	Mg/TJ	CEPMEIP
Coke	0.1400	0.0700	0.0170	Mg/TJ	CEPMEIP
Fuel oils	0.0400	0.0200	0.0100	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP



Table A2.16 NMVOC emission factors applied for NFR 1.A.1.b

Emission source	EF	EF unit	EF Reference
<b>Petroleum refining plants</b>			
Hard coal, brown coal and briquettes	0.02	Mg/TJ	PL (IETU)
Coke	0.01	Mg/TJ	PL (IETU)
Crude oil	0.003	Mg/TJ	CORINAIR
Intermediate from crude oil	0.003	Mg/TJ	PL (IETU)
Gasoline	0.003	Mg/TJ	PL (IETU)
Fuel oil	0.003	Mg/TJ	PL (IETU)
Other products from crude oil	0.003	Mg/TJ	PL (IETU)
Wood and wood waste	0.1	Mg/TJ	PL (IETU)
Natural gas	0.001	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	PL (IETU)
Biogas	0.0025	Mg/TJ	PL (IETU)
Industrial gases	0.0025	Mg/TJ	CORINAIR

Note: PL (IETU) emission factors come from IETU surveys

Table A2.17 Main Heavy Metals emission factors applied for NFR 1.A.1.b

Emission source	Emission factors			Unit	EF Reference
	Cd	Hg	Pb		
<b>Petroleum refining plants</b>					
Hard coal	0.027	0.008	0.17	kg/TJ	PL (IETU)
Brown coal	0.0007	0.005	0.022	kg/TJ	PL (IETU)
Coke	0.023	0.0006	0.13	kg/TJ	PL (IETU)
Fuel oil	0.024		0.03	kg/TJ	PL (IETU)
Natural gas	0.0005	0.0001	0.0002	kg/TJ	PL (IETU)
Industrial gases	0.00071	0.00009	0.0018	kg/TJ	PL (IETU)

Note: PL (IETU) emission factors from IETU surveys

Table A2.18 Additional Heavy Metals emission factors applied for NFR 1.A.1.b

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
<b>Petroleum refining plants</b>						
Hard coal	kg/TJ	0.017	0.022	0.095	0.085	0.69
Brown coal	kg/TJ	0.018	0.011	0.024	0.005	0.11
Coke	kg/TJ	0.002	0.017	0.086	0.076	0.53
Fuel oil	kg/TJ	0.024	0.029	0.068	0.654	0.024
Natural gas	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014
Industrial gases	kg/TJ	0.00034	0.0027	0.0022	0.0036	

Note: all Additional Heavy Metals emission factors applied for SNAP 01 are country specific – PL (IETU) surveys

Table A2.19 PCDD/F emission factors applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Hard coal	0.06	mg TEQ/Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>
Lignite	0.06	mg TEQ/Gg	EF for hard coal was applied
Fuel wood and wood waste	1	mg TEQ/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oil	1	mg TEQ/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic), 1999</i>
Natural gas	0.0005	ng TEQ/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.0005	ng TEQ/GJ	EMEP/EEA Guidebook (2009)

Table A2.20 Emission factors of PCBs applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Hard coal	0.31	g/Gg	EF applied in Bulgaria
Fuel wood and wood waste	0.9	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Fuel oils	0.6	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Table A2.21 HCB emission factors applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Hard coal	0.013	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>

Table A2.22 Benzo(a)pyrene emission factors applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	0.095	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Hard coal	0.586	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	0.586	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	3.43	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Industrial gases	0.67	µg/GJ	EMEP/EEA Guidebook (2009)

Table A2.23 Benzo(b)fluoranthene emission factors applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	1.81	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.24 Benzo(k)fluoranthene emission factors applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel oil	2.83	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

Table A2.25 Indeno(1.2.3-cd)pyrene emission factors applied for NFR 1.A.1.b

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	0.17	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Hard coal	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	6.84	g/Gg	EF for fuel oil was applied
Fuel oil	6.84	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

### I.3. Manufacture of solid fuels and other energy industries (NFR 1.A.1.c)

For category NFR 1.A.1.c aggregate emission data of SO<sub>2</sub> and NO<sub>x</sub> were included from the National Database. CO emissions have been estimated based on confidential data and volume of production.

Table A2.26 PM emission factors applied for NFR 1.A.1.c

Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Hard coal	0.1400	0.0700	0.0170	Mg/TJ	CEPMEIP
Fuel oils	0.0400	0.0200	0.0100	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP
<b>Coal mining, oil / gas extraction, pipeline compressors</b>					
Brown coal	0.1600	0.0800	0.0200	Mg/TJ	CEPMEIP
Coke	0.1400	0.0700	0.0170	Mg/TJ	CEPMEIP
Crude oil		0.0200	0.0100	Mg/TJ	CEPMEIP

Table A2.27 NMVOC emission factors applied for NFR 1.A.1.c

Emission source	EF	EF unit	EF Reference
Hard coal	0.02	Mg/TJ	CORINAIR
Coal briquettes	0.02	Mg/TJ	PL (IETU)
Coke	0.01	Mg/TJ	CORINAIR
Crude oil	0.003	Mg/TJ	CORINAIR
Intermediate from crude oil	0.003	Mg/TJ	PL (IETU)
Natural gas	0.001	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	PL (IETU)
Biogas	0.0025	Mg/TJ	PL (IETU)
Industrial gases	0.0025	Mg/TJ	CORINAIR
<b>Coal mining, oil/gas extraction</b>			
Brown coal	0.02	Mg/TJ	CORINAIR
Gasoline	0.003	Mg/TJ	PL (IETU)
Fuel oil	0.003	Mg/TJ	PL (IETU)
Other products from crude oil	0.003	Mg/TJ	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.28 Main Heavy Metals emission factors applied for NFR 1.A.1.c

Emission source	Emission factors			Unit	EF Reference
	Cd	Hg	Pb		
Hard coal	0.027	0.008	0.17	kg/TJ	PL (IETU)
Brown coal	0.0007	0.005	0.022	kg/TJ	PL (IETU)
Coke	0.023	0.001	0.13	kg/TJ	PL (IETU)
Fuel oil	0.024		0.03	kg/TJ	PL (IETU)
Natural gas	0.0005	0.0001	0.0002	kg/TJ	PL (IETU)
Industrial gases	0.0005	0.0001	0.0002	kg/TJ	PL (IETU)

Note: PL (IETU) emission factors from IETU surveys

Table A2.29 Additional Heavy Metals emission factors applied for NFR 1.A.1.c

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
Hard coal	kg/TJ	0.017	0.022	0.095	0.085	0.69
Brown coal	kg/TJ	0.018	0.011	0.024	0.005	0.11
Coke	kg/TJ	0.002	0.017	0.086	0.076	0.53
Fuel oil	kg/TJ	0.024	0.029	0.068	0.654	0.024
Natural gas	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014
Industrial gases	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014

Note: all Additional Heavy Metals emission factors applied for SNAP 01 are country specific – PL (IETU) surveys

Table A2.30 PCDD/F emission factors applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Hard coal	0.06	mg TEQ/Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>
Lignite	0.06	mg TEQ/Gg	EF for hard coal was applied
Fuel wood and wood waste	1	mg TEQ/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oil	1	mg TEQ/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic), 1999</i>
Natural gas	0.0005	ng TEQ/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.0005	ng TEQ/GJ	EMEP/EEA Guidebook (2009)

Table A2.31 Emission factors of PCBs applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Hard coal	0.31	g/Gg	EF applied in Bulgaria
Lignite (public power)	1.8	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Fuel wood and wood waste	0.9	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Fuel oils	0.6	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Table A2.32 HCB emission factors applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Hard coal	0.013	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>
Fuel wood and wood waste	0.06	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>

Table A2.33 Benzo(a)pyrene emission factors applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	0.095	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Hard coal	0.586	g/Gg	
Lignite	0.586	g/Gg	
Fuel oils	3.43	g/Gg	

Table A2.34 Benzo(b)fluoranthene emission factors applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	1.81	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.35 Benzo(k)fluoranthene emission factors applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel oils	1.81	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

Table A2.36 Indeno(1.2.3-cd)pyrene emission factors applied for NFR 1.A.1.c

Activity	EF	Unit	EF Reference
Fuel wood and wood waste	0.17	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Hard coal	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	6.84	g/Gg	EF for fuel oil was applied
Fuel oil	6.84	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

#### I.4. Stationary combustion in manufacturing industries (NFR 1.A.2)

Most of the emission factors for stationary combustion in manufacturing industries are similar for the particular industries - they are shown below under the section I.4.1 *Stationary Combustion in Manufacturing Industries*.

Process emission factors specific for stationary combustion in the particular industries are shown under appropriate sections NFR 1.A.2.a - NFR 1.A.2.f.

##### I.4.1 Stationary combustion in manufacturing industries (NFR 1.A.2)

Table A2.37 SO<sub>2</sub> emission factors applied for NFR 1.A.2

SO <sub>2</sub> emission source	Emission factor	EF unit
Hard coal	0.016	Mg/Mg
Brown coal	0.006	Mg/Mg
Coke	0.016	Mg/Mg

Note: emission factors applied for combustion of fuels are country specific, based on sulfur content

Table A2.38 NO<sub>x</sub> emission factors applied for NFR 1.A.2

NO <sub>x</sub> emission source	Emission factor	EF unit
Hard coal	0.173	Mg/TJ
Brown coal	0.173	Mg/TJ
Coke	0.173	Mg/TJ
Wood and wood waste	0.15	Mg/TJ
Fuel oils	0.1	Mg/TJ
Natural gas	0.07	Mg/TJ
Industrial gases	0.07	Mg/TJ

Note: emission factors from EMEP/EEA Guidebook 2009

Table A2.39 CO emission factors applied for NFR 1.A.2

CO emission source	Emission factor	EF unit
Hard coal	0.0058	Mg/TJ
Brown coal	0.0058	Mg/TJ
Coke	0.0058	Mg/TJ
Wood and wood waste	1.5	Mg/TJ
Fuel oils	0.0156	Mg/TJ
Natural gas	0.02	Mg/TJ
Industrial gases	0.02	Mg/TJ

Note: emission factors applied for combustion of fuels come from Corinair;

Table A2.40 PM emission factors applied for NFR 1.A.2

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Hard coal, brown coal and coke	0.1000	0.0600	0.0350	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
Wood and wood waste	0.1000	0.0600	0.0350	Mg/TJ	CEPMEIP
Fuel oils	0.0500	0.0400	0.0350	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP

Table A2.41 NMVOC emission factors applied for NFR 1.A.2

Emission source	EF	EF unit	EF Reference
Hard coal, brown coal and coal briquettes	0.02	Mg/TJ	CORINAIR
Crude oil	0.003	Mg/TJ	CORINAIR
Natural gas	0.001	Mg/TJ	CORINAIR
Wood and wood waste	0.1	Mg/TJ	CORINAIR
Biogas	0.0025	Mg/TJ	CORINAIR
Other petroleum products	0.003	Mg/TJ	PL(IETU)
Coke	0.01	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	CORINAIR
Gasoline and oils	0.003	Mg/TJ	PL(IETU)
Industrial gases	0.0025	Mg/TJ	CORINAIR

Note: PL(IETU) emission factors applied for combustion of fuels taken from surveys of the Institute for Ecology of Industrial Areas ( IETU)

Table A2.42 Main Heavy Metals emission factors applied for NFR 1.A.2

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
Coke	0.023	0.0006	0.13	kg/TJ
Wood and wood waste	0.0018	0.0007	0.025	kg/TJ
Fuel oil	0.024		0.03	kg/TJ
Natural gas	0.0005	0.0002	0.0002	kg/TJ
Hard coal	0.027	0.0029 *	0.17	kg/TJ
Brown coal	0.0007	0.0079 **	0.022	kg/TJ
Hard coal briquettes	0.027	0.008	0.17	kg/TJ
Brown coal briquettes	0.0007	0.005	0.022	kg/TJ

Note: most of Main Heavy Metals emission factors for combustion of fuels applied for SNAP 03 are country specific – PL (IETU) surveys

\* Emission factor taken from own survey; country specific.

\*\* Emission factor taken from EMEP/EEA Guidebook 2009

Table A2.43 Additional Heavy Metals emission factors applied for NFR 1.A.2

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
<b>0302 Process furnaces without contact</b>						
Hard coal	kg/TJ	0.017	0.022	0.095	0.085	0.69
Brown coal	kg/TJ	0.018	0.011	0.086	0.005	0.11
Coke	kg/TJ	0.002	0.017	0.068	0.076	0.53
Fuel oil	kg/TJ	0.024	0.029	0.024	0.654	0.024
<b>0303 Processes with contact</b>						
Hard coal	kg/TJ	0.017	0.022	0.095	0.085	0.69
Brown coal	kg/TJ	0.018	0.011	0.086	0.005	0.11
Hard coal briquettes	kg/TJ	0.017	0.022	0.095	0.085	0.69
Brown coal briquettes	kg/TJ	0.018	0.011	0.086	0.005	0.11
Coke	kg/TJ	0.002	0.017	0.068	0.076	0.53
Wood and wood waste	kg/TJ	0.0014	0.0065	0.0046	0.002	0.114
Fuel oil	kg/TJ	0.024	0.029	0.024	0.654	0.024
Natural gas	kg/TJ	0.00009	0.0007	0.0004	0.001	0.014

Note: Additional Heavy Metals emission factors applied for fuels combustion in SNAP 03 are country specific – PL (IETU) surveys

Table A2.44 PCDD/F emission factors applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	0.06	mg TEQ/ Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>
Lignite	0.06	mg TEQ/ Gg	EF for hard coal was applied
Fuel wood and wood waste	1	mg TEQ/ Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oil	1	mg TEQ/ Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic), 1999</i>
Natural gas	0.002	ng TEQ/ GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.002	ng TEQ/ GJ	EMEP/EEA Guidebook (2009)



Table A2.45 Emission factors of PCBs applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	0.31	g/Gg	EF applied in Bulgaria
Lignite	1.8	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Fuel wood and wood waste	0.9	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Coke	3.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic)</i> , 1999
Diesel oil	0.6	g/Gg	EF for fuel oil was applied
Fuel oil	0.6	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Table A2.46 HCB emission factors applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	0.013	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>
Fuel wood and wood waste	0.06	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>

Table A2.47 Benzo(a)pyrene emission factors applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	0.586	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	0.586	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	0.095	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oil	3.43	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.6	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.6	µg/GJ	EMEP/EEA Guidebook (2009)

Table A2.48 Benzo(b)fluoranthene emission factors applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	1.81	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.8	µg/GJ	EMEP/EEA Guidebook (2009)

Table A2.49 Benzo(k)fluoranthene emission factors applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	23.4	g/Gg	
Fuel wood and wood waste	19	g/Gg	
Fuel oils	1.81	g/Gg	
Natural gas	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.8	µg/GJ	EMEP/EEA Guidebook (2009)

Table A2.50 Indeno(1.2.3-cd)pyrene emission factors applied for NFR 1.A.2

Activity	EF	Unit	EF Reference
Hard coal	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Lignite	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel wood and wood waste	0.17	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel oil	6.84	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Natural gas	0.8	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.8	µg/GJ	EMEP/EEA Guidebook (2009)

#### 1.4.2 Stationary combustion in manufacturing industries : Iron and steel (NFR 1.A.2.a)

Table A2.51 SO<sub>2</sub>, NO<sub>x</sub> and CO emission factors applied for NFR 1.A.2.a

Emission source	Emission factor	EF unit
SO <sub>2</sub> emissions		
030301 Sinter and pelletizing plants (agglomeration)	0.463	kg/Mg
NO <sub>x</sub> emissions		
030301 Sinter and pelletizing plants (agglomeration)	0.558	kg/Mg
030303 Gray iron foundries	0.285	kg/Mg
CO emissions		
030301 Sinter and pelletizing plants (agglomeration)	18	kg/Mg

Note: for process emissions emission factors were taken from EMEP/EEA (2009) Guidebook

Table A2.52 POPs emission factors applied for NFR 1.A.2.a

Activity	EF	Unit	EF Reference
PCDD-F emissions			
Sinter and pelletizing plants	1.35	mg TEQ/Gg	<i>Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland</i> ; Danish Environmental Protection Agency and Ministry of the Environment, 2005
PCB emissions			
Sinter and pelletizing plants	0.065	g/Gg	GF/POL/01/004
HCB emissions			
Sinter and pelletizing plants	0.14	g/Gg	<i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland</i> , 2002

**I.4.3 Stationary Combustion in Manufacturing Industries: Non-ferrous Metals  
(NFR 1.A.2.b)**

Table A2.53 SO<sub>2</sub> emission factors applied for NFR 1.A.2.b

SO <sub>2</sub> emission source	Emission factor	EF unit
030304 Primary lead production	6.192	kg/Mg
030305 Primary zinc production	5.292	kg/Mg
030306 Primary copper production	10.276	kg/Mg
030307 Secondary lead production	2.203	kg/Mg
030308 Secondary zinc production	12.232	kg/Mg
030309 Secondary copper production - converters	1.225	kg/Mg
030309 Secondary copper production - other furnaces	1.225	kg/Mg
030310 Secondary aluminium production	0.603	kg/Mg

Note: for process emissions emission factors were taken from EMEP/EEA (2009) Guidebook

Table A2.54 NO<sub>x</sub> and CO emission factors applied for NFR 1.A.2.b

NO <sub>2</sub> emission source	Emission factor	EF unit
<i>NO<sub>x</sub> emissions</i>		
030307 Secondary lead production	0.186	kg/Mg
030310 Secondary aluminium production	0.449	kg/Mg
<i>CO emissions</i>		
030309 Secondary copper production	4.690	kg/Mg

Note: for process emissions emission factors were taken from EMEP/EEA (2009) Guidebook

Table A2.55 PM emission factors applied for NFR 1.A.2.b

PM Emission source	Emission factor			EF unit
	TSP	PM10	PM2.5	
030310 Secondary aluminium production	2	1.4	0.55	kg/Mg

Note: for process emissions emission factors were taken from EMEP/EEA (2009) Guidebook

Table A2.56 Main Heavy Metals emission factors applied for NFR 1.A.2.b

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
030304 Primary lead production	9.8	3	560	kg/Gg
030305 Primary zinc production	2.5	8	113	kg/Gg
030306 Primary copper production	0.42	0.1	230	kg/Gg
030307 Secondary lead production	0.3		40	kg/Gg
030308 Secondary zinc production	14	0.02	85	kg/Gg
030309 Secondary copper production	2		110	kg/Gg

Note: for process emissions EFs for Pb (metal production) are country specific – PL (IETU) surveys while for other emission sources EFs were usually taken from international publications.

Table A2.57 Additional Heavy Metals emission factors applied for NFR 1.A.2.b

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
030304 Primary lead production	kg/Gg	10		7.5		100
030305 Primary zinc production	kg/Gg					294
030306 Primary copper production	kg/Gg	32		334		300
030307 Secondary lead production	kg/Gg	0.2				6
030308 Secondary zinc production	kg/Gg	10				1089
030309 Secondary copper production	kg/Gg	2		75		500

Note: Additional Heavy Metals emission factors applied for process emissions EFs for Cr, Ni are country specific – PL (IETU) surveys while other EFs were taken from international publications

Table A2.58 PCDD/F emission factors applied for NFR 1.A.2.b

SNAP	Activity	EF	Unit	EF Reference
030307	Secondary lead production	8	mg TEQ/Gg	UNEP Chemicals (2005): Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005
030308	Secondary zinc production (basic APCs)	100	mg TEQ/Gg	UNEP Chemicals (2005): Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005
030309	Secondary copper production in converter furnaces	0.01	mg TEQ/Gg	UNEP Chemicals (2005): Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005
030309	Secondary copper production in other furnaces (exc. converters)	50	mg TEQ/Gg	UNEP Chemicals (2005): Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005
030310	Secondary aluminium production (including scrap processing; minimal treatment of inputs, simple dust removal)	150	mg TEQ/Gg	UNEP Chemicals (2005): Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005
030310	Secondary aluminium production (including scrap processing, well-controlled fabric filter, lime injection)	4	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>

Table A2.59 Emission factors of PCB and HCB applied for NFR 1.A.2.b

SNAP	Activity	EF	Unit	EF Reference
	<i>PCB emissions</i>			
030309	Secondary copper production	2.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>
030310	Secondary aluminium production	2.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>
	<i>HCB emissions</i>			
030309	Secondary copper production	39	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001),</i>

#### *I.4.4 Stationary Combustion in Manufacturing Industries: Other NFR 1.A.2.f*

Table A2.60 SO<sub>2</sub> emission factors applied for NFR 1.A.2.f

SO <sub>2</sub> emission source	Emission factor	EF unit
030311Clinker	0.374	kg/Mg
030312Lime	1.414	kg/Mg
030313Asphalt concrete plants	0.0177	kg/Mg
030314Glass - flat	1.962	kg/Mg
030319Bricks and tiles	0.166	kg/Mg
030320Fine ceramic materials	0.247	kg/Mg

Note: for process emissions emission factors were taken from EMEP/EEA (2009) Guidebook

Table A2.61 NO<sub>x</sub> emission factors applied for NFR 1.A.2.f

NO <sub>2</sub> emission source	Emission factor	EF unit
030311Clinker	1.55	kg/Mg
030312Lime	2.236	kg/Mg
030313Asphalt concrete plants	0.0356	kg/Mg
030314Glass - flat	2.931	kg/Mg
030316Glass wool (exc. binding)	1.625	kg/Mg
030319Bricks and tiles	0.142	kg/Mg
030320Fine ceramic materials	0.85	kg/Mg

Note: for process emissions emission factors were taken from EMEP/EEA (2009) Guidebook

Table A2.62 CO emission factors applied for NFR 1.A.2.f

CO emission source	Emission factor	EF unit
030311Clinker	2	kg/Mg
030312Lime	1.936	kg/Mg
030313Asphalt concrete plants	0.2	kg/Mg
030314Glass - flat	0.0061	kg/Mg
030315Glass - container	0.0061	kg/Mg
030319Bricks and tiles	0.415	kg/Mg
030320 Fine ceramic materials	0.456	kg/Mg

\* for process emissions EFs were taken from EMEP/EEA Guidebook (2009)

Table A2.63 PM emission factors applied for NFR 1.A.2.f

PM Emission source	Emission factors			EF unit
	TSP	PM10	PM2.5	
030314Flat glass	0.3	0.27	0.24	kg/Mg
030315Container glass	0.3	0.27	0.24	kg/Mg
030315Glass wool (exc. binding)	0.1	0.09	0.08	kg/Mg

\* for process emissions EFs were taken from EMEP/EEA Guidebook (2009)

Table A2.64 Main Heavy Metals emission factors applied for NFR 1.A.2.f

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
030311 Clinker	0.008*	0.02 *	0.2	kg/Gg

Note: EF for Pb is country specific – PL (IETU) surveys

\* Emission factor based on submission from producers, country specific.

Table A2.65 Additional Heavy Metals emission factors applied for NFR 1.A.2.f

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
030311 Clinker	kg/Gg	0.012	0.1		0.1	0.2

Note: Additional Heavy Metals emission factors applied for process emissions EFs for Cr, Ni and Zn (cement production) are country specific – PL (IETU) surveys while for other emission sources EFs were taken from international publications

Table A2.66 PCDD/F emission factors applied for NFR 1.A.2.f

SNAP	Emission source	EF	Unit	EF Reference
030311	Cement	0.07	mg TEQ/Gg of cement clinker production	GF/POL/01/004 <i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland</i>
030313	Asphalt mixing (no APCs)	0.07	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
030313	Asphalt mixing (scrubbers, fabric filters)	0.007	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
030319	Bricks and tiles (no or minimal APCs)	0.2	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
030319	Bricks and tiles (good APCs)	0.02	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
030320	Ceramics (no or minimal APCs)	0.2	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
030320	Ceramics (good APCs)	0.02	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>

Table A2.67 Emission factors of PCB and HCB applied for NFR 1.A.2.f

SNAP	Emission source	EF	Unit	EF Reference
<b>PCB emissions</b>				
030311	Clinker	0.007	g/Gg	GF/POL/01/004 <i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland, 2002</i>
<b>HCB emissions</b>				
030311	Cement	0.021	g/Gg of cement clinker	

## I.5. Transport (NFR sector 1.A.3)

### I.5.1. Civil and International Aviation (1.A.3.a)

Table A2.68 SO<sub>2</sub> emission factors applied for 1.A.3.a

SO <sub>2</sub> emission source	Emission factor	EF unit	EF Reference
Aviation (LTO & Cruise)	1.0	kg/Mg	GB (2009)

Table A2.69 NO<sub>x</sub> emission factors applied for 1.A.3.a

NO <sub>x</sub> emission source	Emission factor	EF unit	EF Reference
Aviation (LTO & Cruise)			
jet fuel - Civil Aviation	10.3	kg/Mg	GB (2009)
jet fuel - International Aviation	12.8	kg/Mg	GB (2009)
aviation gasoline - Civil Aviation	4.0	kg/Mg	GB (2009)

\* emission factors come from ITS surveys

Table A2.70 CO emission factors applied for 1.A.3.a

CO emission source	Emission factor	EF unit	EF Reference
Aviation (LTO & Cruise)			
jet fuel - Civil Aviation	2.0	kg/Mg	GB (2009)
jet fuel - International Aviation	1.1	kg/Mg	GB (2009)
aviation gasoline - Civil Aviation	1200.0	kg/Mg	GB (2009)

Table A2.71 PM emission factors applied for 1.A.3.a

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Aviation (LTO & Cruise)					
aviation gasoline	0.0300	0.0300	0.0300	kg/Mg	PL(ITS)

Note: PL(ITS) emission factors come from ITS surveys

Table A2.72 NMVOC emission factors applied for 1.A.3.a

Emission source	EF	EF unit	EF Reference
Aviation (LTO & Cruise)			
jet fuel - Civil Aviation	0.1	kg/Mg	GB (2009)
jet fuel - International Aviation	0.5	kg/Mg	GB (2009)
aviation gasoline - Civil Aviation	19.0	kg/Mg	GB (2009)

### 1.5.2. Road Transportation (1.A.3.b)

Table A2.73 SO<sub>2</sub> emission factors applied for 1.A.3.b

SO <sub>2</sub> emission source	Emission factor	EF unit	EF Reference
<b>1 A 3 b i - Road transport: Passenger cars</b>			
Gasoline passenger cars	0.1	kg/Mg	PL (ITS)
Diesel passenger cars	0.1	kg/Mg	PL (ITS)
<b>1 A 3 b ii - Road transport: Light duty vehicles</b>			
Gasoline light - duty vehicles	0.1	kg/Mg	PL (ITS)
Diesel light - duty vehicles	0.1	kg/Mg	PL (ITS)
<b>1 A 3 b iii - Road transport: Heavy duty vehicles</b>			
Gasoline heavy- duty vehicles	0.1	kg/Mg	PL (ITS)
Diesel heavy - duty vehicles	0.1	kg/Mg	PL (ITS)
Buses	0.1	kg/Mg	PL (ITS)
Road transport: Tractors	0.1	kg/Mg	PL (ITS)
<b>1 A 3 b iv - Road transport: Mopeds &amp; motorcycles</b>			
Mopeds and motorcycles < 50 cm <sup>3</sup>	0.1	kg/Mg	PL (ITS)
Motorcycles > 50 cm <sup>3</sup>	0.1	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.74 NO<sub>x</sub> emission factors applied for 1.A.3.b

NO <sub>x</sub> emission source	Emission factor	EF unit	EF Reference
<b>1 A 3 b i - Road transport: Passenger cars</b>			
Gasoline passenger cars without catalyst	34.1	kg/Mg	PL (ITS)
Gasoline passenger cars with catalyst	10.8	kg/Mg	PL (ITS)
Two-stroke passenger cars	9.7	kg/Mg	PL (ITS)
LPG passenger cars	38	kg/Mg	PL (ITS)
LPG passenger cars - low emission	17	kg/Mg	PL (ITS)
Diesel passenger cars – old	13.2	kg/Mg	PL (ITS)
Diesel passenger cars – new	11.5	kg/Mg	PL (ITS)
<b>1 A 3 b ii - Road transport: Light duty vehicles</b>			
Gasoline light - duty vehicles without catalyst	31.7	kg/Mg	PL (ITS)
Gasoline light - duty vehicles with catalyst	10	kg/Mg	PL (ITS)
Diesel light - duty vehicles - old	18.8	kg/Mg	PL (ITS)
Diesel light - duty vehicles - new	14.4	kg/Mg	PL (ITS)
LPG light - duty vehicles	38	kg/Mg	PL (ITS)
LPG light - duty vehicles - low emission	18	kg/Mg	PL (ITS)
<b>1 A 3 b iii - Road transport: Heavy duty vehicles</b>			
Gasoline heavy duty vehicles	35.9	kg/Mg	PL (ITS)
Diesel heavy - duty vehicles - old	53	kg/Mg	PL (ITS)
Diesel heavy - duty vehicles - new	17.8	kg/Mg	PL (ITS)
Buses - old	57.1	kg/Mg	PL (ITS)
Buses - new	20.2	kg/Mg	PL (ITS)
Road transport: Tractors	52	kg/Mg	PL (ITS)
<b>1 A 3 b iv - Road transport: Mopeds &amp; motorcycles</b>			



<b>NO<sub>x</sub> emission source</b>	<b>Emission factor</b>	<b>EF unit</b>	<b>EF Reference</b>
Mopeds and motorcycles < 50 cm <sup>3</sup>	2.5	kg/Mg	PL (ITS)
Motorcycles > 50 cm <sup>3</sup>	6.5	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.75 CO emission factors applied for 1.A.3.b

<b>CO emission source</b>	<b>Emission factor</b>	<b>EF unit</b>	<b>EF Reference</b>
<b>1 A 3 b i - Road transport: Passenger cars</b>			
Gasoline passenger cars without catalyst	230	kg/Mg	PL (ITS)
Gasoline passenger cars with catalyst	80	kg/Mg	PL (ITS)
Two-stroke passenger cars	250	kg/Mg	PL (ITS)
LPG passenger cars	150	kg/Mg	PL (ITS)
LPG passenger cars - low emission	110	kg/Mg	PL (ITS)
Diesel passenger cars – old	14	kg/Mg	PL (ITS)
Diesel passenger cars – new	6	kg/Mg	PL (ITS)
<b>1 A 3 b ii - Road transport: Light duty vehicles</b>			
Gasoline light - duty vehicles without catalyst	230	kg/Mg	PL (ITS)
Gasoline light - duty vehicles with catalyst	80	kg/Mg	PL (ITS)
Diesel light - duty vehicles - old	18	kg/Mg	PL (ITS)
Diesel light - duty vehicles - new	6.5	kg/Mg	PL (ITS)
LPG light - duty vehicles	135	kg/Mg	PL (ITS)
LPG light - duty vehicles - low emission	110	kg/Mg	PL (ITS)
<b>1 A 3 b iii - Road transport: Heavy duty vehicles</b>			
Gasoline heavy duty vehicles	337	kg/Mg	PL (ITS)
Diesel heavy - duty vehicles - old	32.5	kg/Mg	PL (ITS)
Diesel heavy - duty vehicles - new	6	kg/Mg	PL (ITS)
Buses - old	50	kg/Mg	PL (ITS)
Buses - new	5	kg/Mg	PL (ITS)
Road transport: Tractors	46.3	kg/Mg	PL (ITS)
<b>1 A 3 b iv - Road transport: Mopeds &amp; motorcycles</b>			
Mopeds and motorcycles < 50 cm <sup>3</sup>	500	kg/Mg	PL (ITS)
Motorcycles > 50 cm <sup>3</sup>	480	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.76. NH<sub>3</sub> emission factors applied for 1.A.3.b

<b>Emission source</b>	<b>EF</b>	<b>unit</b>	<b>EF reference</b>
Passenger cars - gasoline	0.173	g/kg gasoline	EMEP/EEA Inventory Guidebook (2009)
Passenger cars - diesel	0.018	g/kg diesel	
Light-duty vehicles < 3.5 t – gasoline	0.140	g/kg gasoline	
Light-duty vehicles < 3.5 t – diesel	0.014	g/kg diesel	
Heavy-duty vehicles > 3.5 t, buses and tractors - diesel	0.015	g/kg diesel	
Mopeds and motorcycles - gasoline	0.063	g/kg gasoline	

Table A2.77 PM emission factors applied for 1.A.3.b

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>1 A 3 b i - Road transport: Passenger cars</b>					
Diesel passenger cars - old	6.0000	6.0000	6.0000	kg/Mg	PL(ITS)
Diesel passenger cars - new	1.9000	1.9000	1.9000	kg/Mg	PL(ITS)
Two-stroke passenger cars	0.0110	0.0110	0.0110	kg/Mg	PL(ITS)
Gasoline passenger cars without catalysts	0.0110	0.0110	0.0110	kg/Mg	PL(ITS)
Gasoline passenger cars with catalysts	0.0072	0.0072	0.0072	kg/Mg	PL(ITS)
<b>1 A 3 b ii - Road transport: Light duty vehicles</b>					
Diesel light - duty vehicles – old	6.0000	6.0000	6.0000	kg/Mg	PL(ITS)
Diesel light - duty vehicles – new	1.1000	1.1000	1.1000	kg/Mg	PL(ITS)
Gasoline light - duty vehicles without catalysts	0.0110	0.0110	0.0110	kg/Mg	PL(ITS)
Gasoline light - duty vehicles with catalysts	0.0071	0.0071	0.0071	kg/Mg	PL(ITS)
<b>1 A 3 b iii - Road transport: Heavy duty vehicles</b>					
Diesel heavy - duty vehicles - old	6.0000	6.0000	6.0000	kg/Mg	PL(ITS)
Diesel heavy - duty vehicles - new	1.0000	1.0000	1.0000	kg/Mg	PL(ITS)
Diesel heavy - duty vehicles - gasoline	0.0110	0.0110	0.0110	kg/Mg	PL(ITS)
Buses - old	6.0000	6.0000	6.0000	kg/Mg	PL(ITS)
Buses - new	1.0000	1.0000	1.0000	kg/Mg	PL(ITS)
Tractors	5.2000	5.2000	5.2000	kg/Mg	PL(ITS)
<b>1 A 3 b iv - Road transport: Mopeds &amp; motorcycles</b>					
Mopeds and motorcycles	0.0110	0.0110	0.0110	kg/Mg	PL(ITS)
<b>1 A 3 b vi – Road vehicle tyre and brake wear</b>					
Passenger cars					
Tyre wear	69	3.45	0	kg/mln km	CEPMEIP
Brake wear	6	6	6	kg/mln km	CEPMEIP
Light duty vehicles <3.5 t					
Tyre wear	90	4.5	0	kg/mln km	CEPMEIP
Brake wear	7.5	7.5	7.5	kg/mln km	CEPMEIP
Heavy duty vehicles >3.5 t					
Tyre wear	371.25	18.563	0	kg/mln km	CEPMEIP
Brake wear	32.25	32.25	32.25	kg/mln km	CEPMEIP
Mopeds and motorcycles < 50 cm3					
Tyre wear	34.5	1.725	0	kg/mln km	CEPMEIP
Brake wear	3	3	3	kg/mln km	CEPMEIP
<b>1 A 3 b vii - Road surface wear</b>					
Road abrasion					
Passenger cars	145	7.25	0	kg/mln km	CEPMEIP
Light duty vehicles <3.5 t	190	9.5	0	kg/mln km	CEPMEIP
Heavy duty vehicles >3.5 t	738	26.9	0	kg/mln km	CEPMEIP
Mopeds and motorcycles	73	3.65	0	kg/mln km	CEPMEIP

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.78 NMVOC emission factors applied for 1.A.3.b

Emission source	EF	EF unit	EF Reference
<b>1 A 3 b i - Road transport: Passenger cars</b>			
Gasoline passenger cars without catalyst	44	kg/Mg	PL (ITS)
Gasoline passenger cars with catalyst	4.4	kg/Mg	PL (ITS)
Two-stroke passenger cars	192	kg/Mg	PL (ITS)
LPG passenger cars	25	kg/Mg	PL (ITS)
LPG passenger cars - low emission	6.5	kg/Mg	PL (ITS)
Diesel passenger cars – old	3.5	kg/Mg	PL (ITS)

Emission source	EF	EF unit	EF Reference
Diesel passenger cars – new	1.2	kg/Mg	PL (ITS)
<b>1 A 3 b ii - Road transport: Light duty vehicles</b>			
Gasoline light - duty vehicles without catalyst	45	kg/Mg	PL (ITS)
Gasoline light - duty vehicles with catalyst	5.5	kg/Mg	PL (ITS)
Diesel light - duty vehicles - old	4	kg/Mg	PL (ITS)
Diesel light - duty vehicles - new	1.8	kg/Mg	PL (ITS)
LPG light - duty vehicles	25	kg/Mg	PL (ITS)
LPG light - duty vehicles - low emission	6.5	kg/Mg	PL (ITS)
<b>1 A 3 b iii - Road transport: Heavy duty vehicles</b>			
Gasoline heavy duty vehicles		kg/Mg	PL (ITS)
Diesel heavy - duty vehicles - old	12.5	kg/Mg	PL (ITS)
Diesel heavy - duty vehicles - new	4.9	kg/Mg	PL (ITS)
Buses - old	15.8	kg/Mg	PL (ITS)
Buses - new	3	kg/Mg	PL (ITS)
Road transport: Tractors	8	kg/Mg	PL (ITS)
<b>1 A 3 b iv - Road transport: Mopeds &amp; motorcycles</b>			
Mopeds and motorcycles < 50 cm <sup>3</sup>	300	kg/Mg	PL (ITS)
Motorcycles > 50 cm <sup>3</sup>	180	kg/Mg	PL (ITS)
<b>1 A 3 b v - Road transport: Gasoline evaporation</b>			
Passenger cars	4.11	kg/Mg	PL (ITS)
Light duty vehicles <3.5 t	6.28	kg/Mg	PL (ITS)
Motorcycles and mopeds	0.85	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.79 Main Heavy Metals emission factors applied for 1.A.3.b

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
<b>Road transport</b>				
Unleaded gasoline			4.3	kg/Gg
Diesel oil	0.05			kg/Gg

Note: EFs were taken from international publications

Table A2.80 Additional Heavy Metals emission factors applied for 1.A.3.b

Emission source	Emission factors					Unit
	As	Cr	Cu	Ni	Zn	
<b>Road transport</b>						
Unleaded gasoline		0.5	0.3	0.5		kg/Gg
Diesel oil			0.3	0.5		kg/Gg

Note: EFs were taken from international publications

Table A2.81 PCDD/F emission factors applied for 1.A.3.b

Activity	EF	Unit	EF References
Gasoline	0.104	mg TEQ/Gg	LUA-NRW (1997): <i>Identification of Relevant Industrial Sources of Dioxins and Furans in Europe – The European Dioxin Inventory</i> , Essen 1997
Diesel oil	0.043	mg TEQ/Gg	

Table A2.82 Emission factors of PCBs applied for 1.A.3.b

Activity	EF	Unit	EF References
Motor gasoline	0.02	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>
<i>Passenger cars &amp; Light duty vehicles - Diesel oil</i>	0.625	g/Gg	EF has been calculated based upon literature EF: 0.05 µ/km, assuming average fuel consumption per km as 80 g/km according to data from <i>EMEP EEA Emission Inventory Guidebook</i> EF=0.05 µg/km - Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
<i>Heavy duty vehicles - Diesel oil</i>	22.458	g/Gg	EF has been calculated based upon literature EF: 5.39 µ/km, assuming average fuel consumption per km as 240 g/km according to data from <i>EMEP EEA Emission Inventory Guidebook</i> EF=0.05 µg/km - Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Table A2.83 HCB emission factors applied for 1.A.3.b

Activity	EF	Unit	EF References
<b>Passenger cars</b>			
Motor gasoline	0.000343	g/Gg	EF has been calculated based upon literature EF for unleaded gasoline 0.024 ng/km assuming average fuel consumption 70 g / km EF=0.024 ng/km - NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>
Diesel oil	0.350	g/Gg	EF has been calculated based upon literature EF: 21 ng/km, assuming average fuel consumption 60 g / km EF=21 ng/km - NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i> ;
<b>Light duty vehicles</b>			
Motor gasoline	0.000240	g/Gg	EF has been calculated based upon literature EF for unleaded gasoline 0.024 ng/km assuming average fuel consumption 100 g / km EF=0.024 ng/km - NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>
Diesel oil	0.263	g/Gg	EF has been calculated based upon literature EF: 21 ng/km, assuming average fuel consumption 80 g / km EF=21 ng/km - NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i> ;
<b>Heavy duty vehicles - Diesel oil</b>	0.088	g/Gg	EF has been calculated based upon literature EF: 21 ng/km, assuming average fuel consumption 240 g / km EF=21 ng/km - NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i> ;
<b>Mopeds &amp; motorcycles - Motor gasoline</b>	0.000686	g/Gg	EF has been calculated based upon literature EF for unleaded gasoline 0.024 ng/km assuming average fuel consumption 35 g / km EF=0.024 ng/km - NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>

Table A2.84 Benzo(a)pyrene emission factors applied for 1.A.3.b

Activity	EF	Unit	EF Reference
Motor gasoline	0.0107	kg/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Diesel oil	0.297	kg/Gg	

Table A2.85 Benzo(b)fluoranthene emission factors applied for 1.A.3.b

Activity	EF	Unit	EF Reference
Motor gasoline	0.01498	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	0.41580	g/Gg	

Table A2.86 Benzo(k)fluoranthene emission factors applied for 1.A.3.b

Activity	EF	Unit	EF References
Motor gasoline	0.01498	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	0.4158	g/Gg	

Table A2.87 Indeno(1.2.3-cd)pyrene emission factors applied for 1.A.3.b

Activity	EF	Unit	EF References
Motor gasoline	0.0107	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	0.2970	g/Gg	

### 1.5.3. Railways (1.A.3.c)

Table A2.88 SO<sub>2</sub>, NO<sub>x</sub>, CO and NMVOC emission factors applied for 1.A.3.c

SO2 emission source	Emission factor	EF unit	EF Reference
<b>Diesel locomotives</b>			
SO <sub>2</sub> emissions	0.1	kg/Mg	PL (ITS)
NO <sub>x</sub> emissions	54.0	kg/Mg	PL (ITS)
CO emissions	29.5	kg/Mg	PL (ITS)
NMVOC emissions	12.7	kg/Mg	PL (ITS)

Note: PL (ITS) emission factor based on sulphur content comes from ITS surveys

Table A2.89 NH<sub>3</sub> emission factors applied for 1.A.3.c

Emission source	EF	unit	EF reference
Diesel locomotives	0.007	kg/Mg diesel	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>

Table A2.90 PM emission factors applied for 1.A.3.c

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Diesel locomotives	4.7000	4.7000	4.7000	kg/Mg	PL(ITS)

Note: PL (ITS) emission factor based on sulphur content comes from ITS surveys

Table A2.91 Main Heavy Metals emission factors applied for 1.A.3.c

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
Diesel oil	0.05			kg/Gg

Note: EFs were taken from international publications

Table A2.92 Additional Heavy Metals emission factors applied for 1.A.3.c

Emission source	Emission factors					Unit
	As	Cr	Cu	Ni	Zn	
Diesel oil			0.3	0.5		kg/Gg

Note: EFs were taken from international publications

Table A2.93 PCDD/F emission factors applied for 1.A.3.c

Activity	EF	Unit	EF Reference
Diesel oil	0.043	mg TEQ/Gg	LUA-NRW (1997): <i>Identification of Relevant Industrial Sources of Dioxins and Furans in Europe – The European Dioxin Inventory</i> , Essen 1997

Table A2.94 Benzo(a)pyrene emission factors applied for 1.A.3.c

Activity	EF	Unit	EF Reference
Benzo(a)pyrene emissions			Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	0.297	kg/Gg	
Benzo(k)fluoranthene emissions			
Diesel oil	0.41580	g/Gg	
Indeno(1.2.3-cd)pyrene emissions			
Diesel oil	0.2970	g/Gg	

#### 1.5.4. Navigation (1.A.3.d)

Table A2.95 SO<sub>2</sub> emission factors applied for 1.A.3.d

SO <sub>2</sub> emission source	Emission factor	EF unit	EF Reference
<b>1.A.3.d.ii - National navigation</b>			
Inland waterways - Diesel oil	0.044	kg/Mg	PL (ITS)
<b>Maritime activities</b>			
National sea traffic, diesel oil	0.044	kg/Mg	PL (ITS)
National sea traffic, fuel oil	0.02	Mg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.96 NO<sub>x</sub> emission factors applied for 1.A.3.d

NO <sub>x</sub> emission source	Emission factor	EF unit	EF Reference
<b>1.A.3.d.ii - National navigation</b>			
Inland waterways - Diesel oil	54	kg/Mg	PL (ITS)
<b>Maritime activities</b>			
National sea traffic, diesel oil and fuel oil	58.4	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors come from ITS surveys

Table A2.97 CO emission factors applied for 1.A.3.d

CO emission source	Emission factor	EF unit	EF Reference
<b>1.A.3.d.ii - National navigation</b>			
Inland waterways - Diesel oil	29.5	kg/Mg	PL (ITS)
<b>Maritime activities</b>			
National sea traffic, diesel oil and fuel oil	8	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors come from ITS surveys

Table A2.98 PM emission factors applied for 1.A.3.d

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>1.A.3.d.ii - National navigation</b>					
Inland waterways - Diesel oil	4.7000	4.7000	4.7000	kg/Mg	PL(ITS)
<b>Maritime activities</b>					
National sea traffic, diesel oil and fuel oil	4.0000	4.0000	4.0000	kg/Mg	PL(ITS)

Note: PL (ITS) emission factors come from ITS surveys

Table A2.99 NMVOC emission factors applied for 1.A.3.d

Emission source	EF	EF unit	EF Reference
<b>1.A.3.d.ii - National navigation</b>			
Inland waterways - Diesel oil	12.7	kg/Mg	PL (ITS)
<b>Maritime activities</b>			
National sea traffic, diesel oil and fuel oil	12.7	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors come from ITS surveys

Table A2.100 Main Heavy Metals emission factors applied for 1.A.3.d

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
<b>1.A.3.d.ii - National navigation</b>				
Diesel oil	0.05			kg/Gg

Note: EFs were taken from international publications

Table A2.101 Additional Heavy Metals emission factors applied for 1.A.3.d

Emission source	Emission factors					Unit
	As	Cr	Cu	Ni	Zn	
<b>1.A.3.d.ii - National navigation</b>						
Diesel oil			0.3	0.5		kg/Gg

Note: EFs were taken from international publications

Table A2.102 POPs emission factors applied for 1.A.3.d

Activity	EF	Unit	EF Reference
Benzo(a)pyrene emissions			
Diesel oil	0.297	kg/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Benzo(k)fluoranthene emissions			
Diesel oil	0.41580	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Indeno(1.2.3-cd)pyrene emissions			
Diesel oil	0.2970	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

## I.6. Other sectors – stationary sources (NFR 1.A.4)

Table A2.103 SO<sub>2</sub> emission factors applied for NFR 1.A.4

SO <sub>2</sub> emission source	Emission factor	EF unit
<b>1.A.4.a.i Commercial and institutional plants</b>		
Hard coal	0.0174	Mg/Mg
Coke	0.016	Mg/Mg
Fuel oils	0.006	Mg/Mg
<b>1.A.4.b.i Residential plants</b>		
Hard coal	0.02	Mg/Mg
Brown coal	0.006	Mg/Mg
Coke	0.016	Mg/Mg
Fuel oils	0.006	Mg/Mg
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>		
Hard coal	0.02	Mg/Mg
Coke	0.02	Mg/Mg
Fuel oils	0.006	Mg/Mg

Note: emission factors applied are country specific, based on sulphur content

Table A2.104 NO<sub>x</sub> emission factors applied for NFR 1.A.4

NO <sub>x</sub> emission source	Emission factor	EF unit
<b>1.A.4.a.i Commercial and institutional plants</b>		
Hard coal	0.15	Mg/TJ
Brown coal	0.15	Mg/TJ
Coke	0.15	Mg/TJ
Wood and wood waste	0.2	Mg/TJ
Fuel oils	0.18	Mg/TJ
Natural gas	0.1	Mg/TJ
Industrial gases	0.1	Mg/TJ
<b>1.A.4.b.i Residential plants</b>		
Hard coal	0.155	Mg/TJ
Wood and wood waste	0.07	Mg/TJ
Fuel oils	0.18	Mg/TJ
Natural gas	0.1	Mg/TJ
LPG	0.1	Mg/TJ
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>		
Hard coal	0.155	Mg/TJ
Wood and wood waste	0.07	Mg/TJ
Fuel oils	0.17	Mg/TJ
Natural gas	0.1	Mg/TJ
LPG	0.1	Mg/TJ

Note: emission factors applied come from Corinair



Table A2.105 CO emission factors applied for NFR 1.A.4

CO emission source	Emission factor	EF unit
<b>1.A.4.a.i Commercial and institutional plants</b>		
Hard coal	0.12	Mg/TJ
Brown coal	0.12	Mg/TJ
Coke	0.12	Mg/TJ
Wood and wood waste	1.5	Mg/TJ
Fuel oils	0.015	Mg/TJ
Natural gas	0.02	Mg/TJ
Industrial gases	0.02	Mg/TJ
<b>1.A.4.b.i Residential plants</b>		
Hard coal	3.095	Mg/TJ
Wood and wood waste	6.615	Mg/TJ
Fuel oils	0.015	Mg/TJ
Natural gas	0.05	Mg/TJ
LPG	0.05	Mg/TJ
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>		
Hard coal	0.931	Mg/TJ
Wood and wood waste	6.615	Mg/TJ
Fuel oils	0.05	Mg/TJ
Natural gas	0.029	Mg/TJ
LPG	0.05	Mg/TJ

Note: emission factors applied come from Corinair

Table A2.106 NH<sub>3</sub> emission factors applied for NFR 1.A.4

Emission source	EF	EF unit	EF reference
<b>1.A.4.b.i Residential plants</b>			
Hard coal, brown coal, coke	0.3	kg/TJ	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>
Biomass (wood)	3.8	kg/TJ	

Table A2.107 PM emission factors applied for NFR 1.A.4

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>1.A.4.a.i Commercial and institutional plants</b>					
Hard coal	0.22569	0.14347	0.13685	Mg/TJ	[Kub, 2014]*
Brown coal	0.12612	0.07938	0.06375	Mg/TJ	[Kub, 2014]*
Coke	0.07392	0.03348	0.02	Mg/TJ	[Kub, 2014]*
Wood and wood waste	0.1015	0.09525	0.0921	Mg/TJ	[Kub, 2014]*
Fuel oils	0.040	0.0200	0.0100	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
Industrial gases	0.0050	0.0050	0.0050	Mg/TJ	CEPMEIP
<b>1.A.4.b.i Residential plants</b>					
Hard coal	0.34361	0.24422	0.11516	Mg/TJ	[Kub, 2014]*
Brown coal	0.35668	0.28417	0.10039	Mg/TJ	[Kub, 2014]*
Coke	0.0912	0.0378	0.0200	Mg/TJ	[Kub, 2014]*
Wood and wood waste	0.26742	0.23733	0.22604	Mg/TJ	[Kub, 2014]*
Fuel oils	0.0600	0.0500	0.0400	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
LPG	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>					
Hard coal	0.5000	0.3750	0.1250	Mg/TJ	PL **
Brown coal	0.5000	0.3750	0.1250	Mg/TJ	PL **
Coke	0.1000	0.0400	0.0200	Mg/TJ	PL (IETU)
Wood and wood waste	0.2000	0.1900	0.1800	Mg/TJ	CEPMEIP
Fuel oils	0.0600	0.0500	0.0400	Mg/TJ	CEPMEIP
Natural gas	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP
LPG	0.0002	0.0002	0.0002	Mg/TJ	CEPMEIP

Note: [Kub, 2014 ]\*, emission factors derived from Kubica K., Kubica R., 2014; PL\*\*, emission factors are country specific from IChPW & IETU surveys; PL (IETU) emission factors are country specific from IETU surveys

Table A2.108 NMVOC emission factors applied for NFR 1.A.4

Emission source	EF	EF unit	EF Reference
<b>1.A.4.a.i Commercial and institutional plants</b>			
Hard coal	0.02	Mg/TJ	PL (IETU)
Brown coal	0.02	Mg/TJ	PL (IETU)
Coal briquettes	0.02	Mg/TJ	PL (IETU)
Coke	0.01	Mg/TJ	CORINAIR
Wood and wood waste	0.1	Mg/TJ	CORINAIR
Diesel / fuel oil	0.003	Mg/TJ	PL (IETU)
Other petroleum products	0.003	Mg/TJ	PL (IETU)
Natural gas	0.001	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	CORINAIR
Industrial gases	0.0025	Mg/TJ	CORINAIR
Biogas	0.0025	Mg/TJ	CORINAIR
<b>1.A.4.b.i Residential plants</b>			
Hard coal	0.2	Mg/TJ	CORINAIR
Brown coal	0.2	Mg/TJ	CORINAIR
Coke	0.02	Mg/TJ	CORINAIR
Wood and wood waste	0.4	Mg/TJ	CORINAIR
Diesel oil	0.003	Mg/TJ	PL (IETU)
Natural gas	0.005	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	CORINAIR
Industrial gases	0.0025	Mg/TJ	CORINAIR
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>			
Hard coal	0.2	Mg/TJ	CORINAIR
Brown coal	0.2	Mg/TJ	CORINAIR
Wood and wood waste	0.4	Mg/TJ	CORINAIR
Natural gas	0.005	Mg/TJ	CORINAIR
LPG	0.0035	Mg/TJ	CORINAIR

Note: PL (IETU) emission factors are country specific from IETU surveys

Table A2.109 Main Heavy Metals emission factors applied for NFR 1.A.4

Emission source	Emission factors			Unit	EF Reference
	Cd	Hg	Pb		
<b>1.A.4.a.i Commercial and institutional plants</b>					
Hard coal and hard coal briquettes	0.0052 *	0.008	0.33	kg/TJ	PL (IETU)
Brown coal and brown coal briquettes	0.004 *	0.005	0.022	kg/TJ	PL (IETU)
Coke	0.023	0.001	0.13	kg/TJ	PL (IETU)
Natural gas	0.00052	0.00023	0.001	kg/TJ	PL (IETU)
<b>1.A.4.b.i Residential plants</b>					
Hard coal and hard coal briquettes	0.0052 *	0.052	0.46	kg/TJ	PL (IETU)
Brown coal and brown coal briquettes	0.004 *	0.005	0.217	kg/TJ	PL (IETU)
Coke	0.066	0.001	0.359	kg/TJ	PL (IETU)
Wood and wood waste	0.001	0.0004	0.04	kg/TJ	PL (IETU)
Fuel oil	0.024		0.03	kg/TJ	PL (IETU)
Natural gas	0.00052	0.00023	0.001	kg/TJ	PL (IETU)
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>					
Hard coal	0.0052 *	0.004	0.134	kg/TJ	PL (IETU)
Brown coal	0.004 *	0.005	0.134	kg/TJ	PL (IETU)
Hard coal briquettes	0.0052 *	0.004	0.46	kg/TJ	PL (IETU)
Brown coal briquettes	0.004 *	0.005	0.217	kg/TJ	PL (IETU)
Coke	0.066	0.001	0.359	kg/TJ	PL (IETU)
Wood and wood waste	0.001	0.0004	0.027	kg/TJ	PL (IETU)
Fuel oil	0.024		0.03	kg/TJ	PL (IETU)
Natural gas	0.00052	0.00023	0.000011	kg/TJ	PL (IETU)

Note: \* Own estimation based on Cadmium content in fuel; PL (IETU) emission factors come from IETU surveys

Table A2.110 Additional Heavy Metals emission factors applied for NFR 1.A.4

Emission source	Emission factors					Unit
	As	Cr	Cu	Ni	Zn	
<b>1.A.4.a.i Commercial and institutional plants</b>						
Hard coal	0.034	0.043	0.19	0.17	1.32	kg/TJ
Brown coal	0.018	0.011	0.024	0.005	0.11	kg/TJ
Hard coal briquettes	0.034	0.043	0.19	0.17	1.32	kg/TJ
Brown coal briquettes	0.018	0.011	0.024	0.005	0.11	kg/TJ
Coke	0.002	0.017	0.086	0.076	0.53	kg/TJ
Natural gas	0.000094	0.00066	0.0004	0.00098	0.014	kg/TJ
<b>1.A.4.b.i Residential plants</b>						
Hard coal	0.05	0.06	0.27	0.23	1.85	kg/TJ
Brown coal	0.168	0.11	0.22	0.048	1.07	kg/TJ
Hard coal briquettes	0.05	0.06	0.27	0.23	1.85	kg/TJ
Brown coal briquettes	0.168	0.11	0.22	0.048	1.07	kg/TJ
Coke	0.005	0.045	0.237	0.209	1.45	kg/TJ
Wood and wood waste	0.0005	0.002	0.008	0.002	0.1	kg/TJ
Fuel oil	0.024	0.029	0.068	0.654	0.024	kg/TJ
Natural gas	0.000094	0.00066	0.0004	0.00098	0.014	kg/TJ
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>						

Emission source	Emission factors					Unit
	As	Cr	Cu	Ni	Zn	
Hard coal	0.05	0.06	0.27	0.23	1.85	kg/TJ
Brown coal	0.168	0.11	0.22	0.048	1.07	kg/TJ
Hard coal briquettes	0.05	0.06	0.27	0.23	1.85	kg/TJ
Brown coal briquettes	0.168	0.11	0.22	0.048	1.07	kg/TJ
Coke	0.005	0.045	0.237	0.209	1.45	kg/TJ
Wood and wood waste	0.0005	0.002	0.008	0.002	0.1	kg/TJ
Fuel oil	0.024	0.029	0.068	0.654	0.024	kg/TJ
Natural gas	0.000094	0.00066	0.0004	0.00098	0.014	kg/TJ

\* all Additional Heavy Metals emission factors applied are country specific – PL (IETU) surveys

Table A2.111 PCDD/F emission factors applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Hard coal	0.06	mg TEQ/ Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>
Lignite	0.06	mg TEQ/ Gg	EF for hard coal was applied
Fuel wood and wood waste	1	mg TEQ/ Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oil	1	mg TEQ/ Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic), 1999</i>
Natural gas	2	ng TEQ/ Gg	EMEP/EEA Guidebook (2009)
Industrial gases	2	ng TEQ/ Gg	EMEP/EEA Guidebook (2009)
<b>1.A.4.b.i Residential plants</b>			
Coal	10	mg TEQ/ Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	5	mg TEQ/ Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Coke	0.61	mg TEQ/ Gg	LUA-NRW (1997): <i>Identification of Relevant Industrial Sources of Dioxins and Furans in Europe – The European Dioxin Inventory”, Essen 1997</i>
Natural gas	0.0005	ng TEQ/ Gg	EMEP/EEA Guidebook (2009)
Industrial gases	0.0005	ng TEQ/ Gg	EMEP/EEA Guidebook (2009)
<b>1.A.4.c.i Agriculture/Forestry/Fishing</b>			
Natural gas	0.002	ng TEQ/ Gg	EMEP/EEA Guidebook (2009)
Industrial gases	0.002	ng TEQ/ Gg	EMEP/EEA Guidebook (2009)

Table A2.112 Emission factors of PCB applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Hard coal	0.413	g/Gg	EF applied in Bulgaria
Lignite	1.8	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Fuel wood and wood waste	0.9	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Coke	3.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic), 1999</i>
Fuel oils	0.6	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
<b>1.A.4.b.i Residential plants</b>			
Hard coal	31.6	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Activity	EF	Unit	EF Reference
Lignite	183.2	g/Gg	EMEP/CORINAIR (1994) <i>EMEP/CORINAIR atmospheric emission inventory guidebook</i> .
Fuel wood and wood waste	9	g/Gg	EF applied in Czech Republic
Coke	9.7	g/Gg	EF applied in Czech Republic
Fuel oil	3.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic)</i> , 1999
Diesel oil	0.6	g/Gg	Parma et al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>

Table A2.113 HCB emission factors applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Hard coal	0.013	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>
Fuel wood and wood waste	0.06	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001), 167-182</i>
<b>1.A.4.b.i Residential plants</b>			
Hard coal	0.125	g/Gg	EF applied in Czech Republic www.recetox.muni.cz

Table A2.114 Benzo(a)pyrene emission factors applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Fuel oils	3.43	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.562	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.562	µg/GJ	EMEP/EEA Guidebook (2009)
Hard coal and briquettes	1500	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite and briquettes	845	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Wood and wood waste	2480	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
<b>1.A.4.a.i Commercial and institutional plants</b>			
Hard coal and briquettes	0.586	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite and briquettes	0.586	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Wood and wood waste	0.095	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.115 Benzo(b)fluoranthene emission factors applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent</i>

Activity	EF	Unit	EF Reference
			<i>organic pollutants, 1995</i>
Fuel oils	1.81	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.843	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.843	µg/GJ	EMEP/EEA Guidebook (2009)
<b>1.A.4.b.i Residential plants</b>			
Hard coal	1600	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	1150	g/Gg	
Fuel wood and wood waste	3260	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.116 Benzo(k)fluoranthene emission factors applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Hard coal	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	23.4	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	19	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Diesel oil	1.81	g/Gg	EF for fuel oil was applied
Fuel oils	1.81	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Natural gas	0.843	µg/GJ	EMEP/EEA Guidebook (2009)
Industrial gases	0.843	µg/GJ	EMEP/EEA Guidebook (2009)
<b>1.A.4.b.i Residential plants</b>			
Hard coal	50	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	525	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	1080	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Table A2.117 Indeno(1.2.3-cd)pyrene emission factors applied for NFR 1.A.4

Activity	EF	Unit	EF Reference
Hard coal	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Lignite	17.6	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel wood and wood waste	0.17	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Fuel oils	6.84	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
<b>1.A.4.b.i Residential plants</b>			
Hard coal	3000	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>

Activity	EF	Unit	EF Reference
Lignite	1110	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Fuel wood and wood waste	1760	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995

### 1.7. Agriculture/Forestry/Fishing – mobile sources (1.A.4.c.ii & 1.A.4.c.iii)

Table A2.118 SO<sub>2</sub> emission factors applied for mobile sources

SO <sub>2</sub> emission source	Emission factor	EF unit	EF Reference
<b>1.A.4.c.ii Off-road vehicles and other machinery</b>			
Tractors	0.1	kg/Mg	PL (ITS)
Machinery	0.1	kg/Mg	PL (ITS)
<b>1.A.4.c.iii National fishing</b>			
diesel oil	0.044	kg/Mg	PL (ITS)
fuel oil	0.006	Mg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.119 NO<sub>x</sub> emission factors applied for mobile sources

NO <sub>x</sub> emission source	Emission factor	EF unit	EF Reference
<b>1.A.4.c.ii Off-road vehicles and other machinery</b>			
Tractors	52	kg/Mg	PL (ITS)
Machinery	63	kg/Mg	PL (ITS)
<b>1.A.4.c.iii National fishing</b>			
diesel oil and fuel oil	58.4	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.120 CO emission factors applied for mobile sources

CO emission source	Emission factor	EF unit	EF Reference
<b>1.A.4.c.ii Off-road vehicles and other machinery</b>			
Tractors	46	kg/Mg	PL (ITS)
Machinery	50	kg/Mg	PL (ITS)
<b>1.A.4.c.iii National fishing</b>			
Diesel oil and fuel oil	8	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.121 NH<sub>3</sub> emission factors applied for mobile sources

Emission source	EF	unit	EF reference
<b>1.A.4.c.ii Off-road vehicles and other machinery</b>	0.008	kg/Mg diesel	<i>EMEP/EEA emission inventory guidebook 2009</i>

Table A2.122 PM emission factors applied for mobile sources

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>1.A.4.c.ii Off-road vehicles and other machinery</b>					
Tractors	5.2000	5.2000	5.2000	kg/Mg	PL(ITS)
Machinery	5.2000	5.2000	5.2000	kg/Mg	PL(ITS)
<b>1.A.4.c.iii National fishing</b>					
Diesel oil	4.0000	4.0000	4.0000	kg/Mg	PL(ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.123 NMVOC emission factors applied for mobile sources

Emission source	EF	EF unit	EF Reference
<b>1.A.4.c.ii Off-road vehicles and other machinery</b>			
Tractors	8	kg/Mg	PL (ITS)
Machinery	12.8	kg/Mg	PL (ITS)
<b>1.A.4.c.iii National fishing</b>			
Diesel oil	12.7	kg/Mg	PL (ITS)

Note: PL (ITS) emission factors based on sulphur content come from ITS surveys

Table A2.124 Main Heavy Metals emission factors applied for mobile sources

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
<b>Agriculture/Forestry/Fishing</b>				
Unleaded gasoline			4.3	kg/Gg
Diesel oil	0.05			kg/Gg

Note: EFs were taken from international publications

Table A2.125 Additional Heavy Metals emission factors applied for mobile sources

Emission source	Emission factors					Unit
	As	Cr	Cu	Ni	Zn	
<b>Agriculture/Forestry/Fishing</b>						
Unleaded gasoline		0.5	0.3	0.5		kg/Gg
Diesel oil			0.3	0.5		kg/Gg

Note: EFs were taken from international publications

Table A2.126 PCDD/F emission factors applied for mobile sources

Activity	EF	Unit	EF Reference
Gasoline	0.104	mg TEQ/Gg	LUA-NRW (1997): <i>Identification of Relevant Industrial Sources of Dioxins and Furans in Europe – The European Dioxin Inventory</i> , Essen 1997
Diesel oil	0.043	mg TEQ/Gg	

Table A2.127 Benzo(a)pyrene emission factors applied for mobile sources

Activity	EF	Unit	EF Reference
Diesel oil	0.297	kg/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995



Table A2.128 Indeno(1.2.3-cd)pyrene emission factors applied for SNAP 08

Activity	EF	Unit	EF Reference
Motor gasoline	0.0107	g/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Diesel oil	0.2970	g/Gg	

## I.8. Fugitive emission (NFR sector 1 B)

### I.8.1 Fugitive emission from solid fuels (NFR sector 1.B.1)

– coal mining and handling (NFR 1.B.1.a.)

Table A2.129 NMVOC emission factors applied for NFR 1.B.1.a

Emission source	EF	EF unit
Underground mining – hard coal	0.1	kg/Mg prod

Note: emission factor comes from IETU surveys

Table A2.130 PM emission factors applied for NFR 1.B.1.a

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Extraction of brown coal	0.10172	0.05	0.005	kg/Mg	CEPMEIP
Extraction of hard coal	0.10172	0.05	0.005	kg/Mg	CEPMEIP

– solid fuel transformation (NFR 1.B.1.b.).

Table A2.131 NH<sub>3</sub> emission factors applied for NFR 1.B.1.b

Emission source	EF	unit	EF reference
Coke oven plants	5	g/Mg coke	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>

Table A2.132 PM emission factors applied for NFR 1.B.1.b

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Coke oven plants	0.2	0.2	0.1	kg/Mg	CEPMEIP

Table A2.133 NMVOC emission factors applied for NFR 1.B.1.b

Emission source	EF	EF unit
Coke oven plants	0.0005	Mg/Mg

Note: emission factor comes from IETU surveys

Table A2.134 Main Heavy Metals emission factors applied for NFR 1.B.1.b

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
Coke oven plants	0.05	0.03	0.22	kg/Gg

Note: EF for Main Heavy Metals emission from *Coke oven plants* is country specific – PL (IETU)

Table A2.135 Additional Heavy Metals emission factors applied for NFR 1.B.1.b

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
Coke oven plants	kg/Gg	0.02	0.17	0.09	0.065	0.22

Note: Additional Heavy Metals emission factors applied in SNAP 04 for process emissions were taken from international publications

Table A2.136 POPs emission factors applied for NFR 1.B.1.b

Activity	EF	Unit	EF Reference
<i>Coke production (APCs/flue gas burn out)</i>			
PCDD/F emissions	0.3	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>  Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants, 1995</i>
Benzo(a)pyrene emissions	0.75	kg/Gg	
Benzo(b)fluoranthene emissions	0.25	kg/Gg	
Benzo(k)fluoranthene emissions	0.25	kg/Gg	
Indeno(1.2.3-cd)pyrene emissions	0.30	kg/Gg	

### 1.8.2 Fugitive emissions from oil and natural gas (NFR sector 1.B.2)

– production, transport and refining of oil

Table A2.137 NMVOC emission factors applied for NFR 1.B.2.a

Emission source	EF	EF unit	EF Reference
040101 Petroleum products processing	0.0009	Mg/Gg	PL (IETU)
0504 Liquid fuel distribution (except gasoline distribution)			
050401 Marine terminals	0.3	kg/Mg	CORINAIR
050402 Fuel oil distribution	0.02	kg/Mg	CORINAIR
0505 Gasoline distribution			
050501 Refinery dispatch station	0.31	kg/Mg	CORINAIR
050502 Transport and depots	0.72	kg/Mg	CORINAIR
050503 Service stations (including refueling of cars)	2.8	kg/Mg	CORINAIR

Note: PL (IETU) emission factor comes from IETU surveys

– production, processing, transmission, distribution of gas

Table A2.138 NMVOC emission factors applied for NFR 1.B.2.b

Emission source	EF	EF unit	EF Reference
0503 Extraction of gaseous fuels			
high - methane natural gas	0.068	Mg/hm <sup>3</sup>	PL (IETU)
nitrogenous natural gas	0.063	Mg/hm <sup>3</sup>	PL (IETU)
0506 Gas distribution networks			
natural gas (high - methane)	0.338	Mg/hm <sup>3</sup>	PL (IETU)
natural gas (nitrogenous)	0.784	Mg/hm <sup>3</sup>	PL (IETU)
coke oven gas	0.727	Mg/hm <sup>3</sup>	PL (IETU)

Note: PL (IETU) emission factor comes from IETU surveys

## II. NFR SECTOR 2 – Industrial processes and solvents use

### II.1. Mineral Products (NFR sector 2.A)

Table A2.139 CO emission factors applied for NFR 2.A.2 and 2.A.3

Emission source	Emission factor	EF unit
030312 Lime	1.936	kg/Mg
030313 Flat glass; 030315 Container glass	0.0061	kg/Mg

Table A2.140 PM emission factors applied for NFR 2.A

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
040612 Cement (decarbonizing)	0.22	0.2	0.11	kg/Mg	GB 2009
040614 Calx	0.59	0.24	0.05	kg/Mg	GB 2009
040614 Gypsum (calcined)	0.59	0.24	0.05	kg/Mg	GB 2009
040616 Quarrying of minerals (exc. coal)	0.00007	0.00004	0.000004	kg/Mg	GB 2009
040616 Extraction of zinc-lead ores	0.10172	0.05	0.005	kg/Mg	CEPMEIP
040616 Extraction of copper ores	0.10172	0.05	0.005	kg/Mg	CEPMEIP
040624 Construction and demolition	0.162	0.0812	0.00812	kg/m <sup>2</sup>	GB 2009

Table A2.141 Main Heavy Metals emission factors applied for NFR 2.A.3

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
030314 Flat glass	0.15	0.05	10	kg/Gg

Table A2.142 Additional Heavy Metals emission factors applied for NFR 2.A.3

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
030314 Flat glass	kg/Gg	0.1	2.5	0.5	2	10

Table A2.143 PCDD/F emission factors applied for NFR 2.A.2 and 2.A.3

SNAP	Emission source	EF	Unit	EF Reference
030312	Lime (no or minimal APCs)	10	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
030312	Lime (good APCs)	0.07	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
030314	Flat glass (no or minimal APCs)	0.2	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
030315	Container glass (no or minimal APCs)	0.2	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

## II.2. Chemical Industry (NFR sector 2.B)

Table A2.144 SO<sub>2</sub> emission factors applied for NFR 2.B.10.a

SO <sub>2</sub> emission source	Emission factor	EF unit
040401 Sulfuric acid	2	kg/Mg
040409 Carbon black	22	kg/Mg

Note: emission factor applied for sulfuric acid production is country specific; for other process emissions EF was taken from EMEP/EEA (2009) Guidebook

Table A2.145 NO<sub>x</sub> emission factors applied for NFR 2.B

NO <sub>x</sub> emission source	Emission factor	EF unit
040402 Nitric acid production*	3.8	kg/Mg
040403 Ammonia	1	kg/Mg
040407 NPK fertilisers	0.3	kg/Mg
040409 Carbon black	15	kg/Mg
040410 Titanium dioxide	0.108	kg/Mg

Note: emission factors were taken from EMEP/EEA Guidebook (2009)

\* emission factor derived from initial country studies (the methodology is still developing – the emission factor could be changed)

Table A2.146 NH<sub>3</sub> emission factors applied for NFR 2.B

Emission source	EF	unit	EF reference
040403 Ammonia	0.01	Mg/Gg NH <sub>3</sub>	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>
040619 Soda ash production and use	0.9	Mg/Gg prod. Na <sub>2</sub> CO <sub>3</sub>	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>

Table A2.147 CO emission factors applied for NFR 2.B.1

CO emission source	Emission factor	EF unit
040403 Ammonia	0.1	kg/Mg

Note: emission factors were taken from EMEP/EEA Guidebook (2009)

Table A2.148 CO emission factors applied for NFR 2.B.10.a

CO emission source	Emission factor	EF unit
040409 Carbon black	3	kg/Mg
040517 Formaldehyde	12	kg/Mg

Note: emission factors were taken from EMEP/EEA Guidebook (2009)

Table A2.149 PM emission factors applied for NFR 2.B.6

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
040410 Titanium dioxide	0.3			kg/Mg	GB 2009
040412 Calcium carbide production	0.1			kg/Mg	GB 2009

Table A2.150 PM emission factors applied for NFR 2.B.7

Emission source	EF	unit	EF reference
040619 Soda ash production and use	0.1	kg/Mg	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>

Table A2.151 PM emission factors applied for NFR 2.B.10.a-b

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
040407 NPK Fertilisers	0.3	0.24	0.18	kg/Mg	GB 2009
040412 Calcium carbide production	0.1			kg/Mg	GB 2009
040508 Polyvinylchloride	0.263	0.1	0.05	kg/Mg	GB 2009
040509 Polypropylene	1.5			kg/Mg	GB 2009
040511 Polystyrene (EPS)	0.03			kg/Mg	GB 2009
040511 Polystyrene (GPPS, HIPS)	0.004			kg/Mg	GB 2009
040617 Storage and transport of fertilisers	0.1	0.032	0.004	kg/Mg	CEPMEIP

Table A2.152 NMVOC emission factors applied for NFR 2.B

Emission source	EF	EF unit	EF Reference
040409 Carbon black	0.04	Mg/Mg	CORINAIR
040501 Ethylene	0.011	Mg/Mg	PL (IETU)
040502 Propylene	0.005	Mg/Mg	CORINAIR
040506 Polyethylene low density	0.026	Mg/Mg	PL (IETU)
040508 Polyvinylchloride	0.008	Mg/Mg	PL (IETU)
040509 Polypropylene	0.008	Mg/Mg	CORINAIR
040511 Polystyrene	0.00126	Mg/Mg	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.153 Main Heavy Metals emission factors applied for NFR 2.B.10.a

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
040414 Phosphate fertilizers	0.6			kg/Gg

Note: emission factors were taken from international publications

### II.3. Metal Production (NFR sector 2.C)

Table A2.154 SO<sub>2</sub> emission factors applied for NFR 2.C

SO <sub>2</sub> emission source	Emission factor	EF unit
040207 Electric furnace steel plant	0.06	kg/Mg

Note: emission factor was taken from EMEP/EEA (2009) Guidebook

Table A2.155 NO<sub>x</sub> emission factors applied for NFR 2.C

NO <sub>x</sub> emission source	Emission factor	EF unit
040205 Open hearth furnace steel plant	0.7	kg/Mg
040206 Basic oxygen furnace steel plant	0.01	kg/Mg
040207 Electric furnace steel plant	0.13	kg/Mg
040208 Rolling mills - hot	0.1	kg/Mg

<b>NO<sub>x</sub> emission source</b>	<b>Emission factor</b>	<b>EF unit</b>
040208 Rolling mills - cold	0.07	kg/Mg
040301 Primary aluminium production (electrolysis)	1	kg/Mg

Note: emission factors were taken from international publications

Table A2.156 CO emission factors applied for NFR 2.C

<b>CO emission source</b>	<b>Emission factor</b>	<b>EF unit</b>
040206 Basic oxygen furnace steel plant	3.5	kg/Mg
040207 Electric furnace steel plant	1.7	kg/Mg
040301 Primary aluminium production (electrolysis)	122	kg/Mg

Note: emission factor was taken from EMEP/EEA (2009) Guidebook

Table A2.157 PM emission factors applied for NFR 2.C

<b>PM Emission source</b>	<b>Emission factor</b>			<b>EF unit</b>	<b>EF reference</b>
	<b>TSP</b>	<b>PM10</b>	<b>PM2.5</b>		
040202 Blast furnace charging	0.05	0.04	0.025	kg/Mg	GB 2009
040206 Basic oxygen furnace steel plant	0.3	0.18	0.14	kg/Mg	GB 2009
040207 Electric furnace steel plant	0.3	0.18	0.14	kg/Mg	GB 2009
040208 Rolling mills - hot	0.009			kg/Mg	GB 2009
040208 Rolling mills - cold	0.096			kg/Mg	GB 2009
040209 Sinter and pelletizing plants	0.2	0.1	0.08	kg/Mg	GB 2009
040301 Primary aluminium production	4	3.2	1.4	kg/Mg	GB 2009
040302 Ferrosilicon	1			kg/Mg	GB 2009
040309 Primary lead production	0.073	0.073	0.052	kg/Mg	PL*

Note: PL\* emission factor for Primary lead production is country specific from domestic studies

Table A2.158 NMVOC emission factors applied for NFR 2.C

<b>Emission source</b>	<b>EF</b>	<b>EF unit</b>	<b>EF Reference</b>
040202 Blast furnace charging	0.000237	Mg/Mg	PL (IETU)
040206 Basic oxygen furnace steel plant	0.000038	Mg/Mg	PL (IETU)
040207 Electric furnace steel plant	0.00074	Mg/Mg	PL (IETU)
040208 Rolling mills - hot	0.00003	Mg/Mg	PL (IETU)
040208 Rolling mills - cold	0.000126	Mg/Mg	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.159 Main Heavy Metals emission factors applied for NFR 2.C

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
040202 Blast furnace charging		0.0000001	0.287	kg/Gg
040203 Pig iron tapping			4.5	kg/Gg
040205 Open hearth furnace steel plant	0.2		1.4	kg/Gg
040206 Basic oxygen furnace steel plant	0.025	0.001	0.1	kg/Gg
040207 Electric furnace steel plant	0.25	0.10	5.5	kg/Gg
040209 Sinter and pelletizing plants (excluding 030301)	0.1	0.01	5.4	kg/Gg
040301 Aluminium production	0.1			kg/Gg
040302 Ferro alloys			0.24	kg/Gg
040309 Other (production of batteries)			5	kg/Gg

Note: EF for Pb emissions from *production of batteries* is country specific – PL (IETU) surveys while for other emission sources EFs were taken from international publications

Table A2.160 Additional Heavy Metals emission factors applied for NFR 2.C

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
040202 Blast furnace charging	kg/Gg					0.58
040203 Pig iron tapping	kg/Gg			0.003		0.021
040205 Open hearth furnace steel plant	kg/Gg	0.75	9.8	1.18		40.15
040206 Basic oxygen furnace steel plant	kg/Gg	0.015	0.06	0.03	0.05	0.6
040207 Electric furnace steel plant	kg/Gg	0.1	1	3.1	0.25	23.9
040209 Sinter and pelletizing plants (excluding 030301)	kg/Gg	0.04	0.3	0.6	0.7	8.9
040301 Aluminium production	kg/Gg				0.1	0.15

Note: Additional Heavy Metals emission factors applied for process emissions were taken from international publications

Table A2.161 PCDD/F emission factors applied for NFR 2.C

Activity	EF	Unit	EF Reference
Pig iron tapping	0.01	mg TEQ/Gg	<i>Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland</i> ; Danish Environmental Protection Agency and Ministry of the Environment, 2005
Basic oxygen furnace steel plants	0.02	mg TEQ/Gg	<i>Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland</i> ; Danish Environmental Protection Agency and Ministry of the Environment, 2005
Electric furnace steel plants	3	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
Aluminium production (electrolysis)	2	mg TEQ/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic)</i> , 1999

Table A2.162 Emission factors of PCBs applied for NFR 2.C

Activity	EF	Unit	EF Reference
Pig iron tapping	0.0064	g/Gg	<i>Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland</i> ; Danish Environmental Protection Agency and Polish Ministry of the Environment, 2005
Open heart furnace steel plants	2.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING-Baltic)</i> , 1999
Basic oxygen furnace steel plants	0.0048	g/Gg	<i>Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland</i> ; Danish Environmental Protection Agency and Polish Ministry of the Environment, 2005
Electric furnace steel plants	2.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>
Rolling mills	2.6	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>

Table A2.163 HCB emission factors applied for NFR 2.C

Activity	EF	Unit	EF Reference
Pig iron tapping	0.00146	g/Gg	Opportunities for reduction of dioxin emissions from the metallurgical sector in Poland; Danish Environmental Protection Agency and Ministry of the Environment. Institute of Environmental Protection, 2005
Basic oxygen furnace steel plants	0.00176	g/Gg	

Table A2.164 PAH emission factors applied for NFR 2.C

Activity	EF	Unit	EF Reference
Aluminium production			Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Benzo(a)pyrene emissions	11.000	kg/Gg	
Benzo(b)fluoranthene emissions	40.180	kg/Gg	
Benzo(k)fluoranthene emissions	40.180	kg/Gg	
Indeno(1.2.3-cd)pyrene emissions	5.000	kg/Gg	

#### II.4. Solvent use (NFR sector 2.D)

Table A2.165 NMVOC emission factors applied for NFR 2.D.3

Emission source	EF	EF unit	EF Reference
Fat, edible and non edible oil extraction	0.014	kg/Mg	PL (IETU)
Domestic solvent use (other than paint application)	1.2	Mg/thousand people	PL (IETU)
040610 Roof covering with asphalt materials	0.05	Mg / thous. m <sup>2</sup>	CORINAIR

Note: PL (IETU) emission factors come from IETU surveys; CORINAIR factor was taken from EMEP/EEA (2009) Guidebook

Table A2.166 NMVOC emission factors applied for NFR 2.D.3.d

Emission source	EF	EF unit	EF Reference
<i>Paint application</i>			
Waterborne paints	0.03	Mg/Mg paints	PL (IETU)



Emission source	EF	EF unit	EF Reference
Conventional solvent paint	0.5	Mg/Mg paints	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.167 NMVOC emission factors applied for NFR 2.D.3.e - f

Emission source	EF	EF unit	EF Reference
<i>Degreasing, dry cleaning and electronics</i>			
Metal degreasing	1	Mg/Mg solvent	PL (IETU)
Dry cleaning	0.15	Mg/thousand people	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.168 NMVOC emission factors applied for NFR 2.D.3.g

Emission source	EF	EF unit	EF Reference
Polyvinylchloride processing	0.0078	Mg/Mg	PL (IETU)
Polystyrene foam processing	0.0508	Mg/Mg	PL (IETU)
Rubber processing	0.016	Mg/Mg	PL (IETU)
Pharmaceutical products manufacturing	0.014	Mg/thousand people	PL (IETU)
Paints manufacturing	0.005	Mg/Mg	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.169 NH<sub>3</sub> emission factors applied for NFR 2.D.3.g

Emission source	EF	EF unit	EF Reference
Chemical products manufacturing or processing - Leather tanning	0.68	Mg/Gg	EMEP/EEA emission inventory guidebook (2009)

Table A2.170 PAH emission factors applied for NFR 2.D.3.i

Activity	EF	Unit	EF Reference
<b>Wood preservation</b>			
Benzo(a)pyrene emissions	0.5	kg/Gg	Berdowski et al. (1995): <i>Technical paper to the OSPARCOM-HELCOM-UNECE emission heavy metals and persistent organic pollutants</i> , 1995
Benzo(b)fluoranthene emissions	0.250	kg/Gg	
Benzo(k)fluoranthene emissions			
Indeno(1.2.3-cd)pyrene emissions			

## II.5. Other product use (NFR sector 2.G)

Table A2.171 Emission factors applied for NFR 2.G

Source and emissions	EF	Unit	EF reference
<b>Tobacco combustion</b>			
NO <sub>x</sub> emissions	0.0034652	Mg/Gg	Aasestad, 2007 (Report for Norway)
NMVOC emissions	0.0048374	Mg/Gg	Aasestad, 2007 (Report for Norway)
CO emissions	0.1215475	Mg/Gg	Aasestad, 2007 (Report for Norway)

Source and emissions	EF	Unit	EF reference
TSP emissions	40	Mg/Gg	CEPMEIP
PM10 emissions	40	Mg/Gg	CEPMEIP
PM2.5 emissions	40	Mg/Gg	CEPMEIP
Pb emissions	0.00005	g/Mg	Aasestad, 2007
Cd emissions	0.0001	g/Mg	Aasestad, 2007
Hg emissions	0.0001	g/Mg	Aasestad, 2007
As emissions	0.000159	g/Mg	Aasestad, 2007
Cr emissions	0.000354	g/Mg	Aasestad, 2007
Cu emissions	0.000152	g/Mg	Aasestad, 2007
PCDD/F emissions	0.1	pg TEQ/ cigarette	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

## II.5. Other Production (NFR sectors 2.H and 2.I)

Table A2.172 Emission factors applied for NFR 2.H.1

Source and emissions	Emission factor	EF unit
<b>Pulp and paper</b>		
NOx emissions	1	kg/Mg
CO emissions	5.5	kg/Mg
TSP emissions	1	kg/Mg
PM10 emissions	0.8	kg/Mg
PM2.5 emissions	0.6	kg/Mg

Note: emission factor was taken from EMEP/EEA Guidebook (2009)

Table A2.173 NMVOC emission factors applied for NFR 2.I and 2.H.1

Emission source	EF	EF unit	EF Reference
040601 Chipboard	0.0002	Mg/m <sup>3</sup>	PL (IETU)
040602 Paper pulp	0.001	Mg/Mg	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

Table A2.174 NMVOC emission factors applied for NFR 2.H.2

Emission source	EF	EF unit	EF Reference
040605 Bread	0.0045	Mg/Mg	CORINAIR
040606 Wine	0.000034	Mg/hl	CORINAIR
040607 Beer	0.00002	Mg/hl	CORINAIR
040608 Spirits	0.0024	Mg/hl 100%	CORINAIR

Note: PL (IETU) emission factors come from IETU surveys

Table A2.175 PCDD/F emission factors applied for NFR 2.H.2

Activity	EF	Unit	EF Reference
Other (smoke houses - clean fuel, no flue gas burn out)	6	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
Other (smoke houses - clean fuel, flue gas burn out)	0.6	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

## II.6. Other production, consumption, storage, transportation or handling of bulk products (NFR sector 2.L)

Table A2.176 PM emission factors applied for NFR 2.L

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
040617 Storage and transport of cement	0.01	0.005	0.0005	kg/Mg	CEPMEIP
040617 Storage and transport of coal	0.15	0.06	0.006	kg/Mg	CEPMEIP
040617 Storage and transport of coke	0.11	0.044	0.0044	kg/Mg	CEPMEIP

## III. NFR SECTOR 3 - AGRICULTURE

### III.1 Manure Management (NFR sector 3.B)

Table A2.177 NH<sub>3</sub> emission factors applied for NFR 3.B

NFR	Activity	EF	unit	EF reference
<b>3.B</b>	<b>Manure management</b>			
3.B.1.a	Dairy cows	21.05	kg NH <sub>3</sub> /animal/year	Country specific EF: Pietrzak 2006:  Metoda inwentaryzacji emisji amoniaku ze źródeł rolniczych w Polsce i jej praktyczne zastosowanie. ( <i>Inventory method for Ammonia emissions from agricultural sources in Poland and its practical application</i> ). Woda – Środowisko – Obszary Wiejskie. IMUZ Institute for Land Reclamation and Grassland Farming, 2006: t.6 z.1 (16), s. 319-334.
3.B.1.b	Other cattle	14.60	kg NH <sub>3</sub> /animal/year	
3.B.2	Sheep	1.46	kg NH <sub>3</sub> /animal/year	
3.B.4.d	Goats	1.46	kg NH <sub>3</sub> /animal/year	
3.B.4.e	Horses	9.73	kg NH <sub>3</sub> /animal/year	
3.B.3	Sows	8.64	kg NH <sub>3</sub> /animal/year	
3.B.3	Fattening pigs	6.33	kg NH <sub>3</sub> /animal/year	
3.B.4.g.i	Laying hens	0.29	kg NH <sub>3</sub> /animal/year	
3.B.4.g.ii	Broilers	0.02	kg NH <sub>3</sub> /animal/year	
3.B.4.g.iv	Other poultry	0.15	kg NH <sub>3</sub> /animal/year	
3.B.4.g.ii	Broilers	0.05	kg NH <sub>3</sub> /animal/year	Country specific EF: Atmoterm IŚ 2009: Poradnik metodyczny w zakresie PRTR dla instalacji do intensywnego chowu i hodowli drobiu ( <i>PRTR methodological guidelines for installations of intensive poultry breeding and husbandry</i> ). Atmoterm Inżynieria Środowiska Sp. z o.o. Warszawa, 2009.

Table A2.178 Nitrogen excreted (Nex) in manure by livestock (NFR 3.B)

Livestock	Nex [kg/head/year]
Dairy cattle:	
up to 3.5 thous. kg milk/cow/year	70.30
3.5- 4 thous. kg milk /cow/ year	75.90
4 - 6 thous. kg milk /cow/ year	86.70
above 6 thous. kg milk /cow/ year	119.30
Non-dairy cattle:	
calf (0-3 months)	4.09
calf (3-6 months)	8.64
heifer (6-12 months)	22.20
heifer (12-24 months)	42.40
bull (6-18 months)	22.80
bull (> 24 months)	45.70
Sheep:	
lamb (6-12 months)	3.81
sheep (> 1 year)	7.63
Horses:	
light weight horses	26.16
heavy weight horses	29.27
Swine:	
sows	15.50
sows with 18 litters	37.20
suckling pigs (20-30 kg)	6.69
piglets (30-70 kg)	14.76
butcher hogs (70-110 kg)	14.76

Source: [Jadczyzyn i in. 2000]

Table A2.179 PM emission factors applied for NFR 3.B

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>3.B Manure management</b>					
3.B.1.a Dairy cows	0.888000	0.400000	0.008880	kg/animal	CEPMEIP
3.B.1.b Other cattle	0.888000	0.400000	0.008880	kg/animal	CEPMEIP
3.B.3 Fattening pigs	0.867000	0.390000	0.008670	kg/animal	CEPMEIP
3.B.3 Sows	0.867000	0.390000	0.008670	kg/animal	CEPMEIP
3.B.4.e Horses	0.867000	0.390000	0.008670	kg/animal	CEPMEIP
3.B.4.g.i Laying hens	0.008310	0.003740	0.000831	kg/animal	CEPMEIP
3.B.4.g.ii Broilers	0.008310	0.003740	0.000831	kg/animal	CEPMEIP
3.B.4.g.iv Other poultry	0.554000	0.250000	0.005540	kg/animal	CEPMEIP

### III.2 Agricultural Soils (NFR sector 3.D)

Table A2.180 NH<sub>3</sub> emission factors applied for NFR 3.D.a.i

NFR	Activity	EF	unit	EF reference
3.D.a.i	Cultures with fertilisers	0.074	kg NH <sub>3</sub> /kg N	Country specific EF based on: Pietrzak 2006* and EMEP/CORINAIR Emission Inventory Guidebook - 2006

[Pietrzak S. 2006].

Table A2.181 NO<sub>x</sub> and NMVOC emission factors applied for NFR 3.D.a.i

Emission source	EF	EF unit	EF Reference
<b>3.D.a.i Cultures with fertilizers</b>			
NO <sub>x</sub> emission	0.009857	t NO <sub>x</sub> -N / t N-fertilizer	CORINAIR Emission Inventory Guidebook
NMVOC emission	0.0059554	kg/Gg fertilizer	EMEP EEA EIG 2009

### III.3 Field Burning of Agricultural Residues (NFR sector 3.F)

Table A2.182 PM emission factors applied for NFR 3.F

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
<b>3. Agriculture</b>					
3.F On-field burning of stubble	0.0058	0.0057	0.0054	Mg/Mg	EMEP/EEA GB 2013 table 3-1

Table A2.183 NMVOC emission factors applied for NFR 3.F

Emission source	EF	EF unit	EF Reference
<b>3. Agriculture</b>			
3.F On-field burning of stubble	0.0063	kg/kg of biomass	EMEP/EEA EIG 2009

Table A2.184 PCDD/F emission factors applied for NFR 3.F

SNAP	Activity	EF	Unit	EF Reference
3.F	On-field burning of stubble and straw	5	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

## IV. NFR SECTOR 5 – WASTE

### IV.1. Solid waste disposal on land (NFR SECTOR 5 A)

Table A2.185 NMVOC emission factors applied for NFR 5 A

Emission source	EF	EF unit
Municipal solid waste disposal on land	1.56	kg/Mg

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

### IV.2. Wastewater handling (NFR SECTOR 5D)

Table A2.186 NH<sub>3</sub> emission factors applied for NFR 5.D.1

Emission source	EF	unit	EF reference
Latrines	1.6	[kg/person/year]	EMEP/EEA (2009): <i>EMEP/EEA emission inventory guidebook 2009</i>

Table A2.187 NMVOC emission factors applied for 5.D

Emission source	EF	EF unit
Municipal Waste water treatment	15.0	mg/m <sup>3</sup>

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

### IV.3. Waste incineration (NFR SECTOR 5 C)

#### IV.3.1 Clinical waste incineration (NFR SECTOR 5.C.1.b.iii)

Table A2.188 SO<sub>2</sub> emission factors applied for NFR 5.C.1.b.iii

SO <sub>2</sub> emission source	Emission factor	EF unit
Clinical waste incineration	1.4	kg/Mg

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.189 NO<sub>x</sub> emission factors applied for NFR 5.C.1.b.iii

NO <sub>x</sub> emission source	Emission factor	EF unit
Clinical waste incineration	1.4	kg/Mg

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.190 NMVOC emission factors applied for NFR 5.C.1.b.iii

Emission source	EF	EF unit
Clinical waste incineration	0.0074	Mg/Mg

Note: emission factor applied was taken from Corinair

Table A2.191 PCDD/F emission factors applied for NFR 5.C.1.b.iii

Activity	EF	Unit	EF Reference
Clinical waste incineration (installations that comply with EU Directive)	1.38	mg TEQ/Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>
Clinical waste incineration (minimal APCs)	68	mg TEQ/Gg	GF/POL/01/004 <i>Enabling activities to facilitate early action on the impementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland</i>
Clinical waste incineration (no APCs)	453.3	mg TEQ/Gg	Grochowalski A. (2001): <i>Estimation and analysis of emission factors for PCDD/F and PAHs from selected sources for emission inventor purposes, 2001 (in Polish)</i>

Table A2.192 Emission factors of PCBs applied for NFR 5.C.1.b.iii

Activity	EF	Unit	EF Reference
Clinical waste incineration (installations that comply with EU Directive)	0.39	g/Gg	GF/POL/01/004 <i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland, 2002</i>
Clinical waste incineration (no or minimal APCs)	20	g/Gg	EMEP/CORINAIR atmospheric emission inventory guidebook.

Table A2.193 HCB emission factors applied for NFR 5.C.1.b.iii

Activity	EF	Unit	EF Reference
Clinical waste incineration (installations that comply with EU Directive)	0.295	g/Gg	GF/POL/01/004 <i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland, 2002</i>
Clinical waste incineration (no or minimal APCs)	29	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission</i> , Chemosphere 43 (2001),

### IV.3.2 Industrial waste incineration (including sludges) (NFR SECTOR 5.C.1.b)

Table A2.194 SO<sub>2</sub> emission factors applied for NFR 5.C.1.b.i

SO <sub>2</sub> emission source	Emission factor	EF unit
Industrial waste incineration	0.047	kg/Mg

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.195 NO<sub>x</sub> emission factors applied for NFR 5.C.1.b.i and 5.C.1.b.iv

NO <sub>x</sub> emission source	Emission factor	EF unit
Industrial waste incineration	0.87	kg/Mg
Sludge incineration	0.87	kg/Mg

Note: emission factors applied were taken from EMEP/EEA (2009) Guidebook

Table A2.196 PM emission factors applied for NFR 5.C.1.b.i

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Industrial waste incineration	0.1000	0.0600	0.0350	Mg/Mg	CEPMEIP

Table A2.197 NMVOC emission factors applied for NFR 5.C.1.b.i and 5.C.1.b.iv

Emission source	EF	EF unit
Industrial waste incineration	0.0074	Mg/Mg
Sludge incineration	0.0074	Mg/Mg

Note: emission factors applied were taken from Corinair

Table A2.198 PCDD/F emission factors applied for NFR 5.C.1.b.i and 5.C.1.b.iv

Activity	EF	Unit	EF Reference
Industrial waste incineration (no APCs)	3500	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
Industrial waste incineration (minimal APCs)	350	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
Industrial waste incineration (good APCs)	30	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
Industrial waste incineration (very good APCs)	0.5	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases, 2005</i>
Sewage sludge incineration (with	4	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan</i>

Activity	EF	Unit	EF Reference
APCs)			Releases, 2005

Table A2.199 Emission factors of PCBs applied for NFR 5.C.1.b.i

Activity	EF	Unit	EF Reference
Industrial waste incineration (no APCs)	30.4	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Industrial waste incineration (minimal APCs)	19.3	g/Gg	Parma at al. (1995): <i>Atmospheric emission inventory guidelines for persistent organic pollutants (POPs)</i>
Industrial waste incineration (good and very good APCs)	0.38	g/Gg	GF/POL/01/004 <i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland, 2002</i>

Table A2.200 HCB emission factors applied for NFR 5.C.1.b.i

Activity	EF	Unit	EF Reference
Industrial waste incineration (no or minimal APCs)	19	g/Gg	Bailey (2001): <i>Global hexachlorobenzene emission, Chemosphere 43 (2001),</i>
Industrial waste incineration (good and very good APCs)	0.139	g/Gg	GF/POL/01/004 <i>Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs Convention) in Poland, 2002</i>

### IV.3.3 Municipal waste incineration (NFR SECTOR 5.C.1.a)

Table A2.201 SO<sub>2</sub> emission factors applied for NFR 5.C.1.a

SO <sub>2</sub> emission source	Emission factor	EF unit
Municipal waste incineration	0.4	kg/Mg

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.202 NO<sub>x</sub> emission factors applied for NFR 5.C.1.a

NO <sub>x</sub> emission source	Emission factor	EF unit
Municipal waste incineration	1.8	kg/Mg

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.203 PM emission factors applied for NFR 5.C.1.a

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Municipal waste incineration	0.0001	0.0001	0.0001	Mg/Mg	CEPMEIP

Table A2.204 NMVOC emission factors applied for NFR 5.C.1.a

Emission source	EF	EF unit	EF Reference
Municipal waste incineration	0.0074	Mg/Mg	CORINAIR



Table A2.205 Main Heavy Metals emission factors applied for NFR 5.C.1.a

	Emission factors			Unit
	Cd	Hg	Pb	
Municipal wastes incineration	3	1.1	35	kg/Gg

Note: emission factors applied were taken from EMEP/EEA (2009) Guidebook

Table A2.206 Additional Heavy Metals emission factors applied for NFR 5.C.1.a

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
Municipal wastes incineration	kg/Gg	0.05	0.3	3	0.1	21

Note: Additional Heavy Metals emission factors applied were taken from international publications

Table A2.207 PCDD/F emission factors applied for NFR 5.C.1.a

Activity	EF	Unit	EF Reference
Municipal waste incineration (modern APCs)	0.5	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

Table A2.208 Emission factors of PCBs applied for NFR 5.C.1.a

Activity	EF	Unit	EF Reference
Municipal waste incineration	0.2	g/Gg	NILU (1999): <i>Environmental Cycling of Selected Persistent Organic Pollutants (POPs) in the Baltic Region (POPCYCLING)</i>

Table A2.209 HCB emission factors applied for NFR 5.C.1.a

Activity	EF	Unit	EF Reference
Municipal waste incineration	0.15	g/Gg	EF applied in Hungary

#### IV.3.4 Cremations (NFR SECTOR 5.C.1.b.v)

Table A2.210 SO<sub>2</sub> emission factors applied for NFR 5.C.1.b.v

SO <sub>2</sub> emission source	Emission factor	EF unit
Cremations	0.544	kg/body

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.211 NO<sub>x</sub> emission factors applied for NFR 5.C.1.b.v

NO <sub>x</sub> emission source	Emission factor	EF unit
Cremations	0.309	kg/body

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.212 CO emission factors applied for NFR 5.C.1.b.v

CO emission source	Emission factor	EF unit
Cremations	0.14	kg/body

Note: emission factor applied was taken from EMEP/EEA (2009) Guidebook

Table A2.213 NMVOC emission factors applied for NFR 5.C.1.b.v

Emission source	EF	EF unit
Cremations	0.013	Mg/1000 body

Note: emission factors applied were taken from Corinair

Table A2.214 Main Heavy Metals emission factors applied for NFR 5.C.1.b.v

Emission source	Emission factors			Unit
	Cd	Hg	Pb	
Cremations	0.00311	0.934	0.0186	g/1000 body

Note: emission factors applied were taken from EMEP/EEA (2009) Guidebook

Table A2.215 Additional Heavy Metals emission factors applied for NFR 5.C.1.b.v

Emission source	Unit	Emission factors				
		As	Cr	Cu	Ni	Zn
Cremations	g/1000 body	0.011	0.00311	0.00771	0.0107	

Note: emission factors applied were taken from EMEP/EEA (2009) Guidebook

Table A2.216 PCDD/F emission factors applied for NFR 5.C.1.b.v

Activity	EF	Unit	EF Reference
Cremations	10	µg TEQ / cremation	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

#### IV.3.5 Open burning of agricultural wastes (NFR SECTOR 5.C.2)

Table A2.217 NO<sub>x</sub> emission factors applied for NFR 5.C.2

NO <sub>x</sub> emission source	Emission factor	EF unit
Open burning of agricultural wastes	0.004	Mg/Mg

Note: emission factors applied for Open burning of agricultural wastes is country specific

Table A2.218 CO emission factors applied for NFR 5.C.2

CO emission source	Emission factor	EF unit
Open burning of agricultural wastes	0.064	Mg/Mg

Note: emission factors applied for Open burning of agricultural wastes is country specific

Table A2.219 PM emission factors applied for NFR 5.C.2

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Open burning of agricultural wastes	0.00464	0.00451	0.00419	Mg/Mg	EMEPP/EEA GB 2013 table 3-1

Table A2.220 NMVOC emission factors applied for NFR 5.C.2

Emission source	EF	EF unit	EF Reference
Open burning of agricultural wastes	0.002	Mg/Mg	CORINAIR

Table A2.221 PCDD/F emission factors applied for NFR 5.C.2

Activity	EF	Unit	EF Reference
Open burning of agricultural wastes (excluding SNAP 1003)	0.5	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
Open burning of agricultural wastes (poor combustion conditions)	30	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

## V. Memo Items.

### V.1 Aviation

It was assumed that emission factors for Cruise traffic per fuel use are the same as used for LTO cycle.

### V.2 Other not included in national total (NFR 6 A)

Table A2.222 PM emission factors applied for NFR 6 A

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Car fires	0.0023	0.0023	0.0023	g/amount of fires	Aasestad, 2007

Table A2.223 NMVOC emission factors applied for NFR 7 B

Emission source	EF	EF unit	EF Reference
Non-managed broadleaf forests	10	kg/ha	PL (IETU)
Non-managed coniferous forests	40	kg/ha	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys.

This category of NMVOC emissions will be moved to 11 C category.

### V.3 Forests fires (NFR 11 B)

Table A2.224 PM emission factors applied for NFR 11 B

PM Emission source	Emission factor			EF unit	EF reference
	TSP	PM10	PM2.5		
Forests fires	0.0047	0.0033	0.00282	Mg/Mg	CEPMEIP

Table A2.225 NMVOC emission factors applied for NFR 11 B

Emission source	EF	EF unit	EF Reference
Forest fires	0.013	Mg/ha	PL (IETU)

Note: PL (IETU) emission factors come from IETU surveys

#### V.4 PCDD/F emissions from fires

Table A2.226 PCDD/F emission factors applied for fires

Activity	EF	Unit	EF Reference
Forest and other vegetation fires	5	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
Landfill fires - surface)	0.07	g TEQ/ fire	Update of Dioxin Emission Factors for Forest Fires, Grassland and Moor Fires, Open Burning of Agricultural Residues, Open Burning of Domestic Waste, Landfills and Dump Fires. Pat Costner International POPs Elimination Network, 2006. <a href="http://www.ipen.org/ipenweb/work/dioxin.html">http://www.ipen.org/ipenweb/work/dioxin.html</a>
Landfill fires- deep	0.35	g TEQ/ fire	
Automobile fires	94	µg TEQ / fire of vehicle	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005
Houses and industry plants fires	400	mg TEQ/Gg	UNEP Chemicals (2005): <i>Standardized Toolkit for Identification and Quantification of dioxin and Furan Releases</i> , 2005

### Appendix 3: Key category analysis

Key source categories are here sources that together contribute up to 95 % of the level of reported emissions in Poland. For this report level assessments were carried out for the following pollutants: NO<sub>x</sub>, CO, NMVOC, SO<sub>2</sub>, NH<sub>3</sub>, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, dioxins and furans (PCDD/F), PCB, HCB and PAH. The level assessment was performed for the year 1990 and 2014. The ten largest key sources from the 2014 level assessment are presented in the table A1.1. Detailed analysis for the particular pollutants is presented in the tables below.

Table A3.1 The ten largest key sources from the level assessment for 2014

Pollutant	Key sources in descending order									
SO <sub>2</sub>	1A1a	1A4bi	1A2c	1A4ci	1A2a	1A2f	1A4ai	1A2e		
NO <sub>x</sub>	1A1a	1A3bi	1A4cii	1A3biii	1A4bi	1A3bii	1A2f	1A4ai	3Da1	1A2a
CO	1A4bi	1A3bi	1A4ci	1A2a	1A4cii	1A3bii	1A1a	1A2f	1A3biii	1A2c
NH <sub>3</sub>	3Da1	3B3	3B1a	3B1b	3B4gi	3B4gii				
TSP	1A4bi	1A3bvii	1A1a	1A4ci	1A3bvi	5C1bi	1B1a	2L	3B4giv	1A4cii
NMVOC	2D3d	1A4bi	1A3bv	2D3a	1A3bi	1B2aiv	2D3g	2B10a	1A1a	1A4ci
Cd	1A2b	1A4bi	2C1	1A2c	1A2a	1A1a	1A2f	1A2e	1A1b	1A2d
Hg	1A1a	1A2b	1A4bi	2C1	1A2f	1A4ai	1A4ci	1A2c		
Pb	1A2b	1A4bi	2C1	1A1a	1A3bi	2A3	1A4ai	1A2c	1A2a	1A4ci
As	1A2b	1A4bi	1A1a	1A4ci	1A4ai	1A2c	1A2a			
Cr	1A4bi	1A1a	2C1	2A3	1A4ci	1B1b	2A1	1A3bi	1A2c	1A4ai
Cu	1A2b	1A4bi	1A1a	2C1	1A4ci	1A4ai	1A2c	1A2a		
Ni	1A4bi	1A1a	1A1b	1A4ci	2C1	1A2c	1A4ai	1A2a	1A3bi	1A2f
Zn	1A4bi	1A2b	2C1	1A1a	1A4ci	1A4ai	1A2c	1A2a	1A2f	
PCDD/F	1A4bi	1A2b	2A2	1A1a	3F	1A2a	2C1	1B1b		
HCB	1A2b	1A4bi	1A3bi	1A2a	1A1a	5C1bi	1A3bii	1A2f		
PCB	1A4bi	1A1a	1A3biii	2C1						
PAH	1A4bi	1B1b								

### Sulphur dioxide emissions

Eight source categories have been identified as key sources (level assessment) in SO<sub>2</sub> inventory in Poland. The most important of them are Public Electricity and Heat Production and stationary combustion of fuels in residential plants.

Table A3.2 Level Assessment for sulphur dioxide emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Gg	%	%			Gg	%	%
1A1a	Public electricity and heat production	2164.028	76.95	76.95	1A1a	Public electricity and heat production	401.559	50.19	50.19
1A4bi	Residential: Stationary	251.390	8.94	85.89	1A4bi	Residential: Stationary	203.540	25.44	75.63
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	111.992	3.98	89.87	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	34.789	4.35	79.98
1A4ai	Commercial/institutional: Stationary	66.345	2.36	92.23	1A4ci	Agriculture/Forestry/Fishing: Stationary	33.839	4.23	84.21
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	62.239	2.21	94.44	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	25.297	3.16	87.37
1A4ci	Agriculture/Forestry/Fishing: Stationary	33.994	1.21	95.65	1A2f	Stationary combustion in manufacturing industries and	23.954	2.99	90.36

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Gg	%	%			Gg	%	%
						construction: Non-metallic minerals			
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	29.387	1.04	96.69	1A4ai	Commercial/institutional: Stationary	21.394	2.67	93.03
1A1c	Manufacture of solid fuels and other energy industries	18.092	0.64	97.34	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	17.861	2.23	95.27

## Carbon monoxide emissions

Eleven source categories have been identified as key sources (level assessment) in CO inventory in Poland. The most important of them are combustion of fuels in households and road transportation by passenger cars.

Table A3.3 Level Assessment for carbon monoxide emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Gg	%	%			Gg	%	%
1A4bi	Residential: Stationary	1077.294	43.15	43.15	1A4bi	Residential: Stationary	1501.254	55.53	55.53
1A3bi	Road transport: Passenger cars	495.520	19.85	63.00	1A3bi	Road transport: Passenger cars	448.353	16.58	72.11
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	217.288	8.70	71.70	1A4ci	Agriculture/Forestry/Fishing: Stationary	165.444	6.12	78.23
1A3bii	Road transport: Light duty vehicles	165.649	6.64	78.34	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	153.941	5.69	83.92
1A3biii	Road transport: Heavy duty vehicles and buses	124.166	4.97	83.31	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	73.908	2.73	86.66
1A4ci	Agriculture/Forestry/Fishing: Stationary	113.008	4.53	87.84	1A3bii	Road transport: Light duty vehicles	57.921	2.14	88.80
1A1a	Public electricity and heat production	54.718	2.19	90.03	1A1a	Public electricity and heat production	48.383	1.79	90.59
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	54.649	2.19	92.22	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	47.055	1.74	92.33
1A3biv	Road transport: Mopeds & motorcycles	41.786	1.67	93.89	1A3biii	Road transport: Heavy duty vehicles and buses	39.021	1.44	93.77
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	30.609	1.23	95.12	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	26.015	0.96	94.73
2C1	Iron and steel production	29.395	1.18	96.30	2C1	Iron and steel production	24.287	0.90	95.63

## Nitrogen oxides emission

Fifteen source categories have been identified as key sources (level assessment) in NO<sub>x</sub> inventory in Poland. The most important of them are: stationary combustion of fuels for energy production in public power plants, road transportation, agriculture and households.

Table A3.4 Level Assessment for nitrogen oxides emission sources in 1990 and 2014

NFR code	NFR Source Category	1990	Level	Cumulative	NFR code	NFR Source Category	2014	Level	Cumulative
		Estimate	Assessment	Total of Emission			Estimate	Assessment	Total of Emission
		Gg	%	%			Gg	%	%
1A1a	Public electricity and heat production	552.122	51.41	51.41	1A1a	Public electricity and heat production	231.947	32.08	32.08
1A3biii	Road transport: Heavy duty vehicles and buses	132.642	12.35	63.76	1A3bi	Road transport: Passenger cars	110.773	15.32	47.39
1A3bi	Road transport: Passenger cars	72.157	6.72	70.48	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	84.580	11.70	59.09
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	62.540	5.82	76.30	1A3biii	Road transport: Heavy duty vehicles and buses	70.302	9.72	68.81
1A4bi	Residential: Stationary	57.061	5.31	81.62	1A4bi	Residential: Stationary	61.922	8.56	77.38
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	30.094	2.80	84.42	1A3bii	Road transport: Light duty vehicles	38.476	5.32	82.70
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	27.903	2.60	87.02	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	15.374	2.13	84.82
1A3bii	Road transport: Light duty vehicles	24.320	2.26	89.28	1A4ai	Commercial/institutional: Stationary	14.205	1.96	86.79
1A3c	Railways	23.470	2.19	91.47	3Da1	Inorganic N-fertilizers (includes also urea application)	10.828	1.50	88.29
1A4ai	Commercial/institutional: Stationary	15.821	1.47	92.94	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	10.043	1.39	89.67
1A4ciii	Agriculture/Forestry/Fishing: National fishing	12.883	1.20	94.14	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	9.853	1.36	91.04
3Da1	Inorganic N-fertilizers (includes also urea application)	12.558	1.17	95.31	2B2	Nitric acid production	8.990	1.24	92.28
1A1c	Manufacture of solid fuels and other energy industries	7.759	0.72	96.03	1A4ci	Agriculture/Forestry/Fishing: Stationary	7.909	1.09	93.37
1A1b	Petroleum refining	6.681	0.62	96.65	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	6.582	0.91	94.28
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	6.559	0.61	97.27	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	6.438	0.89	95.17

### Ammonia emissions

Six source categories have been identified as key sources (level assessment) in NH<sub>3</sub> inventory in Poland. The most important of them are: use of fertilizers and manure management.

Table A3.5 Level Assessment for ammonia emission sources in 1990 and 2014

NFR code	NFR Source Category	1990	Level	Cumulative	NFR code	NFR Source Category	2014	Level	Cumulative
		Estimate	Assessment	Total of Emission			Estimate	Assessment	Total of Emission
		Gg	%	%			Gg	%	%
3B1a	Manure management - Dairy cattle	103.526	25.02	25.02	3Da1	Inorganic N-fertilizers (includes also urea application)	80.781	30.47	30.47
3Da1	Inorganic N-fertilizers (includes also urea application)	93.690	22.65	47.67	3B3	Manure management - Swine	56.097	21.16	51.63
3B3	Manure management - Swine	84.789	20.50	68.17	3B1a	Manure management - Dairy cattle	52.175	19.68	71.31
3B1b	Manure management - Non-dairy cattle	74.891	18.10	86.27	3B1b	Manure management - Non-dairy cattle	50.335	18.98	90.29
3B4gi	Manure management - Laying hens	16.259	3.93	90.20	3B4gi	Manure management - Laying hens	12.195	4.60	94.89
5D1	Domestic wastewater handling	10.444	2.52	92.73	3B4gii	Manure management - Broilers	4.057	1.53	96.42

## Particulate matter emissions

Twenty five source categories have been identified as key sources (level assessment) in TSP inventory in Poland. The most important of them are: stationary combustion of fuels in residential plants, Public Electricity and Heat Production and road transport (road abrasion).

Table A3.6 Level Assessment for TSP emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Gg	%	%			Gg	%	%
1A1a	Public electricity and heat production	562.243	56.64	56.64	1A4bi	Residential: Stationary	118.430	30.91	30.91
1A4bi	Residential: Stationary	153.418	15.45	72.09	1A3bvii	Road transport: Automobile road abrasion	38.218	9.97	40.89
5C1bi	Industrial waste incineration	25.091	2.53	74.62	1A1a	Public electricity and heat production	32.747	8.55	49.43
1A4ai	Commercial/institutional: Stationary	24.109	2.43	77.05	1A4ci	Agriculture/Forestry/Fishing: Stationary	24.086	6.29	55.72
2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	23.788	2.40	79.44	1A3bvi	Road transport: Automobile tyre and brake wear	19.907	5.20	60.91
1B1a	Fugitive emission from solid fuels: Coal mining and handling	21.896	2.21	81.65	5C1bi	Industrial waste incineration	14.154	3.69	64.61
3B4giv	Manure management - Other poultry	20.329	2.05	83.70	1B1a	Fugitive emission from solid fuels: Coal mining and handling	13.951	3.64	68.25
1A4ci	Agriculture/Forestry/Fishing: Stationary	18.983	1.91	85.61	2L	Other production, consumption, storage, transportation or handling of bulk products (please specify in the IIR)	12.201	3.18	71.43
1A3bvii	Road transport: Automobile road abrasion	16.285	1.64	87.25	3B4giv	Manure management - Other poultry	9.368	2.45	73.88
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	16.012	1.61	88.86	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	8.283	2.16	76.04
1A3biii	Road transport: Heavy duty vehicles and buses	14.267	1.44	90.30	1A3bi	Road transport: Passenger cars	8.010	2.09	78.13
3B3	Manure management - Swine	11.039	1.11	91.41	1A4ai	Commercial/institutional: Stationary	7.408	1.93	80.07
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	10.384	1.05	92.46	3B3	Manure management - Swine	7.369	1.92	81.99
2C1	Iron and steel production	9.854	0.99	93.45	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	7.030	1.83	83.82
1A3bvi	Road transport: Automobile tyre and brake wear	8.667	0.87	94.32	1A3biii	Road transport: Heavy duty vehicles and buses	5.978	1.56	85.38
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	6.124	0.62	94.94	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	5.656	1.48	86.86
5A	Biological treatment of waste - Solid waste disposal on land	5.133	0.52	95.46	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	5.186	1.35	88.21
3B1b	Manure management - Non-dairy cattle	4.555	0.46	95.92	2C1	Iron and steel production	4.592	1.20	89.41
3B1a	Manure management - Dairy cattle	4.368	0.44	96.36	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	3.566	0.93	90.34
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	4.178	0.42	96.78	2A5a	Quarrying and mining of minerals other than coal	3.562	0.93	91.27
2A5a	Quarrying and mining of minerals other than coal	3.000	0.30	97.08	2A1	Cement production	3.479	0.91	92.18
2G	Other product use (please specify in the IIR)	2.823	0.28	97.36	3B1b	Manure management - Non-dairy cattle	3.062	0.80	92.98
2A1	Cement production	2.754	0.28	97.64	2B10a	Chemical industry: Other (please specify in the IIR)	2.755	0.72	93.70
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	2.748	0.28	97.92	5A	Biological treatment of waste - Solid waste disposal on land	2.621	0.68	94.38
1A3c	Railways	2.609	0.26	98.18	1A3bii	Road transport: Light duty vehicles	2.567	0.67	95.05



## NMVOCs emissions

Twenty two source categories have been identified as key sources (level assessment) in NMVOC inventory in Poland. The most important of them are: industrial paint application, stationary combustion of fuels in households, gasoline evaporation, domestic solvent use and road transportation by passenger cars.

Table A3.7 Level Assessment for NMVOC emission sources in 1990 and 2014

NFR code	NFR Source Category	1990	Level	Cumulative	NFR code	NFR Source Category	2014	Level	Cumulative
		Estimate	Assessment	Total of Emission			Estimate	Assessment	Total of Emission
		Gg	%	%			Gg	%	%
1A3bi	Road transport: Passenger cars	114.590	21.00	21.00	2D3d	Coating applications	120.105	19.81	19.81
1A4bi	Residential: Stationary	69.585	12.75	33.75	1A4bi	Residential: Stationary	95.075	15.68	35.49
2D3a	Domestic solvent use including fungicides	45.688	8.37	42.12	1A3bv	Road transport: Gasoline evaporation	50.773	8.37	43.87
1A3biii	Road transport: Heavy duty vehicles and buses	35.307	6.47	48.59	2D3a	Domestic solvent use including fungicides	46.195	7.62	51.49
1A3bii	Road transport: Light duty vehicles	32.480	5.95	54.55	1A3bi	Road transport: Passenger cars	35.640	5.88	57.36
1A3bv	Road transport: Gasoline evaporation	25.652	4.70	59.25	1B2aiv	Fugitive emissions oil: Refining / storage	29.537	4.87	62.24
2D3d	Coating applications	22.800	4.18	63.43	2D3g	Chemical products	27.408	4.52	66.76
1A1a	Public electricity and heat production	22.151	4.06	67.49	2B10a	Chemical industry: Other (please specify in the IIR)	23.379	3.86	70.61
1A3biv	Road transport: Mopeds & motorcycles	18.302	3.35	70.84	1A1a	Public electricity and heat production	21.494	3.55	74.16
1B2aiv	Fugitive emissions oil: Refining / storage	15.624	2.86	73.70	1A4ci	Agriculture/Forestry/Fishing: Stationary	16.087	2.65	76.81
1B1a	Fugitive emission from solid fuels: Coal mining and handling	14.767	2.71	76.41	1A3biii	Road transport: Heavy duty vehicles and buses	15.525	2.56	79.37
2H2	Food and beverages industry	14.741	2.70	79.11	1B2av	Distribution of oil products	13.805	2.28	81.65
2B10a	Chemical industry: Other (please specify in the IIR)	14.298	2.62	81.73	1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	13.507	2.23	83.88
1B2av	Distribution of oil products	14.029	2.57	84.30	2D3e	Degreasing	10.441	1.72	85.60
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	9.988	1.83	86.13	2H2	Food and beverages industry	10.228	1.69	87.29
1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	9.896	1.81	87.95	1B2b	Fugitive emissions from natural gas (exploration, production, processing, transmission, storage, distribution and other)	9.255	1.53	88.81
2D3g	Chemical products	7.903	1.45	89.39	1A3biv	Road transport: Mopeds & motorcycles	7.988	1.32	90.13
1A4ci	Agriculture/Forestry/Fishing: Stationary	7.639	1.40	90.79	2D3i	Other solvent use (please specify in the IIR)	7.608	1.25	91.38
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	6.869	1.26	92.05	1B1a	Fugitive emission from solid fuels: Coal mining and handling	7.327	1.21	92.59
2D3f	Dry cleaning	5.711	1.05	93.10	1A3bii	Road transport: Light duty vehicles	7.281	1.20	93.79
1A3c	Railways	5.258	0.96	94.06	2D3f	Dry cleaning	5.774	0.95	94.75
2C1	Iron and steel production	4.642	0.85	94.91	1B1b	Fugitive emission from solid fuels: Solid fuel transformation	4.784	0.79	95.54

## Heavy metal emissions

Tables below include emission Level Assessment estimates for Cd, Hg, Pb, As, Cr, Cu, Ni and Zn according to NFR classification.

Fifteen source categories have been identified as key sources (level assessment) in Cd inventory in Poland. The most important of them are: combustion in manufacturing industries, especially in metals production and stationary combustion of fuels in residential plants,.

Table A3.8 Level Assessment for Cd emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A1a	Public electricity and heat production	4.003	17.94	17.94	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	2.661	19.19	19.19
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	3.993	17.90	35.85	1A4bi	Residential: Stationary	1.832	13.22	32.40
2C1	Iron and steel production	2.763	12.39	48.23	2C1	Iron and steel production	1.773	12.78	45.19
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	2.590	11.61	59.84	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	1.392	10.04	55.22
1A4bi	Residential: Stationary	2.504	11.23	71.07	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	1.120	8.07	63.30
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	1.362	6.11	77.17	1A1a	Public electricity and heat production	1.067	7.69	70.99
1A4ai	Commercial/institutional: Stationary	1.091	4.89	82.06	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	1.001	7.22	78.21
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	1.042	4.67	86.73	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.706	5.09	83.30
2B10a	Chemical industry: Other (please specify in the IIR)	0.739	3.31	90.05	1A1b	Petroleum refining	0.383	2.77	86.06
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.687	3.08	93.13	1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.321	2.32	88.38
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.385	1.73	94.85	1A4ci	Agriculture/Forestry/Fishing: Stationary	0.281	2.03	90.41
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.282	1.26	96.12	2B10a	Chemical industry: Other (please specify in the IIR)	0.220	1.58	91.99
1A1b	Petroleum refining	0.282	1.26	97.38	1A3bi	Road transport: Passenger cars	0.205	1.48	93.47
1A1c	Manufacture of solid fuels and other energy industries	0.146	0.65	98.03	1A4ai	Commercial/institutional: Stationary	0.186	1.34	94.82
1A3biii	Road transport: Heavy duty vehicles and buses	0.121	0.54	98.57	2A3	Glass production	0.164	1.18	96.00

Eight source categories have been identified as key sources (level assessment) in Hg inventory in Poland. The most important of them are: Public Electricity and Heat Production, combustion in manufacturing industries, especially in metals production and also stationary combustion of fuels in residential plants.

Table A3.9 Level Assessment for Hg emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A1a	Public electricity and heat production	10.188	71.86	71.86	1A1a	Public electricity and heat production	5.342	55.68	55.68
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	1.297	9.15	81.01	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	1.870	19.49	75.17
1A4bi	Residential: Stationary	0.691	4.87	85.88	1A4bi	Residential: Stationary	0.603	6.29	81.46
1A4ai	Commercial/institutional: Stationary	0.462	3.26	89.14	2C1	Iron and steel production	0.441	4.59	86.06
2C1	Iron and steel production	0.370	2.61	91.75	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.394	4.10	90.16
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.277	1.95	93.70	1A4ai	Commercial/institutional: Stationary	0.231	2.40	92.56
2A1	Cement production	0.250	1.77	95.47	1A4ci	Agriculture/Forestry/Fishing: Stationary	0.177	1.85	94.41

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.179	1.27	96.73	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.132	1.37	95.79

Ten source categories have been identified as key sources (level assessment) in Pb inventory in Poland. The most important of them are: combustion in non-ferrous metals production, stationary combustion of fuels in residential plants and iron and steel production.

Table A3.10 Level Assessment for Pb emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	161.433	26.67	26.67	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	205.744	39.78	39.78
1A4bi	Residential: Stationary	155.781	25.74	52.41	1A4bi	Residential: Stationary	125.141	24.19	63.97
2C1	Iron and steel production	99.342	16.41	68.83	2C1	Iron and steel production	82.515	15.95	79.92
1A1a	Public electricity and heat production	48.129	7.95	76.78	1A1a	Public electricity and heat production	27.769	5.37	85.29
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	29.874	4.94	81.71	1A3bi	Road transport: Passenger cars	13.529	2.62	87.90
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	17.139	2.83	84.55	2A3	Glass production	10.927	2.11	90.02
1A3bi	Road transport: Passenger cars	17.047	2.82	87.36	1A4ai	Commercial/institutional: Stationary	8.986	1.74	91.75
1A4ai	Commercial/institutional: Stationary	14.835	2.45	89.81	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	8.499	1.64	93.40
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	12.965	2.14	91.96	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	6.838	1.32	94.72
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	12.602	2.08	94.04	1A4ci	Agriculture/Forestry/Fishing: Stationary	6.483	1.25	95.97

Eight source categories have been identified as key sources (level assessment) in As inventory in Poland. The most important of them are: combustion in non-ferrous metals production, stationary combustion of fuels in residential plants and in Public Electricity and Heat Production.

Table A3.11 Level Assessment for As emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A4bi	Residential: Stationary	14.034	27.20	27.20	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	18.069	41.17	41.17
1A1a	Public electricity and heat production	13.634	26.42	53.62	1A4bi	Residential: Stationary	13.495	30.75	71.92
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	11.870	23.00	76.62	1A1a	Public electricity and heat production	5.163	11.76	83.68
2C1	Iron and steel production	3.798	7.36	83.98	1A4ci	Agriculture/Forestry/Fishing: Stationary	2.398	5.46	89.15
1A4ci	Agriculture/Forestry/Fishing: Stationary	2.092	4.05	88.04	1A4ai	Commercial/institutional: Stationary	0.925	2.11	91.26
1A4ai	Commercial/institutional: Stationary	1.933	3.75	91.78	2C1	Iron and steel production	0.735	1.67	92.93
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	1.720	3.33	95.12	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.687	1.57	94.50

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	1.116	2.16	97.28	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.553	1.26	95.76

Twelve source categories have been identified as key sources (level assessment) in Cr inventory in Poland. The most important of them are: stationary combustion of fuels in residential plants, Public electricity and heat production and iron and steel production.

Table A3.12 Level Assessment for Cr emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
2C1	Iron and steel production	45.267	45.88	45.88	1A4bi	Residential: Stationary	16.299	36.35	36.35
1A1a	Public electricity and heat production	17.542	17.78	63.65	1A1a	Public electricity and heat production	6.271	13.98	50.33
1A4bi	Residential: Stationary	17.374	17.61	81.26	2C1	Iron and steel production	6.145	13.70	64.03
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	3.275	3.32	84.58	2A3	Glass production	2.732	6.09	70.12
1A4ai	Commercial/institutional: Stationary	2.949	2.99	87.57	1A4ci	Agriculture/Forestry/Fishing: Stationary	2.701	6.02	76.15
1A4ci	Agriculture/Forestry/Fishing: Stationary	2.492	2.53	90.10	1B1b	Fugitive emission from solid fuels: Solid fuel transformation	1.627	3.63	79.78
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	2.336	2.37	92.46	2A1	Cement production	1.581	3.53	83.30
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	2.124	2.15	94.62	1A3bi	Road transport: Passenger cars	1.573	3.51	86.81
2A1	Cement production	1.252	1.27	95.88	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	1.213	2.71	89.52
1A3bi	Road transport: Passenger cars	0.997	1.01	96.90	1A4ai	Commercial/institutional: Stationary	1.206	2.69	92.21
2A3	Glass production	0.863	0.87	97.77	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.976	2.18	94.38
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.855	0.87	98.64	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.790	1.76	96.14

Eight source categories have been identified as key sources (level assessment) in Cu inventory in Poland. The most important of them are: stationary combustion in manufacturing industries, especially in non-ferrous metals production, stationary combustion of fuels in residential plants and Public electricity and heat production.

Table A3.13 Level Assessment for Cu emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	118.327	35.44	35.44	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	181.046	55.47	55.47
1A4bi	Residential: Stationary	77.589	23.24	58.68	1A4bi	Residential: Stationary	72.221	22.13	77.60
1A1a	Public electricity and heat production	64.640	19.36	78.03	1A1a	Public electricity and heat production	19.115	5.86	83.46
2C1	Iron and steel production	19.574	5.86	83.90	2C1	Iron and steel production	15.816	4.85	88.31
1A4ai	Commercial/institutional: Stationary	13.365	4.00	87.90	1A4ci	Agriculture/Forestry/Fishing: Stationary	11.445	3.51	91.81
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	12.366	3.70	91.60	1A4ai	Commercial/institutional: Stationary	5.175	1.59	93.40
1A4ci	Agriculture/Forestry/Fishing: Stationary	10.801	3.23	94.84	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	4.555	1.40	94.80
1A2a	Stationary combustion in	8.020	2.40	97.24	1A2a	Stationary combustion in	3.665	1.12	95.92

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
	manufacturing industries and construction: Iron and steel					manufacturing industries and construction: Iron and steel			

Thirteen source categories have been identified as key sources (level assessment) in Ni inventory in Poland. The most important of them are: stationary combustion of fuels in residential plants, Public electricity and heat production and Petroleum refining.

Table A3.14 Level Assessment for Ni emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A1a	Public electricity and heat production	90.779	37.28	37.28	1A4bi	Residential: Stationary	60.677	43.71	43.71
1A4bi	Residential: Stationary	66.099	27.15	64.43	1A1a	Public electricity and heat production	19.550	14.08	57.80
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	19.535	8.02	72.45	1A1b	Petroleum refining	9.711	7.00	64.79
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	12.669	5.20	77.65	1A4ci	Agriculture/Forestry/Fishing: Stationary	9.584	6.90	71.70
1A4ai	Commercial/institutional: Stationary	11.927	4.90	82.55	2C1	Iron and steel production	6.336	4.56	76.26
1A4ci	Agriculture/Forestry/Fishing: Stationary	11.211	4.60	87.15	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	5.058	3.64	79.91
2C1	Iron and steel production	9.218	3.79	90.94	1A4ai	Commercial/institutional: Stationary	4.661	3.36	83.26
1A1b	Petroleum refining	7.514	3.09	94.03	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	4.070	2.93	86.19
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	5.098	2.09	96.12	1A3bi	Road transport: Passenger cars	3.624	2.61	88.81
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	1.379	0.57	96.69	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	3.292	2.37	91.18
1A3bii	Road transport: Heavy duty vehicles and buses	1.259	0.52	97.20	1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	2.566	1.85	93.03
2A1	Cement production	1.252	0.51	97.72	2A3	Glass production	2.185	1.57	94.60
1A3bi	Road transport: Passenger cars	1.092	0.45	98.16	2A1	Cement production	1.581	1.14	95.74

Nine source categories have been identified as key sources (level assessment) in Zn inventory in Poland. The most important of them are: stationary combustion of fuels in residential plants, stationary combustion of fuels in non-ferrous metals production and iron and steel production.

Table A3.15 Level Assessment for Zn emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A4bi	Residential: Stationary	533.064	29.69	29.69	1A4bi	Residential: Stationary	498.719	36.50	36.50
1A1a	Public electricity and heat production	405.094	22.56	52.24	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	355.263	26.00	62.49
2C1	Iron and steel production	332.029	18.49	70.73	2C1	Iron and steel production	158.111	11.57	74.07
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	167.873	9.35	80.08	1A1a	Public electricity and heat production	107.487	7.87	81.93
1A2f	Stationary combustion in manufacturing industries and construction: Non-	91.375	5.09	85.17	1A4ci	Agriculture/Forestry/Fishing : Stationary	77.933	5.70	87.63

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
	metallic minerals								
1A4ai	Commercial/institutional: Stationary	90.639	5.05	90.22	1A4ai	Commercial/institutional: Stationary	36.569	2.68	90.31
1A4ci	Agriculture/Forestry/Fishing: Stationary	71.784	4.00	94.22	1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	35.109	2.57	92.88
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	59.258	3.30	97.52	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	28.247	2.07	94.95
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	23.845	1.33	98.84	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	22.851	1.67	96.62

### PCDD/F emissions

Eight source categories have been identified as key sources (level assessment) in PCDD/F inventory in Poland. The most important of them are: stationary combustion of fuels in residential plants, stationary combustion in manufacturing of Non-ferrous metals and Lime production.

Table A3.16 Level Assessment for PCDD/F emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		g i-TEQ	%	%			g i-TEQ	%	%
1A4bi	Residential: Stationary	133.723	48.13	48.13	1A4bi	Residential: Stationary	138.324	57.48	57.48
1A4ai	Commercial/institutional: Stationary	34.858	12.55	60.68	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	22.228	9.24	66.71
2A2	Lime production	32.000	11.52	72.20	2A2	Lime production	18.173	7.55	74.26
3F	Field burning of agricultural residues	21.496	7.74	79.93	1A1a	Public electricity and heat production	13.119	5.45	79.71
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	17.655	6.35	86.29	3F	Field burning of agricultural residues	11.909	4.95	84.66
2C1	Iron and steel production	15.501	5.58	91.87	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	11.029	4.58	89.25
1A1a	Public electricity and heat production	11.313	4.07	95.94	2C1	Iron and steel production	11.001	4.57	93.82
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	4.122	1.48	97.42	1B1b	Fugitive emission from solid fuels: Solid fuel transformation	2.870	1.19	95.01

### HCB emissions

Eight source categories have been identified as key sources (level assessment) in HCB inventory in Poland. The most important of them are: non-ferrous metals production, stationary combustion of fuels in residential plants and transport emissions from passenger cars.

Table A3.17 Level Assessment for HCB emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		kg	%	%			kg	%	%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	1.686	22.49	22.49	1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	6.183	45.55	45.55
1A4bi	Residential: Stationary	1.654	22.06	44.55	1A4bi	Residential: Stationary	1.659	12.22	57.77
5C1bi	Industrial waste incineration	1.207	16.10	60.66	1A3bi	Road transport: Passenger cars	1.436	10.58	68.35

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		kg	%	%			kg	%	%
1A1a	Public electricity and heat production	1.070	14.28	74.94	1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	1.104	8.13	76.48
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.917	12.23	87.17	1A1a	Public electricity and heat production	0.939	6.92	83.40
5C1biii	Clinical waste incineration	0.326	4.35	91.51	5C1bi	Industrial waste incineration	0.823	6.06	89.46
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.274	3.65	95.16	1A3bii	Road transport: Light duty vehicles	0.573	4.22	93.69
1A3biii	Road transport: Heavy duty vehicles and buses	0.157	2.09	97.26	1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.305	2.25	95.94

### PCB emissions

Four source categories have been identified as key sources (level assessment) in PCB inventory in Poland. The most important of them are: stationary combustion of fuels in residential plants and Public Electricity and Heat Production.

Table A3.18 Level Assessment for PCB emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		kg	%	%			kg	%	%
1A4bi	Residential: Stationary	420.609	52.54	52.54	1A4bi	Residential: Stationary	451.081	65.83	65.83
1A1a	Public electricity and heat production	146.027	18.24	70.78	1A1a	Public electricity and heat production	132.886	19.39	85.22
1A4ai	Commercial/institutional : Stationary	125.966	15.73	86.51	1A3biii	Road transport: Heavy duty vehicles and buses	45.407	6.63	91.85
2C1	Iron and steel production	42.333	5.29	91.80	2C1	Iron and steel production	32.164	4.69	96.55

### PAH emissions

Two source categories have been identified as key sources (level assessment) in PAH inventory in Poland. They are: stationary combustion of fuels in residential plants and coke production.

Table A3.19 Level Assessment for PAH emission sources in 1990 and 2014

NFR code	NFR Source Category	1990 Estimate	Level Assessment	Cumulative Total of Emission	NFR code	NFR Source Category	2014 Estimate	Level Assessment	Cumulative Total of Emission
		Mg	%	%			Mg	%	%
1A4bi	Residential: Stationary	118.322	80.44	80.44	1A4bi	Residential: Stationary	122.656	85.54	85.54
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	21.295	14.48	94.91	1B1b	Fugitive emission from solid fuels: Solid fuel transformation	14.831	10.34	95.88

## Appendix 4. National energy balance for 2014 in EUROSTAT format

Original units	Hard coal	Patent fuels	Coke	Total lignite	Brown coal briquettes	Tar, benzol	Coke-oven gas	Blast-furn. gas	Gasworks gas and other recovered gases	Total derived gas
	1000 t					1000 t	TJ (GCV)			
Primary production	72540			63877						
Primary production receipt										
Other sources (recovered products)	731									
Recycled products										
Imports	10417	14	193	176	70	3				
Stock change	-1173		164	95						
Exports	8956	8	6687	303	0	369				
Bunke										
Direct use										
<b>Gross inland consumption</b>	<b>73558</b>	<b>6</b>	<b>-6331</b>	<b>63846</b>	<b>70</b>	<b>-366</b>				
<b>Transformation input</b>	<b>55373</b>		<b>1210</b>	<b>63206</b>		<b>0</b>	<b>19766</b>	<b>13937</b>	<b>5069</b>	<b>38773</b>
Conventional thermal power stations	37617			63175			19325	13937	5057	38319
Public thermal power stations	36168			63175			12897	11257	4745	28899
Autoprod. thermal power stations	1449						6428	2680	312	9420
Nuclear power stations										
District heating plants	4764		1	31			442		12	454
Coke-oven plants	12805		68			0				
Blast-furnace plants	184		941							
Gas works										
Refineries										
Patent fuel plants	3									
BKB/PB plants										
Charcoal production plants										
Coal liquefaction plants										
For blended natural gas										
Gas-to-liquids (GTL) plants										
Non-specified transformation input			200							
<b>Transformation output</b>		<b>3</b>	<b>9568</b>			<b>505</b>	<b>77504</b>	<b>25802</b>	<b>6595</b>	<b>109901</b>
Conventional thermal power stations										
Public thermal power stations										
Autoprod. thermal power stations										
Nuclear power stations										
District heating plants										
Coke-oven plants			9568			505	77504			77504
Blast-furnace plants								25802	894	26696
Gas works									44	44
Refineries										
Patent fuel plants		3								
BKB/PB plants										
Non-specified transformation output									5657	5657
<b>Exchanges and transfers, returns</b>										
Interproduct transfers										
Products transferred										
Returns from petrochem. industry										
<b>Consumption of the energy branch</b>	<b>97</b>		<b>0</b>	<b>27</b>			<b>44774</b>		<b>109</b>	<b>44883</b>
Production and distribution of electricity	0		0	2			2			2
Pumped storage stations										
District heating plants	1		0							
Extraction and aggl. of solid fuels	25		0	23			132			132
Coke-oven and gas works plants	65		0	0			44641		109	44749
Oil and nat. gas extraction plants										
Oil refineries	7			2						
Nuclear fuel fabrication plants										
<b>Distribution losses</b>										
<b>Available for final consumption</b>	<b>18088</b>	<b>9</b>	<b>2028</b>	<b>612</b>	<b>70</b>	<b>139</b>	<b>12964</b>	<b>11865</b>	<b>1417</b>	<b>26245</b>
<b>Statistical difference</b>	<b>434</b>		<b>-52</b>	<b>-54</b>		<b>0</b>			<b>1</b>	<b>1</b>
<b>Final non-energy consumption</b>	<b>153</b>					<b>139</b>				
Chemical industry						139				
Other sectors	153									
<b>Final energy consumption</b>	<b>17501</b>	<b>9</b>	<b>2080</b>	<b>667</b>	<b>70</b>		<b>12964</b>	<b>11865</b>	<b>1416</b>	<b>26244</b>
Industry	5060	0	1868	56	2		12963	11865	1374	26202
Iron & steel industry	111	0	1626				10015	11863	99	21978
Chemical industry	2055		105				717			717
Non-ferrous metal industry	4		28				57		1275	1332
Glass, pottery & building mat. industry	1017		88	43			2168			2168
Transport equipment	28		0							
Machinery	63		2	0			5	1		6
Mining and quarrying	15		1							
Food, drink & tobacco industry	1079		16							
Paper and printing	499									
Wood and wood product	68			0						
Construction	5		2	12	2					
Textile, leather & clothing industry	20	0		1						
Not elsewhere specified (Industry)	96	0		1						
Transport										
Railways										
Road transport										
International aviation										
Domestic aviation										
Domestic navigation										
Pipeline transport										
Not elsewhere specified (Transport)										
Other sectors	12442	9	212	610	68		1		41	42
Commercial and public services	1042		22	50			1		2	3
Residential	9900		170	400					40	40
Agriculture/Forestry	1500	9	20	160	68					
Fishing										
Not elsewhere specified (Other)	0									



Original units	Natural gas	Crude oil	Feedstock	Total pet. products	Refinery gas	LPG	Motor spirit	Kerosenes, jet fuels	Naphtha	Gas / diesel oil	Residual fuel oil	Other pet. products
	TJ (GCV)			1000 t			1000 t					
Primary production	173349	951	0									
Primary production receipt												
Other sources (recovered products)				64								
Recycled products												
Imports	451673	23713	155	4831		2032	371	27		1452	73	231
Stock change	1432	-112		291		-8	57	-34	0	280	18	-21
Exports	2880	420		7113		225	694	532	348	968	2892	279
Bunke				147						74	73	
Direct use												
<b>Gross inland consumption</b>	<b>623574</b>	<b>24132</b>	<b>155</b>	<b>-2073</b>		<b>1798</b>	<b>-266</b>	<b>-538</b>	<b>-347</b>	<b>691</b>	<b>-2875</b>	<b>-68</b>
<b>Transformation input</b>	<b>83409</b>	<b>24196</b>	<b>1015</b>	<b>337</b>	<b>26</b>	<b>1</b>				<b>22</b>	<b>288</b>	
Conventional thermal power stations	47737			319	26	0				12	281	
Public thermal power stations	36038			115						10	105	
Autoprod. thermal power stations	11698			203	26	0				1	176	
Nuclear power stations												
District heating plants	10061			17		0				10	7	
Coke-oven plants												
Blast-furnace plants												
Gas works				1		1						
Refineries	25612	24196	1015									
Patent fuel plants												
BKB/PB plants												
Charcoal production plants												
Coal liquefaction plants												
For blended natural gas												
Gas-to-liquids (GTL) plants												
Non-specified transformation input												
<b>Transformation output</b>				<b>24817</b>	<b>603</b>	<b>560</b>	<b>3653</b>	<b>1130</b>	<b>1557</b>	<b>10613</b>	<b>3659</b>	<b>1150</b>
Conventional thermal power stations												
Public thermal power stations												
Autoprod. thermal power stations												
Nuclear power stations												
District heating plants												
Coke-oven plants												
Blast-furnace plants												
Gas works												
Refineries				24817	603	560	3653	1130	1557	10613	3659	1150
Patent fuel plants												
BKB/PB plants												
Non-specified transformation output												
<b>Exchanges and transfers, returns</b>			<b>860</b>	<b>-860</b>	<b>-83</b>	<b>-55</b>			<b>-336</b>	<b>-136</b>		<b>-185</b>
Interproduct transfers												
Products transferred			192	-192		-9				-118		
Returns from petrochem. industry			669	-669	-83	-46			-336	-18		-185
<b>Consumption of the energy branch</b>	<b>53212</b>	<b>0</b>		<b>731</b>	<b>286</b>	<b>4</b>	<b>1</b>	<b>0</b>		<b>34</b>	<b>368</b>	<b>31</b>
Production and distribution of electricity	11			7		0	0			4	1	
Pumped storage stations												
District heating plants	17			3		0	0			3		
Extraction and aggl. of solid fuels	405			28		0	0	0		22		0
Coke-oven and gas works plants	2409			0						0		
Oil and nat. gas extraction plants	11367	0		5		0	0			4		
Oil refineries	39003			688	286	4	0			1	368	30
Nuclear fuel fabrication plants												
<b>Distribution losses</b>	<b>1259</b>											
<b>Available for final consumption</b>	<b>485692</b>	<b>-64</b>		<b>20816</b>	<b>208</b>	<b>2298</b>	<b>3387</b>	<b>592</b>	<b>873</b>	<b>11111</b>	<b>128</b>	<b>866</b>
<b>Statistical difference</b>	<b>1462</b>	<b>-64</b>		<b>-59</b>		<b>-98</b>	<b>11</b>	<b>0</b>		<b>37</b>	<b>16</b>	<b>31</b>
<b>Final non-energy consumption</b>	<b>95888</b>			<b>3060</b>					<b>844</b>			<b>832</b>
Chemical industry	95734			1568				0	844			712
Other sectors	154			1493				0				120
<b>Final energy consumption</b>	<b>388342</b>	<b>0</b>		<b>17815</b>	<b>208</b>	<b>2395</b>	<b>3376</b>	<b>592</b>	<b>29</b>	<b>11074</b>	<b>112</b>	<b>2</b>
Industry	148779			804	208	180	4	1		282	100	2
Iron & steel industry	17885			5		1	0	0		2		0
Chemical industry	16111			395	208	119	0			56	11	
Non-ferrous metal industry	7722			6		0	0	0		4	2	
Glass, pottery & building mat. industry	45414			56		9	0	0		30	17	0
Transport equipment	4376			16		3	0	1		12	0	0
Machinery	9793			51		9	1	0		18	0	1
Mining and quarrying	1107			61		1	0			59		1
Food, drink & tobacco industry	27882			81		21	0	0		35	25	0
Paper and printing	7771			38		2	0			3	32	
Wood and wood product	2253			14		2	0	0		10	1	
Construction	1353			45		3	2	0		31	9	0
Textile, leather & clothing industry	1863			11		1	0			9	0	
Not elsewhere specified (Industry)	5249			24		10	0			12	2	0
Transport	16826			14300		1588	3370	590		8751		0
Railways				98		0		0		98		0
Road transport				13601		1587	3366			8648		0
International aviation								569				
Domestic aviation				595			5	21		0		
Domestic navigation				4						4		
Pipeline transport	16826			1		0	0			1		
Not elsewhere specified (Transport)												
Other sectors	222737	0		2711	0	628	1	0	29	2040	12	
Commercial and public services	74919	0		449	0	78	0	0	29	340	1	
Residential	146220			560		490				70		
Agriculture/Forestry	1598			1702		60	1			1630	11	
Fishing												
Not elsewhere specified (Other)	0			0		0	0			0		

Original units	White spirit	Lubricants	Bitumen	Petroleum coke	Nuclear heat	Total renewables	Solar heat	Geothermal heat	Biomass	Wood	MSW	Biogas, biofuels
	1000 t				TJ	TJ						
Primary production						311567	720	847	300135	258723	1544	39869
Primary production receipt												
Other sources (recovered products)		64										
Recycled products												
Imports	28	209	381	26		39625			39625	33086		6539
Stock change	0	-3	1			-65			-65			-65
Exports	105	568	503	0		17730			17730	8974		8756
Bunk												
Direct use												
<b>Gross inland consumption</b>	<b>-77</b>	<b>-297</b>	<b>-121</b>	<b>26</b>		<b>333397</b>	<b>720</b>	<b>847</b>	<b>321966</b>	<b>282835</b>	<b>1544</b>	<b>37587</b>
<b>Transformation input</b>						<b>102738</b>			<b>102738</b>	<b>96989</b>	<b>16</b>	<b>5734</b>
Conventional thermal power stations						100995			100995	95277		5718
Public thermal power stations						84159			84159	84159		
Autoprod. thermal power stations						16836			16836	11118		5718
Nuclear power stations												
District heating plants						1744			1744	1712	16	16
Coke-oven plants												
Blast-furnace plants												
Gas works												
Refineries												
Patent fuel plants												
BKB/PB plants												
Charcoal production plants												
Coal liquefaction plants												
For blended natural gas												
Gas-to-liquids (GTL) plants												
Non-specified transformation input												
<b>Transformation output</b>	<b>123</b>	<b>541</b>	<b>1229</b>									
Conventional thermal power stations												
Public thermal power stations												
Autoprod. thermal power stations												
Nuclear power stations												
District heating plants												
Coke-oven plants												
Blast-furnace plants												
Gas works												
Refineries	123	541	1229									
Patent fuel plants												
BKB/PB plants												
Non-specified transformation output												
<b>Exchanges and transfers, returns</b>		<b>-64</b>				<b>-9865</b>						
Interproduct transfers												
Products transferred		-64				-9865						
Returns from petrochem. industry												
<b>Consumption of the energy branch</b>	<b>0</b>	<b>7</b>				<b>39</b>			<b>39</b>	<b>39</b>		
Production and distribution of electricity	0	1										
Pumped storage stations												
District heating plants		0										
Extraction and aggl. of solid fuels	0	5				39			39	39		
Coke-oven and gas works plants		0										
Oil and nat. gas extraction plants		0										
Oil refineries												
Nuclear fuel fabrication plants												
<b>Distribution losses</b>												
<b>Available for final consumption</b>	<b>46</b>	<b>173</b>	<b>1108</b>	<b>26</b>		<b>220756</b>	<b>720</b>	<b>847</b>	<b>219189</b>	<b>185807</b>	<b>1528</b>	<b>31853</b>
<b>Statistical difference</b>	<b>0</b>	<b>-57</b>										
<b>Final non-energy consumption</b>	<b>46</b>	<b>230</b>	<b>1108</b>									
Chemical industry	12	0										
Other sectors	35	229	1108									
<b>Final energy consumption</b>				<b>26</b>		<b>220756</b>	<b>720</b>	<b>847</b>	<b>219189</b>	<b>185807</b>	<b>1528</b>	<b>31853</b>
Industry				25		56373			56373	54491	1528	354
Iron & steel industry				2		1			1	1		
Chemical industry						111			111	103		8
Non-ferrous metal industry				0								
Glass, pottery & building mat. industry						2252			2252	724	1528	
Transport equipment						2			2	2		
Machinery				23		93			93	93		
Mining and quarrying						4			4	4		
Food, drink & tobacco industry						988			988	747		241
Paper and printing						27092			27092	26987		105
Wood and wood product						20391			20391	20391		
Construction						81			81	81		
Textile, leather & clothing industry						5			5	5		
Not elsewhere specified (Industry)						5352			5352	5352		
Transport												
Railways						28913			28913			28913
Road transport												
International aviation						28913			28913			28913
Domestic aviation												
Domestic navigation												
Pipeline transport												
Not elsewhere specified (Transport)												
Other sectors				1		135469	720	847	133902	131316		2586
Commercial and public services				1		9253	200	239	8814	6556		2258
Residential						106578	520	608	105450	105450		
Agriculture/Forestry						19638			19638	19310		328
Fishing												
Not elsewhere specified (Other)												

Original units	Wind energy	Hydro energy	Other fuels	Derived heat	Electrical energy
	GWh		TJ		GWh
Primary production	7683	2182	21549		
Primary production receipt					
Other sources (recovered products)				1281	
Recycled products					13508
Imports					
Stock change					
Exports					11342
Bunkers					
Direct use					
<b>Gross inland consumption</b>	<b>7683</b>	<b>2182</b>	<b>21549</b>	<b>1281</b>	<b>2166</b>
<b>Transformation input</b>			<b>812</b>	<b>1338</b>	
Conventional thermal power stations			613	1338	
Public thermal power stations			29	98	
Autoprod. thermal power stations			584	1239	
Nuclear power stations					
District heating plants			199		
Coke-oven plants					
Blast-furnace plants					
Gas works					
Refineries					
Patent fuel plants					
BKB/PB plants					
Charcoal production plants					
Coal liquefaction plants					
For blended natural gas					
Gas-to-liquids (GTL) plants					
Non-specified transformation input					
<b>Transformation output</b>				<b>278517</b>	<b>148642</b>
Conventional thermal power stations				177921	148642
Public thermal power stations				166132	139771
Autoprod. thermal power stations				11790	8872
Nuclear power stations					
District heating plants				100596	
Coke-oven plants					
Blast-furnace plants					
Gas works					
Refineries					
Patent fuel plants					
BKB/PB plants					
Non-specified transformation output					
<b>Exchanges and transfers, returns</b>	<b>-7683</b>	<b>-2182</b>			<b>9865</b>
Interproduct transfers					
Products transferred	-7683	-2182			9865
Returns from petrochem. industry					
<b>Consumption of the energy branch</b>			<b>2</b>	<b>30298</b>	<b>24560</b>
Production and distribution of electricity			1	16522	15176
Pumped storage stations					271
District heating plants				7622	999
Extraction and aggl. of solid fuels			2	3787	6137
Coke-oven and gas works plants				812	859
Oil and nat. gas extraction plants				25	168
Oil refineries				1530	951
Nuclear fuel fabrication plants					
<b>Distribution losses</b>				<b>21600</b>	<b>10250</b>
<b>Available for final consumption</b>			<b>20734</b>	<b>226562</b>	<b>125863</b>
<b>Statistical difference</b>					<b>0</b>
<b>Final non-energy consumption</b>					
Chemical industry					
Other sectors					
<b>Final energy consumption</b>			<b>20734</b>	<b>226562</b>	<b>125863</b>
Industry			20503	23704	48059
Iron & steel industry				1587	6015
Chemical industry			1082	3397	8633
Non-ferrous metal industry				1337	2088
Glass, pottery & building mat. industry			19231	1055	4509
Transport equipment			0	1896	2537
Machinery			2	2493	4397
Mining and quarrying			0	2457	2387
Food, drink & tobacco industry				2119	5745
Paper and printing			125	2701	4228
Wood and wood product			7	2442	1967
Construction			0	507	754
Textile, leather & clothing industry				550	540
Not elsewhere specified (Industry)			55	1164	4260
Transport					3007
Railways					2700
Road transport					19
International aviation					
Domestic aviation					
Domestic navigation					
Pipeline transport					288
Not elsewhere specified (Transport)					
Other sectors			232	202858	74797
Commercial and public services			232	38958	45214
Residential				163000	28083
Agriculture/Forestry				900	1499
Fishing				0	1
Not elsewhere specified (Other)				0	0

# Appendix 5 to Poland's Informative Inventory Report 2016

Uncertainty analysis of emissions of selected air pollutants

Author: Damian Zasina    [damian.zasina@kobize.pl](mailto:damian.zasina@kobize.pl)



Warsaw, February 2016



# Contents

<b>List of Tables</b>	<b>5</b>
<b>List of Figures</b>	<b>7</b>
<b>Streszczenie</b>	<b>9</b>
<b>Summary</b>	<b>9</b>
<b>1 Key category analysis</b>	<b>11</b>
<b>2 Introduction to uncertainty analysis</b>	<b>13</b>
2.1 General typology of uncertainties . . . . .	13
2.2 Emission estimation . . . . .	13
2.3 Statistical expression of uncertainty . . . . .	14
2.3.1 Tier 1 . . . . .	14
2.3.2 Tier 2 . . . . .	14
<b>3 Uncertainty assessment and calculations</b>	<b>15</b>
3.1 Uncertainties of activity data . . . . .	15
3.1.1 NFR 1A1 + 1A2 + 1A4 . . . . .	15
3.1.2 Activities of emission sources in other NFR categories . . . . .	15
3.2 Uncertainties of emission factors . . . . .	20
3.3 Uncertainties of emissions . . . . .	20
3.3.1 NFR 1A1: Public power, cogeneration and district heating . . . . .	20
3.3.2 NFR 1A2: Industrial combustion . . . . .	20
3.3.3 NFR 1A3b: Road transport . . . . .	21
3.3.4 NFR 1A3(a, c, d, e): Other mobile sources and machinery . . . . .	21
3.3.5 NFR 1A4: Commercial, institutional and residential combustion . . . . .	21
3.3.6 NFR 1B: Extraction and distribution of fossil fuels . . . . .	22
3.3.7 NFR 2: Industrial processes & solvent use . . . . .	22
3.3.8 NFR 3: Agriculture activities . . . . .	23
3.3.9 NFR 5: Waste treatment & disposal activities . . . . .	23
3.4 Tier 1 uncertainties – summary . . . . .	24
3.5 Monte Carlo simulations . . . . .	34
<b>4 Abbreviations</b>	<b>45</b>
<b>References</b>	<b>46</b>



# List of Tables

1.1	Key categories in 1990	11
1.2	Key categories in 2014	12
3.1	Activity data sources, NFR Sectors 1A1, 1A2 & 1A4	15
3.2	Activity data sources, NFR 1A2a-b	15
3.3	Activity data sources, NFR 1A2f	16
3.4	Activity data sources, NFR 1A3	16
3.5	Activity data sources, NFR 1B	16
3.6	Activity data sources, NFR 2A	17
3.7	Activity data sources, NFR 2B	17
3.8	Activity data sources, NFR 2C	17
3.9	Activity data sources, NFR 2D	18
3.10	Activity data sources, NFR 2G-L	18
3.11	Activity data sources, NFR 3	19
3.12	Activity data sources, NFR 5	19
3.13	Other activities of emission sources	19
3.14	Emission factor uncertainty rates: summary	20
3.15	Uncertainties: NFR 1A1	20
3.16	Uncertainties: NFR 1A2	20
3.17	Uncertainties: NFR 1A3b	21
3.18	Uncertainties: NFR 1A3(a, c, d, e)	21
3.19	Uncertainties: NFR 1A4	21
3.20	Uncertainties: NFR 1B	22
3.21	Uncertainties: NFR 1B	22
3.22	Uncertainties: NFR 3	23
3.23	Uncertainties: NFR 5	23
3.24	NO <sub>x</sub>	24
3.25	NMVOC	25
3.26	SO <sub>2</sub>	26
3.27	NH <sub>3</sub>	27
3.28	CO	28
3.29	TSP	29
3.30	Pb	30
3.31	Cd	31
3.32	Hg	32
3.33	PCDD/F	33
3.34	Monte Carlo simulation: input parameters	34





## List of Figures

2.1	Scheme of analysis . . . . .	14
3.1	Emission of NO <sub>x</sub> [kt], 2014 . . . . .	35
3.2	Emission of NMVOC [kt], 2014 . . . . .	36
3.3	Emission of SO <sub>2</sub> [kt], 2014 . . . . .	37
3.4	Emission of CO [kt], 2014 . . . . .	38
3.5	Emission of TSP [kt], 2014 . . . . .	39
3.6	Emission of Pb [t], 2014 . . . . .	40
3.7	Emission of Cd [t], 2014 . . . . .	41
3.8	Emission of Hg [t], 2014 . . . . .	42
3.9	Emission of PCDD/F [g I-TEQ], 2014 . . . . .	43



An approximate answer to the right problem  
is worth a good deal more than an exact answer  
to an approximate problem.

\*\*\* John Tukey \*\*\*

## Streszczenie

Niniejszy raport przedstawia wyniki pracy nad analizą niepewności oszacowania emisji wybranych zanieczyszczeń do powietrza, zrealizowanej na potrzeby Konwencji Europejskiej Komisji Gospodarczej Organizacji Narodów Zjednoczonych o Transgranicznym Zanieczyszczaniu Powietrza na Dalekie Odległości, ratyfikowanej przez Polskę w 1985r.

Celem niniejszego raportu jest wypełnienie zobowiązania o przedstawieniu wyników analizy niepewności dla krajowej inwentaryzacji emisji zanieczyszczeń do powietrza, tym samym powinien być on traktowany jako załącznik do tzw. „raportu metodycznego”<sup>1</sup>.

Obliczenia statystyczne wykonano przy pomocy otwartoźródłowego języka statystycznego R.

## Summary

This report summarizes and updates uncertainty estimates of selected air pollutant emissions in Poland. The data on emissions, as well as activities of emission sources are derived from official statistics (Central Statistical Office of Poland and EUROSTAT) primarily. Another supplementary and auxiliary information used for purposes of national air emission inventory compilation is derived from various data sets provided by: National Emission Database (NCEM, 2015), Motor Transport Institute, Energy Market Agency, Institute of Ecology of Industrial Areas, National Headquarters of the State Fire Service and other.

The aim of this report is fulfilling obligation on providing uncertainty analysis, elaborated accordingly with the Chapter 5 of the EMEP/EEA Air Pollutant Emission Inventory Guidebook (EEA, 2013), as a collection guidances on compiling of national air pollutant emission inventory.

All statistical calculations have been prepared using R – the open source platform and statistical language.

---

<sup>1</sup> Raport IIR: [http://www.ceip.at/ms/ceip\\_home1/ceip\\_home/status\\_reporting/](http://www.ceip.at/ms/ceip_home1/ceip_home/status_reporting/), zgłoszenie za rok bieżący będzie dostępne na stronie internetowej konwencji.



# 1 Key category analysis

Key categories in 1990 and 2014 are included in Tables 1.1 and 1.2 below. Main differences between emission inventories for 1990 and 2014 are found in NFR 1A1a (power plants and CHPs) primarily:

- no flue gas desulphurisation (1990)<sup>2</sup>;
- for 1990 emission of main pollutants (SO<sub>2</sub>, NO<sub>x</sub>, TSP and CO) derived directly from national statistics<sup>3</sup>, in 2014 data obtained from NCEM (2015).

For selected categories, such as 1A1c as well as 1B1b emissions in 2014 is estimated also from the national data (NCEM, 2015). For the rest of categories applied methodology has not changed significantly.

Table 1.1: Key categories in 1990

Component	Key categories (Sorted from high to low from left to right)									Total (%)
SO <sub>2</sub>	1A1a	1A4bi								85.9
	(76.9%)	(8.9%)								
NO <sub>x</sub>	1A1a	1A3biii	1A3bi	1A4cii	1A4bi					81.6
	(51.4%)	(12.4%)	(6.7%)	(5.8%)	(5.3%)					
NH <sub>3</sub>	3B1a	3Da1	3B3	3B1b						86.3
	(25.0%)	(22.6%)	(20.5%)	(18.1%)						
NMVOC*	1A3bi	1A4bi	2D3a	1A3biii	1A3bii	1A3bv	2D3d	1A1a	1A3biv	81.7
	(21.0%)	(12.8%)	(8.4%)	(6.5%)	(6.0%)	(4.7%)	(4.2%)	(4.1%)	(3.4%)	
CO	1A4bi	1A3bi	1A2a	1A3bii	1A3biii					83.3
	(43.2%)	(19.8%)	(8.7%)	(6.6%)	(5.0%)					
TSP	1A1a	1A4bi	5C1bi	1A4ai	2L	1B1a				81.6
	(56.6%)	(15.5%)	(2.5%)	(2.4%)	(2.4%)	(2.2%)				
PM10	1A4bi	1A1a	1A4ai	5C1bi	1A3biii	1A4ci	1B1a	1A2f	2L	80.7
	(30.9%)	(24.6%)	(4.3%)	(4.3%)	(4.0%)	(4.0%)	(3.0%)	(2.8%)	(2.7%)	
PM2.5	1A4bi	1A1a	1A3biii	1A4ai	5C1bi	1A4cii	1A2f			80.6
	(28.3%)	(25.9%)	(7.9%)	(7.0%)	(4.8%)	(3.4%)	(3.4%)			
Pb	1A2b	1A4bi	2C1	1A1a	1A2f					81.7
	(26.7%)	(25.7%)	(16.4%)	(8.0%)	(4.9%)					
Hg	1A1a	1A2b								81.0
	(71.9%)	(9.1%)								
Cd	1A1a	1A2f	2C1	1A2a	1A4bi	1A2b	1A4ai			82.1
	(17.9%)	(17.9%)	(12.4%)	(11.6%)	(11.2%)	(6.1%)	(4.9%)			
PCDD/F	1A4bi	1A4ai	2A2	3F	1A2a					86.3
	(48.1%)	(12.5%)	(11.5%)	(7.7%)	(6.4%)					
PAH	1A4bi									80.4
	(80.4%)									
HCB	1A2a	1A4bi	5C1bi	1A1a	1A2b					87.2
	(22.5%)	(22.1%)	(16.1%)	(14.3%)	(12.2%)					

\* Including categories: 1B2aiv (2.9%), 1B1a (2.7%), 2H2 (2.7%), 2B10a (2.6%) (NMVOC < 3%).

<sup>2</sup> The first installation applied in 1994.

<sup>3</sup> Due to lacks in data derived also from 1991.

Table 1.2: Key categories in 2014

Component	Key categories (Sorted from high to low from left to right)									Total (%)
SO <sub>2</sub>	1A1a	1A4bi	1A2c	1A4ci						84.2
	(50.2%)	(25.4%)	(4.3%)	(4.2%)						
NO <sub>X</sub>	1A1a	1A3bi	1A4cii	1A3biii	1A4bi	1A3bii				82.7
	(32.1%)	(15.3%)	(11.7%)	(9.7%)	(8.6%)	(5.3%)				
NH <sub>3</sub>	3Da1	3B3	3B1a	3B1b						90.3
	(30.5%)	(21.2%)	(19.7%)	(19.0%)						
NMVOC*	2D3d	1A4bi	1A3bv	2D3a	1A3bi	1B2aiv	2D3g	2B10a	1A1a	81.6
	(19.8%)	(15.7%)	(8.4%)	(7.6%)	(5.9%)	(4.9%)	(4.5%)	(3.9%)	(3.5%)	
CO	1A4bi	1A3bi	1A4ci	1A2a						83.9
	(55.5%)	(16.6%)	(6.1%)	(5.7%)						
TSP**	1A4bi	1A3bvii	1A1a	1A4ci	1A3bvi	5C1bi	1B1a	2L	3B4giv	80.1
	(30.9%)	(10.0%)	(8.5%)	(6.3%)	(5.2%)	(3.7%)	(3.6%)	(3.2%)	(2.4%)	
PM10***	1A4bi	1A1a	1A4ci	5C1bi	1A4cii	1A3bi	1B1a	1A3biii	2L	80.9
	(38.3%)	(10.4%)	(8.1%)	(3.7%)	(3.6%)	(3.4%)	(2.9%)	(2.6%)	(2.1%)	
PM2.5	1A4bi	1A1a	1A4ci	1A4cii	1A3bi	1A3biii	5C1bi	1A4ai		80.2
	(40.1%)	(10.3%)	(6.3%)	(6.1%)	(5.9%)	(4.4%)	(3.7%)	(3.3%)		
Pb	1A2b	1A4bi	2C1	1A1a						85.3
	(39.8%)	(24.2%)	(16.0%)	(5.4%)						
Hg	1A1a	1A2b	1A4bi							81.5
	(55.7%)	(19.5%)	(6.3%)							
Cd	1A2b	1A4bi	2C1	1A2c	1A2a	1A1a	1A2f	1A2e		83.3
	(19.2%)	(13.2%)	(12.8%)	(10.0%)	(8.1%)	(7.7%)	(7.2%)	(5.1%)		
PCDD/F	1A4bi	1A2b	2A2	1A1a	3F					84.7
	(57.5%)	(9.2%)	(7.6%)	(5.5%)	(4.9%)					
PAH	1A4bi									85.5
	(85.5%)									
HCB	1A2b	1A4bi	1A3bi	1A2a	1A1a					83.4
	(45.5%)	(12.2%)	(10.6%)	(8.1%)	(6.9%)					

\* Including categories: 1A4ci (2.7%), 1A3biii (2.6%), 1B2av (2.3%) (NMVOC < 3%).

\*\* Including categories: 1A4cii (2.2%), 1A3bi (2.1%), 1A4ai (1.9%) (TSP ≤ 2.2%).

\*\*\* Including categories: 1A4ai (2.1%), 1A2c (1.9%), 3B4giv (1.8%) (PM<sub>10</sub> ≤ 2.2%).

Basing on uncertainty analysis elaborated for the purpose of previous submission<sup>4</sup> we would not expect any significant change in Tier 1 uncertainties submitted for the previous year. Any changes neither methodological, nor the input data could be then treated as uncertainty influent. Additionally we determined uncertainties using Tier 2 methodology<sup>5</sup> for each two the most significant categories (presented in Table 1.2).

## 2 Introduction to uncertainty analysis

### 2.1 General typology of uncertainties

Emissions of air pollutants are always flawed with uncertainties. The subject of uncertainty in general is referred to epistemic (or fundamental) uncertainty, defined by Zheng and Frey (2004) and connected with lack of knowledge. According to further works: Frey (2007a,b) can be distinguished at least several types of particular uncertainties connected with emission factors such as depend on:

- design, maintenance and operational practices of the installation (emission source);
- feedstocks and variability of their occurrence (eg. coal beds geographical differentiation);
- ambient conditions seasonality and/or periodicity.

Van Asselt et al. (2001) proposed more intuitional system of uncertainty classification using split into two main classes: *uncertainty due to variability* and *uncertainty due to limited knowledge*.

### 2.2 Emission estimation

Emission of selected pollutant  $X$  is usually considered as a product of 2 variables:

$$E_X^S = A^S \times F_X^S \quad (2.1)$$

Where:  $E_X^S$ , emission (calculated in unit proper for reporting);  $A^S$ , activity rate of emission source  $S$  (production of goods or amount of fuel, or energy used);  $F_X^S$ , emission factor of pollutant  $X$  for source  $S$ .

Total emission of pollutant  $X$  could be presented as sum of emissions from categories (e.g. for NFR or SNAP) or particular sources:

$$E_X^{total} = \sum_{cat} E_X^{cat} = \sum_{cat} \sum_S E_X^S \quad (2.2)$$

Polish emission inventory applies only the main methodologies: *Tier 1* (basic) and *Tier 2* (extended). Differences between these methodologies are described in EEA (2013); Vreuls (2004). Due to lacks in data and another kind of discrepancies in number of cases the uncertainty analysis is carried out using semi-qualitative approach by expert judgement or *relative simple spreadsheet method* defined by Vreuls (2004).

<sup>4</sup> Submission in 2015 for the trend 1995-2013.

<sup>5</sup> Monte Carlo analysis.



## 2.3 Statistical expression of uncertainty

### 2.3.1 Tier 1

The total uncertainty of air pollutant's emission also known as the uncertainty propagation (van Aardenne, 2002; EEA, 2013) could be presented symbolically, as below, for sum (Rule A, Equation 2.3) and for product (Rule B, Equation 2.4) (EEA, 2013, Chapter 5).

$$\mathcal{U}(E_n) = \frac{\sqrt{(\mathcal{U}(E_1) \times x_1)^2 + \dots + (\mathcal{U}(E_n) \times x_n)^2}}{\sum_{i=1}^n x_i} \quad (2.3)$$

$$\mathcal{U}(E) = \sqrt{\mathcal{U}(A)^2 + \mathcal{U}(F)^2} \quad (2.4)$$

For purposes of this analysis, the A and B rules were applied to list of activities ordered in SNAP97 classification. Selection of old classification (SNAP97) was caused by inability of implied emission factor determining. The uncertainty analysis proceeded according with scheme presented below.

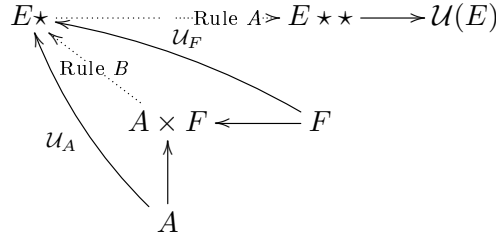


Figure 2.1: Scheme of analysis

where:  $E^*$ , emission (SNAP classified);  $E^{**}$ , emission (NFR-14 classified);  $F$ , emission factor;  $A$ , Activity rate.

### 2.3.2 Tier 2

The shapes and widths of estimated uncertainties are described by PDFs (Monni and Syri, 2003). Assuming statistical distributions (PDFs) for both parameters: emission factor and activity data the new random variable is created (see Equation 2.1). The new random variable, representing emission of air pollutant from particular emission source(s) has assigned PDF.

The idea of using Monte Carlo analysis is to simulate 95% confidence interval (partial or total) for determined PDF. For the number of cases is tendency for assuming normal distribution as a product of two independent normal distributions<sup>6</sup> which is not correct *sensu stricto*.

<sup>6</sup> We assume that random variables representing activity data and emission factor are statistically independent.

## 3 Uncertainty assessment and calculations

### 3.1 Uncertainties of activity data

This part presents description of data sources, applied for compiling national emission inventory. Majority of statistical data on activities of emission sources has been derived from official and national statistics (EUROSTAT & CSO).

#### 3.1.1 NFR 1A1 + 1A2 + 1A4

Activity rates for categories:

- 1A1a, 1A1b, 1A1c
- 1A2 (splitted between: 1A2a, 1A2b, 1A2c, 1A2d, 1A2e and 1A2f)
- 1A4ai, 1A4bi, 1A4ci

were derived from EUROSTAT and are consistent with data used for GHGs inventory. Uncertainty rates for particular fuels are presented in table below.

Table 3.1: Activity data sources, NFR Sectors 1A1, 1A2 & 1A4

Fuel	Unc. rate [%]	Fuel	Unc. rate [%]	Fuel	Unc. rate [%]
Hard coal*	2	Other petr.	2	Diesel oil	5
Brown coal*	2	Petr. coke	2	Fuel oil	5
Crude oil	2	Coke	2	Feedstocks	5
Natural gas	2	LPG	2	Refinery gas	5
Fuel wood	2	Motor gasoline	5	Petr. coke oven gas	5
Biogas	2	Jet kerosene	5	Blast furnace gas	5
Wastes**	2	Jet fuels	5	Gas works gas	5

\* Including briquettes; \*\* Wastes: industrial, municipal (biogenic and non-biogenic).

#### 3.1.2 Activities of emission sources in other NFR categories

**1A2a-b** Stationary combustion (...): Iron and steel, non-ferrous metals

Table 3.2: Activity data sources, NFR 1A2a-b

NFR	Source	Unc. rate [%]	Data source
1A2a	Sinter and pelletizing plants	2	GHG
1A2a	Casting of steel	2	GHG
1A2a	Gray iron foundries	2	GHG
1A2b	Primary prod. of metals (lead, zinc, copper)	2	CSO
1A2b	Secondary prod. of metals (lead*, zinc*, copper**)	5	see below
1A2b	Secondary aluminium prod.	5	CSO

\* Own estimation based on data derived from CSO.

\*\* Technologies: BOFs, electrolysis, other (excl. BOFs and electrolysis). CSO.

**1A2f** Stationary combustion (...): Non-metallic minerals

Table 3.3: Activity data sources, NFR 1A2f

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
1A2f	Clinker	2	CSO
1A2f	Asphalt (batching process)	2	CSO
1A2f	Bricks and tiles	5	CSO*
1A2f	030320 Sanitary ceramic and tiles	5	CSO*

\* Own estimation based on data derived from CSO.

**1A3** Transport

Table 3.4: Activity data sources, NFR 1A3

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
1A3aii(i)	Domestic aviation LTO (civil)	5	EUROSTAT
1A3bi-iv	Road transport	2	EUROSTAT/MTI
1A3bv	Gasoline evaporation	5	EUROSTAT
1A3bvi-vii	Automobile tyre and brake wear, road abrasion	5	MTI
1A3c	Railways (diesel)	5	CSO
1A3dii	National navigation (shipping)	5	CSO
1A4cii	Off-road vehicles and other machinery	5	CSO
1A4ciii	National fishing	5	CSO

**1B** Extraction and distribution of fossil fuels

Table 3.5: Activity data sources, NFR 1B

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
1B1a	Mining (open cast/underground)	2	CSO
1B1b	Solid fuel trans. – Coke oven furnaces	2	CSO
1B2ai	Fugitive emissions oil: Exploration, production, transport	2	CSO
1B2aiv	Fugitive emissions oil: Refining / storage	2	CSO
1B2av	Distribution of oil products	2	CSO
1B2b	Fugitive emissions from natural gas	2	CSO

## 2 Industrial processes

Table 3.6: Activity data sources, NFR 2A

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
2A1	Cement production	2	CSO
2A2	Lime, calx and gypsum prod.	2	CSO
2A3	Glass (flat, container) prod.	5	CSO/NED
2A5a	Quarrying and mining of minerals other than coal	5	CSO
2A5a	Quarrying of ores	2	CSO
2A5b	Construction and demolition	5	CSO

Table 3.7: Activity data sources, NFR 2B

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
2B1	Ammonia prod.	2	CSO
2B2	Nitric acid prod.	2	CSO
2B6	Titanium dioxide prod.	5	CSO
2B7	Soda ash prod.	5	CSO
2B10a	Carbon black prod.	5	CSO
2B10a	Formaldehyde prod.	5	CSO
2B10a	Other activities	2	CSO
2B10b	Storage, handling and transport of chem. products (fertilizers)	2	CSO

Table 3.8: Activity data sources, NFR 2C

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
2C1	Melting (BFs, BOFs, electric arc furnaces)	2	CSO/GHG
2C1	Rolling mills (hot/cold)	5	CSO
2C1	Sinter and pelletizing plants	2	GHG
2C2	Ferrous alloys	2	GHG
2C3	Aluminium prod.	5	CSO
2C5	Production of batteries	2	CSO
2C5	Secondary lead prod.	5	see 1A2a-b

Table 3.9: Activity data sources, NFR 2D

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
2D3a	Domestic solvent use (excl. paint application)	2	CSO
2D3b	040611 Road paving with asphalt	2	CSO
2D3c	040610 Roof covering with asphalt mat.	5	CSO
2D3d	060103,08 Paint application (construction/industrial)	5	CSO*
2D3e	060201 Metal degreasing	5	CSO
2D3f	060202 Dry cleaning	2	CSO
2D3g	060302 PVC processing	2	CSO
2D3g	060304 Polystyrene processing	2	CSO
2D3g	060305 Rubber processing	5	CSO
2D3g	060306 Pharmaceutical products	2	CSO
2D3g	060307 Paints production	5	CSO*
2D3g	060313 Leather tanning	2	CSO
2D3i	060404 Edible and non-edible oil extraction	2	CSO

\* Own estimation based on data from CSO.

Table 3.10: Activity data sources, NFR 2G-L

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
2G	Cigarette smoking [Mg]	10	Own estimation
2G	Cigarette smoking [mln cig.]	2	CSO
2H1	Paper pulp (Kraft process)	2	CSO
2H2	Bread	2	CSO
2H2	Wine	2	CSO
2H2	Beer	2	CSO
2H2	Spirits	5	CSO*
2H2	Smoke houses	5	CSO*
2I	Chipboard prod.	2	CSO
2L	Storage and transport of bulk prod. (cement, coal, coke)	2	CSO

\* Own estimation based on data from CSO.

### 3 Agriculture activities

Table 3.11: Activity data sources, NFR 3

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
3B1a	Dairy cows	5	CSO
3B1b	Other cattle	5	CSO
3B2	Sheep	5	CSO
3B3	Swine	5	CSO
3B4d	Goats	5	CSO
3B4e	Horses	5	CSO
3B4gi	Laying hens	5	CSO
3B4gii	Broilers	5	CSO
3B4giv	Other poultry (incl. turkeys)	5	CSO
3Da1	Inorganic N-fertilizers (incl. urea appl.)	5	CSO
3F	Field burning of agricultural residuals	10	Own estimation

### 5 Waste treatment and disposal activities

Table 3.12: Activity data sources, NFR 5

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
5C1a	Incineration of domestic or municipal wastes	5	CWS
5C1bi	Incineration of industrial wastes	0,05	CWS
5C1biii	Incineration of clinical wastes*	5	CWS
5C1biv	Incineration of sludges from waste water treatment**	5	CWS
5C1bv	Cremations	10	Own estimation/PCAFA
5C2	Open burning of agricultural wastes	5	Own estimation
5D1	Latrines	5	CSO

\* Splitted into categories: incinerators compliant with EU Directive, incinerators with minimal APCs, incinerators without APCs installed. \*\* Splitted into categories: incinerators with good APCs installed, incinerators with very good APCs installed.

### Other activities of emission sources

Table 3.13: Other activities of emission sources

<b>NFR</b>	<b>Source</b>	<b>Unc. rate</b> [%]	<b>Data</b> <b>source</b>
6A	Fires (landfills, cars, houses, factories)	10	SFS
11B	Forests/Forest fires	5	CSO

Chapter on uncertainties in the EMEP/EEA Guidebook [EEA \(2013\)](#) doesn't provide uncertainty range for data covered by the national (official) statistics, however in majority of cases it was assumed uncertainty range of 2% due to methodology and guidance applied for GHGs.

## 3.2 Uncertainties of emission factors

Accordingly to the guidelines (EEA, 2013) and work by Frey (2007a) ranges of emission factor uncertainties (for pollutants: NO<sub>x</sub>, NMVOC, SO<sub>2</sub>, NH<sub>3</sub>, CO, Pb, Cd, Hg and PCDD/F) were assumed basing on table below:

Table 3.14: Emission factor uncertainty rates: summary

Rating	Description*	Typical range of error
A	Excellent	10 to 30%
B	Above average	20 to 60%
C	Average	50 to 200%
D	Below average	100 to 300%
E	Poor	Order of magnitude (approx. $\gg 250\%$ )

\* Description by Frey (2007a). Definition of the rating is presented in EEA (2013).

## 3.3 Uncertainties of emissions

### 3.3.1 NFR 1A1: Public power, cogeneration and district heating

Table 3.15: Uncertainties: NFR 1A1

NFR	NO <sub>x</sub> [%]	NMVOC [%]	SO <sub>2</sub> [%]	NH <sub>3</sub> [%]	CO [%]	Pb [%]	Cd [%]	Hg [%]	PCDD/F [%]
1A1a	23%	26%	12%	NA	40%	37%	24%	34%	48%
1A1b	30%	26%	20%	NA	50%	62%	64%	44%	100%
1A1c	30%	31%	20%	NA	50%	50%	39%	42%	76%

### 3.3.2 NFR 1A2: Industrial combustion

Table 3.16: Uncertainties: NFR 1A2

NFR	NO <sub>x</sub> [%]	NMVOC [%]	SO <sub>2</sub> [%]	NH <sub>3</sub> [%]	CO [%]	Pb [%]	Cd [%]	Hg [%]	PCDD/F [%]
1A2a	28%	50%	15%	NA	70%	90%	90%	90%	100%
1A2b	29%	50%	10%	NA	70%	90%	90%	90%	100%
1A2c	30%	50%	20%	NA	70%	90%	90%	90%	100%
1A2d	30%	50%	20%	NA	70%	90%	90%	90%	100%
1A2e	30%	50%	20%	NA	70%	90%	90%	90%	100%
1A2f	28%	50%	14%	NA	29%	90%	90%	90%	85%
1A2gvii	IE	IE	IE	NA	IE	IE	IE	IE	IE

### 3.3.3 NFR 1A3b: Road transport

Table 3.17: Uncertainties: NFR 1A3b

<b>NFR</b>	<b>NO<sub>x</sub></b> [%]	<b>NMVOC</b> [%]	<b>SO<sub>2</sub></b> [%]	<b>NH<sub>3</sub></b> [%]	<b>CO</b> [%]	<b>Pb</b> [%]	<b>Cd</b> [%]	<b>Hg</b> [%]	<b>PCDD/F</b> [%]
1A3bi	14%	49%	19%	83%	60%	95%	97%	NA	71%
1A3bii	19%	46%	22%	66%	53%	93%	97%	NA	79%
1A3biii	17%	59%	20%	66%	52%	NA	56%	NA	64%
1A3biv	27%	73%	23%	78%	75%	76%	NA	NA	76%
1A3bv	NA	90%	NA	NA	NA	NA	NA	NA	NA

### 3.3.4 NFR 1A3(a, c, d, e): Other mobile sources and machinery

Table 3.18: Uncertainties: NFR 1A3(a, c, d, e)

<b>NFR</b>	<b>NO<sub>x</sub></b> [%]	<b>NMVOC</b> [%]	<b>SO<sub>2</sub></b> [%]	<b>NH<sub>3</sub></b> [%]	<b>CO</b> [%]	<b>Pb</b> [%]	<b>Cd</b> [%]	<b>Hg</b> [%]	<b>PCDD/F</b> [%]
1A3ai(i)	112%	112%	86%	NA	86%	NA	NA	NA	NA
1A3aai(i)	46%	98%	25%	NA	99%	NA	NA	NA	NA
1A3c	50%	100%	30%	50%	100%	IE	50%	NA	100%
1A3di(ii)	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A3dii	39%	78%	27%	NA	92%	100%	45%	100%	91%
1A3ei	50%	IE	70%	NA	NA	IE	IE	IE	NA

### 3.3.5 NFR 1A4: Commercial, institutional and residential combustion

Table 3.19: Uncertainties: NFR 1A4

<b>NFR</b>	<b>NO<sub>x</sub></b> [%]	<b>NMVOC</b> [%]	<b>SO<sub>2</sub></b> [%]	<b>NH<sub>3</sub></b> [%]	<b>CO</b> [%]	<b>Pb</b> [%]	<b>Cd</b> [%]	<b>Hg</b> [%]	<b>PCDD/F</b> [%]
1A4ai	17%	32%	26%	NA	36%	68%	51%	65%	61%
1A4aai	IE	IE	IE	IE	IE	IE	IE	IE	IE
1A4bi	20%	35%	29%	43%	35%	66%	52%	64%	76%
1A4bii	IE	IE	IE	IE	IE	IE	IE	IE	IE
1A4ci	24%	34%	26%	NA	40%	57%	52%	62%	92%
1A4cii	45%	86%	28%	46%	90%	NA	46%	NA	91%
1A4ciii	37%	73%	28%	NA	73%	IE	37%	IE	100%



### 3.3.6 NFR 1B: Extraction and distribution of fossil fuels

Table 3.20: Uncertainties: NFR 1B

NFR	NO <sub>x</sub> [%]	NMVOC [%]	SO <sub>2</sub> [%]	NH <sub>3</sub> [%]	CO [%]	Pb [%]	Cd [%]	Hg [%]	PCDD/F [%]
1B1a	NA	50%	NA	NA	NA	NA	NA	NA	NA
1B1b	30%	50%	70%	50%	NA	70%	70%	NA	NA
1B1c	NA	NA	NA	NA	NA	NO	NO	NO	NA
1B2ai	NA	50%	NA	NA	NA	NA	NA	NA	NA
1B2aiv	30%	39%	70%	NA	NA	NA	NA	NA	NA
1B2av	NA	38%	NA	NA	NA	NA	NA	NA	NA
1B2b	NA	32%	NA	NA	NA	NA	NA	NA	NA

### 3.3.7 NFR 2: Industrial processes & solvent use

Table 3.21: Uncertainties: NFR 1B

NFR	NO <sub>x</sub> [%]	NMVOC [%]	SO <sub>2</sub> [%]	NH <sub>3</sub> [%]	CO [%]	Pb [%]	Cd [%]	Hg [%]	PCDD/F [%]
2A1	NA	NA	NA	NA	NA	70%	70%	70%	NA
2A2	NA	NA	NA	NA	50%	NA	NA	NA	100%
2A3	NA	NA	NA	NA	36%	70%	70%	70%	73%
2B1	30%	NA	NA	50%	50%	NA	NA	NA	NA
2B2	30%	NA	NA	NA	NA	NA	NA	NA	NA
2B6	30%	NA	NA	NA	NA	NA	NA	NA	NA
2B7	NA	NA	NA	50%	NA	NA	NA	NA	NA
2B10a	26%	25%	25%	NA	49%	NA	70%	10%	NA
2C1	20%	34%	30%	NA	39%	25%	37%	58%	99%
2C2	NA	NA	NA	NA	NA	70%	NA	NA	NA
2C3	30%	NA	IE	NA	50%	NA	30%	NA	100%
2C5	IE	NA	NA	NA	NA	70%	NA	NA	NA
2D3a	NA	30%	NA	NA	NA	NA	NA	NA	NA
2D3c	NA	50%	NA	NA	NA	NA	NA	NA	NA
2D3d	NA	28%	NA	NA	NA	NA	NA	NA	NA
2D3e	NA	30%	NA	NA	NA	NA	NA	NA	NA
2D3f	NA	30%	NA	NA	NA	NA	NA	NA	NA
2D3g	NA	19%	NA	50%	NA	NA	NA	NA	NA
2D3i	NA	30%	NA	NA	NA	NA	NA	NA	NA
2G	71%	71%	NA	NA	71%	71%	71%	71%	100%
2H1	30%	50%	NA	NA	50%	NA	NA	NA	NA
2H2	NA	36%	NA	NA	NA	NA	NA	NA	NA
2I	NA	50%	NA	NA	NA	NA	NA	NA	NA

### 3.3.8 NFR 3: Agriculture activities

Table 3.22: Uncertainties: NFR 3

NFR	NO <sub>x</sub> [%]	NMVOC [%]	SO <sub>2</sub> [%]	NH <sub>3</sub> [%]	CO [%]	Pb [%]	Cd [%]	Hg [%]	PCDD/F [%]
3B1a	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B1b	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B2	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B3	NA	NA	NA	86%	NA	NA	NA	NA	NA
3B4d	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B4e	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B4gi	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B4gii	NA	NA	NA	100%	NA	NA	NA	NA	NA
3B4giv	NA	NA	NA	100%	NA	NA	NA	NA	NA
3Da1	30%	150%	NA	100%	NA	NA	NA	NA	NA
3F	NA	150%	NA	NA	150%	NA	NA	NA	NA

### 3.3.9 NFR 5: Waste treatment & disposal activities

Table 3.23: Uncertainties: NFR 5

NFR	NO <sub>x</sub> [%]	NMVOC [%]	SO <sub>2</sub> [%]	NH <sub>3</sub> [%]	CO [%]	Pb [%]	Cd [%]	Hg [%]	PCDD/F [%]
5A	NA	30%	NA	NA	NA	NA	NA	NA	NA
5C1a	50%	50%	30%	NA	50%	100%	100%	100%	100%
5C1bi	37%	37%	22%	NA	37%	NA	NA	NA	99%
5C1biii	48%	48%	29%	NA	48%	NA	NA	NA	76%
5C1bv	71%	51%	32%	NA	51%	71%	71%	71%	100%
5C2	50%	50%	NA	NA	50%	NA	NA	NA	100%
5D1	NA	NA	NA	30%	NA	NA	NA	NA	NA

### 3.4 Tier 1 uncertainties – summary

Table 3.24: NO<sub>x</sub>

NFR	1990	2014			
	C	D	G	H	J
1A1a	552.122	231.947	0.23	0.073 3	0.216 0
1A1b	6.681	3.110	0.30	0.001 3	0.002 9
1A1c	7.759	0.275	0.30	0.000 1	0.000 3
1A2a	27.903	10.043	0.28	0.003 9	0.009 4
1A2b	1.552	1.573	0.29	0.000 6	0.001 5
1A2c	2.572	9.853	0.30	0.004 1	0.009 2
1A2d	0.452	6.582	0.30	0.002 7	0.006 1
1A2e	6.559	6.438	0.30	0.002 7	0.006 0
1A2f	30.094	15.375	0.28	0.005 9	0.014 3
1A3ai(i)	0.420	0.705	1.12	0.001 1	0.000 7
1A3aii(i)	0.017	0.042	0.46	0.000 0	0.000 0
1A3bi	72.157	110.773	0.14	0.021 5	0.103 1
1A3bii	24.320	38.476	0.19	0.010 2	0.035 8
1A3biii	132.642	70.302	0.17	0.016 3	0.065 5
1A3biv	0.492	0.192	0.27	0.000 1	0.000 2
1A3c	23.470	5.281	0.50	0.003 7	0.004 9
1A3dii	2.718	0.268	0.39	0.000 1	0.000 2
1A3ei	NE	0.883	0.50	0.000 6	0.000 8
1A4ai	15.821	14.205	0.17	0.003 4	0.013 2
1A4bi	57.061	61.922	0.20	0.017 4	0.057 7
1A4ci	6.289	7.909	0.24	0.002 6	0.007 4
1A4cii	62.540	84.580	0.45	0.052 3	0.078 8
1A4ciii	12.883	5.956	0.37	0.003 0	0.005 5
1B1b	NE	4.367	0.30	0.001 8	0.004 1
1B2aiv	3.491	2.498	0.30	0.001 0	0.002 3
2B1	0.002	2.651	0.30	0.001 1	0.002 5
2B2	5.993	8.990	0.30	0.003 7	0.008 4
2B6	0.003	0.004	0.30	0.000 0	0.000 0
2B10a	1.967	2.855	0.26	0.001 0	0.002 7
2C1	1.458	1.515	0.20	0.000 4	0.001 4
2C3	0.046	0.016	0.30	0.000 0	0.000 0
2G	0.000	0.000	0.71	0.000 0	0.000 0
2H1	0.523	0.881	0.30	0.000 4	0.000 8
3Da1	12.558	10.828	0.30	0.004 5	0.010 1
5C1a	NA	0.057	0.50	0.000 0	0.000 1
5C1bi	0.231	0.266	0.37	0.000 1	0.000 2
5C1biii	0.078	0.058	0.48	0.000 0	0.000 1
5C1bv	0.000	0.009	0.71	0.000 0	0.000 0
5C2	1.060	1.430	0.50	0.001 0	0.001 3
Total:	1 073.935	723.114		0.242 2	

C, kt; D, kt; G, Combined uncertainty;  $H = (G \cdot D) / \sum D$ ;  $J = D / \sum C$

Table 3.25: NMVOC

NFR	1990	2014			
	C	D	G	H	J
1A1a	22.151	21.494	0.26	0.009 1	0.039 4
1A1b	0.056	0.119	0.26	0.000 1	0.000 2
1A1c	0.221	0.166	0.31	0.000 1	0.000 3
1A2a	1.332	0.531	0.50	0.000 4	0.001 0
1A2b	0.077	0.070	0.50	0.000 1	0.000 1
1A2c	0.203	0.963	0.50	0.000 8	0.001 8
1A2d	0.038	2.936	0.50	0.002 4	0.005 4
1A2e	0.693	0.624	0.50	0.000 5	0.001 1
1A2f	3.315	3.474	0.50	0.002 9	0.006 4
1A3ai(i)	0.016	0.028	1.12	0.000 1	0.000 1
1A3aii(i)	0.015	0.009	0.98	0.000 0	0.000 0
1A3bi	114.590	35.640	0.49	0.028 9	0.065 3
1A3bii	32.480	7.281	0.46	0.005 5	0.013 3
1A3biii	35.307	15.525	0.59	0.015 1	0.028 5
1A3biv	18.302	7.988	0.73	0.009 6	0.014 6
1A3bv	25.652	50.773	0.90	0.075 5	0.093 0
1A3c	5.258	1.242	1.00	0.002 1	0.002 3
1A3dii	0.610	0.062	0.78	0.000 1	0.000 1
1A4ai	1.915	1.329	0.32	0.000 7	0.002 4
1A4bi	69.585	95.075	0.35	0.054 8	0.174 2
1A4ci	7.639	16.087	0.34	0.009 1	0.029 5
1A4cii	9.988	13.507	0.86	0.019 2	0.024 8
1A4ciii	2.802	1.295	0.73	0.001 6	0.002 4
1B1a	14.767	7.327	0.50	0.006 0	0.013 4
1B1b	6.869	4.784	0.50	0.003 9	0.008 8
1B2ai	0.016	0.098	0.50	0.000 1	0.000 2
1B2aiv	15.624	29.537	0.39	0.019 2	0.054 1
1B2av	14.029	13.805	0.38	0.008 6	0.025 3
1B2b	9.896	9.255	0.32	0.004 8	0.017 0
2B10a	14.298	23.379	0.25	0.009 5	0.042 8
2C1	4.642	4.450	0.34	0.002 5	0.008 2
2D3a	45.688	46.195	0.30	0.022 9	0.084 7
2D3c	4.257	3.780	0.50	0.003 1	0.006 9
2D3d	22.800	120.105	0.28	0.055 1	0.220 1
2D3e	4.000	10.441	0.30	0.005 2	0.019 1
2D3f	5.711	5.774	0.30	0.002 9	0.010 6
2D3g	7.903	27.408	0.19	0.008 5	0.050 2
2D3i	3.645	7.608	0.30	0.003 8	0.013 9
2G	0.000	0.000	0.71	0.000 0	0.000 0
2H1	0.523	0.881	0.50	0.000 7	0.001 6
2H2	14.741	10.228	0.36	0.006 2	0.018 7
2I	0.185	0.962	0.50	0.000 8	0.001 8
3Da1	0.008	0.007	1.50	0.000 0	0.000 0
3F	0.975	0.540	1.50	0.001 3	0.001 0
5A	0.000	0.000	0.30	0.000 0	0.000 0
5C1a	NA	0.234	0.50	0.000 2	0.000 4
5C1bi	1.909	2.264	0.37	0.001 4	0.004 1
5C1biii	0.415	0.309	0.48	0.000 2	0.000 6
5C1bv	0.000	0.000	0.51	0.000 0	0.000 0
5C2	0.530	0.693	0.50	0.000 6	0.001 3
Total:	545.678	606.282	25	0.406 1	

Table 3.26: SO<sub>2</sub>

NFR	1990	2014			
	C	D	G	H	J
1A1a	2 164.028	401.559	0.12	0.060 4	0.142 8
1A1b	15.941	13.487	0.20	0.003 4	0.004 8
1A1c	18.092	0.907	0.20	0.000 2	0.000 3
1A2a	62.239	25.297	0.15	0.004 8	0.009 0
1A2b	3.882	3.389	0.10	0.000 4	0.001 2
1A2c	8.192	34.789	0.20	0.008 7	0.012 4
1A2d	1.654	8.188	0.20	0.002 0	0.002 9
1A2e	29.387	17.861	0.20	0.004 5	0.006 4
1A2f	111.992	23.954	0.14	0.004 1	0.008 5
1A3ai(i)	0.033	0.055	0.86	0.000 1	0.000 0
1A3aii(i)	0.002	0.004	0.25	0.000 0	0.000 0
1A3bi	5.395	0.725	0.19	0.000 2	0.000 3
1A3bii	2.301	0.236	0.22	0.000 1	0.000 1
1A3biii	14.465	0.237	0.20	0.000 1	0.000 1
1A3biv	0.172	0.004	0.23	0.000 0	0.000 0
1A3c	3.598	0.010	0.30	0.000 0	0.000 0
1A3dii	0.604	0.000	0.27	0.000 0	0.000 0
1A3ei	IE	0.004	0.70	0.000 0	0.000 0
1A4ai	66.345	21.394	0.26	0.006 9	0.007 6
1A4bi	251.390	203.540	0.29	0.073 9	0.072 4
1A4ci	33.994	33.839	0.26	0.011 2	0.012 0
1A4cii	7.067	0.159	0.28	0.000 1	0.000 1
1A4ciii	1.324	0.002	0.28	0.000 0	0.000 0
1B1b	NE	2.468	0.70	0.002 2	0.000 9
1B2aiv	6.054	3.803	0.70	0.003 3	0.001 4
2B10a	3.941	3.879	0.25	0.001 2	0.001 4
2C1	0.147	0.217	0.30	0.000 1	0.000 1
5C1a	NA	0.013	0.30	0.000 0	0.000 0
5C1bi	0.012	0.007	0.22	0.000 0	0.000 0
5C1biii	0.078	0.058	0.29	0.000 0	0.000 0
5C1bv	0.000	0.016	0.32	0.000 0	0.000 0
Total:	2 812.329	800.101		0.187 8	

Table 3.27: NH<sub>3</sub>

NFR	1990	2014		H	J
	C	D	G		
1A3bi	0.372	0.618	0.83	0.001 9	0.001 5
1A3bii	0.101	0.056	0.66	0.000 1	0.000 1
1A3biii	0.036	0.036	0.66	0.000 1	0.000 1
1A3biv	0.005	0.002	0.78	0.000 0	0.000 0
1A3c	1.117	0.001	0.50	0.000 0	0.000 0
1A4bi	0.217	0.480	0.43	0.000 8	0.001 2
1A4cii	0.009	0.013	0.46	0.000 0	0.000 0
1B1b	0.069	0.048	0.50	0.000 1	0.000 1
2B1	0.000	0.027	0.50	0.000 1	0.000 1
2B7	1.201	1.068	0.50	0.002 0	0.002 6
2D3g	0.018	0.011	0.50	0.000 0	0.000 0
3B1a	103.526	52.175	1.00	0.197 0	0.126 1
3B1b	74.891	50.335	1.00	0.190 1	0.121 7
3B2	6.072	0.325	1.00	0.001 2	0.000 8
3B3	84.789	56.097	0.86	0.182 1	0.135 6
3B4d	0.262	0.119	1.00	0.000 5	0.000 3
3B4e	9.158	2.015	1.00	0.007 6	0.004 9
3B4gi	16.259	12.195	1.00	0.046 1	0.029 5
3B4gii	6.101	4.057	1.00	0.015 3	0.009 8
3B4giv	5.357	2.469	1.00	0.009 3	0.006 0
3Da1	93.690	80.781	1.00	0.305 1	0.195 3
5D1	10.444	2.203	0.30	0.002 5	0.005 3
Total:	413.695	265.130		0.962 0	

Table 3.28: CO

NFR	1990	2014			
	C	D	G	H	J
1A1a	54.718	48.383	0.40	0.007 2	0.019 4
1A1b	0.771	0.157	0.50	0.000 0	0.000 1
1A1c	11.690	1.438	0.50	0.000 3	0.000 6
1A2a	217.288	153.941	0.70	0.039 9	0.061 7
1A2b	0.432	5.404	0.70	0.001 4	0.002 2
1A2c	0.572	26.015	0.70	0.006 7	0.010 4
1A2d	0.107	6.006	0.70	0.001 6	0.002 4
1A2e	2.116	13.196	0.70	0.003 4	0.005 3
1A2f	30.609	47.055	0.29	0.005 0	0.018 8
1A3ai(i)	0.036	0.061	0.86	0.000 0	0.000 0
1A3aii(i)	0.963	0.562	0.99	0.000 2	0.000 2
1A3bi	495.520	448.353	0.60	0.099 7	0.179 6
1A3bii	165.649	57.921	0.53	0.011 3	0.023 2
1A3biii	124.166	39.021	0.52	0.007 5	0.015 6
1A3biv	41.786	17.822	0.75	0.005 0	0.007 1
1A3c	12.527	2.885	1.00	0.001 1	0.001 2
1A3dii	0.814	0.129	0.92	0.000 0	0.000 1
1A4ai	17.769	14.383	0.36	0.001 9	0.005 8
1A4bi	1 077.294	1 501.254	0.35	0.195 8	0.601 3
1A4ci	113.008	165.444	0.40	0.024 6	0.066 3
1A4cii	54.649	73.908	0.90	0.024 6	0.029 6
1A4ciii	1.765	0.816	0.73	0.000 2	0.000 3
2A2	6.195	3.518	0.50	0.000 7	0.001 4
2A3	0.006	0.017	0.36	0.000 0	0.000 0
2B1	0.000	0.265	0.50	0.000 0	0.000 1
2B10a	0.848	3.207	0.49	0.000 6	0.001 3
2C1	29.395	24.287	0.39	0.003 5	0.009 7
2C3	5.609	1.969	0.50	0.000 4	0.000 8
2G	0.009	0.004	0.71	0.000 0	0.000 0
2H1	2.874	4.844	0.50	0.000 9	0.001 9
3F	10.323	5.719	1.50	0.003 2	0.002 3
5C1a	NA	0.022	0.50	0.000 0	0.000 0
5C1bi	0.018	0.010	0.37	0.000 0	0.000 0
5C1biii	0.157	0.117	0.48	0.000 0	0.000 0
5C1bv	0.000	0.004	0.51	0.000 0	0.000 0
5C2	16.818	20.354	0.50	0.003 8	0.008 2
Total:	2 496.500	2 703.709		0.450 3	

Table 3.29: TSP

NFR	1990	2014			
	C	D	G	H	J
1A1a	562.243	32.747	0.26	0.022 4	0.033 0
1A1b	0.503	0.319	0.50	0.000 4	0.000 3
1A1c	0.862	0.189	0.50	0.000 2	0.000 2
1A2a	10.384	5.656	0.70	0.010 3	0.005 7
1A2b	0.680	1.672	0.70	0.003 1	0.001 7
1A2c	1.131	7.030	0.70	0.012 8	0.007 1
1A2d	0.212	1.623	0.70	0.003 0	0.001 6
1A2e	4.178	3.566	0.70	0.006 5	0.003 6
1A2f	16.012	5.186	0.50	0.006 8	0.005 2
1A3ai(i)	0.420	0.011	0.50	0.000 0	0.000 0
1A3aii(i)	0.017	0.003	0.85	0.000 0	0.000 0
1A3bi	1.157	8.010	0.91	0.019 1	0.008 1
1A3bii	0.891	2.567	0.86	0.005 8	0.002 6
1A3biii	14.267	5.978	0.54	0.008 5	0.006 0
1A3biv	0.001	0.000	0.76	0.000 0	0.000 0
1A3c	2.609	0.460	1.00	0.001 2	0.000 5
1A3dii	0.206	0.023	0.81	0.000 0	0.000 0
1A4ai	24.109	7.408	0.42	0.008 1	0.007 5
1A4bi	153.418	118.430	0.39	0.120 7	0.119 3
1A4ci	18.983	24.086	0.41	0.025 8	0.024 3
1A4cii	6.124	8.283	0.91	0.019 6	0.008 3
1A4ciii	0.882	0.408	0.73	0.000 8	0.000 4
2A2	2.001	1.705	0.50	0.002 2	0.001 7
2A3	0.319	0.854	0.50	0.001 1	0.000 9
2B10a	1.817	2.755	0.08	0.000 5	0.002 8
2C1	9.854	4.592	0.21	0.002 5	0.004 6
2C3	0.184	0.065	0.50	0.000 1	0.000 1
2G	2.823	1.417	0.50	0.001 8	0.001 4
2H1	0.523	0.881	0.50	0.001 1	0.000 9
3F	0.232	0.129	1.50	0.000 5	0.000 1
5C1a	NA	0.003	0.50	0.000 0	0.000 0
5C1bi	25.091	14.154	0.37	0.013 5	0.014 3
5C2	1.230	1.608	0.50	0.002 1	0.001 6
Total:	992.727	383.141		0.300 8	

Considering TSP fraction and relations between all fractions of particulates:

$PM_{2.5} \subset PM_{10} \subset TSP$  as well as taking into account estimation of TSP using rescaled emission factors the uncertainty of TSP refers to all fractions.



Table 3.30: Pb

NFR	1990	2014		H	J
	C	D	G		
1A1a	48.129	27.769	0.37	0.020 0	0.045 9
1A1b	1.215	0.504	0.62	0.000 6	0.000 8
1A1c	9.070	0.460	0.50	0.000 4	0.000 8
1A2a	17.139	6.838	0.90	0.011 9	0.011 3
1A2b	161.433	205.744	0.90	0.358 0	0.339 9
1A2c	12.602	8.499	0.90	0.014 8	0.014 0
1A2d	3.895	1.962	0.90	0.003 4	0.003 2
1A2e	12.965	4.311	0.90	0.007 5	0.007 1
1A2f	29.874	5.532	0.90	0.009 6	0.009 1
1A3bi	17.047	13.529	0.95	0.024 8	0.022 4
1A3bii	2.742	0.786	0.93	0.001 4	0.001 3
1A3biv	0.000	0.000	0.76	0.000 0	0.000 0
1A3dii	0.000	0.000	1.00	0.000 0	0.000 0
1A4ai	14.835	8.986	0.68	0.011 9	0.014 8
1A4bi	155.781	125.141	0.66	0.160 0	0.206 8
1A4ci	10.281	6.483	0.57	0.007 2	0.010 7
1B1b	2.547	2.105	0.70	0.002 8	0.003 5
2A1	2.783	3.163	0.70	0.004 3	0.005 2
2A3	3.270	10.927	0.70	0.014 8	0.018 1
2C1	99.342	82.515	0.25	0.039 1	0.136 3
2C2	0.017	0.015	0.70	0.000 0	0.000 0
2C5	0.196	0.886	0.70	0.001 2	0.001 5
2G	0.000	0.000	0.71	0.000 0	0.000 0
5C1a	NA	1.106	1.00	0.002 1	0.001 8
5C1bv	0.000	0.000	0.71	0.000 0	0.000 0
Total:	605.233	517.263		0.696 0	

C, t; D, t; G, Combined uncertainty;  $H = (G \cdot D) / \sum D$ ;  $J = D / \sum C$

Table 3.31: Cd

NFR	1990	2014		H	J
	C	D	G		
1A1a	4.003	1.067	0.24	0.018 4	0.047 8
1A1b	0.282	0.383	0.64	0.017 8	0.017 2
1A1c	0.146	0.095	0.39	0.002 7	0.004 3
1A2a	2.590	1.120	0.90	0.072 7	0.050 2
1A2b	1.362	2.661	0.90	0.172 7	0.119 3
1A2c	0.282	1.392	0.90	0.090 3	0.062 4
1A2d	0.053	0.321	0.90	0.020 9	0.014 4
1A2e	1.042	0.706	0.90	0.045 8	0.031 6
1A2f	3.993	1.001	0.90	0.064 9	0.044 9
1A3bi	0.009	0.205	0.97	0.014 4	0.009 2
1A3bii	0.007	0.109	0.97	0.007 6	0.004 9
1A3biii	0.121	0.118	0.56	0.004 8	0.005 3
1A3c	0.021	0.005	0.50	0.000 2	0.000 2
1A3dii	0.002	0.000	0.45	0.000 0	0.000 0
1A4ai	1.091	0.186	0.51	0.006 9	0.008 4
1A4bi	2.504	1.832	0.52	0.068 7	0.082 1
1A4ci	0.385	0.281	0.52	0.010 5	0.012 6
1A4cii	0.059	0.080	0.46	0.002 6	0.003 6
1A4ciii	0.011	0.005	0.37	0.000 1	0.000 2
1B1b	0.687	0.046	0.70	0.002 3	0.002 1
2A1	0.100	NA	0.70	NA	NA
2A3	0.052	0.164	0.70	0.008 3	0.007 3
2B10a	0.739	0.220	0.70	0.011 1	0.009 9
2C1	2.763	1.773	0.37	0.047 6	0.079 5
2C3	0.005	0.002	0.30	0.000 0	0.000 1
2G	0.000	0.000	0.71	0.000 0	0.000 0
5C1a	NA	0.095	1.00	0.006 8	0.004 3
5C1bv	0.000	0.000	0.71	0.000 0	0.000 0
Total:	22.307	13.866		0.698 2	

Table 3.32: Hg

NFR	1990		2014			
	C	D	G	H	J	
1A1a	10.188	5.342	0.34	0.1870	0.3768	
1A1b	0.001	0.006	0.44	0.0003	0.0004	
1A1c	0.037	0.027	0.42	0.0012	0.0019	
1A2a	0.179	0.106	0.90	0.0099	0.0075	
1A2b	1.297	1.870	0.90	0.1754	0.1319	
1A2c	0.020	0.132	0.90	0.0124	0.0093	
1A2d	0.004	0.030	0.90	0.0029	0.0021	
1A2e	0.072	0.067	0.90	0.0063	0.0047	
1A2f	0.277	0.394	0.90	0.0369	0.0278	
1A3dii	0.001	0.000	1.00	0.0000	0.0000	
1A4ai	0.462	0.231	0.65	0.0155	0.0163	
1A4bi	0.691	0.603	0.64	0.0404	0.0425	
1A4ci	0.154	0.177	0.62	0.0115	0.0125	
2A1	0.250	NA	0.70	NA	NA	
2A3	0.017	0.055	0.70	0.0040	0.0039	
2B10a	0.158	0.073	0.10	0.0008	0.0052	
2C1	0.370	0.441	0.58	0.0267	0.0311	
2G	0.000	0.000	0.71	0.0000	0.0000	
5C1a	NA	0.035	1.00	0.0036	0.0025	
5C1bv	0.000	0.000	0.71	0.0000	0.0000	
Total:	14.178	9.593		0.5347		

Table 3.33: PCDD/F

NFR	1990	2014		H	J
	C	D	G		
1A1a	11.313	13.119	0.48	0.026 4	0.047 2
1A1b	0.287	0.369	1.00	0.001 5	0.001 3
1A1c	0.047	0.036	0.76	0.000 1	0.000 1
1A2a	17.655	11.029	1.00	0.045 8	0.039 7
1A2b	1.316	22.228	1.00	0.092 4	0.080 0
1A2c	0.063	1.310	1.00	0.005 4	0.004 7
1A2d	0.012	0.302	1.00	0.001 3	0.001 1
1A2e	0.231	0.664	1.00	0.002 8	0.002 4
1A2f	2.022	1.817	0.85	0.006 4	0.006 5
1A3bi	0.230	0.504	0.71	0.001 5	0.001 8
1A3bii	0.080	0.113	0.79	0.000 4	0.000 4
1A3biii	0.104	0.090	0.64	0.000 2	0.000 3
1A3biv	0.009	0.004	0.76	0.000 0	0.000 0
1A3c	0.018	0.004	1.00	0.000 0	0.000 0
1A3dii	0.001	0.000	0.91	0.000 0	0.000 0
1A4ai	34.858	1.445	0.61	0.003 7	0.005 2
1A4bi	133.723	138.324	0.76	0.434 0	0.497 9
1A4ci	0.195	1.398	0.92	0.005 4	0.005 0
1A4cii	0.005	0.068	0.91	0.000 3	0.000 2
1A4ciii	0.003	0.002	1.00	0.000 0	0.000 0
2A2	32.000	18.173	1.00	0.075 5	0.065 4
2A3	0.212	0.563	0.73	0.001 7	0.002 0
2C1	15.501	11.001	0.99	0.045 2	0.039 6
2C3	0.092	0.032	1.00	0.000 1	0.000 1
2G	0.007	0.004	1.00	0.000 0	0.000 0
5C1a	NA	0.000	1.00	0.000 0	0.000 0
5C1bi	0.051	0.015	0.99	0.000 1	0.000 1
5C1biii	0.001	0.000	0.76	0.000 0	0.000 0
5C1bv	0.002	0.301	1.00	0.001 3	0.001 1
5C2	1.697	2.218	1.00	0.009 2	0.008 0
Total:	277.825	240.665		0.760 6	

C, g I-TEQ; D, g I-TEQ; G, Combined uncertainty;  $H = (G \cdot D) / \sum D$ ;  $J = D / \sum C$

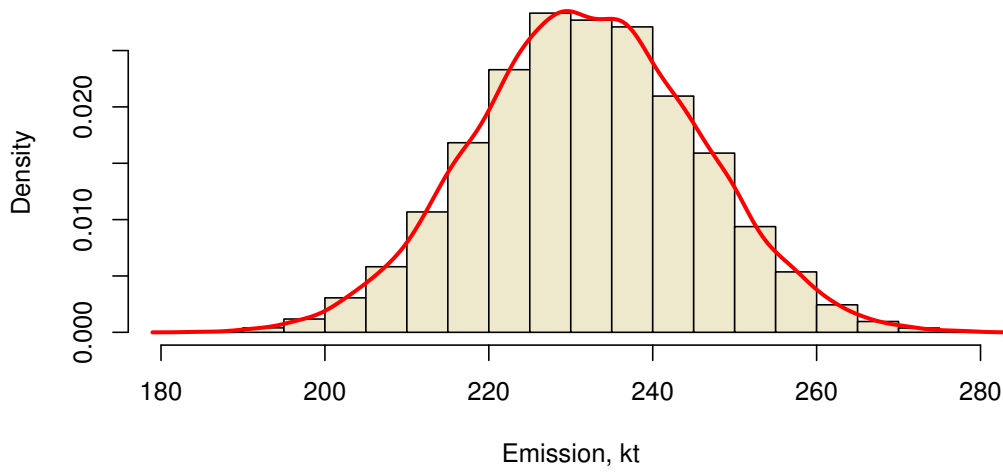
### 3.5 Monte Carlo simulations

For each 2 main key categories emissions of enumerated pollutants (see table below) and sector 1A1a, Tier 2 methodology was applied. Monte Carlo simulation (for 10,000 iterations) was applied for non-standardized variables. Results of the analysis is presented in figures and table below.

Table 3.34: Monte Carlo simulation: input parameters

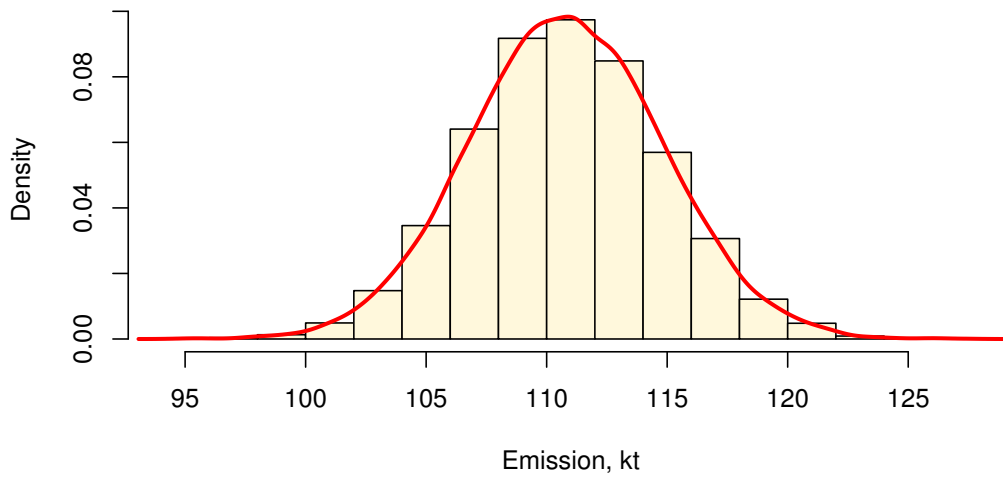
Pollutant	NFR	Average	$\mathcal{U}$ , %	Parameters
NO <sub>x</sub>	1A1a	231.947	±23	$N(\mu = 231.947, \sigma = 13.61)$
	1A3bi	110.773	±14	$N(\mu = 110.773, \sigma = 3.96)$
NMVOC	2D3d	120.105	±28	$N(\mu = 120.105, \sigma = 8.58)$
	1A4bi	95.075	±35	$N(\mu = 95.075, \sigma = 8.49)$
SO <sub>2</sub>	1A1a	401.559	±12	$N(\mu = 401.559, \sigma = 12.29)$
	1A4bi	203.540	±29	$N(\mu = 203.540, \sigma = 15.06)$
CO	1A4bi	1 501.254	±35	$N(\mu = 1501.254, \sigma = 134.04)$
	1A3bi	448.353	±60	$N(\mu = 448.353, \sigma = 68.63)$
TSP	1A4bi	118.430	±39	$N(\mu = 118.430, \sigma = 11.78)$
	1A3bvii	38.218	±70	$N(\mu = 38.218, \sigma = 6.82)$
Pb	1A2b	205.744	±90	$N(\mu = 205.744, \sigma = 47.24)$
	1A4bi	125.141	±66	$N(\mu = 125.141, \sigma = 21.07)$
Cd	1A2b	2.661	±90	$N(\mu = 2.661, \sigma = 0.61)$
	1A4bi	1.832	±52	$N(\mu = 1.832, \sigma = 0.24)$
Hg	1A1a	5.342	±34	$N(\mu = 5.342, \sigma = 0.46)$
	1A2b	1.870	±90	$N(\mu = 1.870, \sigma = 0.43)$
PCDD/F	1A4bi	138.324	±76	$N(\mu = 138.324, \sigma = 26.82)$
	1A2b	22.228	±100	$N(\mu = 22.228, \sigma = 5.67)$

**NO<sub>x</sub>, NFR 1A1a, 2014**



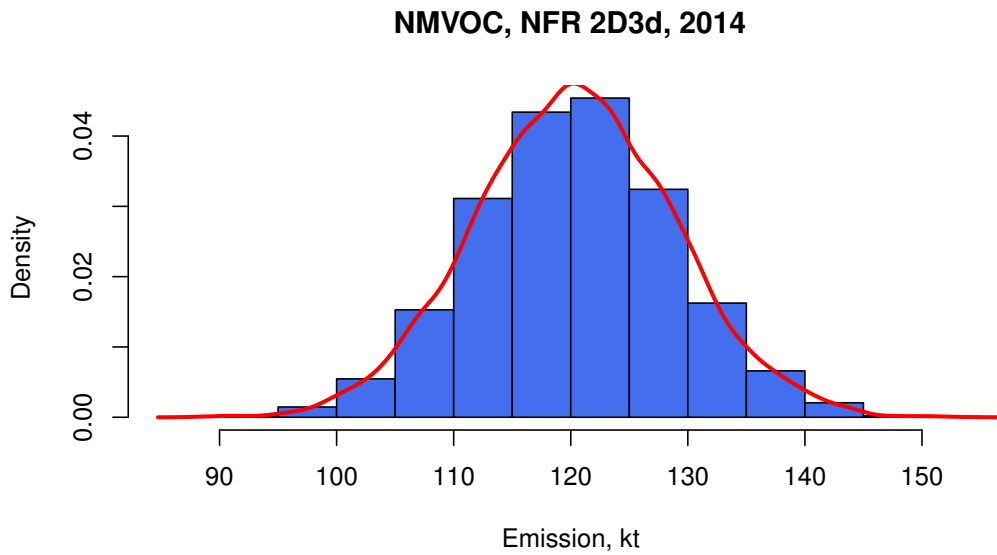
(a) NFR 1A1a

**NO<sub>x</sub>, NFR 1A3bi, 2014**

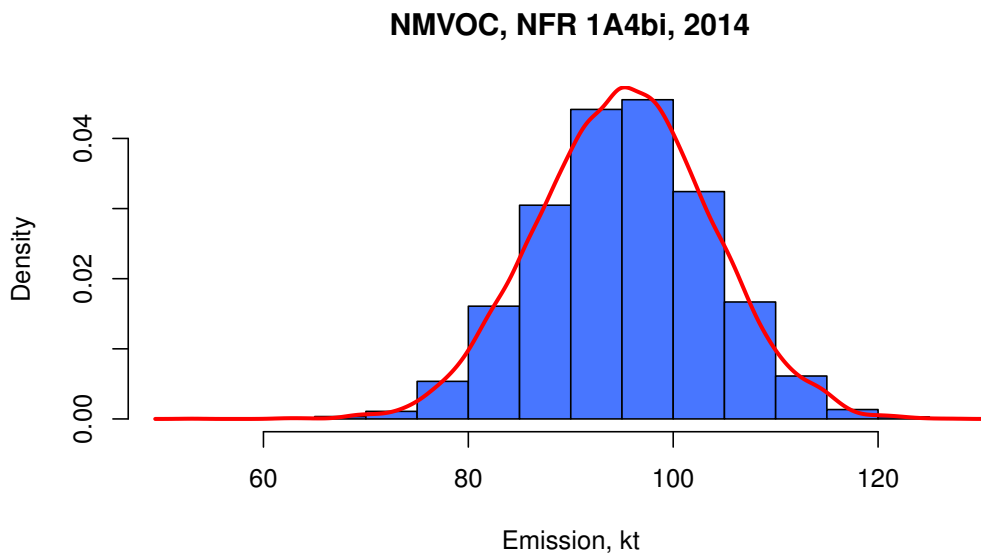


(b) NFR 1A3bi

Figure 3.1: Emission of NO<sub>x</sub> [kt], 2014



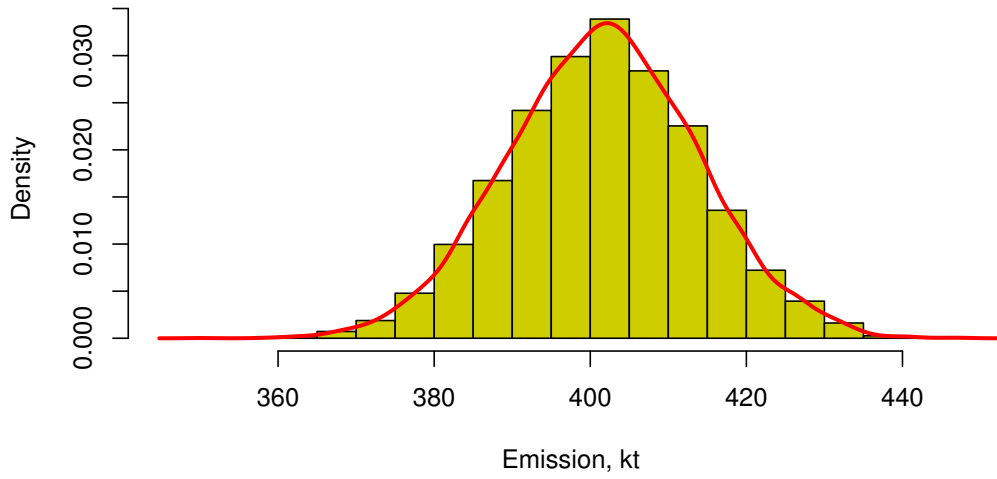
(a) NFR 2D3d



(b) NFR 1A4bi

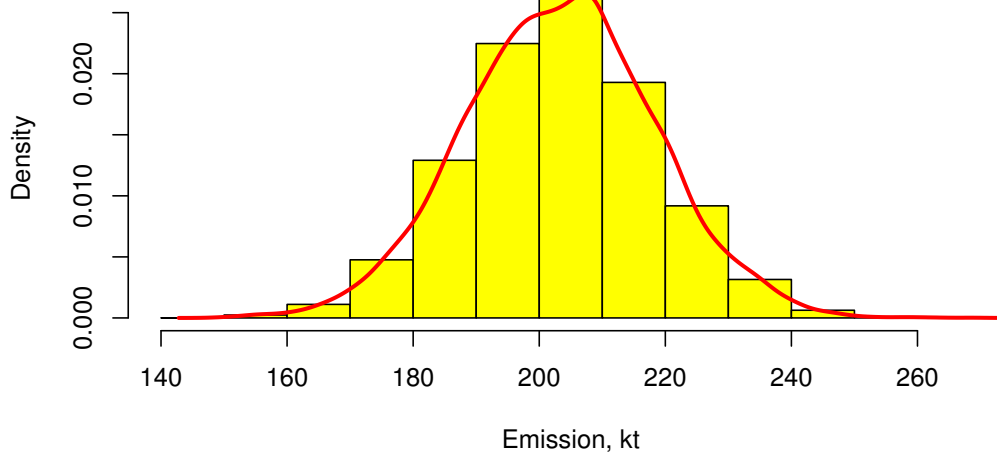
Figure 3.2: Emission of NMVOC [kt], 2014

**SO<sub>2</sub>, NFR 1A1a, 2014**



(a) NFR 1A1a

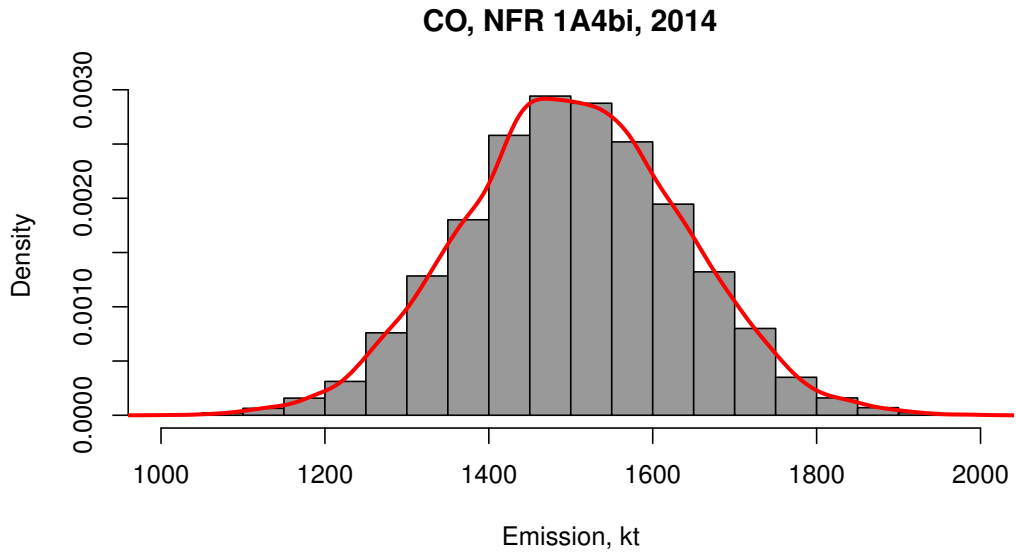
**SO<sub>2</sub>, NFR 1A4bi, 2014**



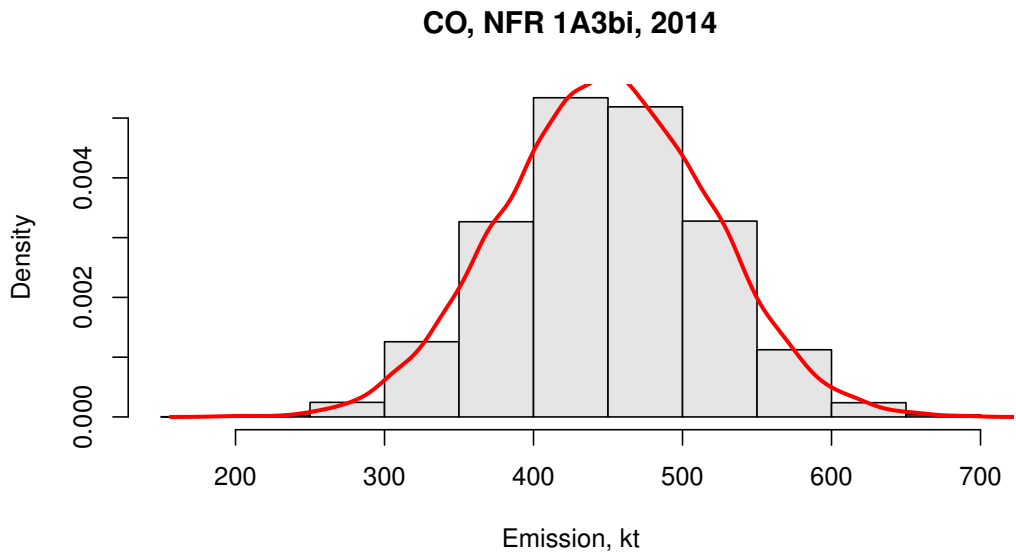
(b) NFR 1A4bi

Figure 3.3: Emission of SO<sub>2</sub> [kt], 2014





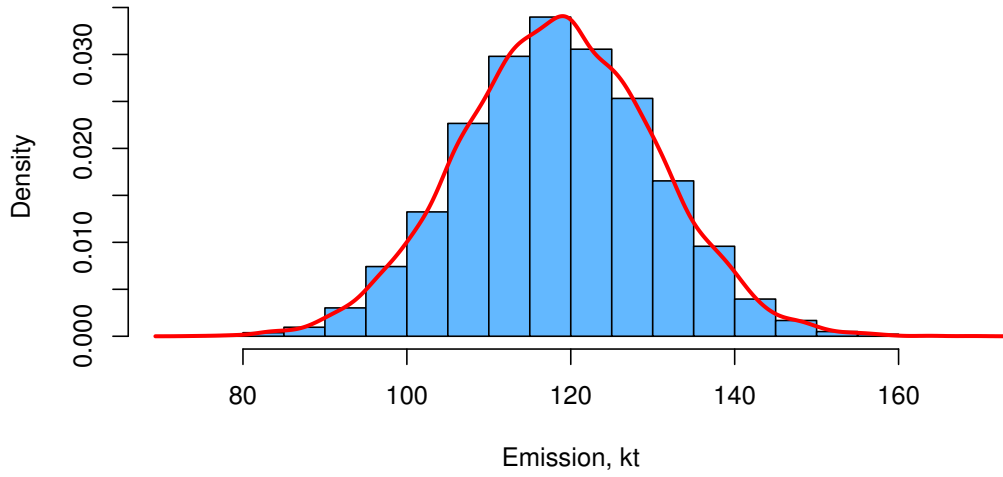
(a) NFR 1A4bi



(b) NFR 1A3bi

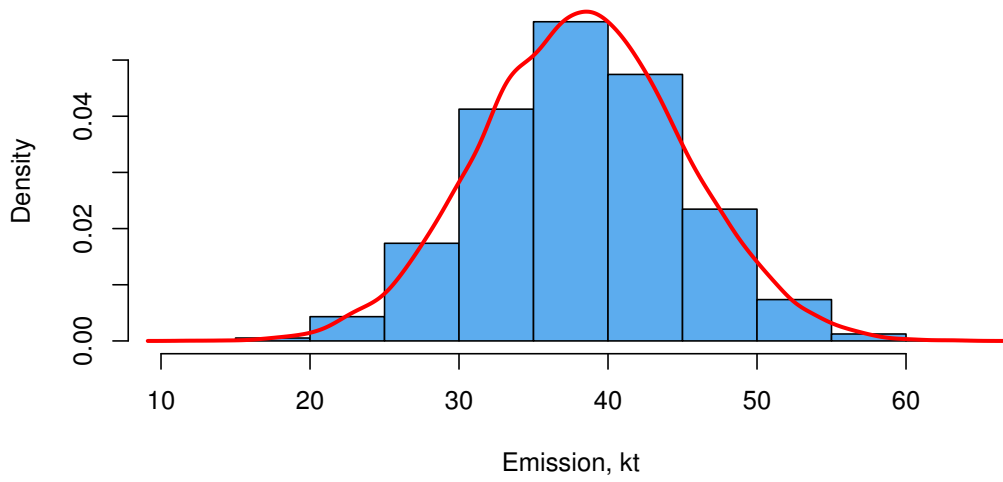
Figure 3.4: Emission of CO [kt], 2014

**TSP, NFR 1A4bi, 2014**



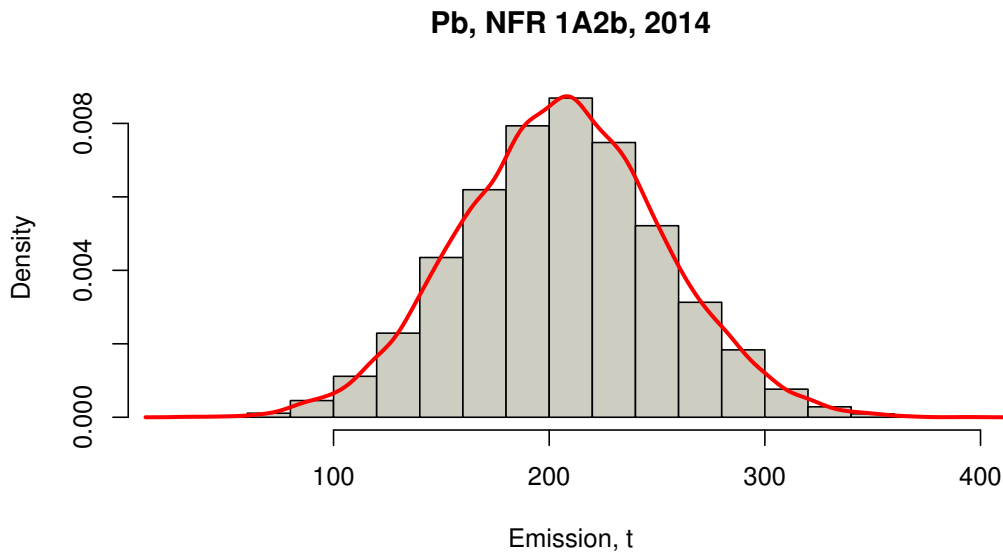
(a) NFR 1A4bi

**TSP, NFR 1A3bvii, 2014**

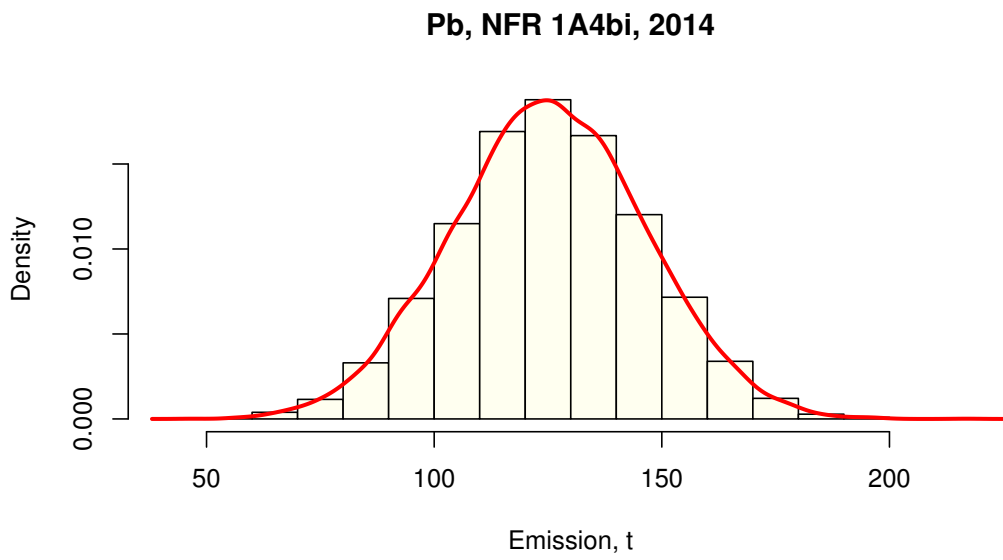


(b) NFR 1A3bvii

Figure 3.5: Emission of TSP [kt], 2014

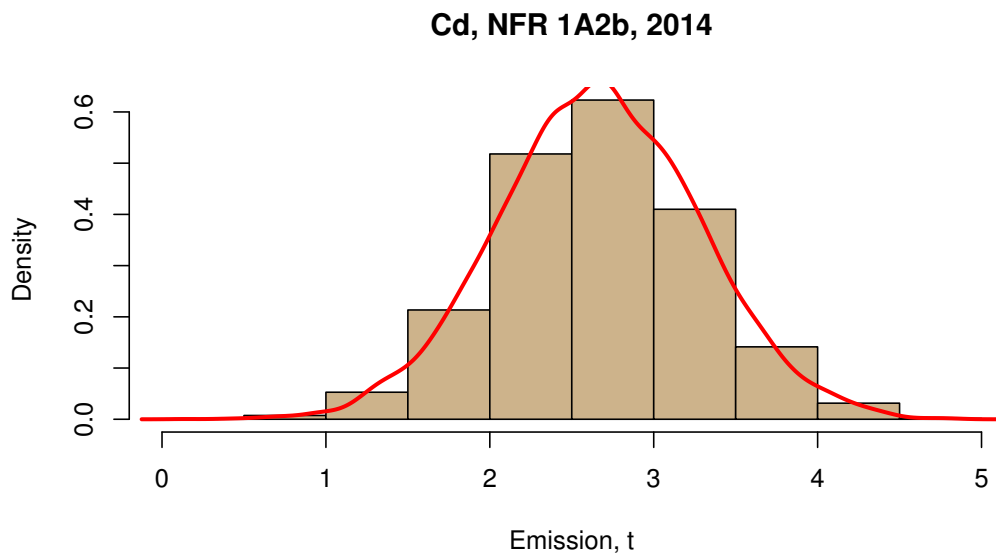


(a) NFR 1A2b

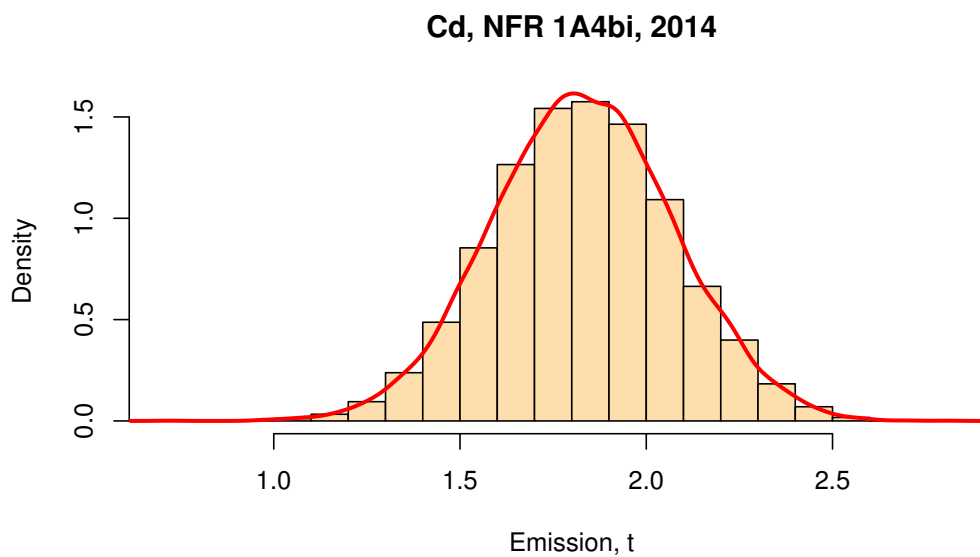


(b) NFR 1A4bi

Figure 3.6: Emission of Pb [t], 2014

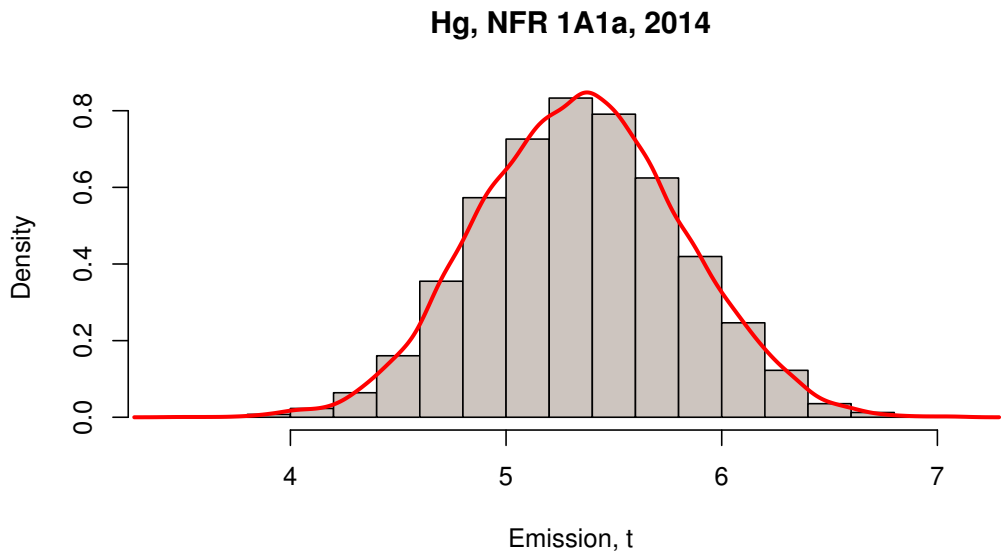


(a) NFR 1A2b

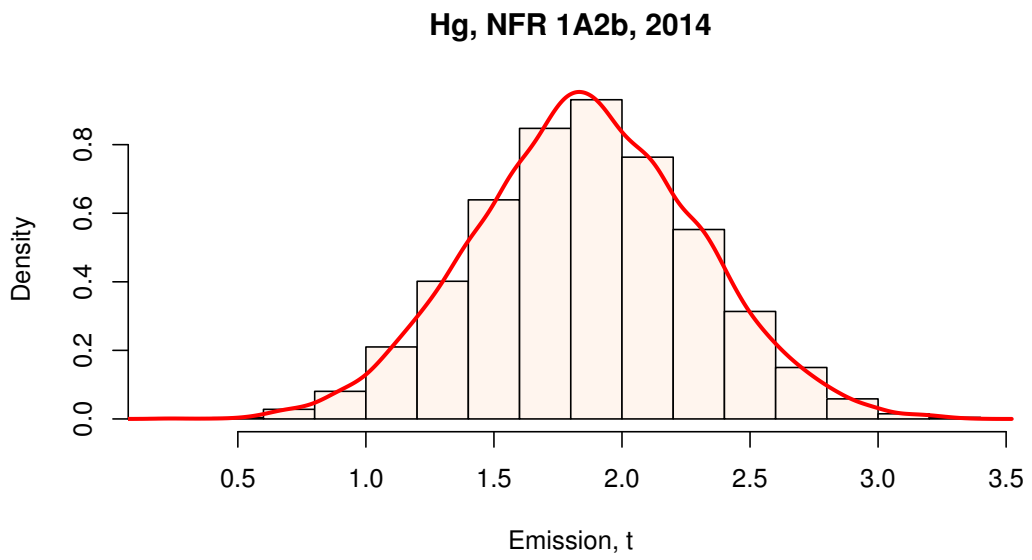


(b) NFR 1A4bi

Figure 3.7: Emission of Cd [t], 2014

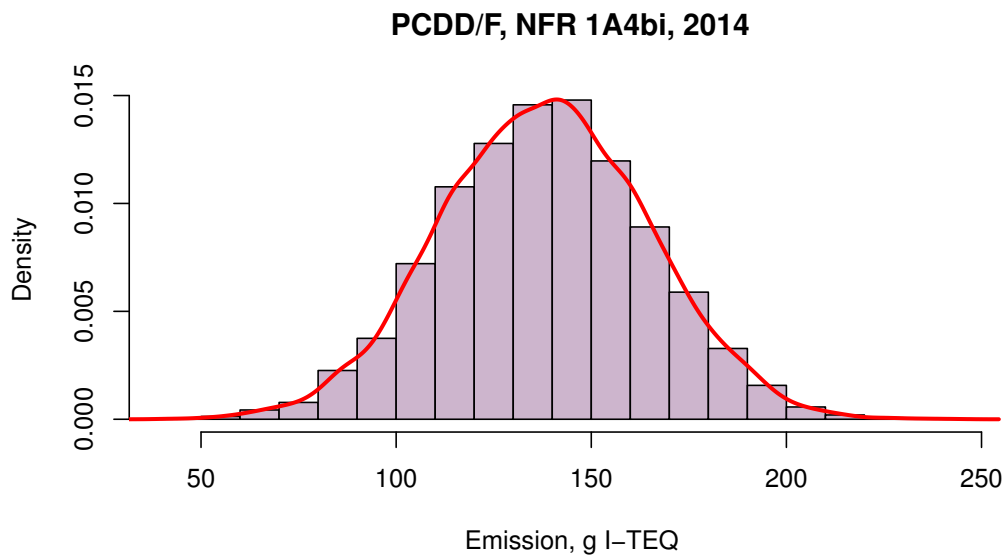


(a) NFR 1A1a

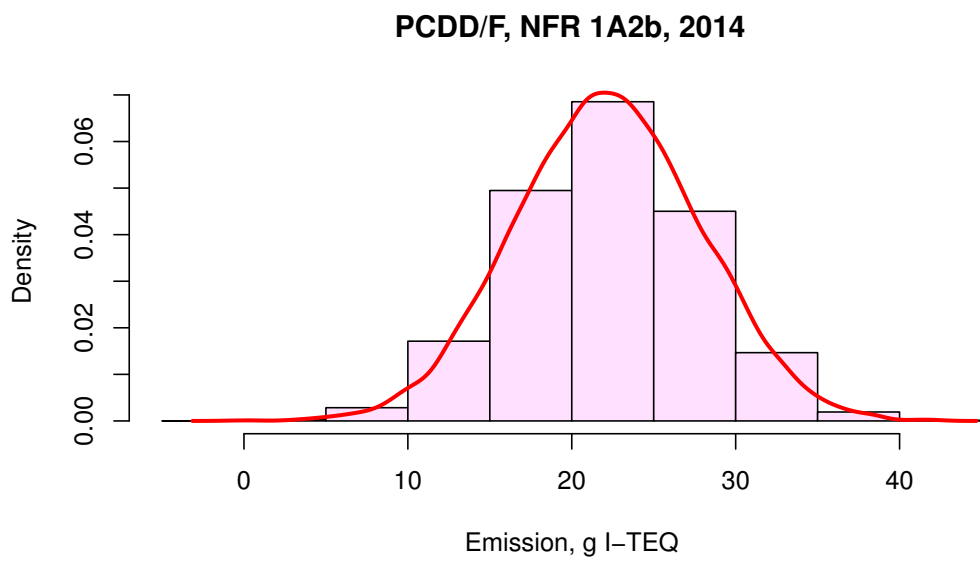


(b) NFR 1A2b

Figure 3.8: Emission of Hg [t], 2014



(a) NFR 1A4bi



(b) NFR 1A2b

Figure 3.9: Emission of PCDD/F [g I-TEQ], 2014



## 4 Abbreviations

APC(s)	Air Pollution Control Device(s)
CHP(s)	Combined Heat and Power
CSO	Central Statistical Office of Poland
CWS	Central Waste System, database of Polish Ministry of Environment
EEA	European Environmental Agency
EF(s)	Emission Factor(s)
EMEP	European Monitoring and Evaluation Programme
EUROCONTROL	European Organization for the Safety of Air Navigation
EUROSTAT	Eurostat database
GHG(s)	Greenhouse gas(es) (inventory)
IEIA	Institute of Ecology of Industrial Areas
IEP-NRI	Institute of Environmental Protection - - National Research Institute
IPCC	Greenhouse Gas Inventory under the UN Framework Convention on Climate Change and its Kyoto Protocol
MTI	Motor Transport Institute
NCEM	The National Centre for Emissions Management (at the IEP-NRI)
NEC	2001/81/EC Directive on National Emission Ceilings
NED	National Emission Database of the IEP-NRI
PCAFA	Polish Cemetery and Funeral Association
PDF(s)	probability density function(s)
SFS	National Headquarters of the State Fire Service
UN ECE	United Nations Economic Commission for Europe



## References

- EEA. EMEP/EEA Air Pollutant Emission Inventory Guidebook. Technical report, EMEP/EEA, 2013. doi:10.2800/92722.
- H.C.H. Frey. Quantification of Uncertainty in Emission Factors and Inventories, 2007a.
- H.C.H. Frey. Quantification of Uncertainty in Air Pollutant Emission Inventories. In *Emission Inventory Conference, Raleigh NC, May 16, 2007*, 2007b.
- S. Monni and S. Syri. Uncertainties in the Finnish 2001 Greenhouse Gas Emission Inventory. Technical report, VTT, 2003. VTT Research Notes 2209.
- NCEM. National emission database, 2015. National Centre for Emissions Management at the Institute of Environmental Protection – National Research Institute.
- M. B. A. van Asselt, R. Langendonck, van Asten F., A. van der Giessen, P. H. M. Janssen, P. S. C. Heuberger, and I. Geuskens. Uncertainty & RIVM's Environmental Outlooks. Documenting a learning process. Technical report, National Institute of Public Health and the Environment, 2001. RIVM report No. 550002001.
- J.A. van Aardenne. *Uncertainties in emission inventories*. PhD thesis, Wageningen University, May, 29th 2002.
- H. Vreuls. Uncertainty analysis of dutch greenhouse emission data. a first qualitative and quantitative (tier 2) analysis. Technical report, SenterNovem, 2004.
- J. Zheng and H.C.H. Frey. Quantification of Variability and Uncertainty Using Mixture Distributions: Evaluation of Sample Size, Mixing Weights and Separation Between Components. *Risk Analysis*, 24(3):553–571, 2004. doi: 10.1111/j.0272-4332.2004.00459.x.