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ESTONIAN INFORMATIVE INVENTORY REPORT 1990-2011

Submitted under the Convention on Long-Range Transboundary Air Pollution

Data sheet

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ABBREVIATIONS

CAS	Chemical Abstracts Service, pollutants nomenclature
CEPMEIP	Co-ordinated European Programme on Particulate Matter Emission Inventories, Projections and Guidance
CLRTAP	Convention on Long Range Transboundary Air Pollution
CN	Combined Nomenclature
CollectER	Point and area sources database
COPERT 4	Road transport database
CORINAIR	CORe INventory AIR emissions programme
GNFR	Gridding NFR (aggregated NFR categories)
EB	Energy Balance
EEA	European Environment Agency
EEB	Estonian Environmental Board
EEIC	Estonian Environment Information Centre
EERC	Estonian Environment Research Centre
EF	Emission factor
EMEP	Cooperative programme for the monitoring and evaluation of the long range transmission of air pollutants in Europe (European monitoring and evaluation programme)
EMTAK	Estonian Classification of Economic Activities
E-PRTR	European Pollutant and Transfer Register
EU	European Union
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies model
IIASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
LCP	Large combustion plant
LPS	Large point sources, equals to the definition of E-PRTR installations

NECD	Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants, OJ L 309, 27 November 2001
NFR	Nomenclature for Reporting
OSIS	Web-interfaced air emissions data system for point sources at the Estonian Environment Information Centre (EEIC)
PP	Power Plant
RAINS	The Regional Air Pollution and Simulation model
QA/QC	Quality assurance/Quality control
SNAP	Selected Nomenclature for Air Pollution
TVP	True Vapour Pressure
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention for Climate Change

Pollutants

As	Arsenic
Cd	Cadmium
CFC	Chlorofluorocarbon
Cr	Chromium
Cu	Copper
CO	Carbon monoxide
HCB	Hexachlorobenzene
HCl	Hydrochloric acid
HFCs	Hydrofluorocarbons
Hg	Mercury
HM	Heavy metals
NH_3	Ammonia
Ni	Nickel

NMVOC	Non-methane volatile organic compounds, any organic compound, excluding methane, having a vapour pressure of 0.01 kPa or more at 293.15 K, or having a corresponding volatility under the particular conditions of use. For the purpose of the UNECE CLRTAP Reporting Guidelines, the fraction of creosote which exceeds this value of vapour pressure at 293.15 K is considered as a NMVOC.
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides, nitric oxide and nitrogen dioxide, expressed as nitrogen dioxide
PAH-4	Polyaromatic hydrocarbons expressed as the sum of benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene and indeno(1,2,3,-cd)pyrene
Pb	Lead
PCDD/PCDF	Dioxins and furans: 1,2,3,7,8-PeCDD; 2,3,4,7,8-PeCDF; 1,2,3,4,7,8-HxCDF; 1,2,3,6,7,8-HxCDF
PCB	Polychlorinated biphenyls
PCP	Pentachlorophenol
PFCs	Perfluorocarbons
$PM_{2.5}$	Particulate matter, the mass of particulate matter that is measured after passing through a size-selective inlet with a 50 per cent efficiency cut-off at 2.5 µm aerodynamic diameter
PM_{10}	Particulate matter, the mass of particulate matter that is measured after passing through a size-selective inlet with a 50 per cent efficiency cut-off at 10 µm aerodynamic diameter
POP	Persistent organic pollutants, (lindane, dichloro-diphenyl-trichloroethane (DDT), polychlorinated biphenyl (PCBs), pentabromodiphenyl ether (PeBDE), perfluorooctane sulfonate (PFOS), hexachlorobutadeine (HCBD), octabromodiphenyl ether (OctaBDE), polychlorinated naphthalenes (PCNs), pentachlorobenzene (PeCB) and short-chained chlorinated paraffins (SCCP)
Se	Selenium
SCCP	Short-chained chlorinated paraffins
SO_2	Sulphur dioxide
SO_x	Sulphur oxides, all sulphur compounds expressed as sulphur dioxide
TSP	Total suspended particulates. The mass of particles, of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions
Zn	Zinc

Units

g	Gramme
g I-Teq	Gramme International Toxic Equivalent
Gg	Gigagramme, 10^9 gramme
GJ	Gigajoule, 10^9 joule
GWh	Gigawatt hour
kg	Kilogramme, 10^3 gramme
kPa	Kilopascal, 10^3 Pa
Mg	Megagramme, 10^6 gramme
mg	Milligramme, 10^{-3} gramme
µg	Mikrogramme, 10^{-6} gramme
MJ	Megajoule, 10^6 joule
ng	Nanogramme, 10^{-9} gramme
TJ	Terajoule, 10^{12} joule
PJ	Petajoule, 10^{15} joule

Notation keys

IE	Included elsewhere – Emissions for this source are estimated and included in the inventory but not presented separately for this source (the source where included is indicated).
NA	Not applicable – The source exists but relevant emissions are considered never to occur. Instead of NA, the actual emissions are presented for source categories where both the sources and their emissions are well-known due to availability of bottom-up data (i.e. mainly in the energy and industrial processes sectors).
NE	Not estimated – Emissions occur, but have not been estimated or reported.
NO	Not occurring – A source or process does not exist within the country.
C	Confidential information – Emissions are aggregated and included elsewhere in the inventory because reporting at a disaggregated level could lead to the disclosure of confidential information.
NR	Not relevant - According to paragraph 9 in the Emission Reporting Guidelines, emission inventory reporting should cover all years from 1980 onwards if data are available. However, NR (not relevant) is introduced to ease the reporting where emissions are not strictly required by the different protocols.

EXECUTIVE SUMMARY

Estonia, as a party to the Convention on Long-range Transboundary Air Pollution (CLRTAP) is required to report annual emission data, projections of main pollutants, activity data and provide an Informative Inventory Report. The emissions data of all pollutants for the period 1990-2011 together with projections were submitted on 14 February 2013. The first IIR was submitted in 2010.

The current report contains an explanation of pollutant trends and key categories, information about sectoral methodologies, recalculations and planned inventory improvements.

The latest recalculations in the emission inventory were done for the time period from 1990 to 2010. The reasons for the recalculations are specified in Table 0.1 below:

Table 0.1. The status of recalculations in 2013 submission

NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1.A.1.c	Manufacture of solid fuels and other energy industries	Correction of emission of one shale oil manufacturing factory - Narva Oil Plant AS; the report of the operator contained summary NMVOC and methane emissions (the share of CH_4 in total emission is about 95-97%)	NMVOC	1990-2010
1.A.2.f.ii	Mobile Combustion in manufacturing industries and construction	Additionally calculated NH_3 emissions from gasoline combustion	NH_3	1990-2000, 2002-2007, 2009-2010
1.A.2.f.ii	Mobile Combustion in manufacturing industries and construction	Correction of sulphur content in fuels	SOx	2006-2007, 2009-2010
1.A.3.a.i(i)	International aviation (LTO)	Correction of pollutants emission factors for some specific aircraft types	NO_x, NMVOC, SO_x, $PM_{2,5}$, PM_{10}, TSP, CO	2000-2010
1.A.3.a.ii(i)	Civil aviation (Domestic, LTO)	Correction of pollutants emission factors for some specific aircraft types	NO_x, NMVOC, SO_x, $PM_{2,5}$, PM_{10}, TSP, CO	1990-2010
1.A.3.b.i; 1.A.3.b.iii	Road transport: Passenger cars; Road transport:, Heavy duty vehicles	Activity data are correctly divided between road transport subsectors and correction in annual millage driven in small extent.	NO_x, NMVOC, SO_x, NH_3, $PM_{2,5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, Diox, PAHs	2008-2010
1.A.3.b.ii	Road transport: Light duty vehicles	Activity data are correctly divided between road transport subsectors and correction in annual millage driven in small extent.	Pb, Cr, Zn	2008-2010

NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1.A.3.b.v	Road transport: Gasoline evaporation	Activity data are correctly divided between road transport subsectors and correction in annual millage driven in small extent.	NMVOC	2010
1.A.3.b.vi, 1.A.3.b.vii	Road transport: Automobile tyre and brake wear; Road transport: Automobile road abrasion	Correction in annual millage driven in small extent.	$PM_{2,5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn	2008-2010
1.A.3.c	Railways	Correction of sulphur content in fuels	SO_2	2010
1.A.3.a.ii(ii)	Civil aviation (Domestic, Cruise)	Correction of statistical fuel consumption	NO_x, NMVOC, SO_x, NH_3, $PM_{2,5}$, PM_{10}, TSP, CO	1990-2003, 2005- 2009
1.A.3.a.i(ii)	International aviation (Cruise)	Correction of statistical fuel consumption	NO_x, NMVOC, SO_x, NH_3, $PM_{2,5}$, PM_{10}, TSP, CO	2000-2010
1.A.3.d.ii	National navigation (Shipping)	Updated emission factors in the EMEP/EEA Guidebook	NO_x, NMVOC, SO_x, NH_3, $PM_{2,5}$, PM_{10}, TSP, CO	1990-2010
1.A.4.a.ii	Commercial / institutional: Mobile	Correction of sulphur content in fuels	SO_x	2000
1.A.4.b.i	Residential: Stationary plants	Correction of activity data (the amount of pellets was considered twice)	All pollutants	2010
1.A.4.c.ii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Correction of sulphur content in fuels	SO_x	2006-2010
1.A.3.d.i(i)	International maritime navigation	Correction of emission factors for PCB	PCB	1990-2010
3.D.3	Other product use	Correction of point sources emission	$PM_{2,5}$, PM_{10}, TSP, CO	2008-2010
6.D	Other waste(s)	Correction of activity data (amount of compost production from waste)	NH_3	2010

Detailed sector by sector explanations concerning the recalculations are presented in Chapter 10.

The differences in total emissions between the 2012 and 2013 submissions are presented in Table 0.2.

Table 0.2. Difference between the 2012 and 2013 submissions (%)

Year	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP	Pb	Cd
1990	0.01	-0.11	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1991	0.01	-0.09	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1992	0.02	-0.15	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1993	0.12	-0.95	0.00	0.00	0.02	NR	NR	0.00	0.00	0.00
1994	0.01	-0.76	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1995	0.01	-0.64	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1996	0.02	-0.55	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1997	0.02	-0.54	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1998	0.02	-0.51	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1999	0.02	-1.26	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
2000	0.02	-2.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.02	-1.33	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
2002	0.03	-1.63	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
2003	0.03	-2.74	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
2004	0.03	-1.64	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
2005	0.03	-2.39	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00
2006	0.04	-2.99	0.00	0.11	0.01	-0.05	-0.04	-0.03	0.00	0.00
2007	0.06	-5.22	0.00	0.09	0.02	0.01	0.01	0.01	0.00	0.00
2008	0.05	-3.52	0.00	0.05	0.00	-0.08	-0.10	-0.16	0.00	0.00
2009	-0.01	-3.33	0.00	0.00	0.01	-0.07	-0.05	-0.07	0.00	0.00
2010	-0.15	-8.30	-0.01	0.04	-2.56	-2.22	-1.64	-1.62	-0.06	-0.11

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs total	HCB	PCB
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1998	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006	0.00	0.00	0.00	0.00	0.00	0.00	3.86	0.00	0.00	0.00
2007	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	-0.04	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2010	-0.12	-0.01	-0.02	-0.13	-0.04	-0.17	-1.43	-3.09	-4.63	-1.27

Despite strides towards inventory improvement, there are still activities for which emissions have not been estimated:

- 4.F Field burning of agricultural wastes
- 11.B Forest fires

Priorities for future inventory improvement:

- To check the POPs emissions from energy industries;
- To provide uncertainty analysis for all key sources;
- To check the activities data and emission factors in energy industries. The main problem – discrepancy of the data regarding fuel consumption in statistical energy balance and the reports of the enterprises;
- To check data from facilities in the solvent use sector for the years 1990-2005.

1. INTRODUCTION

1.1. National inventory background

Estonia ratified the Convention on Long-range Transboundary Air Pollution in 2000 and became a party to the Convention and the following protocols:

- The 1985 Helsinki Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at least 30 per cent;
- The 1988 Sofia Protocol concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes;
- The 1991 Geneva Protocol concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes;
- The 1984 Geneva Protocol on Long-term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP);
- The 1998 Aarhus Protocol on Persistent Organic Pollutants (POPs);
- The 1998 Aarhus Protocol on Heavy Metals.

According to the Guidelines for Estimating and Reporting Emission Data, each party must report the annual national emission data of pollutants in the source category and shall submit an informative inventory report to the Convention Secretariat.

Estonia's Informative Inventory Report is due by March 2013. The report contains information on Estonian emission inventories from 1990 to 2011. The inventories detail the anthropogenic emissions of main pollutants (SO_x, NO_x, NMVOC, NH_3 and CO), particulate matter (TSP, PM_{10}, $PM_{2.5}$), heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Zn,) and persistent organic pollutants (dioxins, HCB, PAHs, PCB).

1.2. Institutional arrangements for inventory preparation

The Ambient Air Protection Act regulates data collection and reporting. Methods for the calculation of emissions are laid down in several regulations of the Minister of the Environment. The Air Pollution Database consists of data on point sources (about 1,850 for 2011) and diffuse sources. Structure and emission calculations from small point sources and area sources are mainly based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook.

The Estonian Environment Information Centre (EEIC) is responsible for collecting, analysing, storing, reporting and publishing environment-related information and data. The EEIC performs the final data quality control and assurance procedure before it is submitted. In preparation for the inventory and in compiling basic data, the Estonian Environment Information Centre cooperates with the Ministry of the Environment, the Ministry of Economic Affairs and Communications, the Ministry of Agriculture, and Statistics Estonia.

The important aim of the inventory is to test the effectiveness of governmental environmental policies and provide national and international bodies with official emission

data within the country. The emission data is updated every year and the results are reported annually.

1.3. The process of inventory preparation

1.4. Methods and data sources

The processes of inventory preparation vary for different sources of pollution.

The Estonian national air pollution inventory preparation can be described as an annual cycle, primarily because there is an annual reporting obligation. In order to improve the quality of the inventory and use resources more efficiently, analysis of inventory preparation has to be a part of inventory preparation. The main activities of inventory preparation are given in Figure 1.1. The databases in question are given in Figure 1.3.

Figure 1.1. The main activities of inventory preparation

The national database contains data for both point and diffuse sources of emissions. The emission inventory for the period of 1990–1999 is based on data pertaining to the large point sources and area sources. From 2000 to 2004, CollectER software was used to accumulate data (both point and area). In order to accumulate data on point sources, the Estonian Environment Information Centre created a new web-interface air emission data system for the point sources (OSIS) in 2004, where operators of point sources directly complete their annual air pollution reports. In 2000, there were data on 600 enterprises in the database; however, by 2011, the number had increased to 1,850.

The point sources information system contains data that is reported by the facilities that have a pollution permit. Each facility submits data on the emissions of polluting substances together with data regarding burnt fuel, used solvents, liquid fuel distribution, etc. Data are presented on each source of pollution and on the facility as a whole. The owners of point sources can directly add their calculated or measured annual emissions into the system or use OSIS calculation models, which use legally regulated estimation methodologies. The operator can also calculate emissions through the use of other available methods, though this should be co-ordinated with the Ministry of the Environment (regulated by the Ambient Air Protection Act). After entering the report into the system, the local department of the environment confirms receipt of the report; at this point, final verification at the EEIC is carried out and the data are then ready for use in various reports.

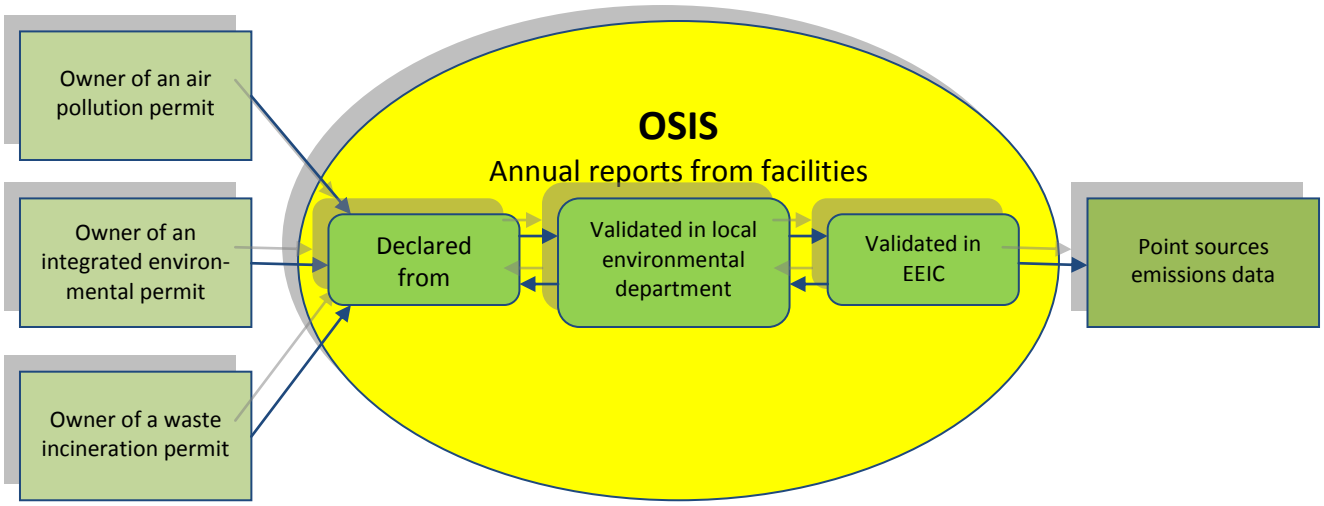

Figure 1.2. Validation of Estonian point sources data

At present, the EEIC uses the CollectER tool for the calculation of emissions from diffuse sources.

With regard to the calculation of emissions from road transport, we are using the COPERT 4 methodology and emission factors. Total emissions are calculated on the basis of the combination of firm technical data (e.g. emission factors) and activities data (e.g. number of vehicles, annual mileage per vehicle, average trip, speed, fuel consumption, monthly temperatures). EEIC has obtained vehicle data (passenger cars, light and duty vehicles, buses, motorcycles) and annual mileage per vehicle from the Estonian Road Administration. Meteorological data is provided by the Meteorological and Hydrological Institute and data pertaining to fuel consumption by Statistics Estonia.

By means of the special export module, data on point sources (emissions and burnt fuel) are transferred from OSIS to CollectER. The national emission inventory data that are stored in the CollectER annual inventory databases are used for reporting.

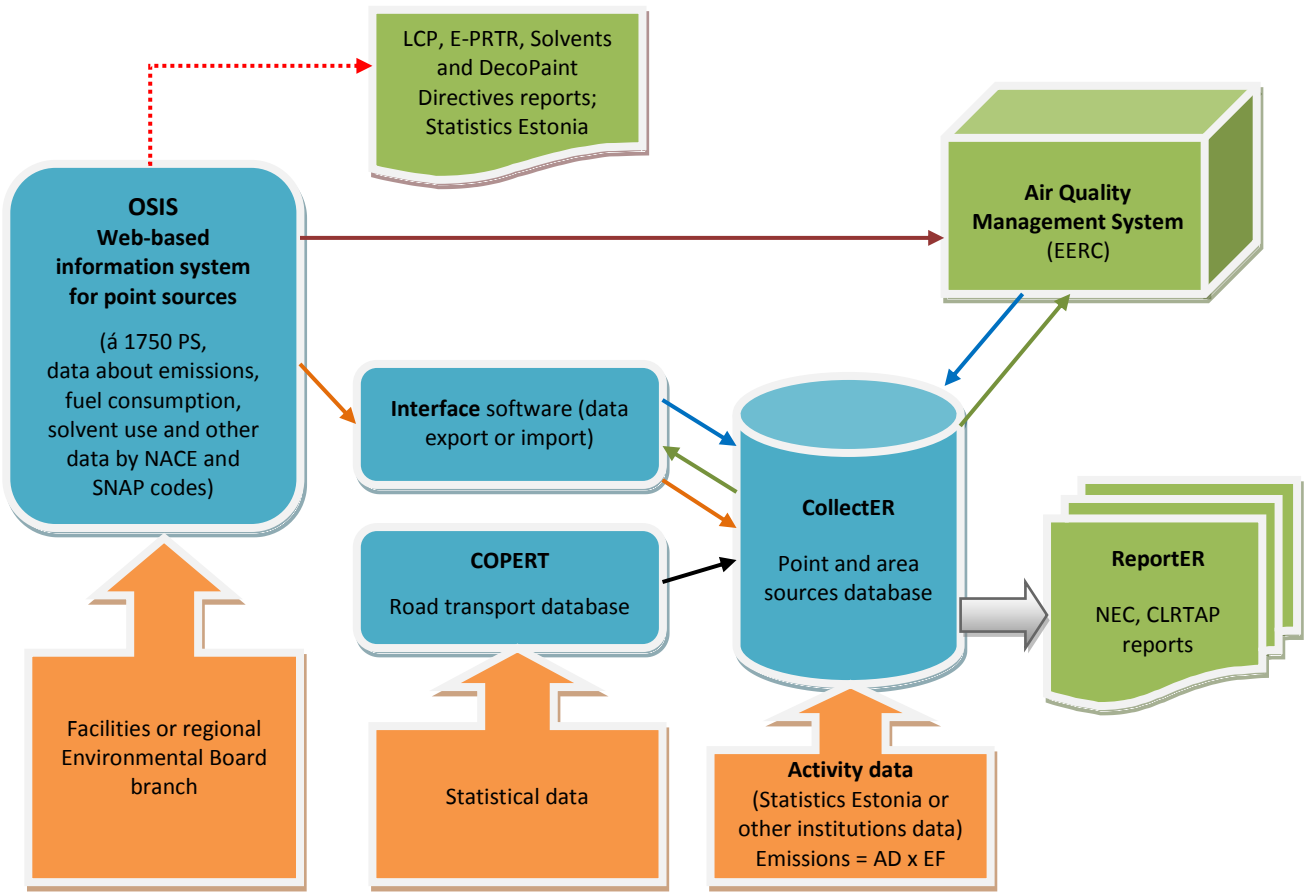

Figure 1.3. Air pollution database structure

1.5. Key Categories

This chapter presents the results of Estonian key sources analyses.

Key sources analysis is based on methods described in Chapter 2 of the EMEP/EEA air pollutant emission inventory Guidebook 2009.

Key categories are the categories of emissions that have a significant influence on the total inventory in terms of the absolute level of emissions (certain year). The key categories are those that together represent 80% of the inventory level or trend. According to the study, for certain emissions ("Key sources analysis and uncertainty assessment of sulphur dioxide, nitrogen oxides and ammonia emissions in Estonia" Elo Mandel, Tallinn 2009) in 2007 there were no significant differences between the results of the level and trend assessment of key sources analysis. So, for 2011, only the level assessment was chosen.

The results of the key source category analysis for main pollutants are presented in Annex I in ascending NFR category order. The results of all pollutants (including main pollutants), which are reported under CLRTAP, are in Table 1.1.

The energy (1.A.1.a) and road transport (1.A.3.b.i – 1.A.3.b.iii) sectors are the main sources of NO_x. Energy sector emissions are mainly from oil-shale power plants.

Combustion in residential plants (1.A.4.b.i) is also a main source of NMVOC (46.2%). Additionally, road transport (1.A.3.b.i), natural gas distribution (1.B.2.b), and public electricity and heat productions (1.A.1.a) constitute key sources.

According to level assessment, a SO_2 emission for 2011 from the energy sector is responsible for 91% of SO_2 emissions in 2011. The majority of these emissions come from two oil shale power plants in east Estonia (Eesti and Balti power plants).

Agriculture is the key source for ammonia, especially livestock manure management (4.B.1.a – 4.B.1.b), and the use of mineral fertilises (4.D.1.a), which are the main sources of pollution regarding ammonia.

The combustion in residential plants is a key source for TSP, PM_{10} and $PM_{2.5.}$ For TSP and $PM_{2.5}$ the influence of public electricity and heat productions (1.A.1.a) is also significant.

According to level assessment, 64.8% of CO emissions come from residential combustion plants (1.A.4.b.i). In addition, road transport (1.A.3.b.i) and the oil-shale industry (1.A.1.c) are the main polluters of CO. Combustion in the residential sector is also a key source for PCB and dioxins.

The energy (1.A.1.a) sector is a main source of heavy metals and PCB. In addition, road transport (1.A.3.b.vi) is a key polluter for Cu too.

Table 1.1. Results of key source analysis

Pollutant	Key sources categories (sorted from high to low from left to right)										Total (%)
NO_x	1 A 1 a	1 A 3 b iii	1 A 3 b i	1 A 4 c ii	1 A 2 f i	1 A 3 c					
	41.3%	16.0%	9.5%	6.0%	5.1%	5.0%					82.9%
NMVOC	1 A 4 b i	1 B 2 a v	1 A 3 b i	3 A 1	3 D 2	4 B 1 a	4 B 1 b	3 B 1	4 B 8	3 A 2	
	46.2%	5.3%	5.2%	5.1%	4.1%	4.0%	3.2%	3.1%	2.8%	2.6%	81.6%
SO_x	1 A 1 a										
	91.1%										91.1%
NH_3	4 B 1 a	4 D 1 a	4 B 1 b	4 B 8							
	31.5%	24.1%	16.6%	13.0%							85.2%
$PM_{2.5}$	1 A 1 a	1 A 4 b i									
	44.3%	41.3%									85.5%
PM_{10}	1 A 1 a	1 A 4 b i									
	60.0%	26.2%									86.2%
TSP	1 A 1 a	1 A 4 b i									
	59.2%	25.3%									84.6%
CO	1 A 4 b i	1 A 1 c	1 A 3 b i								
	64.8%	10.8%	10.5%								86.2%
Pb	1 A 1 a										
	94.7%										94.7%
Cd	1 A 1 a										
	93.3%										93.3%
Hg	1 A 1 a										
	96.5%										96.5%
As	1 A 1 a										
	99.2%										99.2%
Cr	1 A 1 a										
	95.4%										95.4%
Cu	1 A 1 a	1 A 3 b vi									
	50.2%	39.7%									89.9%
Ni	1 A 1 a										
	93.9%										93.9%
Zn	1 A 1 a										
	90.1%										90.1%
DIOX	1 A 1 a	1 A 4 b i									
	57.2%	28.9%									86.1%
benzo(a) pyrene	1 A 4 b i	1 A 1 a									
	77.7%	15.1%									92.8%
benzo(b) fluoranthene	1 A 4 b i	1 A 1 a									
	73.4%	18.0%									91.4%
benzo(k) fluoranthene	1 A 4 b i										
	80.6%										80.6%
Indeno(1,2,3-cd)pyrene	1 A 4 b i										
	82.2%										82.2%
PAH total 1-4	1 A 4 b i	1 A 1 a									
	77.6%	15.1%									92.7%
HCB	1 A 4 b i	1 A 1 a									
	56.4%	31.4%									87.8%
PCB	1 A 4 b i	1 A 1 a									
	64.1%	25%									89%

1.6. QA/QC and Verification methods

A quality management system has been developed to support the inventory of air pollutant emissions.

Quality Control (QC) is a system of routine technical activities, to measure and control the quality of the inventory as it is being developed.

Quality Assurance (QA) activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation/development process.

Estonia's QA/QC plan consists of six parts:

- **Stakeholder engagement (stakeholders = e.g. suppliers of data, reviewers, recipients, other inventory compiling institutes):**
  Estonian inventory was reviewed under stage 3 review in 2011 summer by the EMEP emission centre CEIP acting as review secretariat. The results are available centre CEIP home page (http://www.ceip.at/review-process/centralised-review-stage-3/)
- **Data collection,**
  Includes both point sources emissions and diffuse sources activity data collection. Before using activity data common statistical quality checking related to the assessment of trends has been carried out.
  EEIC is using only point sources data which is checked and validated by local environmental departments.
- **Data manipulation**
  Common statistical quality checking has been carried out.
- **Inventory compilation**
  Before submitting data to CEIP/EEA NFR formats have to been checked with RepDab.
- **Reporting**
- **Archiving**

1.7. General uncertainty evaluation

The uncertainty assessment has not yet been evaluated in Estonia. Undertaking a quantitative uncertainty assessment is planned for the next submissions.

1.8. General Assessment of Completeness

Table 1.2. Sources not estimated (NE)

NFR09 code	Substance(s)	Reason for not estimated
1.A.3.b.i	Hg, As, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
1.A.3.b.ii	Hg, As, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).

NFR09 code	Substance(s)	Reason for not estimated
1.A.3.b.iii	Hg, As, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
1.A.3.b.iv	Hg, As, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
1.A.3.b.v	PCDD/PCDF, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
1.A.3.b.vi	Hg, As, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
1.A.3.b.vii	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
4.B.6	TSP	No emission factor in new GB
4.D.1.a	TSP	No emission factor in new GB
4.F	All	Will be calculated for next year's submission
1.A.3.d.i.(i)	NH_3, PAHs	No emission factor in new GB
11.B	All	Will be calculated for next year's submission
7.B	All	Will be calculated for next year's submission

Table 1.3. Sources included elsewhere (IE)

NFR09 code	Substance(s)	Included in NFR code
1.A.2.a	PCDD/PCDF, PAHs, HCB, PCBs	1.A.2.f.i
1.A.2.b	PCDD/PCDF, PAHs, HCB, PCBs	1.A.2.f.i
1.A.2.c	PCDD/PCDF, PAHs, HCB, PCBs	1.A.2.f.i
1.A.2.d	PCDD/PCDF, PAHs, HCB, PCBs	1.A.2.f.i
1.A.2.e	PCDD/PCDF, PAHs, HCB, PCBs	1.A.2.f.i
1.A.5.a	All	1.A.4.a.i
1.A.5.b	All	1.A.4.a.ii
1.B.1.b	All	1.B.1.a
2.A.1	All, partially TSP, PM_{10}, $PM_{2.5}$	1.A.2.f.i
2.A.2	All, partially TSP, PM_{10}, $PM_{2.5}$	1.A.2.f.i
3.A.3	NMVOC	3.A.1
4.B.4	NO_x, NMVOC, NH_3	4.B.3
6.C.a	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn	6.C.b

2. POLLUTANTS EMISSION TRENDS

Estonia has been reporting data regarding national total and sectoral emissions under the LRTAP Convention since 2000s.

Estimates are available as follows:

- NO_x, SO_2, NH_3, NMVOC, CO, TSP: 1990-2011
- PM_{10} and $PM_{2.5}$: 2000-2011
- All heavy metals: 1990-2011
- POPs: 1999-2011

Table 2.1. Main pollutant emissions in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP
1990	73.616	70.175	273.609	24.591	226.579	NR	NR	277.332
1991	67.921	66.852	251.290	21.781	225.987	NR	NR	277.195
1992	43.705	45.005	191.662	19.102	127.103	NR	NR	248.691
1993	39.509	37.203	155.897	14.032	123.607	NR	NR	196.399
1994	42.064	41.026	150.235	13.164	149.537	NR	NR	174.873
1995	39.176	49.835	116.107	11.489	196.929	NR	NR	134.261
1996	42.458	52.379	125.139	10.385	219.320	NR	NR	123.533
1997	41.233	54.344	116.205	10.757	228.727	NR	NR	100.211
1998	38.336	46.120	104.315	10.839	181.156	NR	NR	88.516
1999	36.787	45.571	97.605	9.411	190.279	NR	NR	87.163
2000	37.651	45.188	96.959	9.511	182.610	21.238	37.352	74.774
2001	40.080	44.910	90.688	9.562	188.466	22.213	37.303	73.051
2002	41.062	44.213	86.989	8.865	181.735	22.759	33.366	52.507
2003	41.762	43.072	100.241	9.776	174.275	20.852	29.977	48.614
2004	39.178	43.154	88.245	10.082	171.219	22.080	30.170	45.914
2005	36.633	40.136	76.282	9.778	157.690	19.910	26.872	37.216
2006	35.411	38.340	69.937	9.972	143.821	15.227	20.417	27.907
2007	38.642	38.542	87.970	10.311	162.706	20.307	29.018	35.955
2008	35.797	36.949	69.375	10.901	166.752	19.995	25.390	31.645
2009	30.248	35.450	54.827	10.004	168.255	18.586	23.271	28.399
2010	36.748	35.015	83.215	10.256	172.019	23.299	31.831	37.578
2011	35.654	33.105	72.690	10.382	147.802	26.461	41.771	49.334
trend 1990-2011, %	**-51.6**	**-52.8**	**-73.4**	**-57.8**	**-34.8**	**24.5**	**11.5**	**-82.2**

Sulphur dioxide

During the period of 1990-2011, the emissions of sulphur dioxide had decreased by about 73.4%, which was largely influenced by a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 167 PJ in 2011) (Figure and Table 2.1). The latter, in turn, was the result of a restructuring of the economy. Likewise, the export possibilities, regarding electricity, have also noticeably decreased. The use of local fuels (including wood, oil shale oil) and natural gas has been constantly increasing since 1993, while the relevance of heavy fuel oil, in the production of thermal energy, has reduced. The use of fuel with lower sulphur content was also the reason for a decrease in SO_2 emissions (with regard to fuel for road transport and heating).

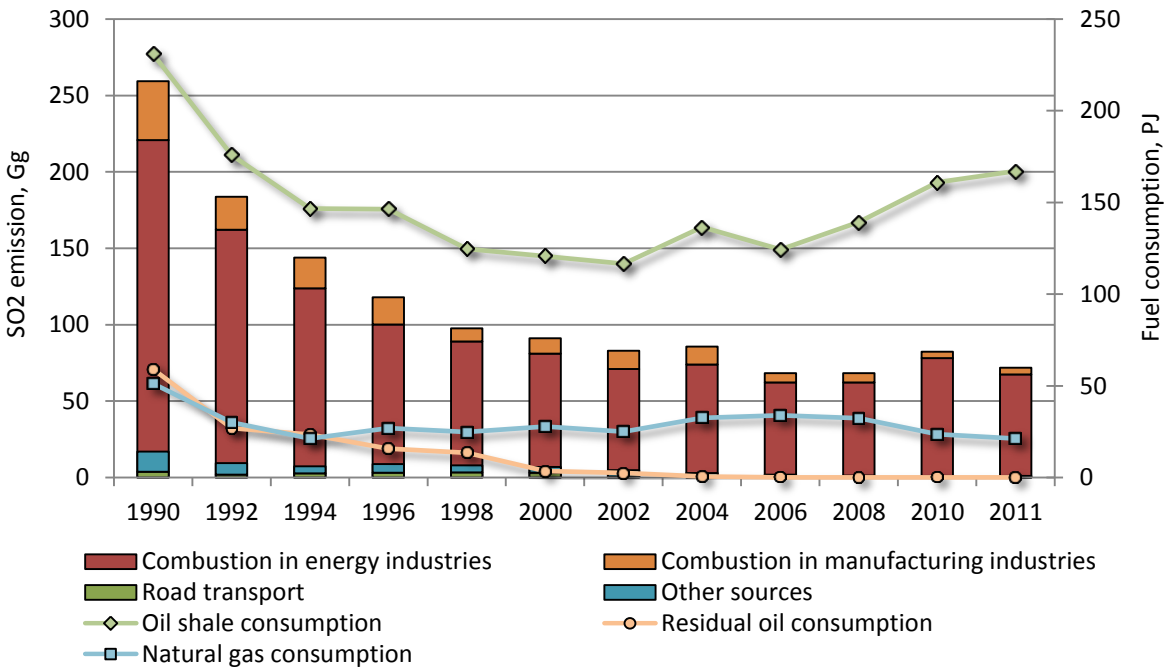

Figure 2.1. SO_2 emissions in the period 1990-2011

In 2011, SO_2 emissions had decreased about 12.7% compared to 2010 in the result of the decrease in electricity production for the same period. The other reason for emissions decreasing is the installation of the semi-dry NID (Novel Integrated Desulphurisation) technology, which uses the fly ash in the gas itself and does not require any additional compounds to bind the SO_2.[1] On the energy units which hasn't been equipped with the clearing equipment, alternative methods of reduction of SO_2 emissions are used, such as water injection to furnaces of PC (old pulverised combustion boilers). Water injection lowers flame temperature and therefore improves conditions for sulphur capture with limestone included in oil shale.

The energy sector (NFR 1.A.1.a-c) is responsible for about 93% of total emissions (2011). The share of SO_2 emissions from the two large oil shale Narva Power Plants (PP) (Eesti and Balti) is about 77.9% of total emissions. The main reason for the drop in emissions from 2004 is the launch of two new boilers at the Narva PP that are based on circulating fluidized-bed

[1] Eesti Energia. Environmental Reports 2009/2010 and 2011

(CFB) technology. The new boilers have reduced SO_2 emissions to virtually zero. Emissions have also been considerably reduced by shutting down the old blocks. Also, the new desulphurisation NID equipment design and installation process ensure that the desulphurisation equipment will be able to operate at the required levels of efficiency and reliability for the next 15 years. The Eesti Energia continued working to install and fine-tune the NID technology-based emission reduction filters to cut SO_2 emissions from four generating units of the Eesti PP. This solution means that these filter equipped units will meet the tighter limits on sulphur emissions in flue gasses that will come in from 2016. Measures are also being taken to reduce nitrogen emissions and this will mean that the units will be able to work at full capacity after 2016, without limits. These scrubbers will also reduce the solid particle content of flue gases[2].

Nitrogen oxides

Emissions of nitrogen oxides have decreased by 51.6% compared to 1990 (Figure 2.2). The reduction is mainly due to the decrease in energy production and the transport sector during the period of 1990-1993 (the consumption of petrol by road transport dropped 58% at this time and diesel by 45%. The increasing share of catalyst cars in more recent years was also a contributing factor in the reduction of NO_x emissions. The energy industry and road transport sector are the main sources of nitrogen oxide emissions – 42.4% and 27.4% respectively. The share of other mobile sources was 14.8% in 2011 (Figure 2.3).

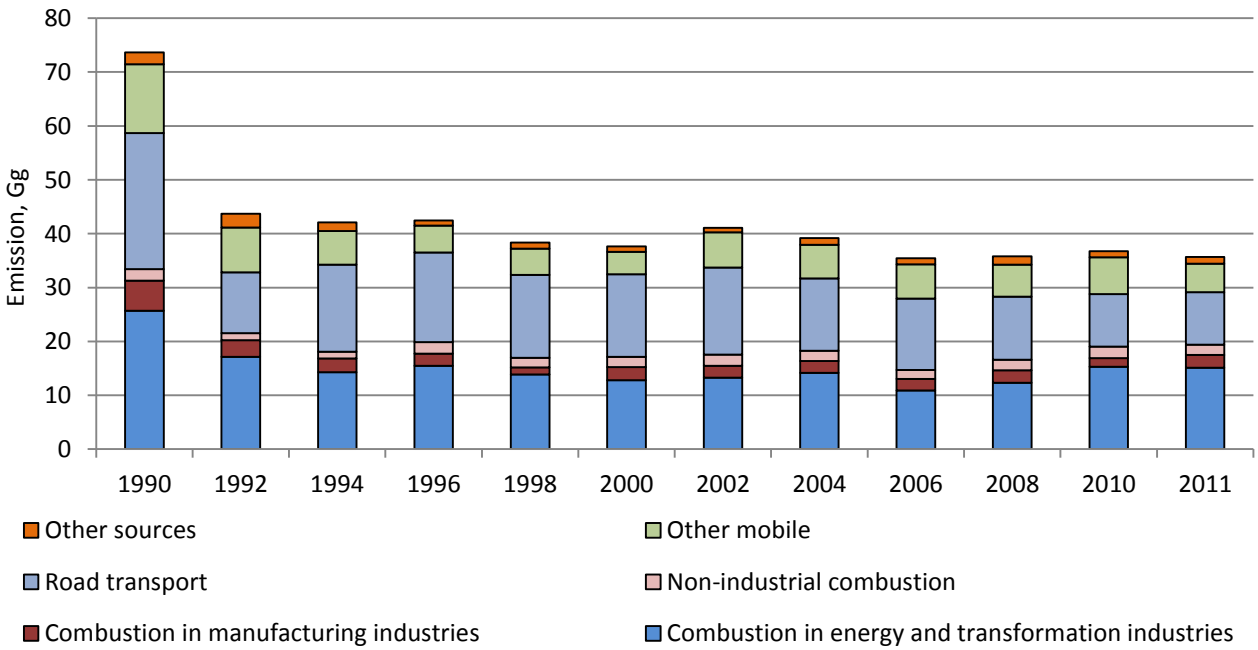

Figure 2.2. NO_x emissions in the period 1990-2011

In 2011, NO_x emissions had decreased about 3% compared to 2010 due to the decreasing of electricity production for the same period.

[2] Eesti Energia. Environmental Reports 2009/2010 and 2011

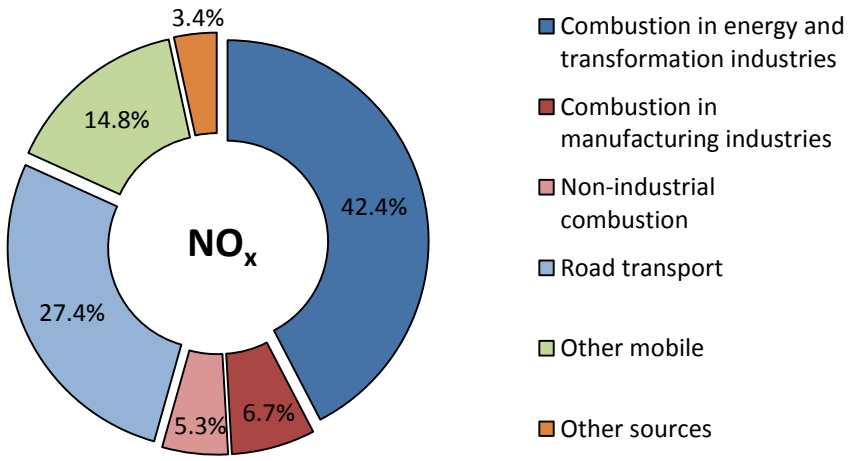

Figure 2.3. NO_x emissions by sources of pollution in 2011

Non-methane volatile compounds

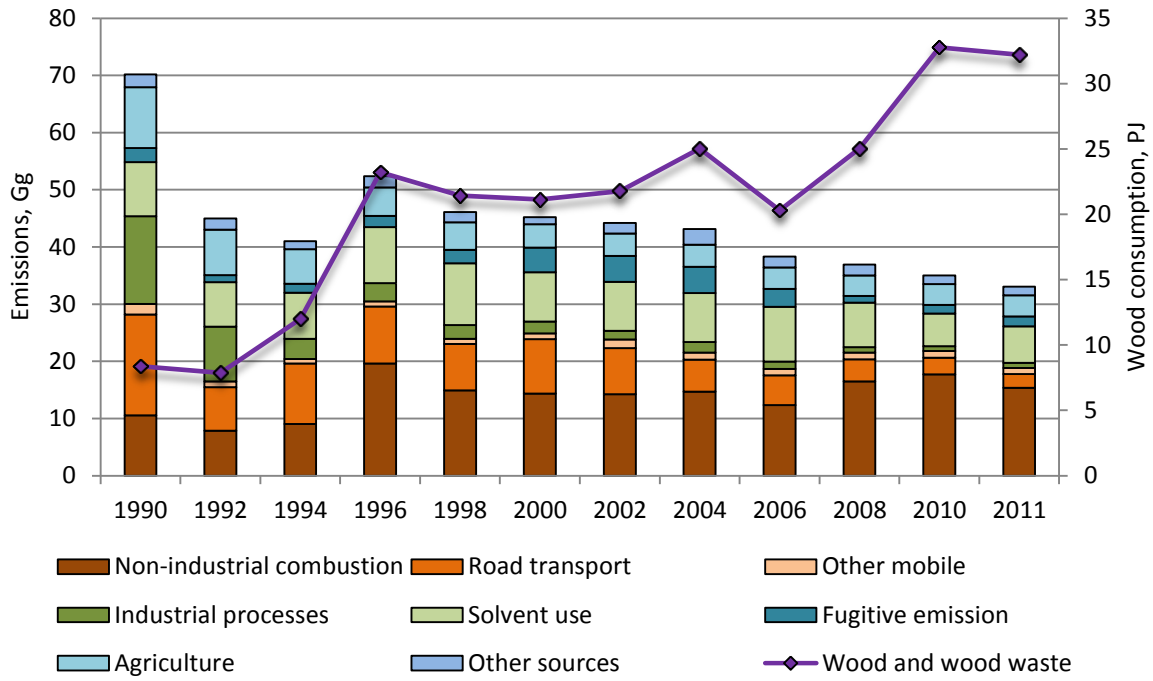

Figure 2.4. Emissions of non-methane volatile organic compounds in the period 1990-2011

The total emissions of non-methane volatile organic compounds have decreased by 52.9% between 1990 and 2011. In 1990, the main polluters of NMVOC were road transport (25%) and industrial processes (22%), while in 2011 the dominant sources were non-industrial combustion (47%) and solvent use (19%) (Figure 2.5). The primary reason for this change was a decrease in the use of motor fuel in the transport sector and an increase in the consumption of diesel compared to petrol. Secondly, during 1990-2011, the manufacture of chemical products fell. Emissions from non-industrial fuel combustion (mainly in households)

have increased since 1995. These are the result of the increasing tendency towards wood and wood waste combustion (the NMVOC emission factor for these fuels is much higher for the domestic stoves and higher than for other fuels combustion). The growth of fugitive emissions from fuels can be explained by the increase of emissions from marine terminals.

In 2011, NMVOC emissions decreased 5.5% compared to 2010 mainly due to decreasing biomass consumption in residential combustion plants and also to decreasing of emission from road transport (Figure 2.4). The small increase in emissions for the same period was observed in the solvent use, liquid fuel distribution and industry.

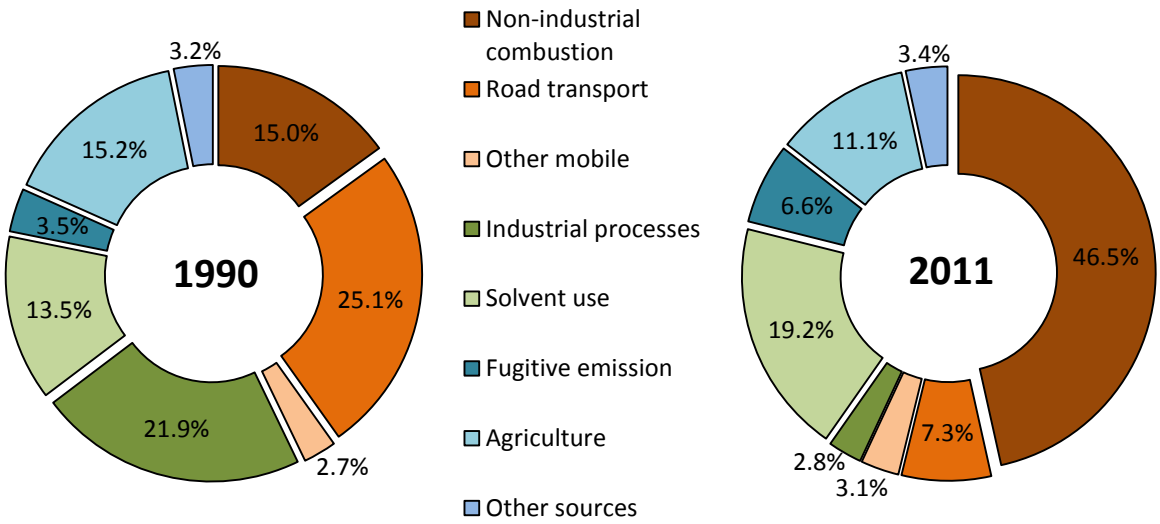

Figure 2.5. NMVOC emissions by sources of pollution in 1990 and 2011

Ammonia

Total NH_3 emissions have decreased by 57.8% from 1990 to 2011 due to a reduction in the number of animals and use of fertilisers (Figure 2.6). Livestock manure management and mineral fertiliser use are the main sources of pollution regarding ammonia (about 93.5%). Road transport makes up 2% of total emissions and has increased in recent years due to a growth in new car usage. The share of fugitive emissions from solid fuels (oil shale open cast mining, mainly explosive works) is also about 2%. The total share that industry and waste management make is about 2.2% of total ammonia emissions.

Emission in 2011 remained practically at the level of 2010.

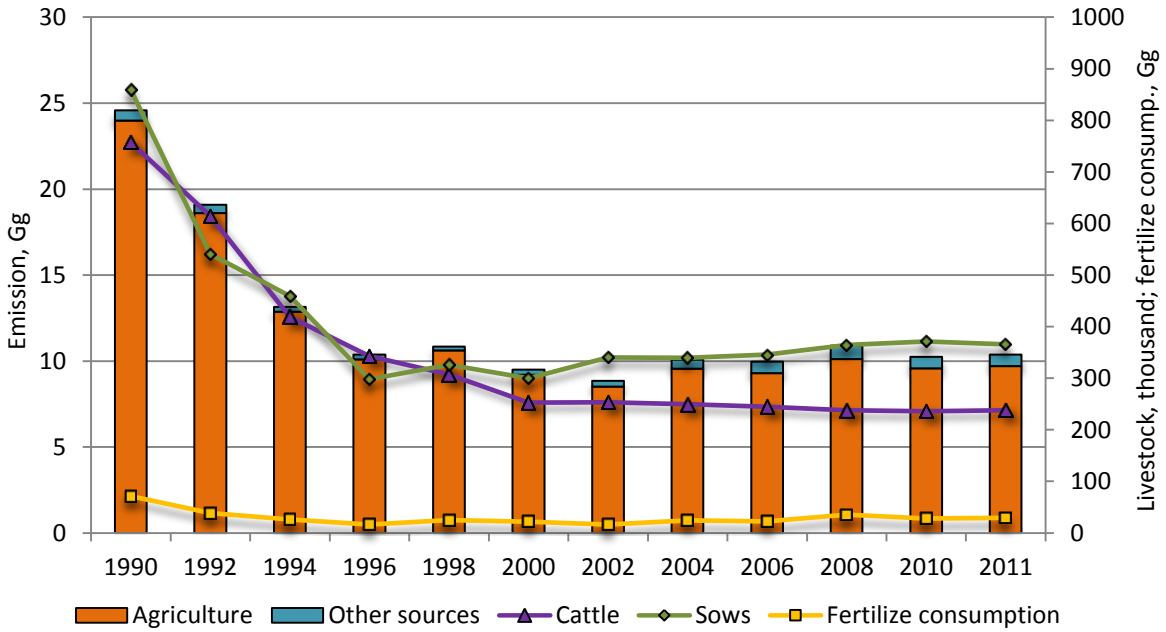

Figure 2.6. Emissions of ammonia in the period 1990-2011

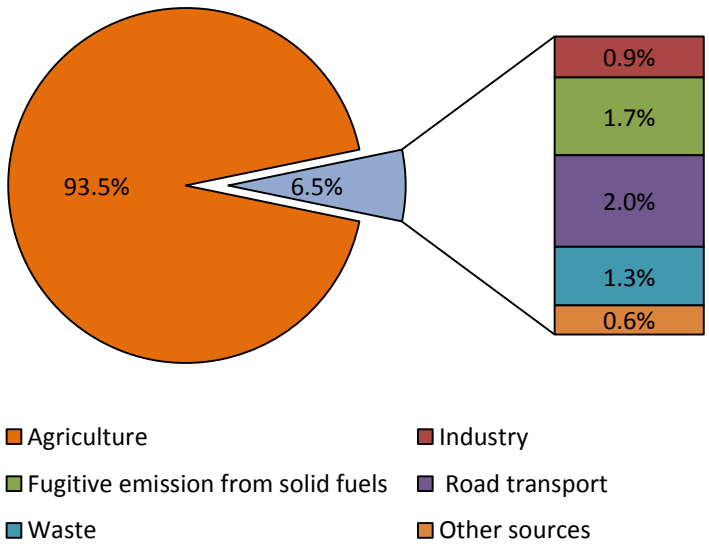

Figure 2.7. Ammonia emissions by sources of pollution in 2011

Carbon monoxide

In the period 1990-2011, the emissions of carbon monoxide decreased by 34.8%. That was, among other things, caused by the reduction in the use of vehicle fuels, and in recent years by a decrease in the number of cars using petrol (Figure 2.8). In 2011, the biggest polluters of CO were combustion in the non-industrial sector (about 66%), combustion in energy industry (14%, mainly from shale oil production industry) and road transport – 12% (Figure 2.9).

In 2011, carbon monoxide emission decreased 14.1% compared to 2010 mainly due to decreasing of biomass consumption in residential combustion plants and decreasing of emissions from road transport. One of the reasons is also the reduction in production of shale oil at the Eesti Energia Õlitööstus AS plant.

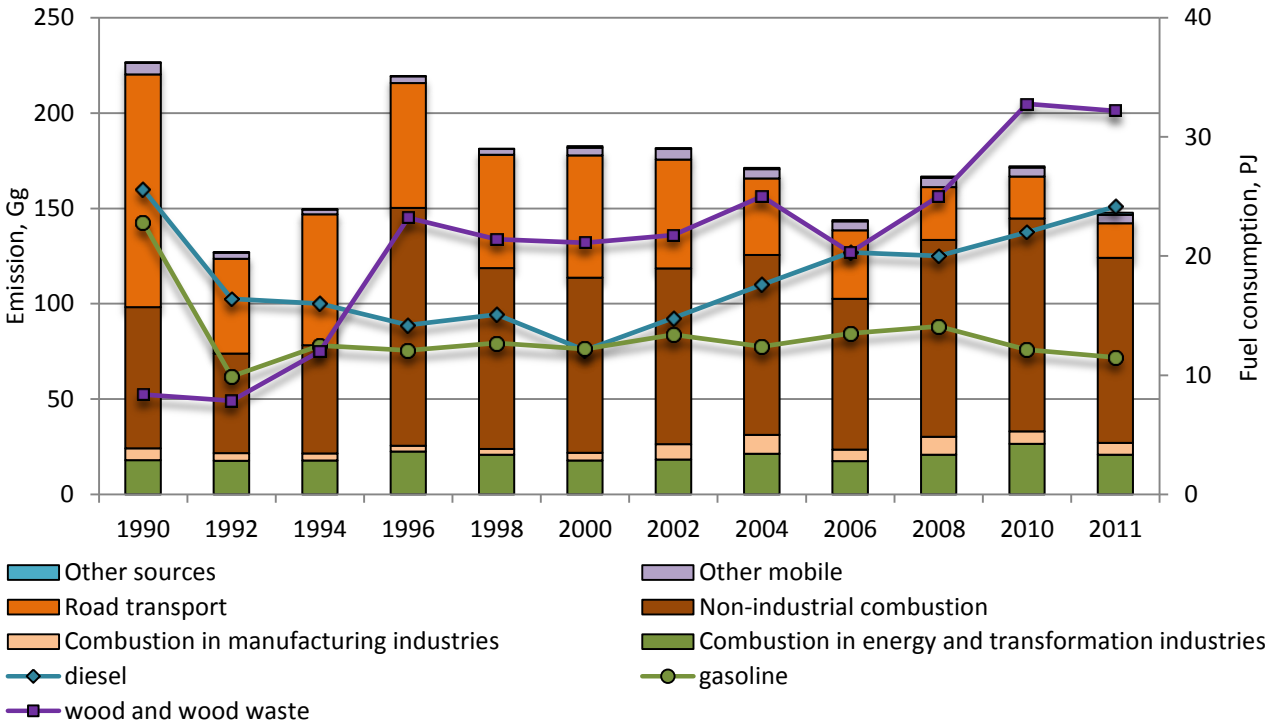

Figure 2.8. Emissions of carbon monoxide in the period 1990-2011

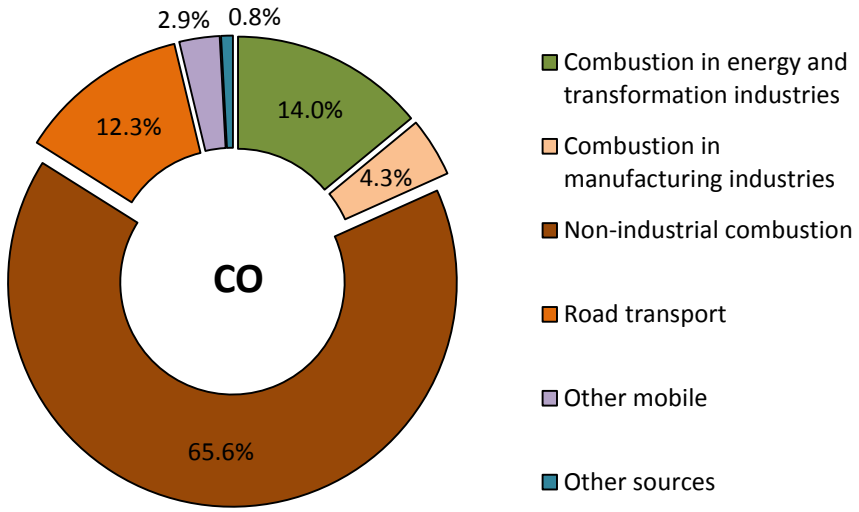

Figure 2.9. CO emissions by sources of pollution in 2011

Particulates

The emissions of TSP are shown in Figure 2.10.

In 1990-2011, TSP emission dropped significantly – by 82.2%. This is due to the increase in the efficiency of combustion devices and cleaning installations (especially in oil shale power plants and the cement factory) as well as the decrease in electricity production. The significant growth of TSP emissions in 2011 compared 2010 (31.3%) was due to the increase in electricity production by 34% in Baltic PP (Eesti Energia Narva Elektrijaamad AS) and also as a result of bad operation of electric precipitators on two power units of power plant.

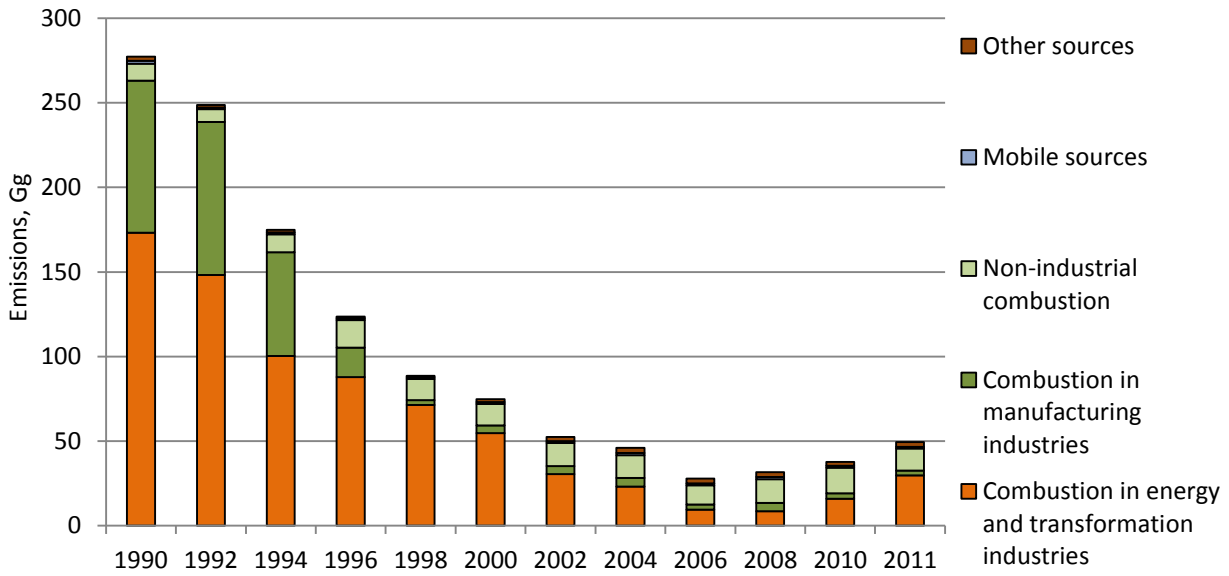

Figure 2.10. TSP emissions in the period 1990-2011

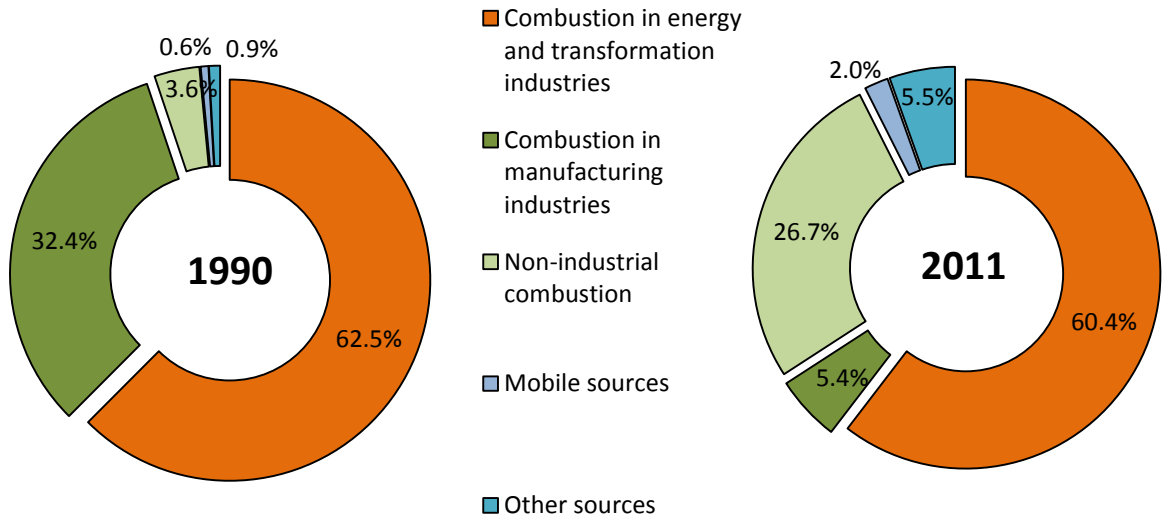

Figure 2.11. TSP emissions by sources of pollution in 1990 and 2011

In 1990, the main polluters of TSP were energy industry (62%) and combustion in manufacturing industries (32%). In 2011 the same dominant source – energy industry (60%), while share of non-industrial combustion had increased by 23% and share of industrial combustion had decreased by 27% comparing to 1990 (Figure 2.11). The main reason for such change is the modernisation of cleaning equipment at cement plant and increase in a share of wood combustion in domestic sector.

The emissions of fine particulates PM_{10} and $PM_{2.5}$ are shown in Figure 2.12.

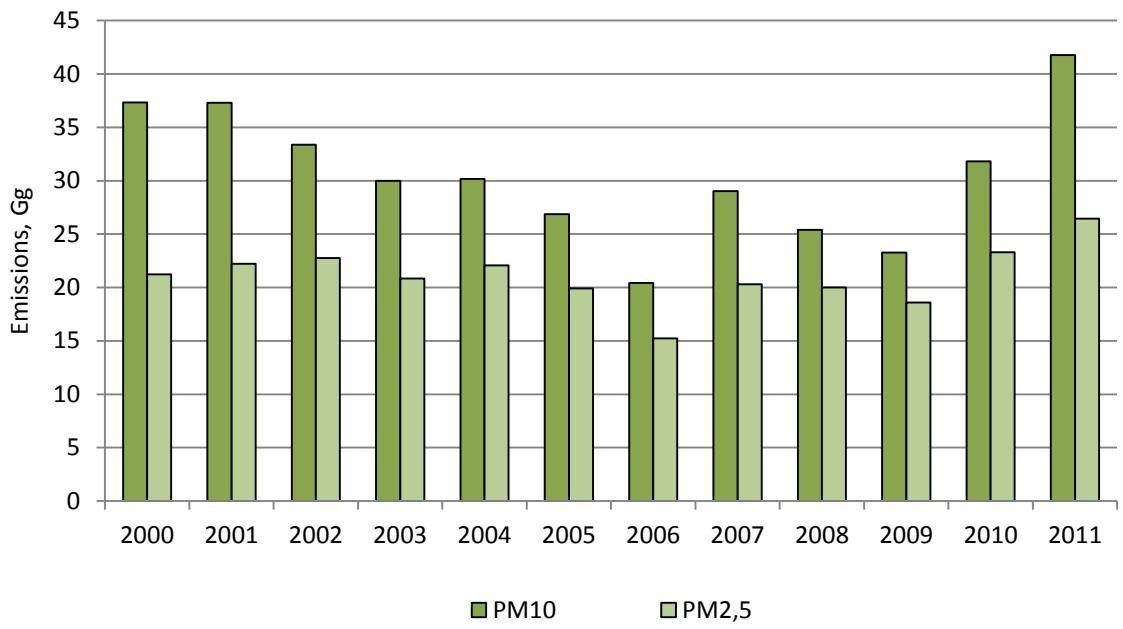

Figure 2.12. PM_{10} and $PM_{2.5}$ emissions in the period 2000-2011

In the period 2000-2011, the emissions of PM_{10} and $PM_{2.5}$ increased by 11.8% and 24.6% respectively. The main reason of that is growth of electricity production.

The primary sources of fine particulates (PM_{10}) emission in 2011 were combustion in energy and transformation industries (61%, mainly oil shale combustion) and non-industrial combustion (28%) (Figure 2.13). The distribution of $PM_{2.5}$ emissions by sources of pollution is also visible in Figure 2.13.

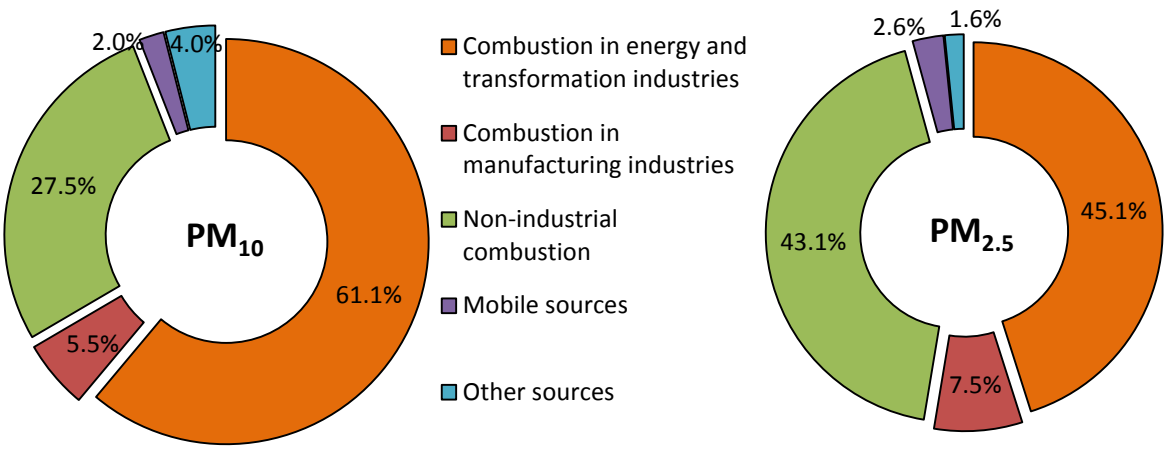

Figure 2.13. PM_{10} and $PM_{2.5}$ emission by activities in 2011

Heavy metals

Emissions of heavy metals dropped significantly and are shown in Table 2.2 and Figure 2.14.

Heavy metals are mainly released by combustion in energy and transformation industries and from mobile sources. The energy industry (mainly oil shale power plants) is a big heavy metals polluter in Estonia. The emissions of lead decreased by 81.4% due to the modernisation of cleaning equipment at both the Narva PP and Kunda Nordic Cement and due to the decrease in energy production. The other reason is that the use of leaded petrol was discontinued in Estonia in 2000.

Table 2.2. Heavy metal emissions in the period 1990-2011 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	205.457	4.402	1.121	18.860	18.301	10.104	27.360	105.251
1991	188.138	4.201	1.021	16.451	15.957	9.361	25.926	96.366
1992	123.967	2.996	0.830	14.030	13.714	6.690	17.027	78.317
1993	102.451	2.217	0.640	10.840	10.377	5.451	14.343	60.746
1994	122.549	2.867	0.640	10.680	10.220	5.957	12.870	63.853
1995	85.442	1.956	0.600	10.070	9.662	5.085	10.501	58.492
1996	65.857	1.047	0.600	10.360	9.886	4.638	10.943	56.010
1997	46.438	1.067	0.600	10.200	9.600	4.605	9.823	55.599
1998	39.097	1.006	0.530	9.150	8.623	4.174	8.872	50.307
1999	39.025	0.946	0.500	8.710	8.224	4.028	7.650	48.222
2000	35.897	0.561	0.505	8.590	8.096	3.718	6.621	44.555
2001	36.324	0.548	0.500	8.390	7.972	3.996	6.495	44.434
2002	35.542	0.568	0.500	8.360	8.079	4.155	6.308	43.840
2003	37.580	0.628	0.580	10.110	9.525	4.477	6.795	52.440
2004	36.308	0.588	0.540	9.790	9.098	4.489	6.732	52.209
2005	35.026	0.579	0.520	9.220	8.841	4.476	6.503	48.659
2006	31.481	0.549	0.520	8.590	8.219	4.360	5.833	44.293
2007	39.876	0.680	0.650	11.080	10.461	5.037	6.791	55.925
2008	34.933	0.612	0.573	9.415	9.000	4.636	5.996	49.069
2009	28.244	0.479	0.443	7.610	7.197	4.005	4.910	39.900
2010	38.734	0.667	0.631	10.974	10.236	4.887	6.653	55.883
2011	38.140	0.654	0.631	10.887	10.107	4.835	6.482	54.796
trend 1990-2011, %	**-81.4**	**-85.1**	**-43.7**	**-42.28**	**-44.8**	**-52.2**	**-76.3**	**-47.9**

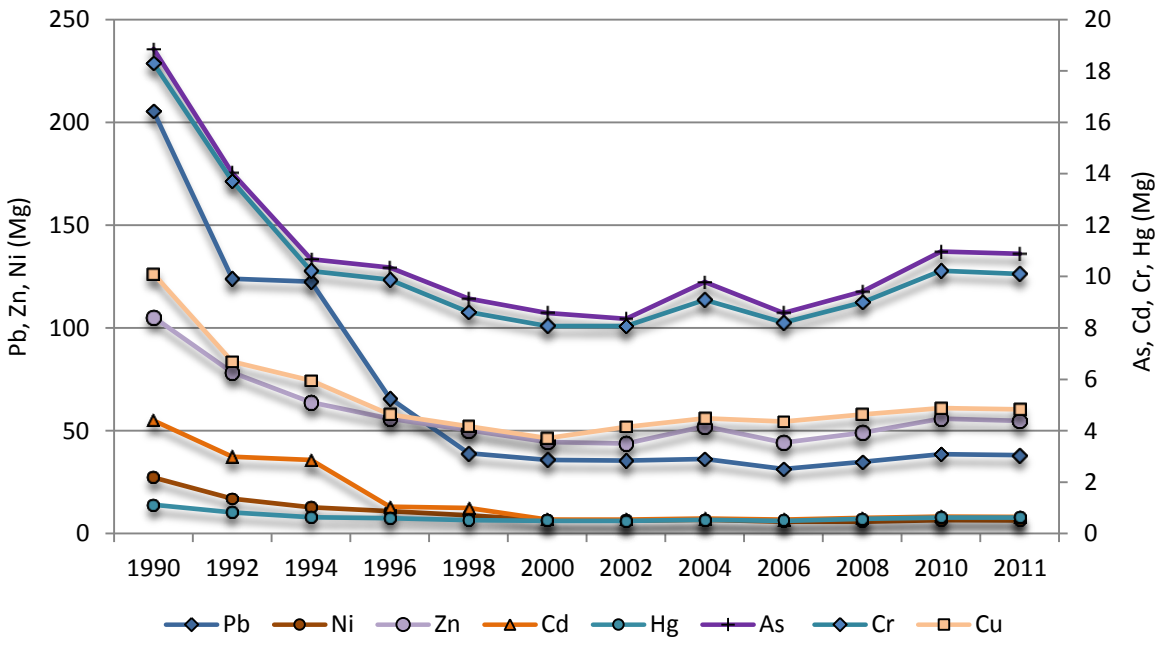

Figure 2.14. Heavy metals emissions in the period 1990-2011

Persistent organic pollutants

The emissions of POPs are shown in Table 2.3 and Figure 2.15.

Table 2.3. POPs emission in the period 1990-2011

	dioxines/ furanes	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	PAHs, total	HCB	PCB
	g I-Teq	Mg					kg	
1990	5.666	3.641	4.289	2.217	2.052	12.201	0.060	10.154
1991	5.413	3.531	4.208	2.145	1.992	11.876	0.060	10.190
1992	4.296	2.552	2.911	1.538	1.475	8.476	0.050	7.266
1993	3.554	2.142	2.411	1.309	1.266	7.128	0.040	10.569
1994	3.832	2.572	2.840	1.570	1.578	8.559	0.070	7.995
1995	4.528	4.359	4.756	2.640	2.727	14.481	0.120	9.190
1996	4.928	5.040	5.558	3.080	3.178	16.856	0.140	10.454
1997	4.832	5.005	5.506	3.048	3.165	16.725	0.140	10.325
1998	3.813	3.998	4.445	2.430	2.506	13.379	0.130	9.026
1999	3.454	3.861	4.298	2.346	2.423	12.929	0.120	8.154
2000	3.399	3.757	4.164	2.269	2.366	12.557	0.130	7.070
2001	3.539	3.727	4.186	2.261	2.338	12.511	0.140	9.613
2002	3.758	3.810	4.259	2.312	2.398	12.778	0.130	9.409
2003	4.125	3.953	4.422	2.371	2.483	13.230	0.146	10.256
2004	3.811	4.150	4.668	2.482	2.568	13.867	0.184	9.219
2005	3.373	3.771	4.278	2.232	2.308	12.589	0.150	8.883
2006	2.879	3.762	3.870	2.063	2.029	11.724	0.120	8.068
2007	4.909	3.943	4.351	2.413	2.519	13.226	0.130	7.957
2008	5.183	4.209	4.620	2.536	2.679	14.045	0.147	9.119
2009	4.867	4.517	4.981	2.712	2.862	15.072	0.173	9.666
2010	5.528	4.900	5.462	2.913	3.072	16.346	0.206	10.916
2011	5.429	4.265	4.765	2.540	2.672	14.241	0.177	9.801
trend 1990-2011, %	**-4.2**	**17.2**	**11.1**	**14.6**	**30.2**	**16.7**	**195.2**	**-3.5**

In the period 1990-2011 dioxin and PCB emissions have decreased by about 4.2% and 3.5% respectively. All other POPs have increased for the same period. The main source of PCB emission is oil shale combustion, and it directly depends on the amount of burned fuel. The main sources of dioxin emission are the energy sector (includes also waste combustion as fuel), wood and wood waste combustion in the domestic sector, combustion in industry (includes also waste combustion as fuel, mainly in cement manufacturing industry), and industrial/hospital waste incineration.

Emissions of PAHs and HCB have increased due to increasing biomass consumption in the energy and residential sectors. The main contributor into total emission is residential sector. On the second place is an energy industry.

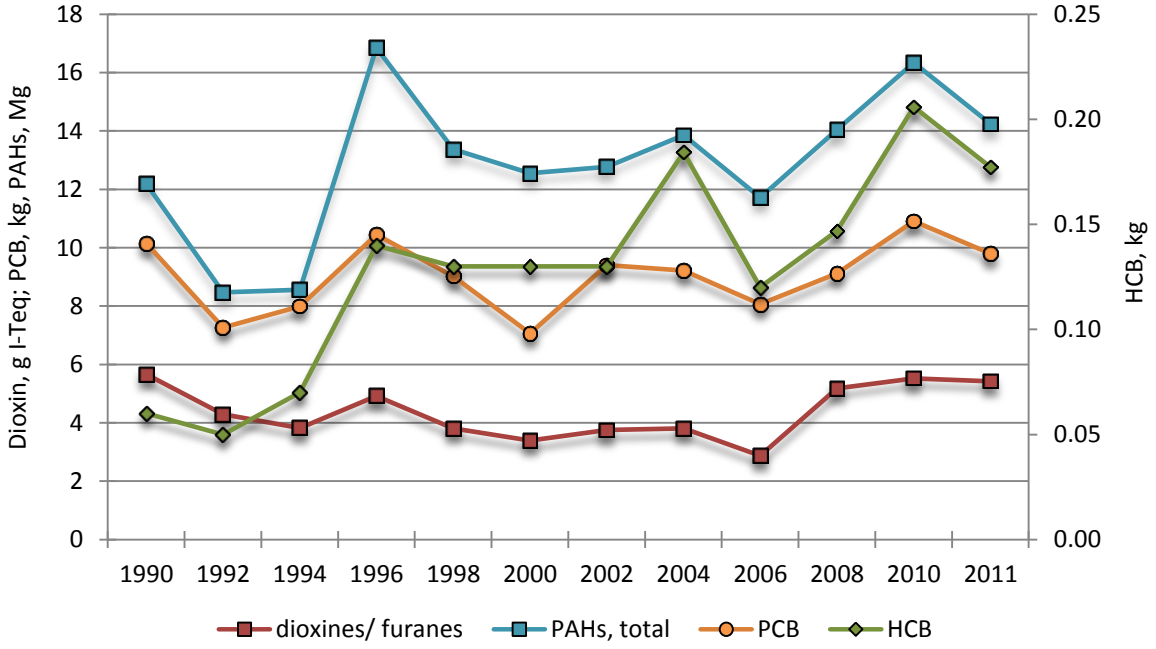

Figure 2.15. POPs emissions in the period 1990-2011

3. ENERGY SECTOR (NFR 1)

3.1. Overview of the sector

The energy sector is the main source of SO_2, NO_x, CO, particulates, HM and POPs in Estonia. In 2011, the energy sector contributed 99.7% of total SO_2 emissions, 96.7% of total NO_x emissions, 95.2% of TSP emissions, 99.7% of total CO emissions and 99.97% of Pb emissions (Figure 3.5, 3.6 and Table 3.1). During the period 1990-2011, the emissions of sulphur dioxide from the energy sector decreased by approximately 73.4% and the emissions of nitrogen oxides by about 51.8% resulting from a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 167 PJ in 2011) (Figure 3.1). The decreasing of SO_2 and NO_x emissions in 2011 compared to 2010 was by 12.6% and 3.3% respectively, which was due to the decrease in electricity production for the same period and also the installation of the semi-dry NID (Novel Integrated Desulphurisation) technology in the Eesti Energia Narva Elektrijaamad AS (Estonian PP). The increase of TSP, PM_{10} and $PM_{2.5}$ emissions by 32% was due to the increase in electricity production by 34% in Baltic PP and also as a result of a bad operation of electric precipitators on two power units of power plant (Table 3.1).

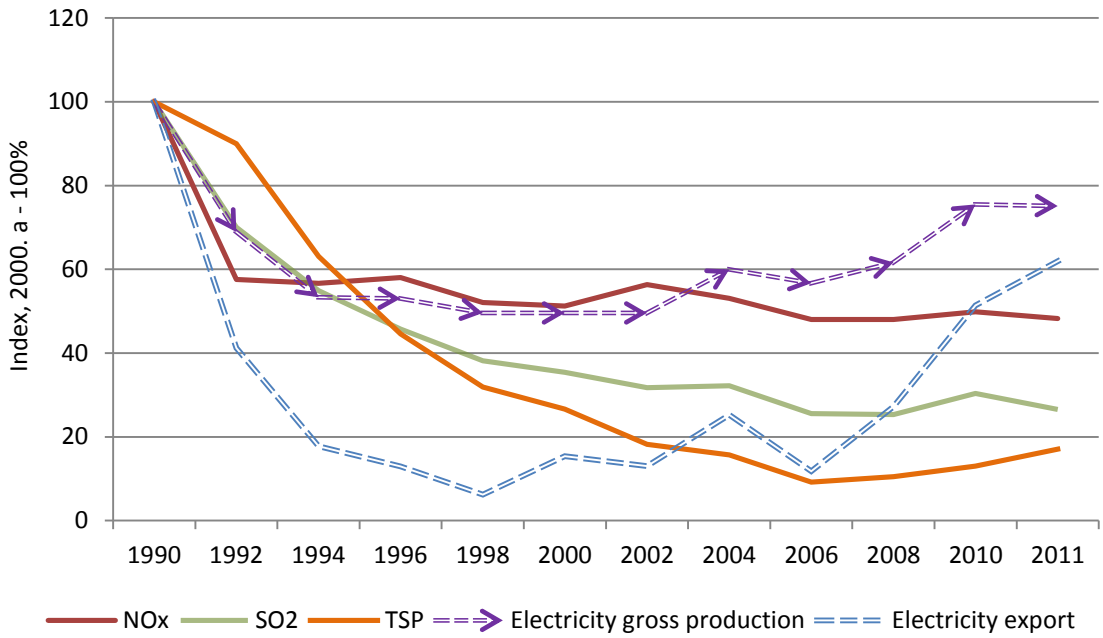

Figure 3.1. Pollutants emissions, electricity production and export in 1990-2011

Estonia is relatively rich in natural resources, both mineral and biological. It is a unique country whose energy production depends primarily on the use of oil shale. In 2011, the share of domestic fuels – oil shale, wood and peat – accounted for about 81.5% (from which oil shale is about 68%) of the primary energy supply. Imported fuels (natural gas, fuel oils, coal and motor fuels) made up 17.9% (Figure 3.2). Renewals formed about 14% of the primary energy supply in 2011, with wood fuel prevailing. In Estonia, renewable energy is generated from hydro- and wind energy as well as biomass. Since electricity generation has accelerated in hydroelectric power plants and wind parks, the proportion of renewable energy has increased. In 2011, the production of wind and hydro energy increased by 31%

compared to 2010. The generation of hydro energy has been stable over the past three years. In 2008, the share of electricity generated from renewable sources was only 2.1% in the total electricity consumption; in 2009 it was 6.1%, and in 2010 – 8.1%. The growth was due to the enlargement of the existing wind parks and the commissioning of new wood fuel-based combined heat and power plants. In 2011 year the 50% of the primary energy was used for the production of electricity and 16% for heat generation.

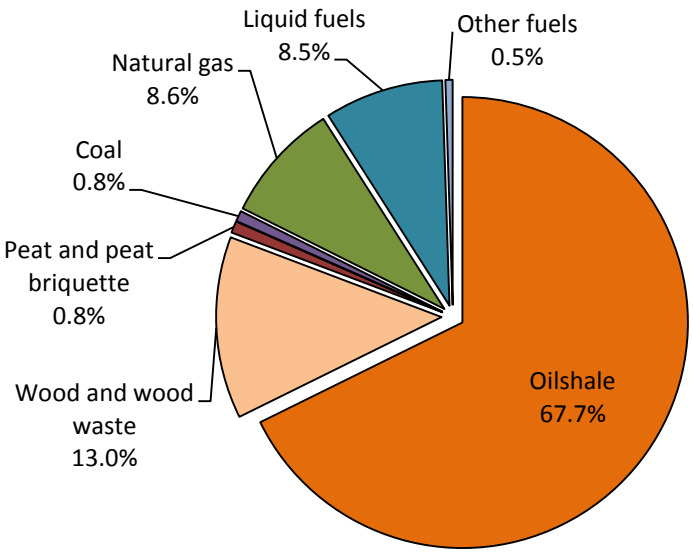

Figure 3.2. Structure of primary energy supply in Estonia in 2011

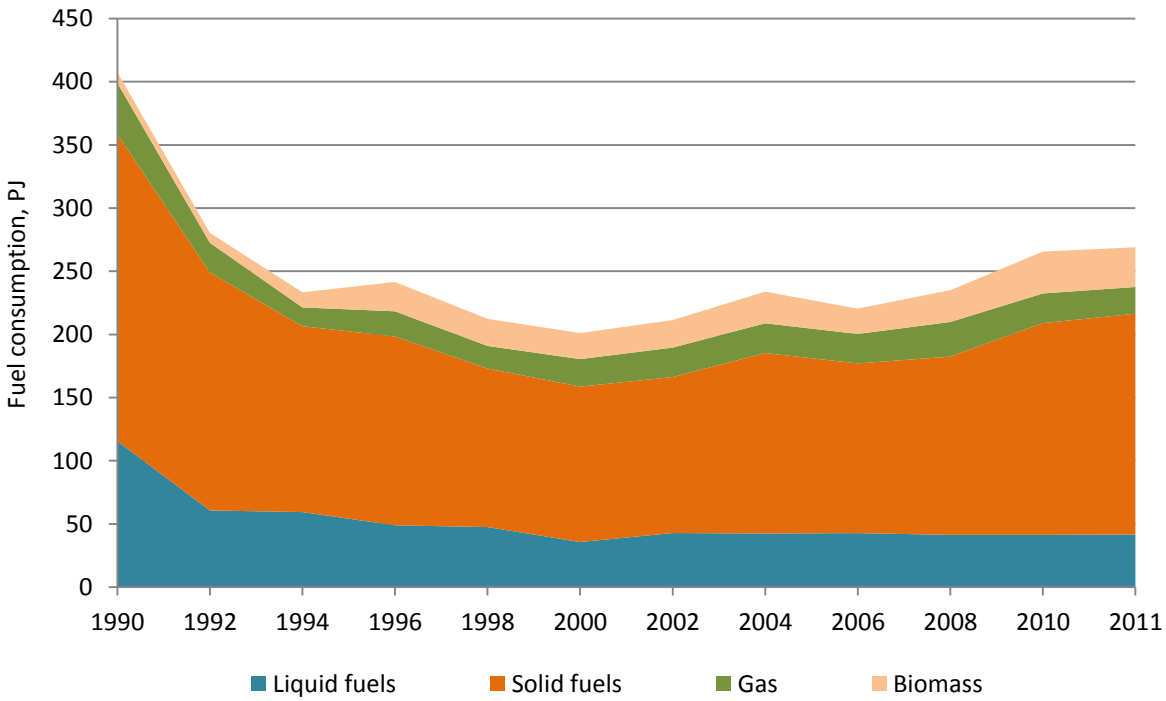

Figure 3.3. Fuel consumption in the period 1990-2011

Domestic fuels have a large share in Estonia's total energy resources and in the balance of primary energy – mainly based on oil shale. In 2011, 18.7 million tonnes of oil shale was produced, which is 4% more than in 2010. The majority of oil shale is consumed in power plants and as raw material for shale oil. The demand for shale oil in Estonia and in external markets increased the production of shale oil by about 7%. Nearly three quarters of the production was exported – 13% more than in 2010. More than half (54%) of this amount was exported to the Netherlands, followed by Russia (15%) and the United Kingdom (8%). At the same time, the production of other fuels declined. Due to decreased external demand, the production of peat, peat briquettes and wood pellets fell about 10% compared to 2010. Exports of pellets decreased nearly 7% (Greenhouse Gas Emissions in Estonia 1990-2011, National Inventory Report under the UNFCCC and the Kyoto Protocol, Tallinn 2013).

In terms of the efficiency of electricity generation, the renovation of two units in the Narva PP of Eesti Energia AS was essential. These resulted in introducing a new technology – the combustion of oil shale in a low-temperature circulating fluidized bed (CFB). Renovation of the 8th unit in the Eesti PP was finished in November 2003. Since the beginning of 2004, the new and more efficient unit has been in constant commercial use. In 2005, the specific fuel consumption for electricity generation in AS Narva Elektrijaamad decreased as a result of shutting down the older boilers: in May 2005, AS Narva Elektrijaamad terminated the use of the old low-efficiency and high-polluting equipment of the first three stages in the Balti PP. On 1 June 2005, the renovated unit no. 11 in the Balti PP was launched. The two boilers of the new unit fire oil shale in a circulating fluidized bed. The new units save more than 20% in fuel. The pollution level is several times lower than that stipulated in EU environmental regulations. The successful operation of the new CFBC units allows for the construction of additional units to continue.

Table 3.1. Pollutant emissions from the energy sector in the period 1990-2011

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg								Mg	
1990	71.46	34.76	273.61	0.06	NR	NR	274.85	226.24	205.46	4.40
1991	66.21	33.27	251.29	0.05	NR	NR	275.74	225.69	188.14	4.20
1992	41.14	19.73	191.66	0.04	NR	NR	247.22	126.80	123.97	3.00
1993	38.00	19.10	155.90	0.04	NR	NR	195.41	123.60	102.45	2.22
1994	40.51	23.38	150.23	0.06	NR	NR	173.44	149.50	122.55	2.87
1995	38.14	30.74	116.11	0.10	NR	NR	133.01	196.93	85.44	1.96
1996	41.48	34.32	125.14	0.12	NR	NR	122.59	219.32	65.86	1.05
1997	40.19	36.12	116.21	0.13	NR	NR	99.39	228.72	46.44	1.07
1998	37.22	28.08	104.31	0.11	NR	NR	87.75	181.14	39.10	1.01
1999	35.76	29.54	97.61	0.12	NR	NR	86.38	190.28	39.03	0.95
2000	36.61	30.14	96.92	0.17	20.96	35.97	73.09	182.08	35.89	0.56
2001	39.01	31.29	90.61	0.20	21.90	35.96	71.11	187.95	36.31	0.55
2002	40.24	30.21	86.83	0.22	22.40	31.84	50.16	181.45	35.53	0.57
2003	40.81	28.72	100.08	0.22	20.50	28.44	46.20	173.96	37.58	0.63
2004	37.91	28.83	88.06	0.29	21.68	28.44	43.05	170.86	36.07	0.59
2005	35.67	25.65	76.13	0.31	19.52	25.03	34.61	157.34	34.76	0.58
2006	34.33	23.74	69.82	0.35	14.91	18.46	25.18	143.43	31.27	0.55
2007	37.41	24.86	87.94	0.41	19.93	27.01	33.21	162.25	39.87	0.68
2008	34.29	24.58	69.35	0.42	19.61	23.60	28.89	166.26	34.93	0.61
2009	29.18	24.52	54.78	0.39	18.24	21.72	26.41	167.79	28.24	0.48

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg								Mg	
2010	35.63	24.73	83.17	0.40	23.00	30.43	35.67	171.54	38.72	0.67
2011	34.47	22.07	72.66	0.45	26.12	40.32	46.99	147.36	38.13	0.65
1990-2011, %	**-51.8**	**-36.5**	**-73.4**	**652.7**	**24.6**	**12.1**	**-82.9**	**-34.9**	**-81.4**	**-85.1**

	Hg	As	Cr	Cu	Ni	Zn	PAH	Dioxines	HCB	PCB
	Mg							g I-Teq	kg	
1990	1.12	18.86	18.30	10.10	27.36	105.25	12.20	5.20	0.06	10.15
1991	1.02	16.45	15.96	9.36	25.93	96.37	11.88	4.94	0.06	10.19
1992	0.83	14.03	13.71	6.69	17.03	78.32	8.48	3.84	0.05	7.27
1993	0.64	10.84	10.38	5.45	14.34	60.75	7.13	3.10	0.04	10.57
1994	0.64	10.68	10.22	5.96	12.87	63.85	8.56	3.39	0.07	7.99
1995	0.60	10.07	9.66	5.09	10.50	58.49	14.48	4.10	0.12	9.19
1996	0.60	10.36	9.89	4.64	10.94	56.01	16.86	4.50	0.14	10.45
1997	0.60	10.20	9.60	4.60	9.82	55.60	16.72	4.21	0.14	10.32
1998	0.53	9.15	8.62	4.17	8.87	50.31	13.38	3.25	0.13	9.03
1999	0.50	8.71	8.22	4.03	7.65	48.22	12.93	3.16	0.12	8.15
2000	0.51	8.59	8.09	3.71	6.62	44.53	12.56	3.00	0.13	7.07
2001	0.50	8.39	7.95	4.00	6.48	44.37	12.51	3.18	0.14	9.61
2002	0.50	8.36	8.04	4.14	6.27	43.70	12.78	3.14	0.13	9.41
2003	0.58	10.11	9.52	4.47	6.79	52.32	13.23	3.64	0.15	10.25
2004	0.54	9.79	9.10	4.49	6.73	52.21	13.87	3.15	0.18	9.22
2005	0.52	9.22	8.77	4.46	6.47	48.64	12.59	2.73	0.15	8.88
2006	0.52	8.59	8.16	4.34	5.81	44.28	11.72	2.72	0.12	8.07
2007	0.65	11.08	10.40	5.02	6.77	55.91	13.23	4.61	0.13	7.96
2008	0.57	9.42	8.92	4.63	5.95	49.07	14.05	4.72	0.15	9.12
2009	0.44	7.61	7.15	3.98	4.90	39.90	15.07	4.28	0.17	9.67
2010	0.63	10.97	10.15	4.87	6.64	55.88	16.35	5.21	0.21	10.92
2011	0.63	10.89	10.02	4.82	6.46	54.80	14.24	5.07	0.18	9.80
1990-2011, %	**-43.7**	**-42.3**	**-45.3**	**-52.3**	**-76.4**	**-47.9**	**16.7**	**-2.5**	**195.2**	**-3.5**

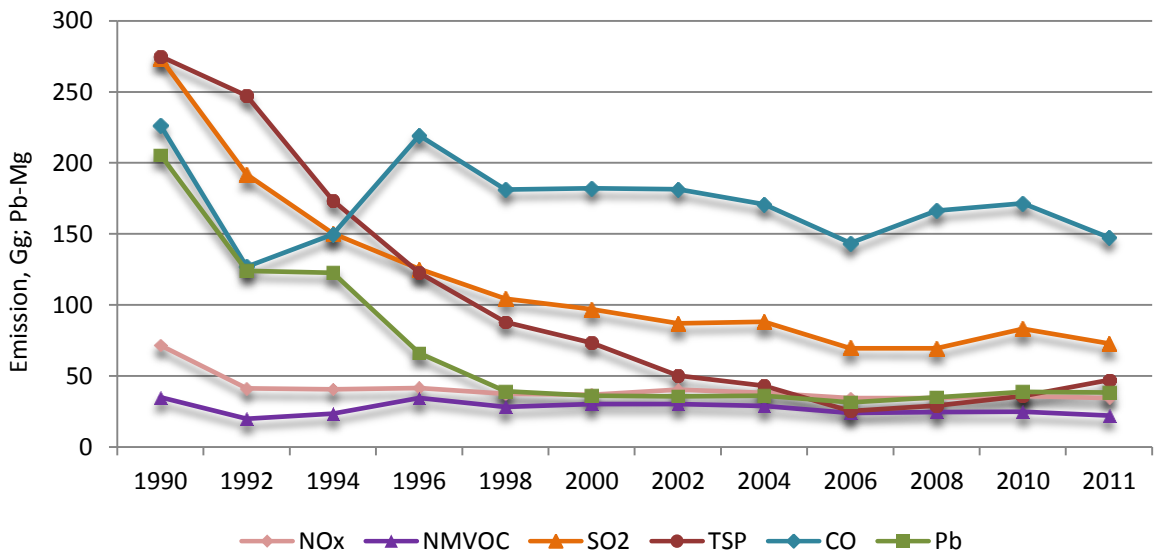

Figure 3.4. Pollutant emissions from the energy industry in the period 1990-2011

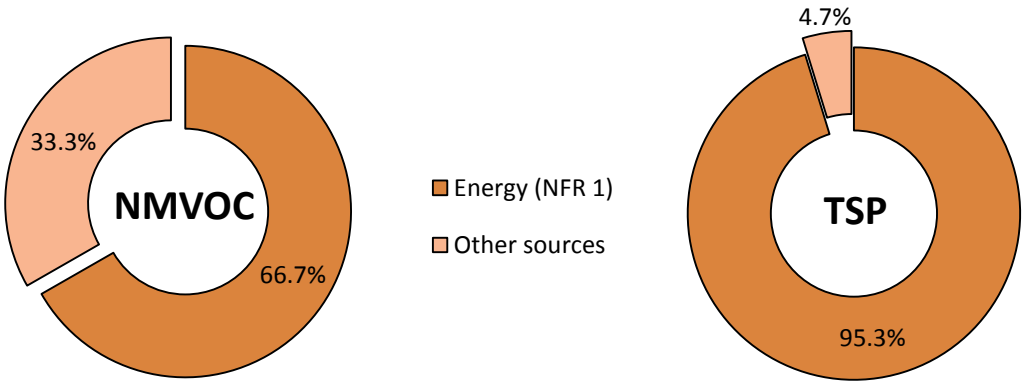

Figure 3.5. Share of NMVOC and TSP emissions from the energy sector in total emissions in 2011

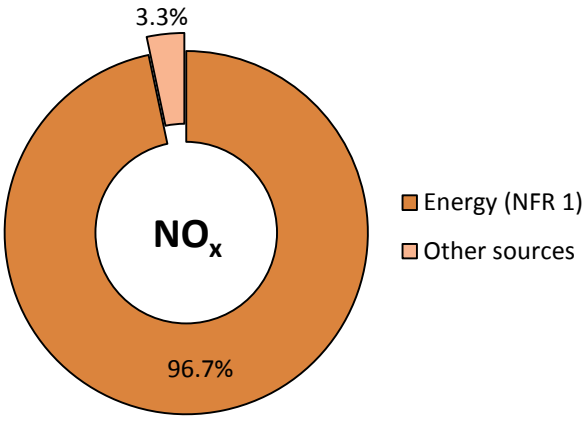

Figure 3.6. Share of NO_x emissions from the energy sector as a percentage of total emissions in 2011

3.2. Stationary fuel combustion

3.2.1. Sources category description

Table 3.2. Stationary fuel combustion activities

NFR	Source	Description	Emissions reported
1.A.1	**Energy Industries**		
	a. Public electricity and heat production	Includes emissions from public power and district heating plants on the basis of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	b. Petroleum refining	Includes emissions from process furnace in the oil shale industry. Only two point sources data.	NMVOC, NO_x, CO
	c. Manufacture of solid fuels and other energy industries	Includes emissions from solid fuel transformation plants. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB

NFR	Source	Description	Emissions reported
1.A.2	**Stationary combustion in manufacturing industries and construction**		
	a. Iron and steel	Includes emissions from processes with contact (SNAP 030303). Only point sources data.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, As, Cr, Cu, Ni, Zn, PCDD/ PCDF, PAHs, PCB
	b. Non-ferrous metals	Includes emissions from processes with contact (SNAP 030307 - secondary lead production, 030308 - secondary zinc production, 030310 - secondary aluminium production). Only point sources data.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, As, Cr, Cu, Zn
	c. Chemicals		IE, reported under 1.A.2.f.i
	d. Pulp, Paper and Print		IE, reported under 1.A.2.f.i
	e. Food processing, beverages and tobacco		IE, reported under 1.A.2.f.i
	f.i Other	Includes emissions from all boilers in the manufacturing industry, other processes with contact: cement, lime, glass, bricks and other productions. (SNAP 0301, 030311-030326). Data of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1.A.4	**Non-industrial combustion plants**		
	a.i Commercial / institutional: Stationary	Includes emissions from boilers or other equipment in the commercial sector. Data of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	b.i Residential: Stationary plants	Includes emissions from boilers and other equipment in the residential sector. Only diffuse sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	c.i Agriculture/Forestry/Fishing: Stationary	Includes emissions from boilers and other equipment in the agriculture and foresty sectors. Data of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1.A.5.a	**Other stationary (including military)**		IE, reported under 1.A.4.a.i

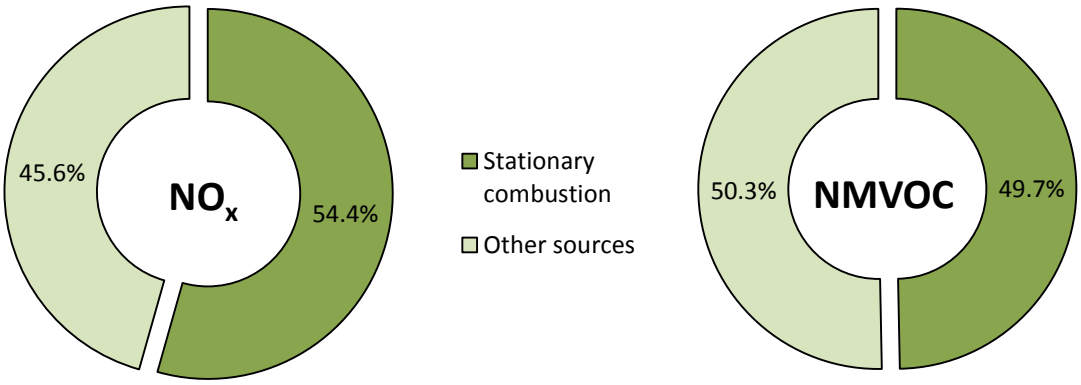

Figure 3.7. NO_x and NMVOC emissions from stationary fuel combustion and other sources in 2011

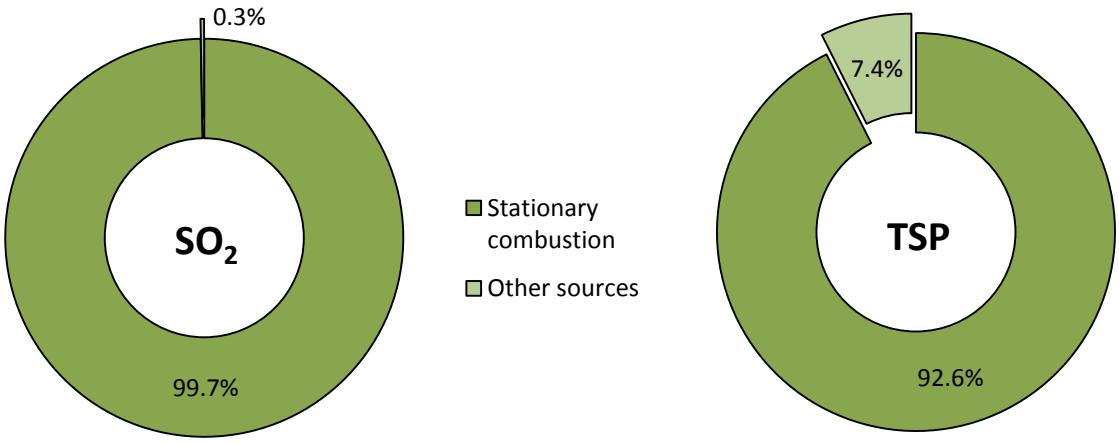

Figure 3.8. SO_2 and TSP emissions from stationary fuel combustion and other sources in 2011

Table 3.3. Pollutant emissions from stationary fuel combustion in the period 1990-2011

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg								Mg	
1990	33.43	12.85	266.71	0.04	NR	NR	273.13	98.26	126.73	4.39
1991	30.51	12.41	244.67	0.03	NR	NR	274.09	98.52	118.44	4.19
1992	21.51	9.92	187.72	0.03	NR	NR	246.27	73.93	89.64	2.99
1993	16.75	8.69	151.61	0.03	NR	NR	194.25	63.99	67.36	2.21
1994	18.08	10.75	146.16	0.04	NR	NR	172.35	78.31	79.53	2.86
1995	18.28	18.79	112.46	0.07	NR	NR	132.00	130.35	60.65	1.95
1996	19.89	21.85	121.27	0.08	NR	NR	121.58	150.26	44.15	1.04
1997	18.30	21.51	112.32	0.08	NR	NR	98.33	146.13	36.60	1.06
1998	16.94	16.92	100.33	0.06	NR	NR	86.73	118.71	33.03	1.00
1999	16.12	16.63	94.09	0.06	NR	NR	85.43	113.19	31.47	0.94
2000	17.14	16.42	93.77	0.06	20.06	34.97	71.88	113.67	30.86	0.56
2001	18.15	15.89	89.70	0.06	21.11	35.05	69.91	115.21	30.33	0.54
2002	17.55	16.70	85.72	0.07	21.42	30.72	48.78	118.55	29.99	0.56
2003	20.00	17.60	99.37	0.06	19.57	27.39	44.84	121.29	35.31	0.62
2004	18.26	17.56	87.45	0.06	20.69	27.34	41.69	125.56	33.96	0.58
2005	16.22	15.88	75.75	0.05	18.58	23.95	33.25	114.84	32.62	0.57
2006	14.70	14.64	69.48	0.05	13.96	17.36	23.76	102.59	29.80	0.54
2007	18.17	18.04	87.62	0.06	18.97	25.91	31.80	124.11	38.33	0.67
2008	16.61	19.18	69.07	0.07	18.70	22.54	27.53	133.55	33.34	0.60
2009	13.95	19.63	54.62	0.07	17.44	20.72	25.16	138.30	26.84	0.47
2010	19.05	18.86	83.03	0.07	22.16	29.35	34.32	144.78	38.20	0.66
2011	19.39	16.44	72.48	0.06	25.34	39.29	45.67	124.05	37.64	0.66
1990-2011, %	**-42.0**	**28.7**	**-72.8**	**54.9**	**26.3**	**12.3**	**-83.3**	**26.2**	**-70.3**	**-85.0**

	Hg	As	Cr	Cu	Ni	Zn	PAH 4 total	Dioxines	HCB	PCB
	Mg							g I-Teq	kg	
1990	1.12	18.86	18.17	7.35	27.31	102.66	4.97	12.11	0.06	10.13
1991	1.02	16.45	15.84	6.87	25.88	93.99	4.72	11.79	0.06	10.17
1992	0.83	14.03	13.65	5.31	17.00	77.08	3.74	8.43	0.05	7.26
1993	0.64	10.84	10.31	3.96	14.31	59.39	3.00	7.08	0.04	10.56
1994	0.64	10.68	10.14	4.32	12.84	62.26	3.25	8.51	0.07	7.99
1995	0.60	10.07	9.59	3.65	10.48	57.02	3.97	14.44	0.12	9.18
1996	0.60	10.36	9.81	3.10	10.92	54.45	4.35	16.81	0.14	10.44
1997	0.60	10.20	9.52	2.99	9.80	53.94	4.06	16.68	0.14	10.32
1998	0.53	9.15	8.55	2.69	8.85	48.85	3.14	13.34	0.13	9.02
1999	0.50	8.71	8.15	2.54	7.63	46.69	3.03	12.89	0.12	8.15
2000	0.51	8.59	8.01	2.18	6.60	42.99	2.86	12.52	0.13	7.07
2001	0.50	8.39	7.86	2.16	6.46	42.50	3.01	12.47	0.14	9.61
2002	0.50	8.36	7.94	2.14	6.24	41.72	2.98	12.73	0.13	9.41
2003	0.58	10.11	9.42	2.54	6.75	50.39	3.49	13.18	0.15	10.25
2004	0.54	9.79	9.00	2.52	6.70	50.24	3.00	13.82	0.16	9.22
2005	0.52	9.22	8.67	2.44	6.44	46.59	3.01	12.54	0.15	8.88
2006	0.52	8.59	8.05	2.18	5.78	42.08	2.56	11.67	0.12	8.07
2007	0.65	11.08	10.28	2.75	6.74	53.59	4.44	13.17	0.13	7.96
2008	0.57	9.42	8.81	2.39	5.92	46.79	4.55	13.99	0.15	9.12
2009	0.44	7.61	7.05	1.98	4.87	37.85	4.13	15.02	0.17	9.66
2010	0.63	10.97	10.05	2.73	6.61	53.75	5.06	16.29	0.21	10.91
2011	0.63	10.89	9.91	2.65	6.43	52.63	4.92	14.19	0.18	9.80
1990-2011, %	**-43.6**	**-42.3**	**-45.5**	**-63.9**	**-76.4**	**-48.7**	**-0.9**	**17.1**	**195.3**	**-3.3**

Energy related activities (without transport) are the most significant contributors to SO_2 emissions – 99.7% in 2011. The share of mobile sources in total emissions is very small – 0.14% (Figure 3.8 and 3.9, includes in other sources). The oil shale power plants contribute about 78% to total SO_2 emissions. Estonian oil shale is high-ash shale (up to 46%), with low net caloric value (8.4-9.0 MJ/kg) and sulphur content of 1.4% to 1.8%. Two different combustion technologies, the old pulverized combustion of oil shale and the new circulated fluidized bed combustion technology are currently used in the Estonian power plants. In the combined heat and power block of the Balti PP, around 10% of the fuel used is biomass, which is burned together with oil shale. This has significantly increased the proportion of renewable energy both in the Eesti Energia portfolio and in overall electricity production in Estonia. Each year, the new power block produces 130-140 GWh of renewable energy, enough to cover 2% of annual electricity consumption in Estonia. Renewable energy from biofuel in the Narva PP provides enough electricity to cover the annual consumption of 50,000 Estonian families. (Eesti Energia)

The Narva PP are investing in scrubbers to reduce sulphurous and nitrous wastes from flue gas, in order to make energy production from oil shale cleaner and to ensure that the current production capacity can be maintained after the environmental requirements become stricter in 2012 and 2016.

By 2012, sulphur scrubbers using dust combustion will be installed on four old energy production units of the Eesti PP.

Studies and tests conducted in 2009 and 2010 showed that the nitrogen oxides emissions can also be cut below the limits permitted in the stricter environmental requirements that will enter into force in 2016, and so it is also planned to supply the same units of the Eesti PP with nitrogen oxides scrubbers. (Eesti Energia)

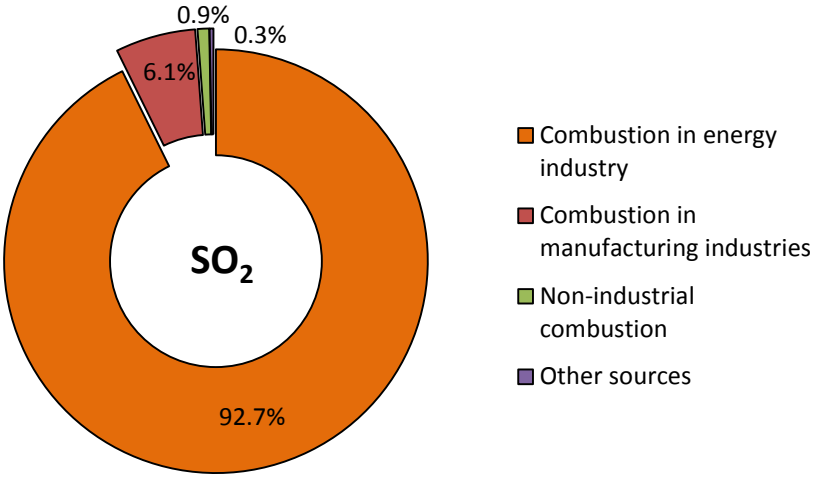

Figure 3.9. SO_2 emissions by sources of pollution in 2011

Non-industrial combustion is responsible for about 94% of total NMVOC emissions in stationary combustion, for about 78% of CO and 29% of TSP emissions (Figures 3.10, 3.13, 3.14). Combustion in energy and transformation industries is responsible for 93% of SO_2 and for the 17% of CO emissions in stationary combustion (thus the main part of carbon monoxide emitted from Narva shale oil production plant) (Figure 3.10, 3.12, 3.14).

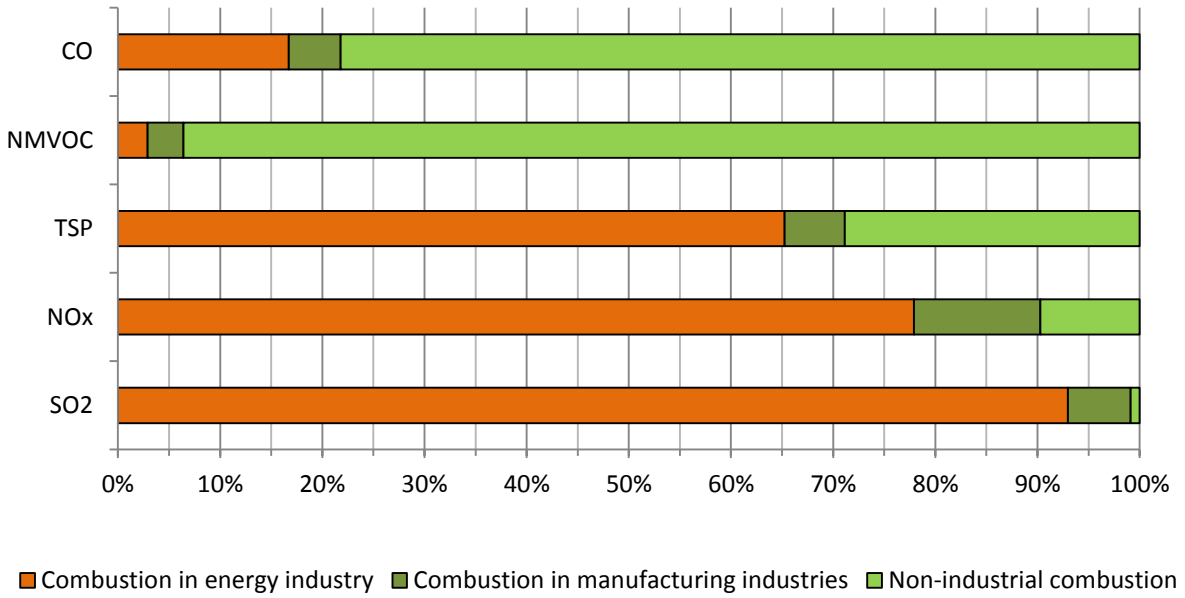

Figure 3.10. Distribution of pollutants emissions by sector in stationary combustion in 2011

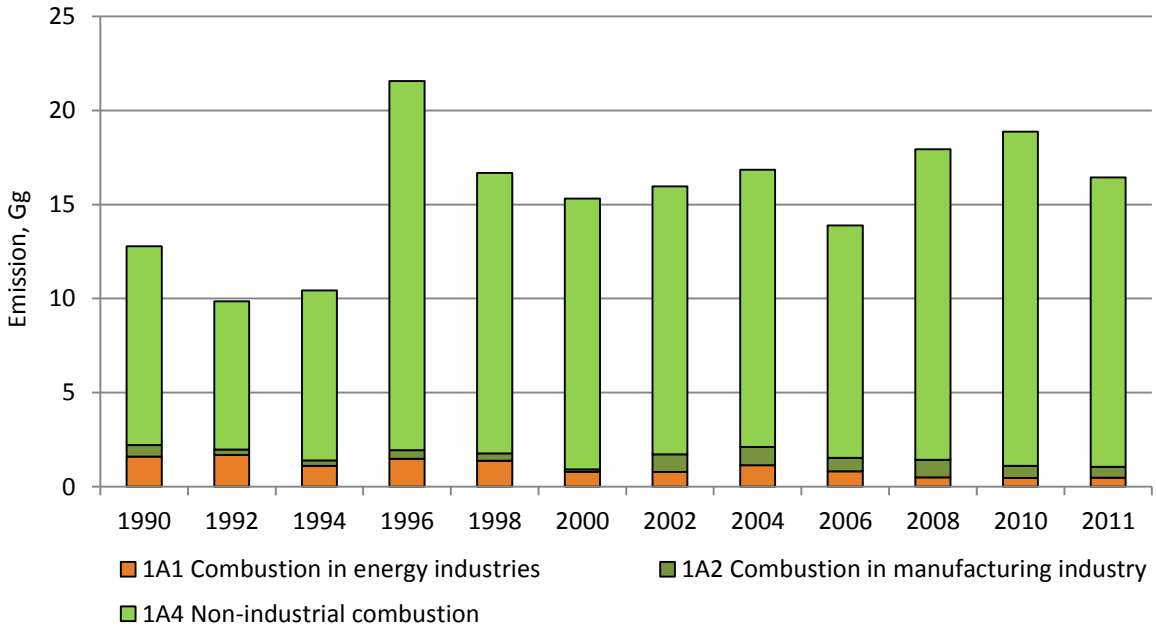

Figure 3.11. Distribution of NMVOC emissions by sector in stationary combustion in the period 1990-2011

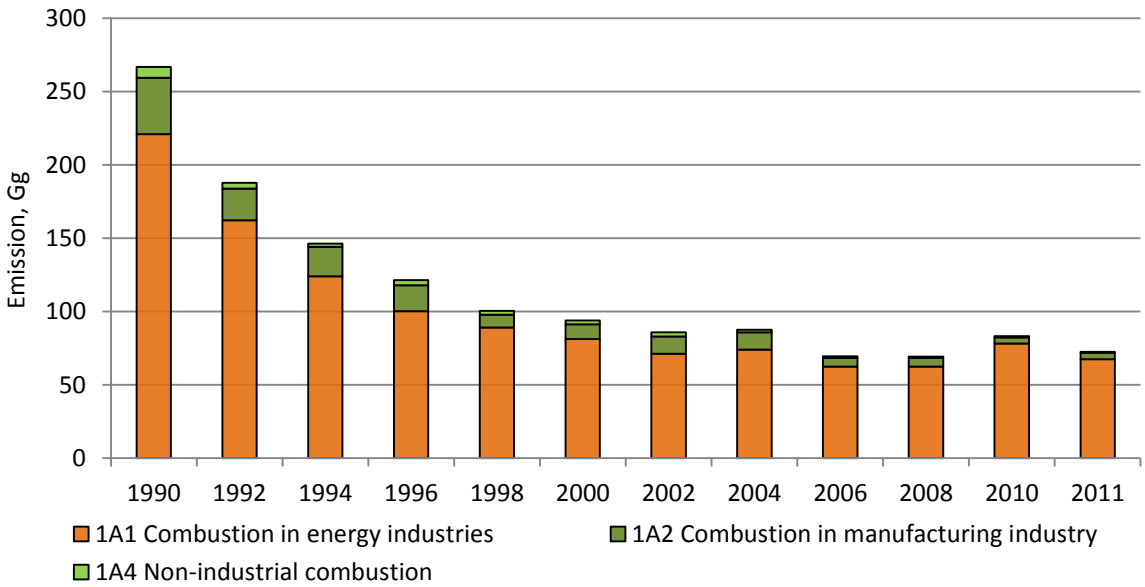

Figure 3.12. Distribution of SO_2 emissions by sector in stationary combustion in the period 1990-2011

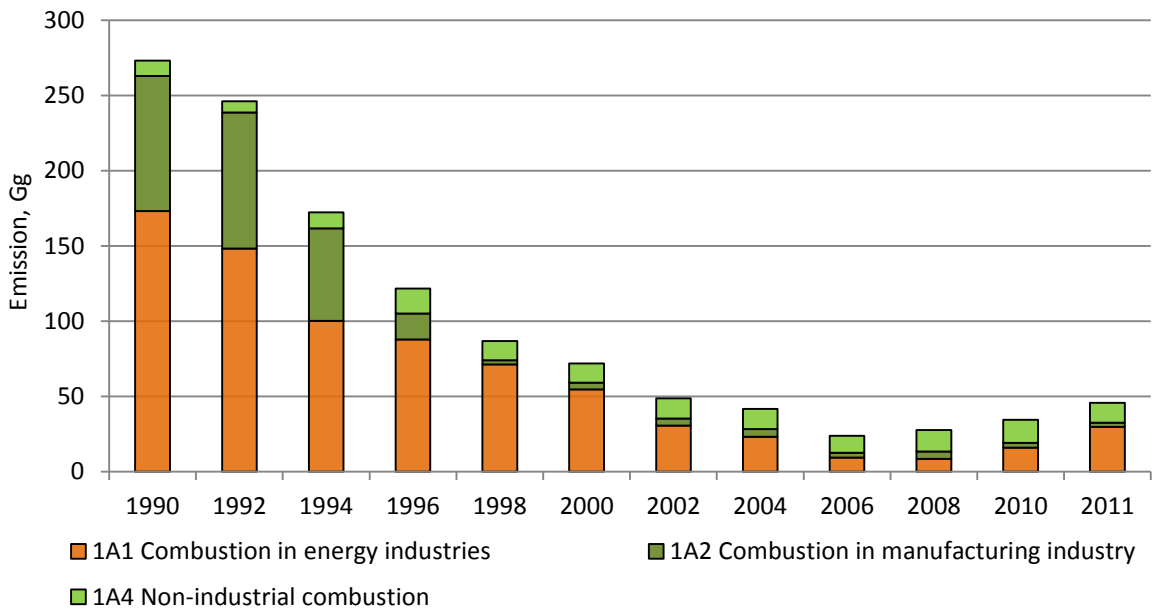

Figure 3.13. Distribution of TSP emissions by sector in stationary combustion in the period 1990-2011

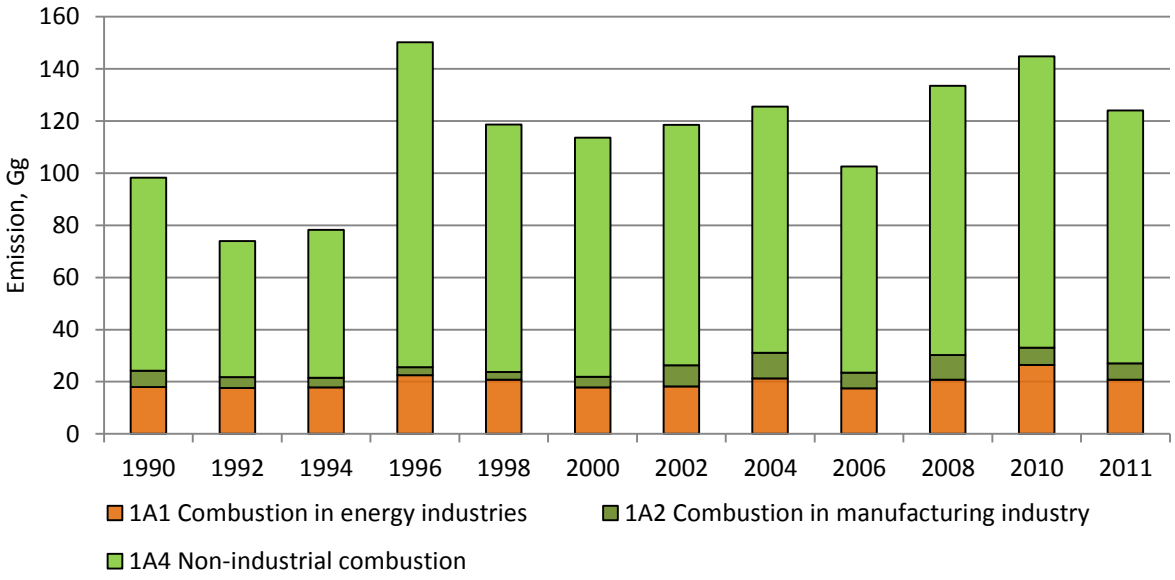

Figure 3.14. Distribution of CO emissions by sector in stationary combustion in the period 1990-2011

3.2.2. Methodological issues

NFR 1.A.1.a Public electricity and heat production**, NFR 1.A.2.f.i** Other Stationary combustion in manufacturing industries and construction, and **NFR 1.A.4.a.i, c.i** Non-industrial combustion plants (stationary combustion related to commercial and agriculture) include pollutants emission data from point sources (PS) reported by operators and from diffuse sources.

NFR 1.A.1.b Petroleum refining (only two facilities reported emissions from process furnace in the shale oil industry)**.** Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.1.c The manufacture of solid fuels includes pollutants emission data reported by shale oil production facilities (oil shale transformation processes). Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

The production of shale oil in Estonia is carried out at three factories: Eesti Energia Õlitööstus AS (Narva Oil Plant AS), Kiviõli Keemiatööstuse OÜ (Kiviõli Oil Shale Processing & Chemicals Plant) and VKG Oil AS (under Viru Chemistry Group Ltd).

Two different technologies are applied in the production of shale oil: ***the old one*** - the technology of processing large-particle oil shale in vertical retorts with gaseous heat carrier. The process itself takes place in a vertical retort with a cross-sectional heat carrier (Kiviter type retort). Oil shale from which a small-sized fraction has been selected is fed to the retort from above. Oil shale from the loading box enters a distillation chamber and moves downwards, and hot flows of fuel gases pass through this chamber towards the oil shale movement. Oil and water vapours and gas of low heating value that originate from distillation are emitted from the retort top and are fed to the condensation unit where oil and water condense. Raw oil is refined in oil extraction and distillation units. Phenol water reaches the phenol recovery unit. Retort gas is partly fed back into the process and is burnt to create the heat carrier required, while the remaining gas is sent to the power plant for heat and power production. Semi-coke from oil shale processing is discharged from the retort base and is stored in a semi-coke storage area. ***The second technology*** of processing is fine-grained oil shale with solid heat carrier (SHC). The Solid Heat Carrier Plant (SHCP) is designed for the thermal decomposition (pyrolysis) of fine-grained technological oil shale, with the objective of producing shale oils, gas with high calorific value and high-pressure steam. The oil shale pyrolysis process is effected in a drum rotating reactor in the absence of air, at a temperature of 450–500 °C, due to the mixture of oil shale with hot ash (as a solid heat carrier). The vapour-gas mixture that appears in the reactor during the pyrolysis process is fed through several process vessels to be refined from ash and mechanical impurities, and then it is subject to a distillation process to produce liquid products and gas with high calorific value. Liquid products are fed to other units for loading as final products or for further processing. Gas is fed to the heat power plant for heat and power production. Steam is fed to the heat power plant for power production. The by-products of this process include phenol water, flue gases and ash from thermal processing.

In the Kiviõli Oil Shale Processing and VKG Oil plants, both these technologies are used.

Eesti Energia Õlitööstus AS operates an industrial plant producing liquid fuels from oil shale. This plant is the only one of its kind in the world and uses the efficient Enefit-140 solid heat carrier system, which was developed and patented by Eesti Energia engineers. Eesti Energia Õlitööstus produces liquid fuels and retort gas, which is used in electricity production in the Narva power plants. Oil Industry produces about one million barrels of liquid fuels per year. Currently, about one fifth of the oil shale mined in Estonia is used in the production of fuel oil and chemicals. In 2009, Eesti Energia started building a new oil plant with Enefit-280 technology, which is cleaner and more reliable and has a higher production capacity. This

new generation of technology has been developed jointly by Eesti Energia and the international engineering company Outotec. Eesti Energia is planning to expand its oil business and to build a hydrogen processing complex by 2016, creating a business that can produce liquid fuels that are of higher quality than the current shale oil and that will meet all the legal requirements for use as motor fuel.

Under this code, data are also given on boilers in oil shale mining and other fuel transformation industries. Operators used measurement results or the combined method for emission estimations.

NFR 1.A.2.a Iron and steel and **1.A.2.a.b** Non-ferrous metals includes emissions from processes with contact reported by operators. Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.4.b.i Residential: Stationary plants include pollutant emissions data from diffuse sources.

According to national legislation, all operators with boiler capacity from 0.3 MW must prepare an annual report. The report for the energy-related activities contains data about the type and capacity of boilers, fuel characteristics and consumption, pollutant emissions and so on.

Fuel consumption data from point sources has been summarized by SNAP codes. Emissions from the diffuse sources were calculated by using data on fuel consumption from Energy Balance (EB), prepared by Estonian Statistics:

Diffuse sources Fuel = EB fuel – PS fuel

The main tables of Energy Balance contain summary data for the district heating and industrial boilers (SNAP 01 and SNAP 03). Fuel consumption by the manufacturing industry is only shown under final consumption (SNAP 0303). In this case, it is difficult to compare fuel data from the national database (by SNAP) and the Estonian Energy Balance. For determining fuel consumption by diffuse sources, combined data from two tables were used: “Energy balance sheet” and “Consumption of fuel by branches of the economy”.

Emissions from PS have been calculated according to national emission factors and fuel consumption or on the basis of measurements. According to national legislation, all large combustion plants >100 MW are obliged to carry out continuous monitoring. For other sources, the frequency of measurements is regulated by emission permits. National emission factors for the calculation of emissions from boilers were adopted by a Regulation of the Minister of the Environment in 2004 (Tables 3.4-3.8).

Table 3.4. TSP emission factors for boilers (g/GJ)

	P < 10 MW				50 MW > P > 10 MW		
	burner	extended furnace	grate-fired furnace	fluidized	burner	extended furnace	fluidized
Coal			3000				
Oil shale			12000				
- cyclone					3000		
- electrostatic precipitator					1000		
Peat							
- no control		1000	2000				
- cyclone		220	230	700			700
- cyclone + multicyclone				80			
- electrostatic precipitator							80
Wood							
- no control			1000	1000	1000		1000
- cyclone		240	240	500		70	
- electrostatic precipitator						70	80
Heavy fuel oil	100				100		
Oil shale oil	100				100		
Light fuel oil	100				100		

Table 3.5. NO_x emission factors for boilers (g/GJ)

	P < 10 MW				50 MW > P > 10 MW	
	burner	extended furnace	grate-fired furnace	fluidized	burner	fluidized
Coal		200	200			
Oil shale					150	
Peat		300	300	300		300
Wood		100	100	100	100	100
Heavy fuel oil	200				250	
Oil shale oil	150				200	
Light fuel oil	100					
Gas	60				100	

Table 3.6. NMVOC emission factors for boilers (g/GJ)

	P < 10 MW	50 MW > P > 10 MW
Coal	15	1.5
Peat	100	
Wood	48	
Heavy fuel oil	3	3
Oil shale oil	1.1	
Light fuel oil	1.5	
Gas	4	2.5

Table 3.7. Carbone monoxide emission factors for boilers (g/GJ)

	P < 10 MW				50 MW > P > 10 MW	
	burner	extended furnace	grate-fired furnace	fluidized	burner	fluidized
Coal		100	100			
Oil shale					100	
Peat		1200	500	100		200
Wood		1200	1000	400		200
Heavy fuel oil	100				100	
Oil shale oil	100				100	
Light fuel oil	100				100	
Gas	60				40	

Table 3.8. Heavy metal emission factors for boilers (mg/GJ)

Fuel /purification equipment	Heavy metals EF							
	Hg	Cd	Pb	Cu	Zn	As	Cr	Ni
Coal								
- no control	5	30	700	100	230	90	400	400
- cyclone	5	10	200			20	80	80
- electrostatic precipitator	5	5	40			5	10	10
Oil shale								
- electrostatic precipitator	5	5	300	20	410	90	80	50
Fuel /purification equipment	**Heavy metals EF**							
	Hg	**Cd**	**Pb**	**Cu**	**Zn**	**As**	**Cr**	**Ni**
Peat								
- no control	5	10	200	50	150	100	80	350
- cyclone	5	4	50			30	20	80
- electrostatic precipitator	5	0.7	15			7	6	25
Wood								
- no control	0.5	5	200	5	500	1	35	30
- cyclone	0.5	2	60			0.3	10	10
- electrostatic precipitator	0.5	0.5	15			0.1	2	2
Heavy fuel oil								
- no control	0.03	0.3	20	10	40	2	1	300
- cyclone	0.03	0.2	10			1	0.5	150
Oil shale oil	0.04	0.11	50	16	290	24	3.5	8
Light fuel oil	0.03	0.04	10	11	6	6	2	4

The SO_2 emissions are calculated by formula:

$$\text{Emissions} = 0.02 \times B \times S^r \times (1-\eta), \text{ where}$$

B – fuel consumption,

S^r – sulphur content in fuel,

η – retention of sulphur in ash.

At present, Estonia has no national emission factors for PM_{10} and $PM_{2.5}$. For emission calculations from point sources, CEPMEIP project emission factors were used (not directly, but shared from TSP, because some national EFs differ from CEPMEIP emission factors). For example, with regard to an oil shale power plant, TSP emission factors were first estimated on the basis of emissions (operator data on the base of measurements) and fuel usage data for various boilers, followed by emissions of fine particles, depending on technology (high, medium or low).

Currently, the national methodology is being co-ordinated by the Ministry of the Environment.

Pollutant emissions from residual sectors have been calculated on the basis of activity data from the Energy Balance and Guidebook emission factor (Table 3.9).

Table 3.9. Pollutant emission factors for area energy sources

Pollutant	Units	Coal	Wood, peat	Gaseous fuels	Liquid fuels
SO_2	g/GJ	900	10	0	138
NO_x	g/GJ	130	80	60	70
NH_3	g/GJ	0	4	0	0
CO	g/GJ	5300	6100	30	60
NMVOC	g/GJ	490	980	10	15
TSP	g/GJ	450	800	1	8
PM_{10}	g/GJ	400	700	1	5
$PM_{2.5}$	g/GJ	400	700	1	5
As	mg/GJ	2	1	NA	1
Cd	mg/GJ	2	1	NA	1
Cr	mg/GJ	11	3	NA	16
Cu	mg/GJ	22	9	NA	8
Hg	mg/GJ	7	1	NA	1
Ni	mg/GJ	13	4	NA	240
Pb	mg/GJ	130	40	NA	16
Zn	mg/GJ	220	130	NA	9
Dioxin	ng/GJ	70	100	1.5	10
Benzo(a)pyrene	mg/GJ	230	210	NA	22
Benzo(b)fluoranthene	mg/GJ	330	220	NA	26
Benzo(k)fluoranthene	mg/GJ	130	130	NA	13
Indeno(1,2,3_cd)pyrene	mg/GJ	110	140	NA	15
HCB	mg/GJ	0.0006	0.00634	NA	0

Activity data

Discrepancies in the data on solid fuels between energy balance and the point sources database are possible, and these are the reasons for the distinction in the data regarding the consumed oil shale, which operators are represented in the Statistical Office and to Point Sources information system (OSIS) (the data in tonnes is identical, but not in TJ).

Table 3.10. Fuel consumption in stationary fuel combustion in the period 1990-2011 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Liquid fuels	68.14	64.99	36.07	34.97	32.27	22.62	23.08	20.67	19.75	18.26	10.69
Solid fuels	242.83	226.34	188.36	148.61	147.05	142.65	149.43	147.28	125.48	115.40	123.02
Biomass	8.37	8.21	7.86	7.38	12.00	20.01	23.22	24.27	21.42	20.50	20.63
Gas	40.61	42.36	23.42	11.79	14.89	17.32	19.90	19.24	17.86	17.44	21.78
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid fuels	11.28	9.67	9.13	9.53	8.26	6.31	5.46	5.22	4.75	5.94	6.01
Solid fuels	119.11	123.45	138.39	142.88	138.48	134.29	164.07	141.09	132.00	167.58	174.75
Biomass	21.94	21.77	23.85	25.01	24.22	20.05	22.85	25.02	27.42	32.79	31.24
Gas	23.33	23.32	24.05	23.53	23.55	23.35	26.13	27.41	20.67	23.48	21.17

3.2.3. Sources-specific QA/QC and verification

Several QC procedures are used in the framework of inventory preparation.

Before usage data are presented by operators, the data in reports (emissions, fuel used, methods of calculations) are verified. The Point Sources information system consists of calculation modules on the basis of national emission factors, and if the operator uses the calculation module, one can be relatively certain that the received results are correct.

The data on fuel consumption is then summarized by SNAP codes and compared to the Statistical energy balance data. There are difficulties in comparing the consumption of fuel in activities. The principle of a database that, for example, the industrial boiler is designated SNAP 03 not dependent on that, is heat sold or is used for own needs.

No some improvements were made in this reporting year.

3.2.4. Sources-specific planned improvements

- To improve the QA/QC procedure.
- To make the basic decision on the usage of all point sources in the calculation of emissions from stationary combustion. Using only large sources data are possible and remained part are counted as diffuse sources. Therefore, there can only be a problem with particles (because a section of the facilities use control equipment). To eliminate this problem, it is possible to calculate the IEF for each fuel and use it as a calculation emission from diffuse sources.
- To correct EF for NFR 1.A.4.b.i residential combustion sector.
- To provide uncertainty analysis.

3.3. Transport

3.3.1. Overview of the sector

Table 3.11. Transport sector reporting activities

NFR	Source	Description	Method	Emissions
1.A.2.f.ii	Mobile Combustion in manufacturing industries and construction	Mobile combustion in manufacturing industries and construction land based mobile machinery (e.g. rollers, asphalt pavers, excavators, cranes, tractors, other industrial machinery)	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1.A.3.a.i-ii.(i)	International and Civil aviation (LTO)	Activities include all use of aircraft (jets, turboprop powered and piston engine aircraft, helicopters) consisting of passengers and freight transport.	Tier 2	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP, CO
1.A.3.a.i-ii.(ii)	International and Civil aviation (Cruise)	Activities include all use of aircraft consisting of passengers and freight transport.	Tier 1	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP, CO
1.A.3.b.i-iv	Road transport	Road transport includes use of vehicles with combustion engines: passengers cars, light duty vehicles, heavy duty trucks, buses and motorcycles	Tier 3	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs
1.A.3.b.v	Road transport: Gasoline evaporation	Gasoline evaporation from automobiles	Tier 3	NMVOC
1.A.3.b.vi	Automobile tyre and brake wear	PM and heavy metal emissions from automobile tyre and brake wear	Tier 3	$PM_{2.5}$, PM_{10}, TSP, Pb, Cd, Cr, Cu, Ni, Se, Zn,
1.A.3.b.vii	Road transport: Automobile road abrasion	PM emissions from road abrasion	Tier 1	$PM_{2.5}$, PM_{10}, TSP
1.A.3.c	Railways	Railway transport operated by steam and diesel locomotives	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs, HCB
1.A.3.d.ii	National navigation (Shipping)	Merchant ships, passenger ships, technical ships, pleasure and tour ships and other inland vessels.	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs

NFR	Source	Description	Method	Emissions
1.A.4.a.ii	Commercial/Institutional: Mobile	Commercial and institutional land based mobile machinery. This source category includes 1 A 5 b Other, Mobile - Military sector	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1.A.4.b.ii	Residential: Household and gardening (mobile)	Household and gardening sector includes various machinery: lawn mowers, wood splitters, lawn and garden tractors, etc.	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1.A.4.c.ii	Agriculture/Forestry/ Fishing: Off-road vehicles and other machinery	Land based mobile off-road vehicles and other machinery used in the agriculture/forestry sector (agricultural tractors, harvesters, combines, etc.).	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1.A.4.c.iii	Agriculture/Forestry/ Fishing: National fishing	National fishing sector covers emissions from fuels combusted for inland, coastal and deep-sea fishing.	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs, HCB, HCH, PCBs
1.A.3.d.i.(i)	International maritime navigation	Vessels of all flags that are engaged in international water-borne navigation.	Tier 1 (cruise); Tier 3 (hotelling, maneuvering)	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs, HCB, HCH, PCBs

Table 3.11 gives an overview of all the transport sectors and the methodologies used for calculating emissions from the transport sector. In this chapter, the trends and shares in emissions from the different source categories within the transport sector are described. A detailed description of methodology, activity data, emission factors and emissions is given in each subsector.

The transport sector is a major contributor to national emissions. The sector includes road transport, which is the largest and most important emission source (Figure 3.16). The share of mobile sources in total national emissions in 2011 was the following: NO_x – 42.2%, NMVOC – 10.4% and CO – 15.2%. The share of other pollutants is not so significant. The emissions of most compounds have decreased during the time series, mainly due to stricter emission standards for road vehicles. The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have decreased compared to 1990 by 60.4%, 82.3% and 82.4%, respectively. The trend of the emissions of these categories is given in Figure 3.16, Tables 3.16-3.18.

Total emissions from the transport sector reduced in 2011 compared to 2010. The reason for the decrease is reduced fuel consumption compared to the previous year.

Some recalculations have been made for the following sectors: road transport, aviation, industrial machinery, railways, navigation, commercial and agricultural sector.

The main reasons for recalculations were the following: correction of emission factors and sulphur content in fuels and activity data for the road transport sector. Recalculations led to a change in total emissions. A detailed overview is given in each transport subsector and Chapter 10.

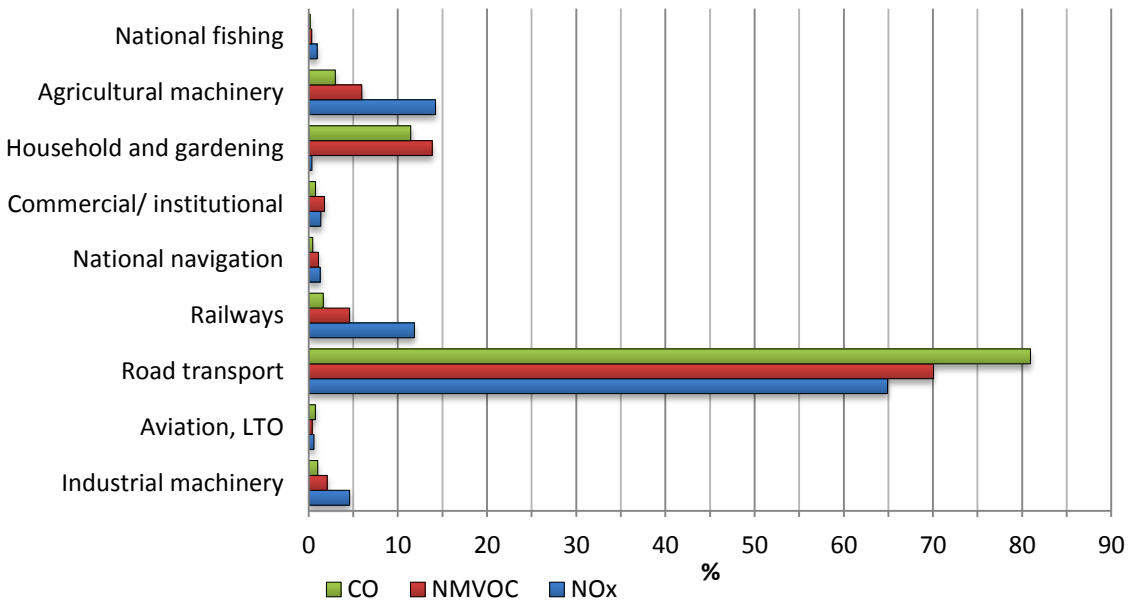

Figure 3.15. NO_x, NMVOC and CO emissions from the transport sector in 2011

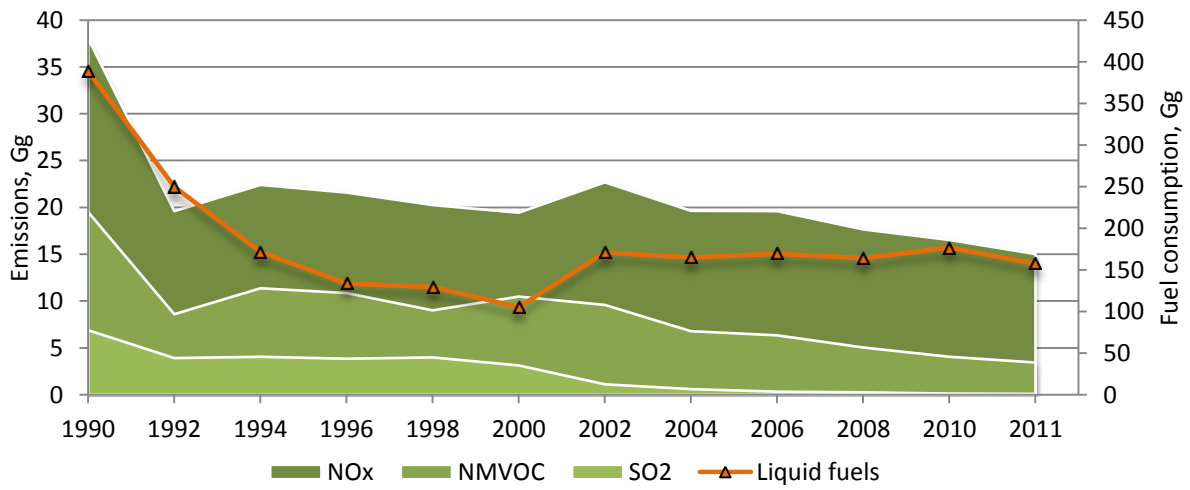

Figure 3.16. NO_x, NMVOC and CO emissions from the transport sector in the period 1990-2011

Table 3.12. Total emissions from the transport sector in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	38.030	19.517	6.899	0.019	NR	NR	1.721	127.979
1991	35.699	18.683	6.620	0.018	NR	NR	1.653	127.167
1992	19.630	8.603	3.942	0.009	NR	NR	0.955	52.872
1993	21.254	9.502	4.287	0.013	NR	NR	1.158	59.606
1994	22.429	11.363	4.075	0.024	NR	NR	1.093	71.187
1995	19.860	10.638	3.647	0.030	NR	NR	1.013	66.579
1996	21.588	10.854	3.869	0.040	NR	NR	1.014	69.060
1997	21.892	12.184	3.885	0.051	NR	NR	1.058	82.587
1998	20.281	9.023	3.985	0.048	NR	NR	1.024	62.426
1999	19.642	10.751	3.515	0.063	NR	NR	0.946	77.089
2000	19.460	10.498	3.149	0.112	0.895	0.985	1.098	68.210
2001	20.853	10.810	0.908	0.141	0.781	0.890	1.025	72.556
2002	22.685	9.595	1.109	0.147	0.970	1.083	1.222	62.625
2003	20.802	7.926	0.711	0.161	0.923	1.032	1.162	52.324
2004	19.645	6.808	0.615	0.224	0.975	1.088	1.221	45.039
2005	19.445	6.471	0.382	0.214	0.931	1.047	1.179	42.328
2006	19.624	6.345	0.335	0.241	0.937	1.060	1.203	40.590
2007	19.235	5.903	0.309	0.256	0.951	1.081	1.230	37.918
2008	17.661	5.046	0.262	0.254	0.883	1.011	1.162	32.437
2009	15.194	4.564	0.139	0.228	0.731	0.847	0.981	29.335
2010	16.550	4.051	0.128	0.215	0.772	0.895	1.040	26.569
2011	15.048	3.455	0.102	0.208	0.699	0.825	0.976	22.499
trend 1990-2011, %	**-60.4**	**-82.3**	**-98.5**	**984.1**	**-21.9**	**-16. 2**	**-43.3**	**-82.4**

Table 3.13. Total emissions of heavy metals from the transport sector in the period 1990-2011

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg		kg		Mg				
1990	78.727	0.012	0.940	0.476	0.131	2.754	0.050	0.006	2.591
1991	69.698	0.011	1.130	0.572	0.118	2.491	0.048	0.006	2.376
1992	34.327	0.006	0.387	0.196	0.064	1.380	0.027	0.003	1.237
1993	35.089	0.007	0.000	0.000	0.069	1.491	0.029	0.003	1.356
1994	43.019	0.007	0.435	0.220	0.080	1.637	0.027	0.003	1.593
1995	24.788	0.006	0.308	0.156	0.073	1.433	0.022	0.002	1.468
1996	21.707	0.007	0.466	0.236	0.077	1.537	0.024	0.003	1.561
1997	9.841	0.007	0.292	0.148	0.081	1.615	0.024	0.003	1.660
1998	6.064	0.006	0.111	0.056	0.074	1.480	0.023	0.002	1.462
1999	7.552	0.006	0.024	0.012	0.075	1.490	0.021	0.002	1.535
2000	5.027	0.006	0.047	0.024	0.077	1.528	0.022	0.002	1.547
2001	5.984	0.008	0.063	0.032	0.093	1.841	0.026	0.003	1.875
2002	5.542	0.008	0.008	0.004	0.100	1.998	0.030	0.003	1.985
2003	2.270	0.008	0.200	0.267	0.096	1.929	0.036	0.004	1.933
2004	2.108	0.008	0.141	0.188	0.099	1.972	0.034	0.004	1.974
2005	2.136	0.009	0.126	0.168	0.102	2.014	0.034	0.004	2.049
2006	1.470	0.009	0.064	0.085	0.110	2.160	0.034	0.004	2.203
2007	1.545	0.010	0.063	0.084	0.116	2.274	0.035	0.004	2.327
2008	1.591	0.009	0.131	0.174	0.114	2.246	0.037	0.004	2.271
2009	1.402	0.009	0.170	0.227	0.102	2.003	0.035	0.004	2.044
2010	0.516	0.009	0.103	0.137	0.108	2.143	0.035	0.004	2.135

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg		kg		Mg				
2011	0.488	0.009	0.054	0.071	0.111	2.165	0.032	0.003	2.162
trend 1990-2011, %	**-99.4**	**-26.9**	**-94.3**	**-85.1**	**-14.99**	**-21.4**	**-35.9**	**-40.6**	**-16.5**

Table 3.14. Total emissions of POPs from the transport sector in the period 1990-2011

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					g	kg	
1990	0.226	0.022	0.040	0.017	0.012	0.091	0.074	NA	0.020
1991	0.223	0.022	0.039	0.015	0.012	0.088	0.089	NA	0.024
1992	0.096	0.012	0.022	0.008	0.005	0.047	0.030	NA	0.008
1993	0.104	0.013	0.023	0.009	0.006	0.051	0.033	NA	0.009
1994	0.142	0.012	0.021	0.010	0.008	0.050	0.034	NA	0.009
1995	0.128	0.009	0.017	0.010	0.007	0.042	0.024	NA	0.007
1996	0.148	0.010	0.019	0.010	0.008	0.047	0.037	NA	0.010
1997	0.152	0.009	0.018	0.010	0.007	0.045	0.023	NA	0.006
1998	0.111	0.008	0.016	0.010	0.006	0.040	0.009	NA	0.002
1999	0.132	0.007	0.014	0.009	0.006	0.037	0.002	NA	0.001
2000	0.137	0.007	0.014	0.009	0.006	0.037	0.004	NA	0.001
2001	0.167	0.008	0.017	0.011	0.008	0.043	0.005	NA	0.001
2002	0.156	0.011	0.020	0.012	0.008	0.050	0.001	NA	0.000
2003	0.151	0.010	0.019	0.011	0.007	0.048	0.535	NA	0.003
2004	0.149	0.011	0.019	0.012	0.008	0.049	0.377	NA	0.002
2005	0.152	0.011	0.019	0.012	0.008	0.050	0.336	NA	0.002
2006	0.161	0.012	0.021	0.013	0.009	0.055	0.170	NA	0.001
2007	0.168	0.013	0.022	0.013	0.009	0.057	0.168	NA	0.001
2008	0.169	0.012	0.021	0.013	0.009	0.055	0.348	NA	0.002
2009	0.153	0.011	0.019	0.012	0.008	0.050	0.453	NA	0.002
2010	0.148	0.013	0.021	0.013	0.009	0.056	0.274	NA	0.001
2011	0.143	0.012	0.021	0.014	0.009	0.056	0.143	NA	0.001
trend 1990-2011, %	**-36.6**	**-43.1**	**-48.3**	**-18.3**	**-23.6**	**-38.2**	**93.2**	**NA**	**-96.6**

3.3.2. Aviation (1.A.3.a.i-ii (i-ii))

3.3.2.1. Source category description

Estonia's inventory contains estimates for both domestic and international aviation. Emission estimates from the aviation sector include all aircraft types: helicopters, jets, turboprop powered and piston engine aircraft.

Emissions from the aviation sector are split into different aircraft activities, and allocations are made according to the requirements for reporting:

- 1.A.3.a.ii (i) Civil aviation (Domestic, LTO)
- 1.A.3.a.i (i) International aviation (LTO)
- 1.A.3.a.ii (ii) Civil aviation (Domestic, Cruise)
- 1.A.3.a.i (ii) International aviation (Cruise)

In addition, emissions from the cruise phase are reported as a memo item, and are not included in national totals.

The aviation sector has quite a minor share in total emissions. The total contribution of aircraft LTO emissions to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide was 0.6%, 0.4% and 0.7% respectively, in the transport sector in 2011. Other pollutants have an even smaller share.

Aviation emissions reflect the level of overall aviation activity. The growth of air travel over the past decades has been noticeable. During the period 1990-2011, the emission of NO_x, NMVOC and CO from LTO phase increased by 66.1%, 8.0%, 37.2%, respectively (Figures 3.17-3.19, Table 3.15), mainly due to changes in fuel consumption and the number of landing and take-off operations. This is roughly in line with the trends in the numbers of air passengers and freight transported over the same period (Figure 3.21). Figures 3.17-3.19 illustrate the importance of the international aviation sector, which contributes the majority of emissions from the aviation sector.

The emissions of NO_x, NMVOC and CO increased in 2011 compared to 2010 by 21.6%, 26.5% and 23.2%, respectively, due to the growth of fuel consumption and the number of landing and take-off operations at the same period by 20.6% and 14.1%, respectively (Figures 3.17-3.19, 3.21, Tables 3.15-3.16, 3.19).

Recalculations

All the emissions from the aviation sector for the period 1990-2010 have been recalculated because emission factor values for some specific aircraft types were corrected. An overview of the updated data is given in Chapter 10.

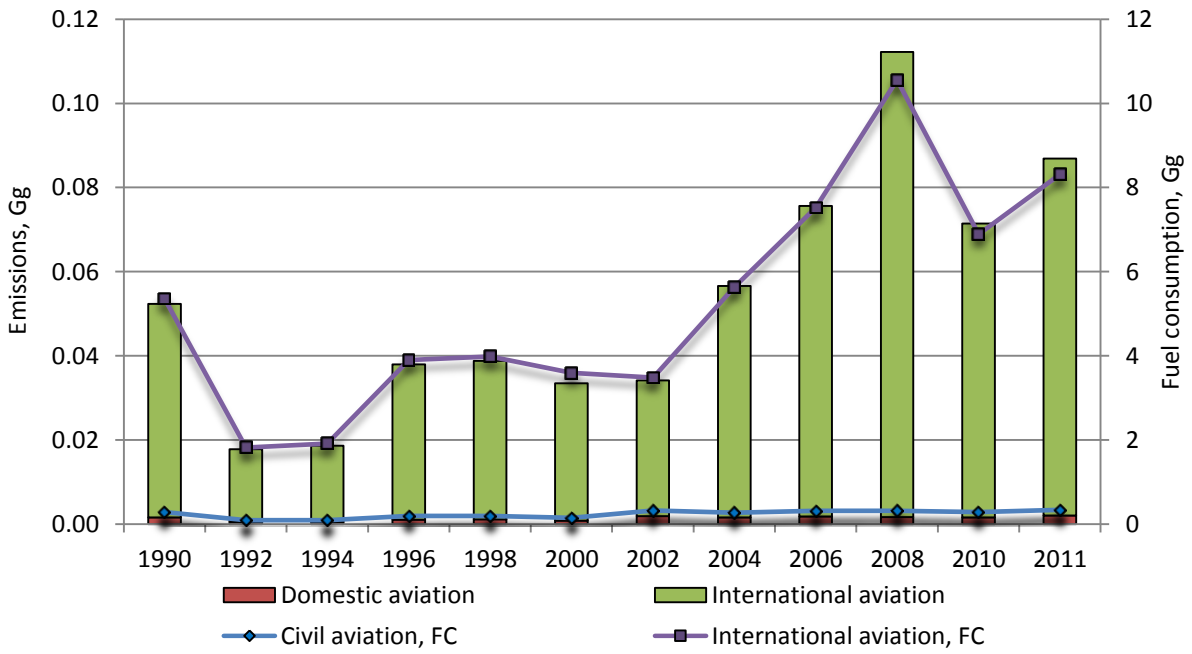

Figure 3.17. NO_x emissions from the LTO-cycle in the period 1990-2011

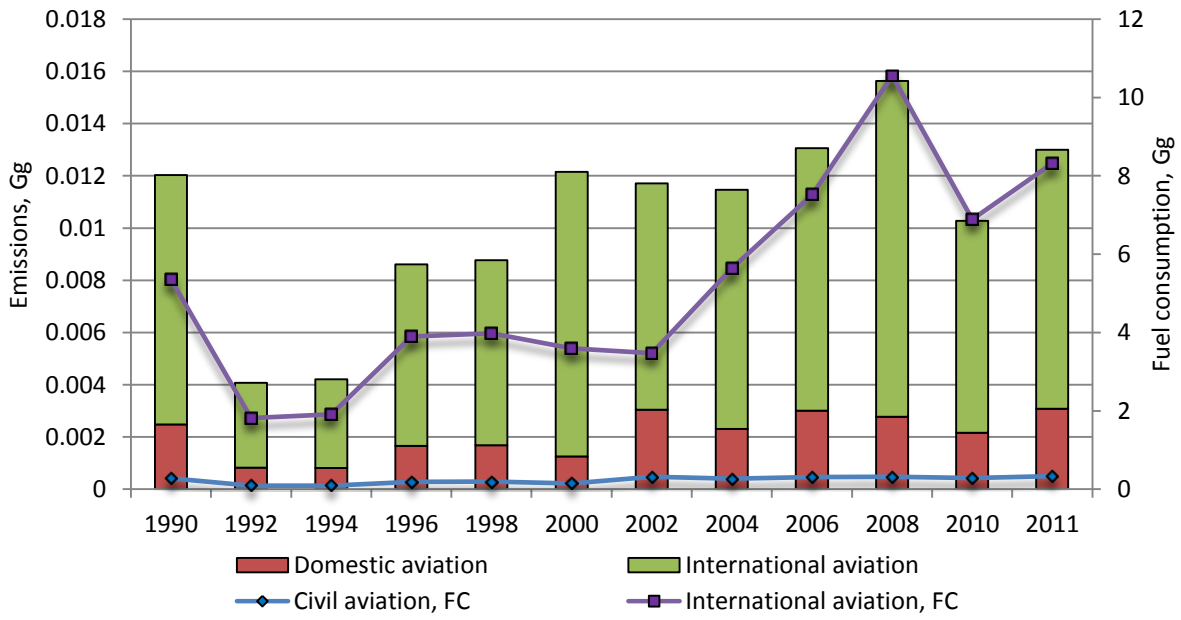

Figure 3.18. NMVOC emissions from the LTO-cycle in the period 1990-2011

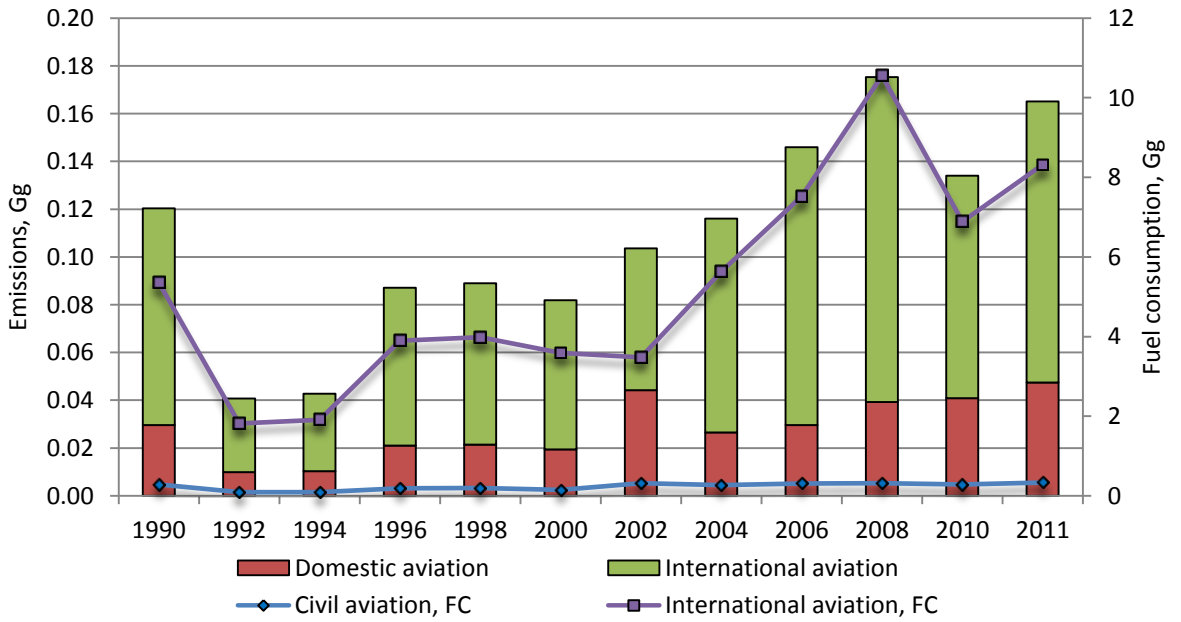

Figure 3.19. CO emissions from the LTO-cycle in the period 1990-2011

Table 3.15. Emissions from the LTO-cycle in the aviation sector in the period 1990-2011

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg				Mg			Gg
1990	0.052	0.012	0.006	NA	NR	NR	0.392	0.120
1991	0.052	0.012	0.006	NA	NR	NR	0.392	0.120
1992	0.018	0.004	0.002	NA	NR	NR	0.133	0.041
1993	0.019	0.004	0.002	NA	NR	NR	0.141	0.043
1994	0.019	0.004	0.002	NA	NR	NR	0.139	0.043
1995	0.030	0.007	0.003	NA	NR	NR	0.221	0.068
1996	0.038	0.009	0.004	NA	NR	NR	0.283	0.087
1997	0.036	0.008	0.004	NA	NR	NR	0.265	0.082

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg				Mg			Gg
1998	0.039	0.009	0.004	NA	NR	NR	0.289	0.089
1999	0.037	0.008	0.004	NA	NR	NR	0.275	0.084
2000	0.033	0.012	0.004	NA	0.314	0.314	0.314	0.082
2001	0.033	0.010	0.004	NA	0.282	0.282	0.282	0.078
2002	0.034	0.012	0.004	NA	0.272	0.272	0.272	0.104
2003	0.042	0.010	0.004	NA	0.330	0.330	0.330	0.103
2004	0.057	0.011	0.006	NA	0.441	0.441	0.441	0.116
2005	0.078	0.015	0.008	NA	0.652	0.652	0.652	0.155
2006	0.076	0.013	0.008	NA	0.642	0.642	0.642	0.146
2007	0.090	0.013	0.009	NA	0.780	0.780	0.780	0.156
2008	0.112	0.016	0.010	NA	0.941	0.941	0.941	0.175
2009	0.075	0.010	0.007	NA	0.603	0.603	0.603	0.129
2010	0.071	0.010	0.007	NA	0.558	0.558	0.558	0.134
2011	0.087	0.013	0.008	NA	0.638	0.638	0.638	0.165
trend 1990-2011, %	**66.1**	**8.01**	**49.8**	**NA**	**103.2**	**103.2**	**62.7**	**37.2**

Table 3.16. Emissions from the cruise phase in the aviation sector in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.385	0.015	0.030	NA	NR	NR	0.006	0.035
1991	0.385	0.015	0.030	NA	NR	NR	0.006	0.035
1992	0.128	0.005	0.010	NA	NR	NR	0.002	0.012
1993	0.206	0.008	0.016	NA	NR	NR	0.003	0.019
1994	0.165	0.006	0.013	NA	NR	NR	0.003	0.015
1995	0.190	0.007	0.015	NA	NR	NR	0.003	0.017
1996	0.153	0.006	0.012	NA	NR	NR	0.002	0.014
1997	0.237	0.009	0.019	NA	NR	NR	0.004	0.021
1998	0.147	0.006	0.012	NA	NR	NR	0.002	0.013
1999	0.230	0.009	0.018	NA	NR	NR	0.004	0.021
2000	0.224	0.009	0.018	NA	0.004	0.004	0.004	0.020
2001	0.158	0.006	0.012	NA	0.002	0.002	0.002	0.014
2002	0.187	0.007	0.015	NA	0.003	0.003	0.003	0.017
2003	0.177	0.007	0.014	NA	0.003	0.003	0.003	0.016
2004	0.298	0.011	0.023	NA	0.005	0.005	0.005	0.027
2005	0.501	0.020	0.039	NA	0.008	0.008	0.008	0.043
2006	0.301	0.012	0.024	NA	0.005	0.005	0.005	0.026
2007	0.511	0.020	0.040	NA	0.008	0.008	0.008	0.044
2008	0.216	0.008	0.017	NA	0.003	0.003	0.003	0.019
2009	0.321	0.012	0.025	NA	0.005	0.005	0.005	0.028
2010	0.376	0.015	0.029	NA	0.006	0.006	0.006	0.033
2011	0.320	0.012	0.025	NA	0.005	0.005	0.005	0.028
trend 1990-2011, %	**-16.95**	**-15.4**	**-17.4**	**NA**	**42.3**	**42.3**	**-17.4**	**-19.3**

3.3.2.2. Methodological issues

Emissions calculations from the LTO cycle are based on the Tier 2 method and cruise emission calculations Tier 1 (EMEP/EEA air pollutant emission inventory guidebook 2009).

For the LTO phase, fuel consumed and the emissions of pollutants per LTO cycle are based on representative aircraft type group data. The energy use by aircraft is calculated for both domestic and international LTOs by multiplying the LTO fuel consumption factor for each representative aircraft type (Table 3.17) by the corresponding number of LTOs. In order to calculate domestic and international LTO emissions, the number of LTOs for each aircraft type is multiplied by the respective emissions per LTO.

Cruise energy usage is estimated as the difference between the total fuel use from aviation fuel sale statistics and the total calculated LTO fuel use (Table 3.19). Fuel-based cruise emission factors are taken from the EMEP/EEA guidebook as a single set for an average aircraft (Table 3.18). Finally, when given the fuel related cruise emission factors, total domestic and international energy use and emissions can be calculated. All the calculations are made by using the following equations:

*LTO Emissions = Number of LTOs * Emission Factor LTO*

*LTO Fuel Consumption = Number of LTOs * Fuel Consumption per LTO*

*Cruise Emissions = (Total Fuel Consumption – LTO Fuel Consumption) * Emission Factor Cruise*

All flights to and from Estonia's airports are separated into domestic and international flights. Separate emission estimates are made for domestic and international civil aircraft, which are divided into emissions from the landing and take-off (LTO) phase and the cruise phase.

Detailed aircraft type data with take-off and landing activity are supplied by 7 Estonian airports. Estonian aircraft movement statistics count landing and take-off as two different activities. However, methodology defines both one landing and one take-off as a full LTO cycle. Therefore, statistical aircraft movement data is divided in two (Figure 3.20).

The methodology requires information on the number of LTOs grouped by representative aircraft types (Table 3.17). This kind of detailed knowledge is hard to obtain (individual aircraft with their specific engines) and therefore data is an aggregated level for practical reasons (Figure 3.21). Assumptions are made if missing data exist in some situations.

In spite of the different levels of aviation statistics, it is possible to divide the air traffic activity into the number of LTOs per aircraft type by using different statistical sources. Estonian emission calculations are based on the EMEP/EEA methodology and other referenced sources in the guidebook (IPCC, FOCA, ICAO engine database, etc.).

A complete emission calculation (LTO and cruise emissions for domestic and international flights) was carried out by EEIC between 1992 and 2011. Extrapolation has been done for 1990 and 1991.

Table 3.17. Emission factors for the LTO-cycle (kg/LTO)

	NO_x	NMVOC	SO_2	$PM_{2.5}$	CO	Fuel consumption
Turbofans (Jets)[1,2,3]						
Airbus A310	23.2	5	1.5	0.14	25.8	1540.5
Airbus A320	10.8	1.7	0.8	0.09	17.6	802.3
Bae 111	4.9	19.3	0.7	0.17	37.7	681.6
Bae 146	4.2	0.9	0.6	0.08	9.7	569.5
B727	12.6	6.5	1.4	0.22	26.4	1412.8
B737-100	8	0.5	0.9	0.1	4.8	919.7
B737-400	8.3	0.6	0.8	0.07	11.8	825.4
B747-100-300	55.9	33.6	3.4	0.47	78.2	3413.9
B747-400	56.6	1.6	3.4	0.32	19.5	3402.2
B757	19.7	1.1	1.3	0.13	12.5	1253
B767-300	26	0.8	1.6	0.15	6.1	1617.1
B777	53.6	20.5	2.6	0.2	61.4	2562.8
Fokker 100	5.8	1.3	0.7	0.14	13.7	744.4
Fokker 28	5.2	29.6	0.7	0.15	32.7	666.1
2XB737-100	16	1	1.8	0.2	9.6	1839.4
McDonnell Douglas DC-9	7.3	0.7	0.9	0.16	5.4	876.1
McDonnell Douglas DC-10	41.7	20.5	2.4	0.32	61.6	2381.2
McDonnell Douglas	12.3	1.4	1	0.12	6.5	1003.1
C525	0.74	3.01	0.34	0	34.07	340
EC RJ_100ER	2.27	0.56	0.33	0	6.7	330
ERJ-145	2.69	0.5	0.31	0	6.18	310
GLF4	5.63	1.23	0.68	0	8.88	680
GLF5	5.58	0.28	0.6	0	8.42	600
RJ85	4.34	1.21	0.6	0	11.21	600
Turboprop[3]						
turboprop, <1000 sph/engine	0.3	0.58	0.07	0	2.97	70
turboprop, 1000-2000 sph/engine	1.51	0	0.2	0	2.24	200
turboprop, >2000 sph/engine	1.82	0.26	0.2	0	2.33	200
Piston engine[4]						
microlight aircraft	0.03	0.04	0.00	0	0.94	1.4
4 seat single engine (<180hp)	0.01	0.06	0.00	0	3.93	3.9
singe engine high performance (180-360hp)	0.02	0.16	0.00	0	7.33	7.5
twin engine high performance (2x235hp)	0.05	0.22	0.01	0	19.33	21.6
Helicopters[5]						
A109	0.13	0.89	0.02	0.01	1.31	32.8
A139	0.38	0.68	0.03	0.01	0.97	60.3
ALO3	0.11	0.28	0.01	0.00	0.40	21.4
AS32	0.65	0.49	0.04	0.02	0.68	77.4
AS35	0.18	0.22	0.01	0.01	0.32	27.5
AS50	0.15	0.24	0.01	0.01	0.35	25.2
AS55	0.15	0.82	0.02	0.01	1.20	34.8
H269	0.01	0.09	0.00	0.00	6.59	6.6
B412	0.64	0.49	0.04	0.02	0.69	77.0
B06	0.08	0.35	0.01	0.00	0.50	18.2
EC35	0.21	0.71	0.02	0.01	1.03	41.1
EN48	0.08	0.34	0.01	0.00	0.48	18.6
MI8	0.53	0.55	0.04	0.02	0.78	70.0

	NO_x	NMVOC	SO_2	$PM_{2.5}$	CO	Fuel consumption
Helicopters[5]						
R22	0.01	0.09	0.00	0.00	6.21	6.2
R44	0.02	0.11	0.00	0.00	8.79	8.8
S76	0.29	0.59	0.02	0.01	0.85	48.2

1. *EMEP/EEA. (2009). EMEP/EEA air pollutant emission inventory guidebook 2009. Technical guidance to prepare national emission inventories. Technical report No 9/2009;*
2. *ICAO (1995): Engine exhaust emissions databank. First edition. Doc 9646-AN/943. (Updated January 2012).*
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4. *Rindlisbacher. T. (2007): Aircraft Piston Engine Emissions Summary Report, Reference: 0/3/33/33-05-003.022.*
5. *Rindlisbacher. T. (2009): Guidance on the Determination of Helicopter Emissions, Edition 1, Reference: 0/3/33/33-05-20. FOCA, Bern.*

Table 3.18. Emission factors for the cruise phase (kg/t)

	NO_x	CO	NMVOC	SO_2	$PM_{2.5}$
Domestic aviation	3150	2	0.1	1	0.2
International aviation	3150	1.1	0.5	1	0.2

Table 3.19. Fuel consumption in the aviation sector in the period 1990-2011 (Gg)

	Domestic LTO	Domestic cruise	International LTO	International cruise	Total
1990	0.285	1.515	5.358	28.842	36.000
1991	0.285	1.515	5.358	28.842	36.000
1992	0.095	0.505	1.821	9.579	12.000
1993	0.096	1.124	1.943	15.157	18.320
1994	0.095	0.725	1.917	12.333	15.070
1995	0.150	0.971	3.041	14.059	18.221
1996	0.194	0.817	3.902	11.298	16.211
1997	0.181	0.952	3.657	17.750	22.540
1998	0.198	0.616	3.987	10.987	15.788
1999	0.188	0.672	3.784	17.418	22.062
2000	0.153	0.638	3.596	16.982	21.369
2001	0.170	0.608	3.562	11.871	16.211
2002	0.322	0.480	3.480	14.253	18.535
2003	0.333	0.415	4.142	13.478	18.368
2004	0.273	0.792	5.640	22.651	29.356
2005	0.308	0.239	7.568	38.987	47.102
2006	0.314	0.090	7.523	23.436	31.363
2007	0.291	0.126	8.966	39.791	49.174
2008	0.321	0.402	10.560	16.539	27.822
2009	0.284	0.267	7.134	24.901	32.586
2010	0.287	0.277	6.893	29.138	36.595
2011	0.339	0.532	8.319	24.536	33.726

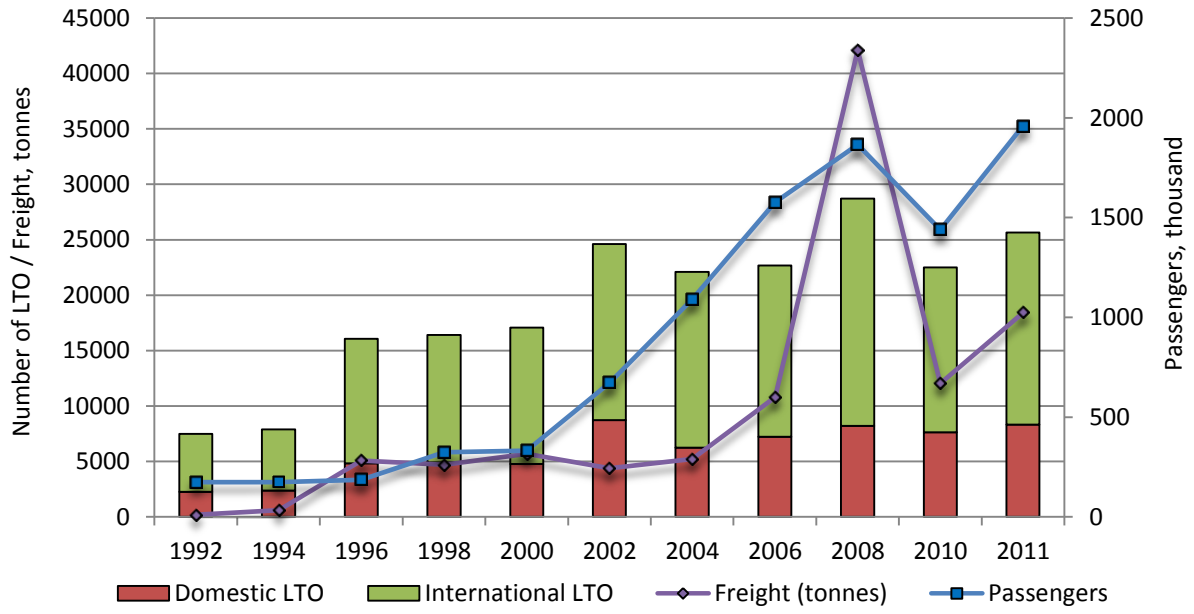

Figure 3.20. Number of LTO-cycles, passenger numbers and freight transported in the period 1990-2011

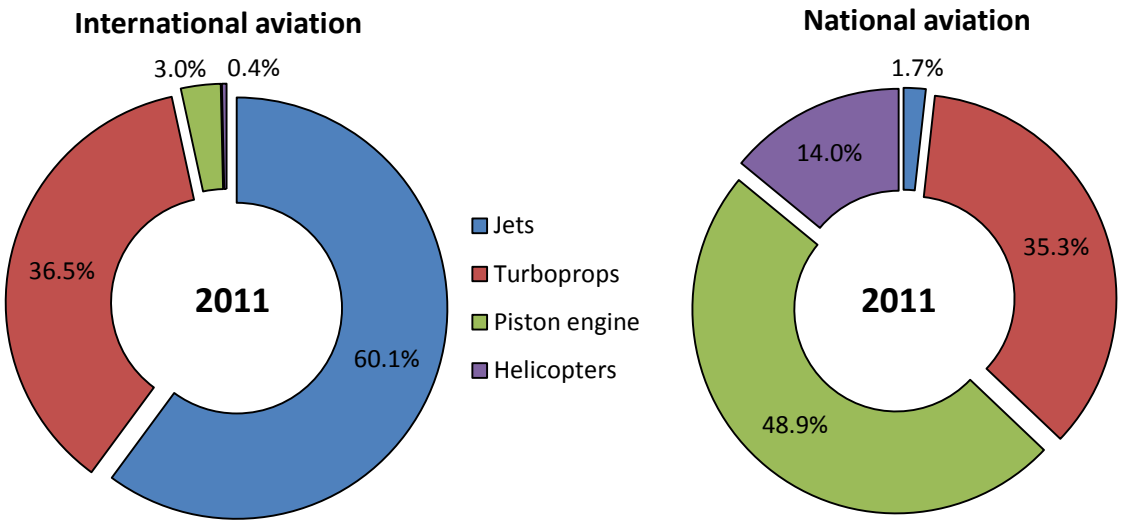

Figure 3.21. The share of different aircraft types in domestic and international civil aviation in 2011

3.3.2.3. Source-specific QA/QC and verification

Common statistical quality checking related to assessment of trends has been carried out.

3.3.2.4. Source-specific planned improvements

The aviation sector is not a key category and contributes only a marginal share in total emissions. Therefore, there are currently no improvements planned for this sector.

3.3.3. Road transport (1.A.3.b.i-vii)

3.3.3.1. Source category description

Road transport is the largest and most important emission source in the transport sector. This sector includes all types of vehicles on roads (passenger cars, light duty vehicles, heavy duty trucks, buses, motorcycles). The source category does not cover farm and forest tractors that drive occasionally on the roads because they are included in other sectors as off-roads (agricultural and industrial machinery, etc.).

The road transport sector includes emissions from fuel combustion, road abrasion, tyre and brake wear and NMVOC emissions from gasoline evaporation.

Road transport contributed to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide by 64.9%, 70.0% and 80.9% respectively, in 2011. Emissions from the main pollutants and particulate matter have decreased significantly throughout the time series with the exception of NH_3. The decrease in emissions has mainly been caused by the stricter emission standards for road vehicles. The lead emissions from road transport have decreased about 99.4% since 1990 (Figure 3.26). The reduction of emissions is connected with the prohibition on leaded gasoline in 2000. The share of road transport in total Pb emissions was 1.2% in 2011. The reduction of the sulphur content in fuels has led to a substantial decrease of SO_2 emissions in the road transport sector (Figure 3.25). In 2001, the sulphur content was reduced from 5000 ppm (diesel) and 1000 ppm (gasoline) to 500 ppm and since that, the sulphur content in fuel has been gradually reduced even more. Currently, all road transport fuels are sulphur free (sulphur content less than 10 ppm). Therefore, SO_x emissions have decreased by 99.8% between 1990 and 2011.

Total emissions from road transport have not changed much in 2011 compared to 2010, although there has been an increase in the number of vehicles, average annual mileage and fuel consumption by 13.0%, 3.5% and 3.3%, respectively. There has been no significant change in emissions due to the number of new vehicles that are designed to reduce both energy consumption and pollutant emissions.

In the figures below (Figures 3.22-3.26), a detailed overview of NO_x, NMVOC, CO, SO_x and Pb emission sources in the road transport sector is provided. All the emission trends are presented in Tables 3.20-3.22.

Fuel consumption has changed over the decades in the road transport sector. In the 1990s, gasoline consumption dominated, but from 2003 we can see a continuous growth in diesel consumption in road transport (Figure 3.27). This trend can be explained by the fact that the popularity of vehicles with gasoline engines has declined in recent years, and diesel engines dominate due to their greater fuel efficiency and torque compared to gasoline engines. Since 1990, the number of gasoline passenger cars and light duty vehicles equipped with catalytic

converters has increased, resulting in decreasing emissions of e.g. NO_x and NMVOC by 88% and 86% respectively, between 1990 and 2011. Diesel engines are the main power source in heavy-duty trucks and buses, and their share is rapidly growing in passenger cars as well.

Therefore, the reasons for emission reductions were a 49% decrease in gasoline consumption during the period 1990-2011 and an increasing amount of new cars that are designed to reduce both energy consumption and pollutant emissions, as a result of new technologies.

In addition, over the last few years, steps have been taken to use biofuels in road transport. The share of biofuels in fuels for road transport accounted for 0.03% in 2005 and increased to 1% in 2011 (Table 3.28).

Recalculations

All the emissions from the transport sector for the period 2008-2010 are recalculated. The main reasons for the recalculations are: activity data are correctly divided between road transport subsectors and therefore annual mileage driven is also changed in a small extent. An overview of the updated data is given in Chapter 10.

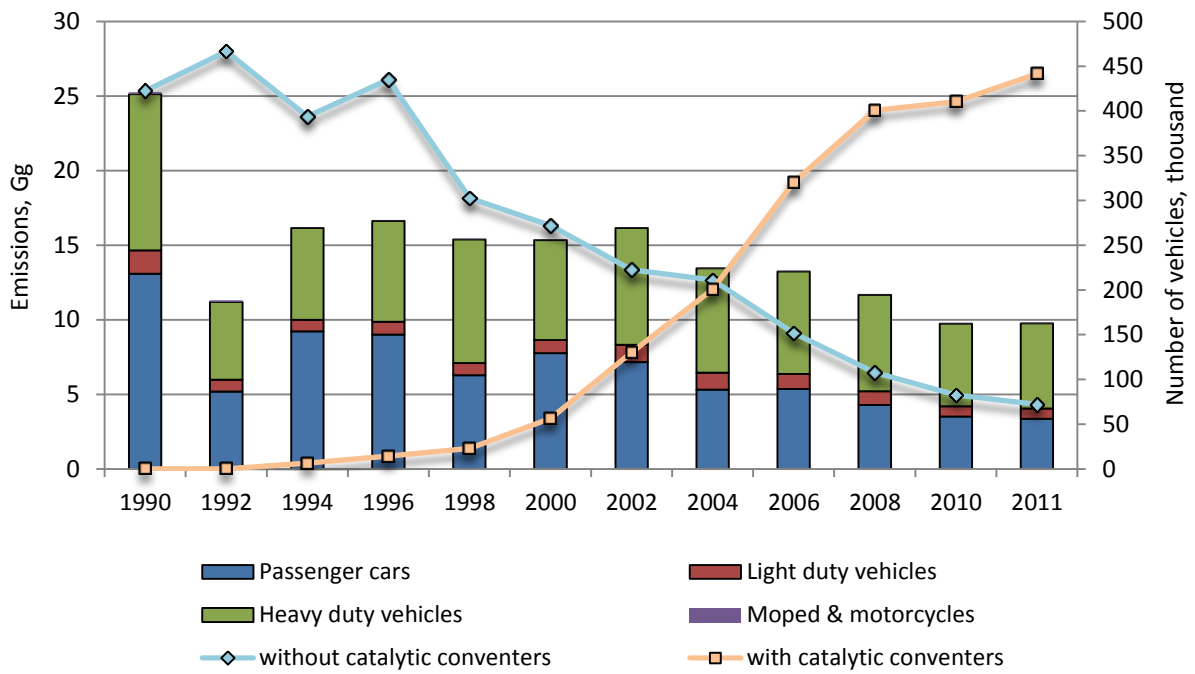

Figure 3.22. NO_x emissions from road transport in the period 1990-2011

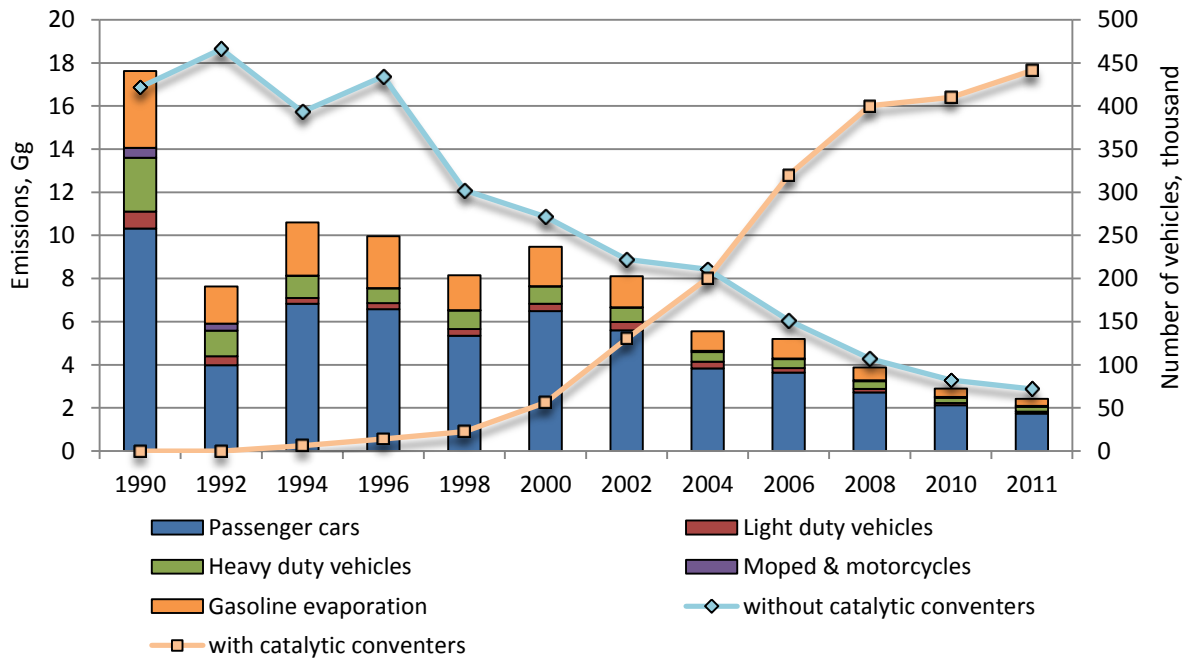

Figure 3.23. NMVOC emissions from road transport in the period 1990-2011

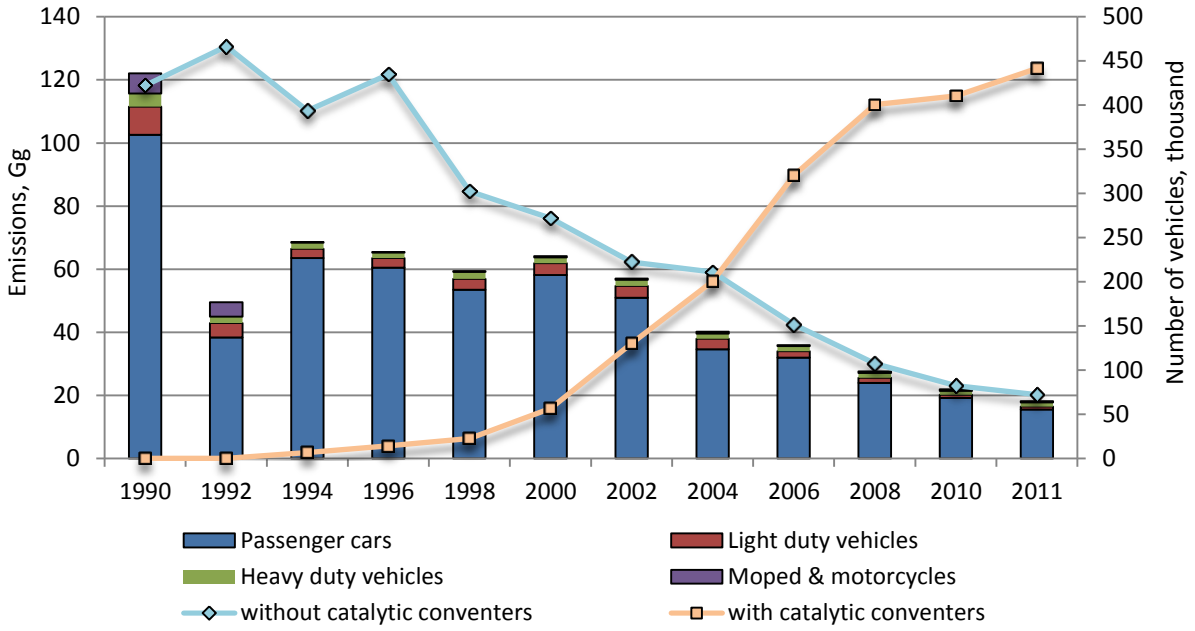

Figure 3.24. CO emissions from road transport in the period 1990-2011

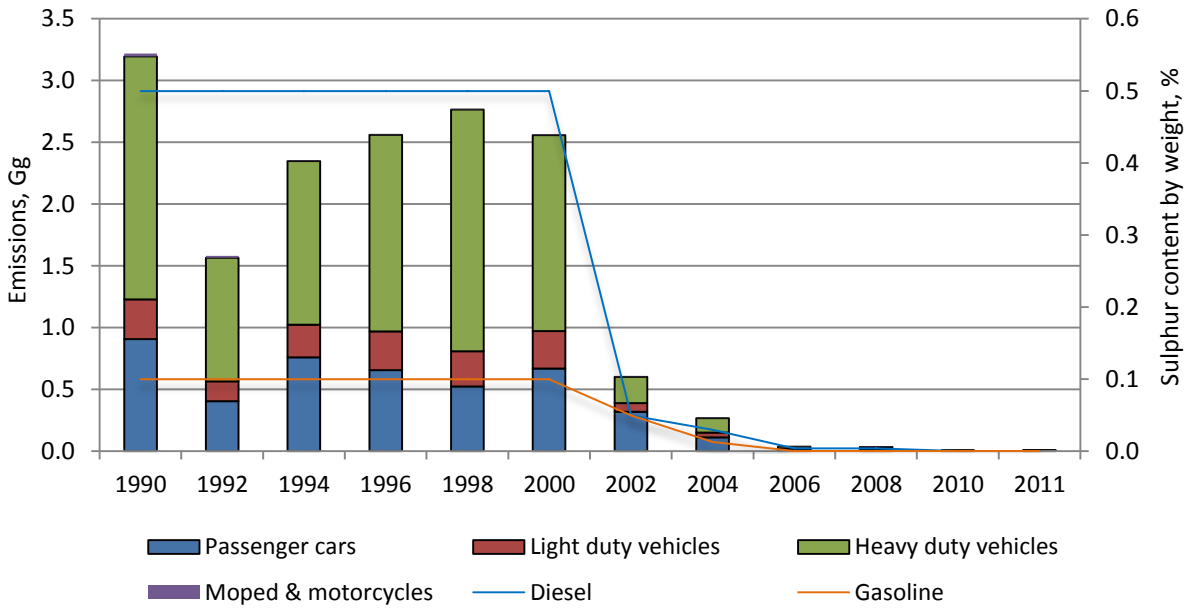

Figure 3.25. SO_2 emissions from road transport in the period 1990-2011

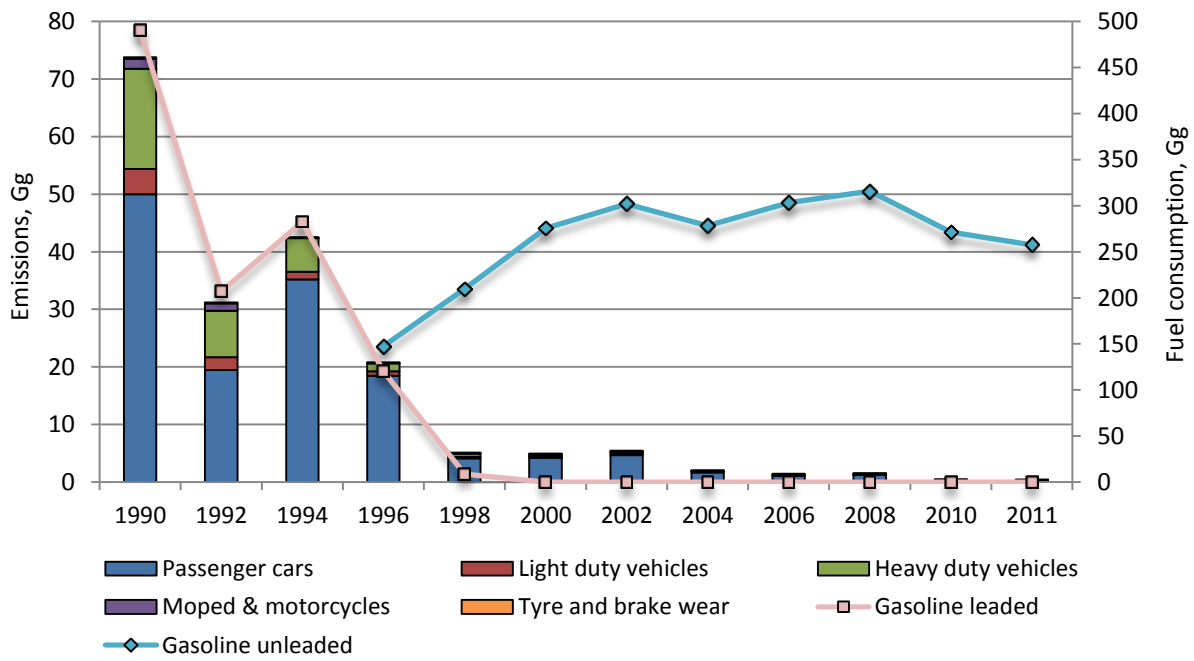

Figure 3.26. Pb emissions from road transport in the period 1990-2011

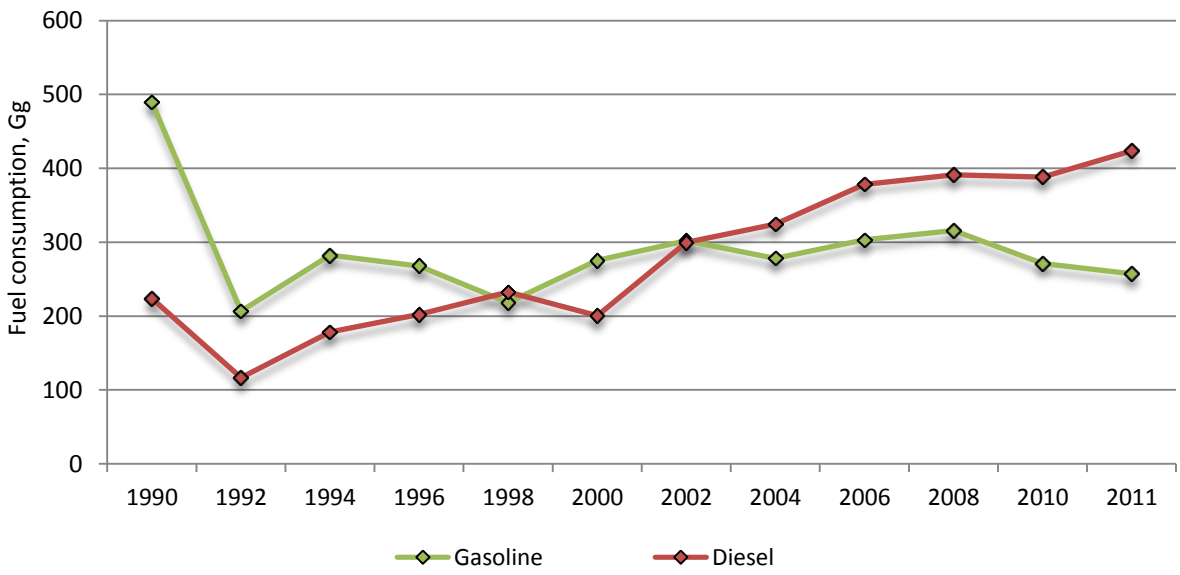

Figure 3.27. Gasoline and diesel consumption in the road transport sector in the period 1990-2011

Table 3.20. Emissions from road transport in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	25.250	17.631	3.220	0.016	NR	NR	1.018	122.056
1991	22.949	16.782	2.930	0.015	NR	NR	0.942	121.144
1992	11.294	7.633	1.583	0.007	NR	NR	0.509	49.562
1993	12.446	8.118	1.859	0.011	NR	NR	0.608	55.237
1994	16.147	10.599	2.350	0.022	NR	NR	0.759	68.550
1995	15.786	9.725	2.598	0.029	NR	NR	0.812	63.319
1996	16.632	9.970	2.561	0.039	NR	NR	0.759	65.492
1997	17.350	11.321	2.700	0.050	NR	NR	0.825	79.040
1998	15.387	8.155	2.765	0.047	NR	NR	0.790	59.370
1999	15.632	9.857	2.587	0.062	NR	NR	0.767	73.653
2000	15.350	9.468	2.558	0.111	0.713	0.800	0.910	64.102
2001	16.780	9.653	0.581	0.140	0.587	0.694	0.826	67.794
2002	16.157	8.102	0.602	0.146	0.657	0.767	0.902	57.007
2003	13.910	6.503	0.293	0.160	0.603	0.708	0.835	46.870
2004	13.458	5.556	0.267	0.223	0.684	0.793	0.923	40.177
2005	13.284	5.380	0.063	0.213	0.647	0.758	0.888	37.946
2006	13.243	5.196	0.036	0.240	0.627	0.747	0.886	35.973
2007	12.876	4.716	0.037	0.255	0.618	0.745	0.891	33.100
2008	11.684	3.882	0.036	0.253	0.554	0.680	0.829	27.631
2009	9.535	3.313	0.012	0.227	0.464	0.576	0.707	24.406
2010	9.757	2.894	0.006	0.214	0.459	0.578	0.719	21.925
2011	9.765	2.420	0.008	0.207	0.453	0.577	0.725	18.206
trend 1990-2011, %	**-61.3**	**-86.3**	**-99.8**	**1161.6**	**-36.4**	**-27.8**	**-28.8**	**-85.1**

Table 3.21. Emissions of heavy metals from road transport in the period 1990-2011 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	73.785	0.008	NE	NE	0.112	2.152	0.024	0.002	2.214
1991	66.237	0.008	NE	NE	0.098	1.887	0.021	0.002	1.994
1992	31.167	0.004	NE	NE	0.051	0.991	0.011	0.001	0.999
1993	33.265	0.004	NE	NE	0.057	1.087	0.012	0.001	1.108
1994	42.559	0.005	NE	NE	0.071	1.351	0.015	0.001	1.414
1995	24.026	0.005	NE	NE	0.067	1.258	0.014	0.001	1.357
1996	20.813	0.005	NE	NE	0.070	1.320	0.015	0.001	1.422
1997	8.922	0.006	NE	NE	0.075	1.416	0.016	0.001	1.536
1998	5.104	0.005	NE	NE	0.068	1.273	0.014	0.001	1.338
1999	6.743	0.005	NE	NE	0.070	1.329	0.015	0.001	1.440
2000	4.944	0.005	NE	NE	0.072	1.359	0.015	0.001	1.446
2001	5.902	0.007	NE	NE	0.088	1.669	0.018	0.002	1.773
2002	5.445	0.007	NE	NE	0.091	1.717	0.019	0.002	1.820
2003	2.127	0.007	NE	NE	0.088	1.644	0.018	0.002	1.761
2004	2.065	0.007	NE	NE	0.092	1.712	0.019	0.002	1.818
2005	2.112	0.007	NE	NE	0.094	1.759	0.019	0.002	1.896
2006	1.444	0.008	NE	NE	0.102	1.889	0.021	0.002	2.042
2007	1.516	0.008	NE	NE	0.108	1.999	0.022	0.002	2.164
2008	1.569	0.008	NE	NE	0.107	1.989	0.022	0.002	2.117
2009	1.372	0.007	NE	NE	0.095	1.770	0.019	0.002	1.904
2010	0.490	0.007	NE	NE	0.100	1.862	0.020	0.002	1.967
2011	0.467	0.008	NE	NE	0.105	1.940	0.021	0.002	2.029
trend 1990-2011, %	**-99.4**	**-10.2**	**NE**	**NE**	**-6.3**	**-9.8**	**-10.9**	**-4.6**	**-8.4**

Table 3.22. Total emissions of POPs from road transport in the period 1990-2011

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					kg		
1990	0.202	0.006	0.015	0.013	0.009	0.043	NE	NA	NE
1991	0.194	0.005	0.013	0.010	0.009	0.037	NE	NA	NE
1992	0.086	0.003	0.007	0.006	0.004	0.020	NE	NA	NE
1993	0.093	0.003	0.008	0.007	0.005	0.022	NE	NA	NE
1994	0.130	0.004	0.010	0.008	0.006	0.027	NE	NA	NE
1995	0.120	0.004	0.009	0.007	0.006	0.027	NE	NA	NE
1996	0.136	0.004	0.009	0.007	0.006	0.027	NE	NA	NE
1997	0.144	0.004	0.010	0.008	0.007	0.029	NE	NA	NE
1998	0.108	0.003	0.009	0.008	0.005	0.026	NE	NA	NE
1999	0.132	0.004	0.009	0.008	0.006	0.027	NE	NA	NE
2000	0.136	0.004	0.009	0.008	0.006	0.026	NE	NA	NE
2001	0.166	0.005	0.011	0.009	0.007	0.032	NE	NA	NE
2002	0.156	0.005	0.012	0.010	0.007	0.034	NE	NA	NE
2003	0.150	0.006	0.011	0.010	0.007	0.033	NE	NA	NE
2004	0.149	0.006	0.012	0.010	0.007	0.035	NE	NA	NE
2005	0.151	0.007	0.012	0.010	0.008	0.037	NE	NA	NE
2006	0.160	0.007	0.013	0.011	0.009	0.040	NE	NA	NE
2007	0.168	0.008	0.014	0.012	0.009	0.043	NE	NA	NE
2008	0.169	0.008	0.013	0.012	0.009	0.042	NE	NA	NE
2009	0.152	0.007	0.012	0.011	0.008	0.038	NE	NA	NE
2010	0.147	0.008	0.013	0.012	0.008	0.041	NE	NA	NE

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					kg		
2011	0.143	0.008	0.014	0.013	0.009	0.044	NE	NA	NE
trend 1990-2011, %	**-29.2**	**49.4**	**-7.6**	**1.0**	**-5.9**	**2.7**	**NE**	**NA**	**NE**

3.3.3.2. Methodological issues

1) Fuel combustion

Emission calculations from road transport are based on the Tier 3 method, whereby exhaust emissions are calculated using a combination of reliable technical and detailed activity data. Tier 3 is implemented in COPERT 4 programme (Computer Programme to calculate Emissions from Road Transport, Copert 4 version 9.1), which is used for the calculations and is distributed by the European Environment Agency. Total emissions are calculated through a combination of default COPERT emission factors and activity data (e.g. number of vehicles, annual mileage per vehicle, average trip, speed, fuel consumption, monthly temperatures, driving and evaporation share). The vehicle classes are defined by the vehicle category, fuel type, weight class, environmental class and in some instances the engine type and/or the emission reduction technology.

Calculations demand annual mileage per vehicle category (Table 3.26) and the number of vehicles (Table 3.27), which is supplied by the Estonian Road Administration. These improved statistics are available from 2001 and data for the years 1990-2000 is extrapolated. Meteorological data is obtained from the Meteorological and Hydrological Institute and fuel consumption data from Statistics Estonia.

Therefore, the calculation of emissions from road vehicles is a very complicated and demanding procedure that requires good quality activity data and detailed emission factors.

Emissions from different types of vehicles are heavily dependent on the engine operation conditions. Driving situations impose different engine operating conditions, and therefore a distinct emission performance. Different activity data and emission factors are attributed to each driving situation. Total emissions are calculated by combining activity data for each vehicle category with appropriate emission factors. The emission factors vary according to the input data (driving situations, climatic conditions, etc.). In this calculation method, total exhaust emissions from road transport are calculated as the sum of hot and cold emissions:

$$E_{TOTAL} = E_{HOT} + E_{COLD}$$

where,

E_{TOTAL} – total emissions of any pollutant for spatial and temporal resolution of the application,

E_{HOT} – emissions during stabilized (hot) engine operation, when the engine is at its normal operating temperature,

E_{COLD} – emissions during transient engine operation (cold start).

Exhaust emissions of CO, NMVOC, NO_x, NH_3 and PM in these source categories depend on fuel type, emission reduction technology, vehicle type and vehicle use. These emissions are calculated on the basis of vehicle kilometres and specific emission factors for a variation of different vehicle classes and for three different road types (urban, rural, highway).

Emissions of SO_2 and heavy metals are dependent on fuel consumption and fuel type. SO_2 and heavy metals emissions are calculated by multiplying statistical fuel use (Table 3.28) by emission factors (Tables 3.23-3.25). The emission factors are based on the sulphur and heavy metal content of the fuels.

- **SO_2** emissions are estimated on the assumption that all sulphur in the fuel is completely transformed into SO_2. Equation:

$$E_{SO2} = 2 \times k \times FC$$

where:

E_{SO2} – emissions of SO_2,

k – weight related sulphur content in fuel (kg/kg fuel),

FC – fuel consumption.

Table 3.23. Sulphur content of fuel (by weight %)

Fuel	1990	2001	2003	2004	2005	2006	2007	2009	2010	2011
Gasoline	0.1	0.05	0.015	0.013	0.005	0.001	0.0008	0.0008	0.00051	0.00055
Diesel	0.5	0.05	0.035	0.030	0.005	0.004	0.0040	0.0010	0.00048	0.00062

- **Pb** emissions are estimated according to the calculation that 75% of lead contained in gasoline is emitted into the air. Equation:

$$E_{Pb} = 0.75 \times k \times FC$$

where:

E_{Pb} – emissions of Pb

k – weight related lead content of gasoline (kg/kg)

FC – fuel consumption

Table 3.24. Lead content in gasoline (g/l)

Fuel	1990	2003	2006	2010
Leaded gasoline	0.150	-	-	-
Unleaded gasoline	0.013	0.005	0.003	0.0001

- Emissions of **other heavy metals** are estimated on the assumption that the total quantity is emitted to the atmosphere. Equation:

$$E_{Heavy\ metal} = k \times FC$$

where:

k – weight related content of heavy metal in fuel (kg/kg)

FC – fuel consumption

Table 3.25. Heavy metals content in fuel (mg/kg)

Fuel	Cd	Cu	Cr	Ni	Se	Zn
Gasoline/Bioethanol	0.0108	0.0418	0.0159	0.0130	0.0002	2.1640
Diesel/Biodiesel	0.0087	0.2120	0.0300	0.0088	0.0001	1.7380

Table 3.26. Average annual mileage in the road transport sector (million km per year)

	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	5,601.3	687.2	1,584.3	317.1	8,189.9
1991	5,612.3	668.1	1,195.8	230.5	7,706.7
1992	2,278.0	346.9	783.4	230.0	3,638.3
1993	2,619.9	377.9	831.4	223.3	4,052.6
1994	4,224.7	421.8	843.9	5.1	5,495.4
1995	3,880.1	446.8	842.7	7.7	5,177.3
1996	4,172.4	494.9	850.3	10.0	5,527.6
1997	4,396.3	555.4	923.7	12.8	5,888.3
1998	3,165.2	455.9	1,064.4	10.5	4,696.0
1999	4,012.0	512.2	902.4	14.5	5,441.1
2000	4,125.7	505.5	899.8	15.9	5,546.9
2001	5,271.2	729.3	1,011.3	16.2	7,028.1
2002	5,176.5	872.8	1,053.7	17.3	7,120.3
2003	5,219.5	825.3	941.5	19.3	7,005.6
2004	5,419.8	958.5	942.5	32.8	7,353.7
2005	5,801.9	958.9	898.5	10.7	7,669.9
2006	6,451.1	950.0	941.9	19.2	8,362.3
2007	6,989.5	978.3	962.4	28.1	8,958.3
2008	6,829.0	965.6	996.9	29.8	8,821.3
2009	6,546.7	727.4	818.6	26.6	8,119.3
2010	6,455.7	763.6	982.1	27.0	8,228.4
2011	6,632.5	817.4	1,043.5	25.1	8,518.5

Table 3.27. Number of vehicles in the road transport sector (thousand)

	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	240.9	31.1	44.5	105.7	422.2
1991	261.1	35.4	50.3	100.2	447.0
1992	283.5	34.2	48.8	100.0	466.5
1993	317.4	34.0	48.8	97.1	497.3
1994	337.8	24.7	35.4	2.2	400.1

	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1995	383.4	30.1	42.5	3.3	459.3
1996	378.3	28.4	37.9	4.2	448.8
1997	381.5	27.9	36.8	5.4	451.6
1998	264.8	19.6	36.3	4.4	325.1
1999	295.7	21.2	31.1	6.1	354.2
2000	273.1	19.5	29.1	6.7	328.5
2001	273.9	26.4	30.9	6.8	338.0
2002	285.8	29.6	29.9	7.3	352.5
2003	314.4	32.5	30.0	8.1	385.0
2004	335.1	36.8	30.5	9.1	411.5
2005	354.7	33.5	26.0	3.5	417.7
2006	402.1	36.3	29.1	4.2	471.7
2007	429.2	37.5	29.5	5.8	502.0
2008	436.3	38.5	27.1	6.0	507.9
2009	424.0	36.9	27.0	6.7	494.7
2010	422.1	36.3	26.9	7.4	492.7
2011	440.2	37.9	27.2	8.1	513.4

Table 3.28. Fuel consumption in the road transport sector (Gg)

	Gasoline	Diesel	Bioethanol	Biodiesel
1990	490.16	223.95	-	-
1991	440.05	205.00	-	-
1992	206.98	116.86	-	-
1993	220.89	141.70	-	-
1994	282.63	178.45	-	-
1995	242.96	211.25	-	-
1996	268.09	202.46	-	-
1997	298.91	210.25	-	-
1998	218.62	232.76	-	-
1999	274.61	203.74	-	-
2000	275.70	200.65	-	-
2001	328.79	251.76	-	-
2002	302.07	299.94	-	-
2003	288.95	294.89	-	-
2004	278.49	324.87	-	-
2005	284.61	347.76	0.00	0.17
2006	303.29	377.37	0.00	1.23
2007	317.94	404.75	0.02	0.57
2008	313.76	388.30	2.15	3.15
2009	287.71	346.51	0.15	1.82
2010	264.64	384.94	6.86	3.57
2011	251.77	423.28	5.93	0.72

2) Automobile tyre wear, brake wear and road abrasion

Tyre wear, brake wear and road surface wear are abrasion processes. Emission calculations cover those particles emitted as a direct result of the wear of tyres, brakes or surfaces.

Airborne particles are produced as a result of the interaction between a vehicle's tyres and the road surface, and also when the brakes are applied to decelerate the vehicle. A secondary mechanism involves the evaporation of material from surfaces at the high temperatures developed during contact. Emissions from these sectors are considered in relation to the general vehicle classes (1.A.3.b.i-iv).

Automobile tyre and brake wear calculations are based on the Tier 2 method and using the COPERT model (EMEP/CORINAIR Emission Inventory Guidebook 2009).

The road abrasion sector is not included in the COPERT model and therefore these emissions are calculated separately using Tier 1 default emission factors from the EMEP/EEA Guidebook.

3) Gasoline evaporation

This sector includes NMVOC evaporative fuel-related emissions from gasoline vehicles, which are not derived from fuel combustion. Most evaporative emissions of VOCs emanate from the fuel systems (tanks, injection systems and fuel lines) of petrol vehicles. Evaporative emissions from diesel vehicles are considered negligible.

Gasoline evaporation calculations are based on the Tier 3 method and using the COPERT model (EMEP/CORINAIR Emission Inventory Guidebook 2009).

3.3.3.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.3.4. Source-specific planned improvements

Include more detailed vehicle subsectors in the calculations: mopeds, hybrid and LPG/CNG vehicles.

3.3.4. Railways (1.A.3.c)

3.3.4.1. Source category description

Railway transport in Estonia is a small emission source in the transport sector. This sector concerns the movement of goods or people and is mostly performed by diesel locomotives.

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 11.8%, 4.6% and 1.6%, respectively, in the transport sector in 2011.

The emissions of NO_x, NMVOC and CO have decreased compared to 1990 by 26.7%, 29.6% and 39.7%, respectively. The trend of all the emissions is given in Tables 3.29-3.31.

Emissions from rail primarily originate from the combustion of diesel and light fuel oil by locomotives. Since emissions from the railway sector are calculated according to the Tier 1 method, which takes into account the amount of fuel consumed and default emission factors, the deviations of time series can be explained by statistical fuel consumption deviations in the railway sector. As shown in Figure 3.28, freight turnover shows similar changes; therefore, all the emissions are directly influenced by freight rail activity.

Fuel consumption decreased by 32% in 2011 compared to 2010; as a result, all emissions have decreased by the same percentage.

Recalculations

A minor correction has been made in the SO_2 emissions for 2010. The recalculation concerns using corrected sulphur content in fuels. An overview of the updated data is given in Chapter 10.

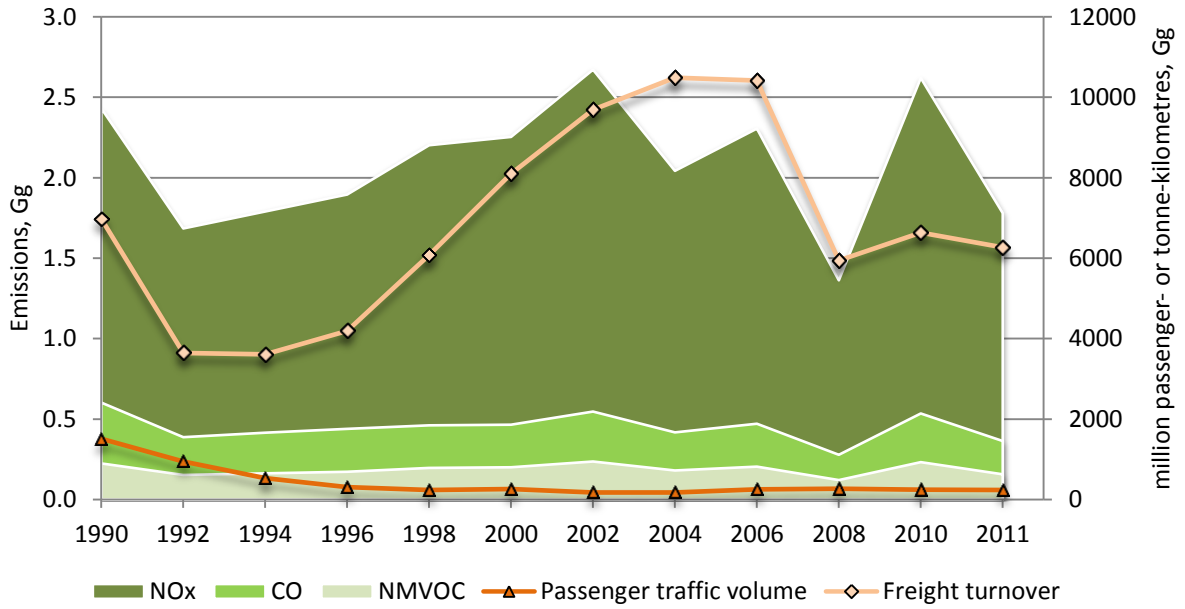

Figure 3.28. NO_x, NMVOC and CO emissions from the railway sector in the period 1990-2011

Table 3.29. Emissions from railway transport in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	2.431	0.224	0.567	0.000	NR	NR	0.085	0.603
1991	2.278	0.213	0.559	0.000	NR	NR	0.083	0.593
1992	1.685	0.153	0.364	0.000	NR	NR	0.055	0.388
1993	1.791	0.163	0.388	0.000	NR	NR	0.058	0.413
1994	1.791	0.163	0.390	0.000	NR	NR	0.059	0.415
1995	1.736	0.157	0.365	0.000	NR	NR	0.055	0.389
1996	1.897	0.173	0.413	0.000	NR	NR	0.062	0.440
1997	1.736	0.157	0.363	0.000	NR	NR	0.055	0.388

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1998	2.203	0.197	0.433	0.000	NR	NR	0.066	0.462
1999	2.411	0.214	0.463	0.000	NR	NR	0.070	0.495
2000	2.254	0.200	0.177	0.000	0.060	0.063	0.066	0.466
2001	2.097	0.187	0.167	0.000	0.056	0.059	0.062	0.435
2002	2.673	0.237	0.199	0.000	0.070	0.074	0.078	0.547
2003	2.358	0.209	0.170	0.000	0.062	0.065	0.068	0.482
2004	2.044	0.181	0.153	0.000	0.053	0.056	0.059	0.417
2005	2.201	0.195	0.168	0.000	0.058	0.060	0.064	0.449
2006	2.306	0.205	0.168	0.000	0.060	0.063	0.067	0.471
2007	1.939	0.172	0.121	0.000	0.051	0.053	0.056	0.396
2008	1.362	0.121	0.050	0.000	0.036	0.037	0.040	0.278
2009	1.834	0.163	0.050	0.000	0.048	0.050	0.053	0.375
2010	2.620	0.233	0.070	0.000	0.069	0.072	0.076	0.535
2011	1.782	0.158	0.068	0.000	0.047	0.049	0.052	0.364
trend 1990-2011, %	**-26.7**	**-29.6**	**-88.0**	**-26.1**	**-21.8**	**-21.8**	**-38.97**	**-39.7**

Table 3.30. Emissions of heavy metals from railway transport in the period 1990-2011

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg	kg			Mg			kg	Mg
1990	0.016	0.674	0.940	0.476	0.004	0.080	0.005	0.674	0.070
1991	0.019	0.687	1.130	0.572	0.004	0.076	0.005	0.687	0.072
1992	0.007	0.408	0.387	0.196	0.002	0.055	0.003	0.408	0.042
1993	0.007	0.435	0.419	0.212	0.002	0.059	0.003	0.435	0.045
1994	0.007	0.439	0.435	0.220	0.002	0.059	0.003	0.439	0.045
1995	0.005	0.400	0.308	0.156	0.002	0.057	0.003	0.400	0.041
1996	0.008	0.466	0.466	0.236	0.003	0.062	0.003	0.466	0.048
1997	0.005	0.397	0.292	0.148	0.002	0.057	0.003	0.397	0.040
1998	0.002	0.445	0.111	0.056	0.002	0.072	0.003	0.445	0.045
1999	0.000	0.465	0.024	0.012	0.002	0.078	0.003	0.465	0.047
2000	0.001	0.441	0.047	0.024	0.002	0.073	0.003	0.441	0.044
2001	0.001	0.414	0.063	0.032	0.002	0.068	0.003	0.414	0.042
2002	0.000	0.512	0.008	0.004	0.003	0.087	0.004	0.512	0.051
2003	0.000	0.450	0.000	0.000	0.002	0.077	0.003	0.450	0.045
2004	0.000	0.390	0.000	0.000	0.002	0.066	0.003	0.390	0.039
2005	0.000	0.420	0.000	0.000	0.002	0.071	0.003	0.420	0.042
2006	0.000	0.440	0.000	0.000	0.002	0.075	0.003	0.440	0.044
2007	0.000	0.370	0.000	0.000	0.002	0.063	0.003	0.370	0.037
2008	0.000	0.260	0.000	0.000	0.001	0.044	0.002	0.260	0.026
2009	0.000	0.350	0.000	0.000	0.002	0.060	0.002	0.350	0.035
2010	0.000	0.500	0.000	0.000	0.003	0.085	0.004	0.500	0.050
2011	0.000	0.340	0.000	0.000	0.002	0.058	0.002	0.340	0.034
trend 1990-2011, %	**-100.0**	**-49.6**	**-100.0**	**-100.0**	**-56.5**	**-28.0**	**-50.1**	**-49.6**	**-51.3**

Table 3.31. Emissions of POPs from railway transport in the period 1990-2011

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					g	kg	
1990	0.024	0.007	0.009	0.004	0.003	0.023	0.074	NA	0.020
1991	0.029	0.008	0.011	0.005	0.003	0.026	0.089	NA	0.024
1992	0.010	0.003	0.004	0.002	0.001	0.011	0.030	NA	0.008
1993	0.011	0.003	0.005	0.002	0.001	0.012	0.033	NA	0.009
1994	0.011	0.004	0.005	0.002	0.001	0.012	0.034	NA	0.009
1995	0.008	0.003	0.004	0.002	0.001	0.010	0.024	NA	0.007
1996	0.012	0.004	0.005	0.003	0.001	0.013	0.037	NA	0.010
1997	0.008	0.003	0.004	0.002	0.001	0.009	0.023	NA	0.006
1998	0.003	0.002	0.003	0.002	0.001	0.007	0.009	NA	0.002
1999	0.001	0.002	0.002	0.002	0.000	0.006	0.002	NA	0.001
2000	0.001	0.002	0.003	0.002	0.000	0.006	0.004	NA	0.001
2001	0.002	0.002	0.002	0.002	0.000	0.006	0.005	NA	0.001
2002	0.000	0.002	0.003	0.002	0.000	0.006	0.001	NA	0.000
2003	0.000	0.001	0.002	0.002	0.000	0.006	0.000	NA	0.000
2004	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	0.000
2005	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	0.000
2006	0.000	0.001	0.002	0.002	0.000	0.005	0.000	NA	0.000
2007	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	0.000
2008	0.000	0.001	0.001	0.001	0.000	0.003	0.000	NA	0.000
2009	0.000	0.001	0.002	0.001	0.000	0.004	0.000	NA	0.000
2010	0.000	0.002	0.003	0.002	0.000	0.006	0.000	NA	0.000
2011	0.000	0.001	0.002	0.001	0.000	0.004	0.000	NA	0.000
trend 1990-2011, %	**-100.0**	**-77.9**	**-73.1**	**-60.9**	**-84.6**	**-73.5**	**-100.0**	**NA**	**-100.0**

3.3.4.2. Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions from the railway transport sector are calculated by multiplying the statistical fuel consumption (Table 3.36) by respective emission factors. Default emission factors for the main pollutants and heavy metals are taken from the EMEP/EEA guidebook and are presented in Tables 3.32-3.34.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.36) by emission factors (Table 3.35). SO_2 emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO_2. Equation:

$$E_{SO2} = 2 \times k \times FC$$

where:

E_{SO2} – emissions of SO_2

k – weight related sulphur content in fuel (kg/kg fuel)

FC – fuel consumption

Table 3.32. Emission factors for railway transport

Fuel	Unit	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
Light fuel oil/ Diesel	kg/t	52.4	4.65	equation	0.007	1.37	1.44	1.52	10.7
Coal	g/GJ	173	88.8	900	-	108	117	124	931

Table 3.33. Emission factors for heavy metals

Fuel	Unit	Pb	Cd	Hg	As	Cu	Cr	Ni	Se	Zn
Light fuel oil/ Diesel	g/t	-	0.01	-	-	1.7	0.05	0.07	0.01	1
Coal	mg/GJ	134	1.8	7.9	4	13.5	17.5	13	1.8	200

Table 3.34. Emission factors for POPs

Fuel	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	PCBs
	µg I-TEQ/t	g/t				mg/t	
Light fuel oil/ Diesel	-	0.03	0.05	0.0344	0.0079	-	-
	ng I-TEQ/GJ	mg/GJ					
Coal	203	45.5	58.9	23.7	18.5	0.00062	0.17

Table 3.35. Sulphur content of fuel (by weight %)

Fuel	1990	2000	2001	2003	2004	2005	2006	2008	2009	2011
Light fuel oil	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Diesel	0.5	0.5	0.05	0.035	0.03	0.005	0.004	0.004	0.001	0.1

Table 3.36. Fuel consumption in the railway sector

	Coal	Diesel	Light fuel oil
	TJ	Gg	
1990	119	0	46
1991	143	0	43
1992	49	0	32
1993	53	0	34
1994	55	0	34
1995	39	0	33
1996	59	0	36
1997	37	0	33
1998	14	0	42
1999	3	0	46
2000	6	0	43
2001	8	0	40
2002	1	2	49

	Coal	Diesel	Light fuel oil
	TJ	Gg	
2003	0	3	42
2004	0	1	38
2005	0	0	42
2006	0	2	42
2007	0	7	30
2008	0	1	25
2009	0	10	25
2010	0	15	35
2011	0	34	0

3.3.4.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.4.4. Source-specific planned improvements

Railway sector emission recalculations are based on Tier 2 methodology. The improvements to be carried out in the inventory methodology will depend on how possible it is to attain detailed information from railway operators.

3.3.5. National navigation (1.A.3.d.ii)

3.3.5.1. Source category description

Domestic navigation includes the most important domestic water transport in Estonia: merchant ships, passenger and technical ships, and other inland vessels.

National navigation in Estonia is also a small emission source in the transport sector. The share of navigation transport in total transport emissions in 2011 was: NO_x – 1.3%, NMVOC – 1.1%, CO – 0.4%. Detailed emission data are provided in Tables 3.37-3.39.

Deviations of time series can be explained by changing statistical fuel consumption in the national navigation sector (Figure 3.29). Fuel consumption decreased 38% in 2011 compared to 2010; therefore, all the emissions decreased to the same extent.

Recalculations

A minor correction has been made in emissions. The recalculations mainly concern using updated emission factors for the navigation sector and an overview of the updated data is given in Chapter 10.

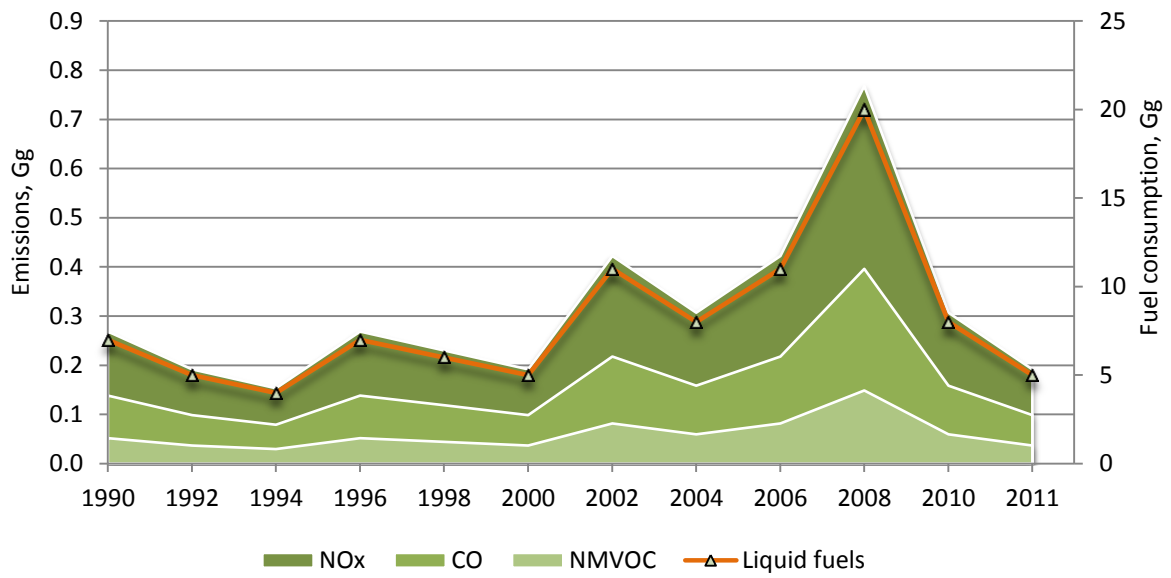

Figure 3.29. NO_x, NMVOC and CO emissions from the national navigation sector in the period 1990-2011

Table 3.37. Emissions from national navigation (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.269	0.052	0.070	0.000	NR	NR	0.032	0.139
1991	0.269	0.052	0.070	0.000	NR	NR	0.032	0.139
1992	0.192	0.037	0.050	0.000	NR	NR	0.023	0.099
1993	1.421	0.276	0.370	0.000	NR	NR	0.170	0.733
1994	0.154	0.030	0.040	0.000	NR	NR	0.018	0.079
1995	0.154	0.030	0.040	0.000	NR	NR	0.018	0.079
1996	0.269	0.052	0.070	0.000	NR	NR	0.032	0.139
1997	0.230	0.045	0.060	0.000	NR	NR	0.028	0.119
1998	0.230	0.045	0.060	0.000	NR	NR	0.028	0.119
1999	0.192	0.037	0.050	0.000	NR	NR	0.023	0.099
2000	0.192	0.037	0.020	0.000	0.023	0.023	0.023	0.099
2001	0.269	0.052	0.028	0.000	0.032	0.032	0.032	0.139
2002	0.422	0.082	0.044	0.000	0.051	0.051	0.051	0.218
2003	0.346	0.067	0.036	0.000	0.041	0.041	0.041	0.178
2004	0.307	0.060	0.032	0.000	0.037	0.037	0.037	0.158
2005	0.307	0.060	0.032	0.000	0.037	0.037	0.037	0.158
2006	0.422	0.082	0.044	0.000	0.051	0.051	0.051	0.218
2007	0.653	0.127	0.068	0.000	0.078	0.078	0.078	0.337
2008	0.768	0.149	0.080	0.000	0.092	0.092	0.092	0.396
2009	0.307	0.060	0.032	0.000	0.037	0.037	0.037	0.158
2010	0.307	0.060	0.016	0.000	0.037	0.037	0.037	0.158
2011	0.192	0.037	0.010	0.000	0.023	0.023	0.023	0.099
trend 1990-2011, %	**-28.6**	**-28.6**	**-85.7**	**-28.6**	**0.0**	**0.0**	**-28.6**	**-28.6**

Table 3.38. Emissions of heavy metals from national navigation

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	kg					Mg	kg		Mg
1990	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1991	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1992	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
1993	NA	0.370	NA	NA	1.850	0.063	2.590	0.370	0.037
1994	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
1995	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
1996	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1997	NA	0.060	NA	NA	0.300	0.010	0.420	0.060	0.006
1998	NA	0.060	NA	NA	0.300	0.010	0.420	0.060	0.006
1999	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
2000	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
2001	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
2002	NA	0.110	NA	NA	0.550	0.019	0.770	0.110	0.011
2003	NA	0.090	NA	NA	0.450	0.015	0.630	0.090	0.009
2004	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2005	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2006	NA	0.110	NA	NA	0.550	0.019	0.770	0.110	0.011
2007	NA	0.170	NA	NA	0.850	0.029	1.190	0.170	0.017
2008	NA	0.200	NA	NA	1.000	0.034	1.400	0.200	0.020
2009	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2010	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2011	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
trend 1990-2011, %	**NA**	**-28.6**	**NA**	**NA**	**-28.6**	**-28.6**	**-28.6**	**-28.6**	**-28.6**

Table 3.39. Emissions of POPs from national navigation

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					kg		
1990	NA	0.210	0.350	NA	NA	0.560	NA	NA	NA
1991	NA	0.210	0.350	NA	NA	0.560	NA	NA	NA
1992	NA	0.150	0.250	NA	NA	0.400	NA	NA	NA
1993	NA	1.110	1.850	NA	NA	2.960	NA	NA	NA
1994	NA	0.120	0.200	NA	NA	0.320	NA	NA	NA
1995	NA	0.120	0.200	NA	NA	0.320	NA	NA	NA
1996	NA	0.210	0.350	NA	NA	0.560	NA	NA	NA
1997	NA	0.180	0.300	NA	NA	0.480	NA	NA	NA
1998	NA	0.180	0.300	NA	NA	0.480	NA	NA	NA
1999	NA	0.150	0.250	NA	NA	0.400	NA	NA	NA
2000	NA	0.150	0.250	NA	NA	0.400	NA	NA	NA
2001	NA	0.210	0.350	NA	NA	0.560	NA	NA	NA
2002	NA	0.330	0.550	NA	NA	0.880	NA	NA	NA
2003	NA	0.270	0.450	NA	NA	0.720	NA	NA	NA
2004	NA	0.240	0.400	NA	NA	0.640	NA	NA	NA
2005	NA	0.240	0.400	NA	NA	0.640	NA	NA	NA
2006	NA	0.330	0.550	NA	NA	0.880	NA	NA	NA
2007	NA	0.510	0.850	NA	NA	1.360	NA	NA	NA
2008	NA	0.600	1.000	NA	NA	1.600	NA	NA	NA
2009	NA	0.240	0.400	NA	NA	0.640	NA	NA	NA
2010	NA	0.240	0.400	NA	NA	0.640	NA	NA	NA

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					kg		
2011	NA	0.150	0.250	NA	NA	0.400	NA	NA	NA
trend 1990-2011, %	**NA**	**-28.6**	**-28.6**	**NA**	**NA**	**-28.6**	**NA**	**NA**	**NA**

3.3.5.2. Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions in the national navigation sector are calculated by multiplying the statistical fuel consumption (Table 3.43) by respective emission factors. Default emission factors for the main pollutants are taken from the EMEP/EEA guidebook and are presented in Tables 3.40-3.41.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.43) by emission factors (Table 3.42). SO_2 emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO_2. Equation:

$$E_{SO2} = 2 \times k \times FC$$

where:

E_{SO2} – emissions of SO_2

k – weight related sulphur content in fuel (kg/kg fuel)

FC – fuel consumption

Table 3.40. Emission factors for national navigation transport (kg/t)

	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
Marine diesel oil/ marine gas oil	37.088	7.177	0.007	4.423	4.423	4.423	19.248

Table 3.41. Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t				mg/t			
Marine diesel oil/ marine gas oil	0.01	0.05	1.7	0.07	0.01	1	0.03	0.05

Table 3.42. Sulphur content of fuel (by weight %)

	1990	2000	2006	2010
Marine diesel oil/ marine gas oil	0.5	0.2		0.1
Bunker Fuel Oil	2.7		1.5	

Table 3.43. Fuel consumption in the navigation sector (Gg)

	Light fuel oil	Diesel
1990	0	7
1991	0	7
1992	0	5
1993	32	5
1994	0	4
1995	0	4
1996	0	7
1997	0	6
1998	0	6
1999	0	5
2000	2	5
2001	2	5
2002	4	7
2003	2	7
2004	2	6
2005	0	8
2006	5	6
2007	12	5
2008	13	7
2009	2	6
2010	2	6
2011	0	5

3.3.5.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.5.4. Source-specific planned improvements

National navigation sector recalculations are based on detailed activity data. The improvements to be carried out in the inventory methodology will depend on how possible it is to attain detailed information from ports and the Estonian Maritime Administration.

3.3.6. Other non-road mobile machinery

This chapter covers several mobile sources: industrial machinery (1.A.2.f.ii), commercial (1.A.4.a.ii), household and gardening (1.A.4.b.ii), agricultural machinery (1.A.4.c.ii) and national fishing (1.A.4.c.iii) sector.

All these mobile sources are combined in one chapter because each of these sectors has minor importance in total transport emissions, and all the emission calculations are made using the Tier 1 methodology.

3.3.6.1. Source category description

Other non-road machinery includes following sectors and activities:

- The industrial machinery sector (1.A.2.f.ii) includes mobile combustion in manufacturing industries and construction land-based mobile machinery: tractors, cranes and any other mobile machine that run on petroleum fuels.
- Commercial sector (1.A.4.a.ii) includes different small gasoline and diesel working machinery in the residential sector.
- The household and gardening sector (1.A.4.b.ii) include various machinery: trimmers, lawn mowers, chainsaws, snowmobiles, other vehicles and equipment.
- The agricultural sector (1.A.4.a.ii) includes off-road vehicles and other machinery used in agriculture/forestry (agricultural tractors, harvesters, combines, etc.).
- National fishing sector (1.A.4.c.iii) covers activities from inland, coastal and deep-sea fishing.

The total contributions to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 21.4%, 23.9% and 16.3%, respectively, in the transport sector in 2011.

All the emissions have decreased in the period 1990 to 2011, and in 2011 compared to 2010. Deviations of time series can be explained by changing statistical fuel consumption in the non-road machinery sector (Figures 3.30-3.32) and the share of some specific sector in total non-road machinery emissions.

The most important deployment of mobile machinery is the use in the agricultural and industrial sector, which are responsible for approximately 86% of total energy use, where diesel is the dominant fuel type, with 81% of energy use in 2011.

Recalculations

A minor correction has been made in all other non-road machinery sectors. The recalculations mainly concern using updated emission factors and corrections made in sulphur content in fuels. An overview of the updated data is given in Chapter 10.

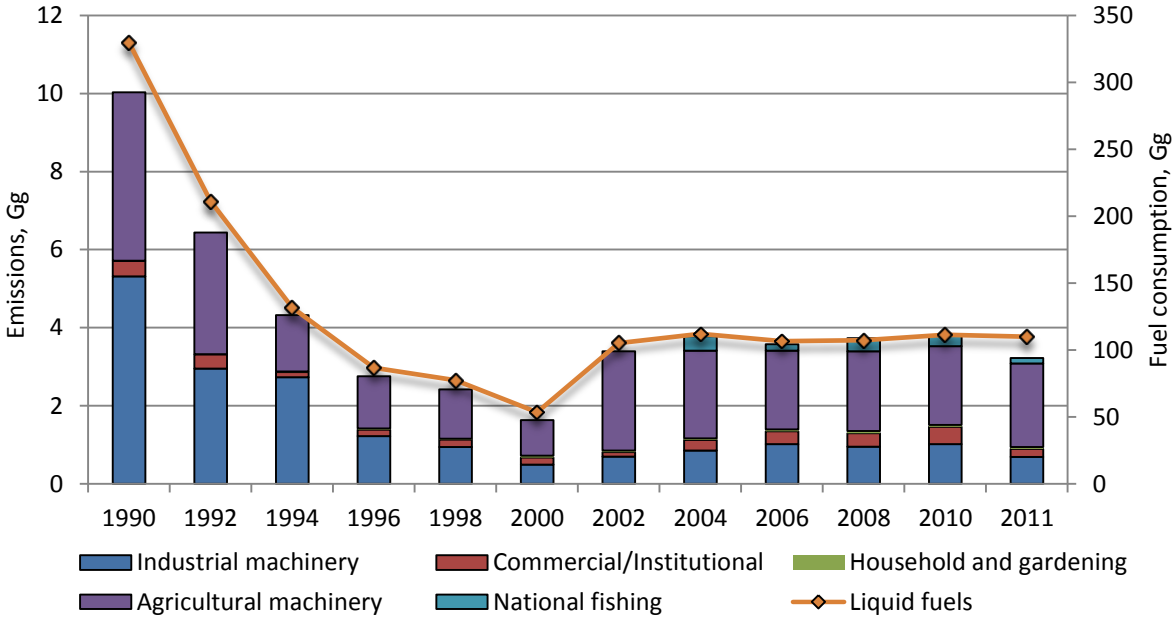

Figure 3.30. NO_x emissions from other non-road machinery in the period 1990-2011

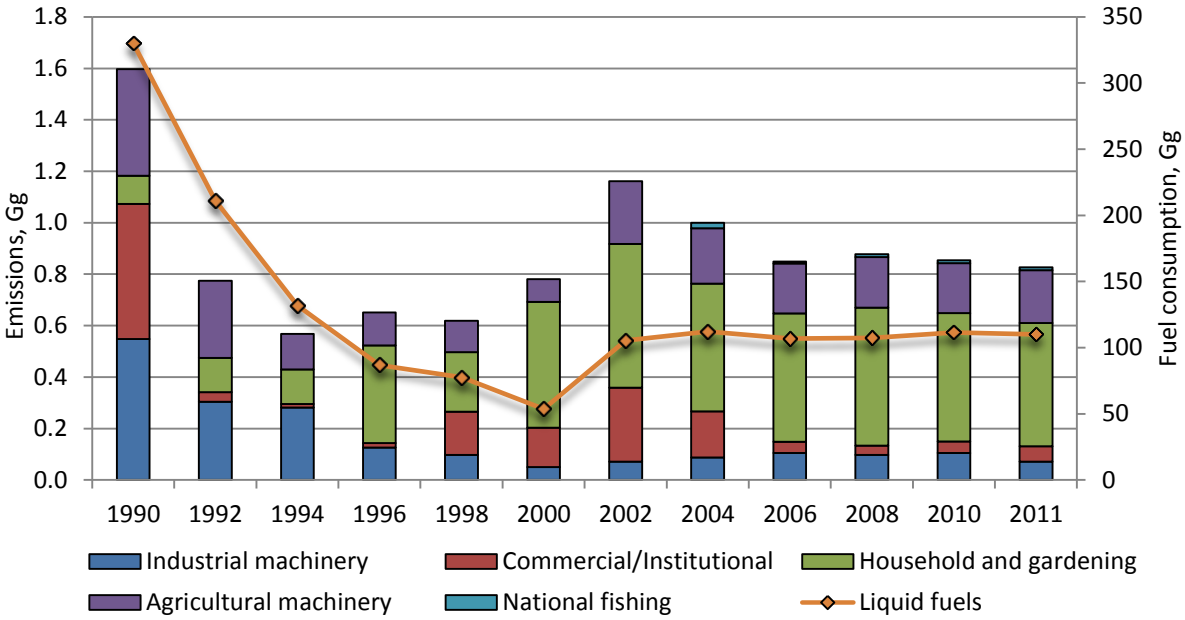

Figure 3.31. NMVOC emissions from other non-road machinery in the period 1990-2011

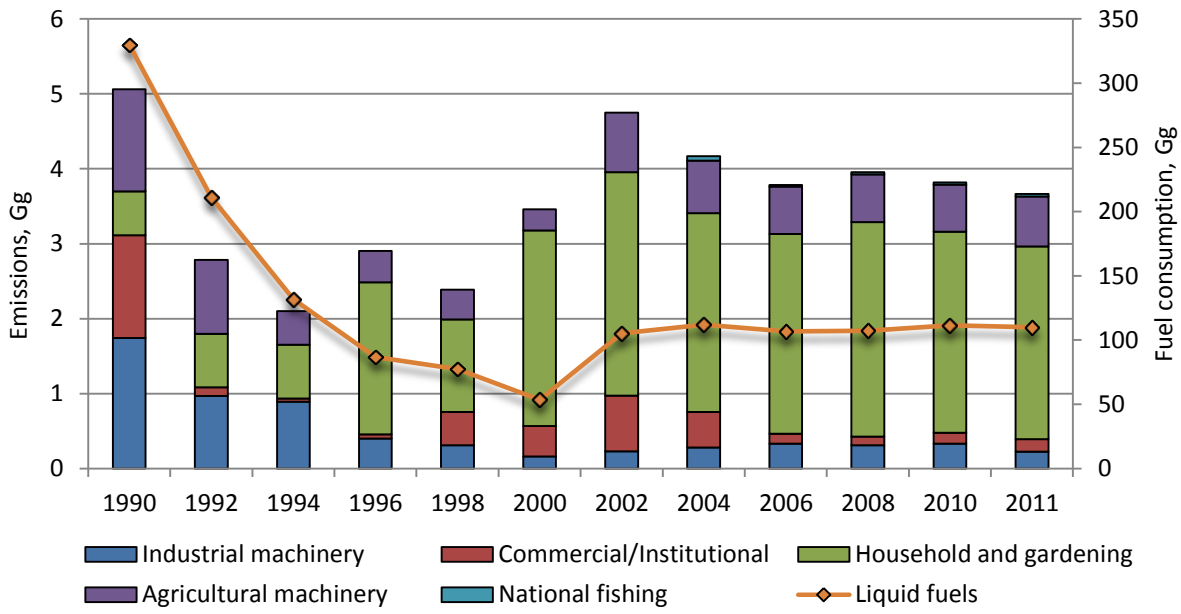

Figure 3.32. CO emissions from other non-road machinery in the period 1990-2011

Table 3.44. Emissions from other non-road machinery in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	10.028	1.597	3.036	0.002	NR	NR	0.586	5.061
1991	10.151	1.625	3.056	0.002	NR	NR	0.596	5.171
1992	6.441	0.775	1.943	0.002	NR	NR	0.368	2.783
1993	5.577	0.942	1.668	0.001	NR	NR	0.321	3.180
1994	4.319	0.568	1.293	0.001	NR	NR	0.256	2.100
1995	2.155	0.720	0.640	0.001	NR	NR	0.127	2.724
1996	2.753	0.651	0.821	0.001	NR	NR	0.161	2.902
1997	2.540	0.653	0.758	0.001	NR	NR	0.149	2.959
1998	2.421	0.619	0.723	0.001	NR	NR	0.141	2.385
1999	1.370	0.634	0.412	0.000	NR	NR	0.085	2.758
2000	1.630	0.780	0.390	0.000	0.099	0.099	0.099	3.461
2001	1.673	0.909	0.129	0.000	0.105	0.105	0.105	4.110
2002	3.399	1.162	0.261	0.001	0.192	0.192	0.192	4.750
2003	4.147	1.136	0.207	0.001	0.217	0.217	0.217	4.692
2004	3.780	1.000	0.157	0.001	0.201	0.201	0.201	4.170
2005	3.575	0.821	0.111	0.001	0.190	0.190	0.190	3.619
2006	3.577	0.849	0.079	0.001	0.198	0.198	0.198	3.783
2007	3.677	0.875	0.074	0.001	0.204	0.204	0.204	3.929
2008	3.734	0.878	0.086	0.001	0.200	0.200	0.200	3.957
2009	3.444	1.019	0.038	0.001	0.182	0.183	0.183	4.268
2010	3.795	0.854	0.028	0.001	0.207	0.207	0.207	3.817
2011	3.222	0.826	0.008	0.001	0.176	0.176	0.176	3.665
trend 1990-2011, %	**-67.9**	**-48.3**	**-99.7**	**-69.8**	**77.2**	**77.3**	**-70.0**	**-27.6**

Table 3.45. Emissions of heavy metals from other non-road machinery in the period 1990-2011

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg		kg		Mg				
1990	4.926	0.003	0.000	0.000	0.015	0.510	0.021	0.003	0.300
1991	3.443	0.003	0.000	0.000	0.015	0.517	0.021	0.003	0.304
1992	3.153	0.002	0.000	0.000	0.010	0.325	0.013	0.002	0.191
1993	1.817	0.002	0.000	0.000	0.008	0.283	0.012	0.002	0.167
1994	0.453	0.001	0.000	0.000	0.006	0.221	0.009	0.001	0.130
1995	0.756	0.001	0.000	0.000	0.003	0.112	0.005	0.001	0.066
1996	0.887	0.001	0.000	0.000	0.004	0.142	0.006	0.001	0.084
1997	0.914	0.001	0.000	0.000	0.004	0.132	0.005	0.001	0.078
1998	0.958	0.001	0.000	0.000	0.004	0.125	0.005	0.001	0.073
1999	0.809	0.000	0.000	0.000	0.002	0.074	0.003	0.000	0.044
2000	0.082	0.001	0.000	0.000	0.003	0.088	0.004	0.001	0.052
2001	0.081	0.001	0.000	0.000	0.003	0.092	0.004	0.001	0.054
2002	0.096	0.001	0.000	0.000	0.005	0.176	0.007	0.001	0.103
2003	0.143	0.001	0.200	0.267	0.006	0.193	0.014	0.002	0.118
2004	0.043	0.001	0.141	0.188	0.005	0.180	0.012	0.002	0.109
2005	0.024	0.001	0.126	0.168	0.005	0.170	0.011	0.001	0.103
2006	0.026	0.001	0.064	0.085	0.005	0.178	0.009	0.001	0.106
2007	0.028	0.001	0.063	0.084	0.005	0.183	0.010	0.001	0.109
2008	0.022	0.001	0.131	0.174	0.005	0.179	0.012	0.001	0.108
2009	0.030	0.001	0.170	0.227	0.005	0.160	0.012	0.001	0.098
2010	0.026	0.001	0.103	0.137	0.005	0.183	0.011	0.001	0.110
2011	0.021	0.001	0.054	0.071	0.005	0.158	0.008	0.001	0.094
trend 1990-2011, %	**-99.6**	**-68.7**	**NA**	**NA**	**-68.7**	**-69.0**	**-60.8**	**-63.4**	**-68.6**

Table 3.46. Emissions of POPs from other non-road machinery in the period 1990-2011

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	mg I-Teq	Mg					kg		
1990	0.000	0.009	0.015	NA	NA	0.024	0.000	NA	0.000
1991	0.000	0.009	0.015	NA	NA	0.024	0.000	NA	0.000
1992	0.000	0.006	0.010	NA	NA	0.015	0.000	NA	0.000
1993	0.000	0.005	0.008	NA	NA	0.013	0.000	NA	0.000
1994	0.000	0.004	0.006	NA	NA	0.010	0.000	NA	0.000
1995	0.000	0.002	0.003	NA	NA	0.005	0.000	NA	0.000
1996	0.000	0.003	0.004	NA	NA	0.007	0.000	NA	0.000
1997	0.000	0.002	0.004	NA	NA	0.006	0.000	NA	0.000
1998	0.000	0.002	0.004	NA	NA	0.006	0.000	NA	0.000
1999	0.000	0.001	0.002	NA	NA	0.003	0.000	NA	0.000
2000	0.000	0.002	0.003	NA	NA	0.004	0.000	NA	0.000
2001	0.000	0.002	0.003	NA	NA	0.004	0.000	NA	0.000
2002	0.000	0.003	0.005	NA	NA	0.008	0.000	NA	0.000
2003	0.869	0.003	0.005	NA	NA	0.009	0.535	NA	2.539
2004	0.613	0.003	0.005	NA	NA	0.008	0.377	NA	1.791
2005	0.546	0.003	0.005	NA	NA	0.008	0.336	NA	1.595
2006	0.277	0.003	0.005	NA	NA	0.008	0.170	NA	0.809
2007	0.273	0.003	0.005	NA	NA	0.009	0.168	NA	0.798
2008	0.566	0.003	0.005	NA	NA	0.008	0.348	NA	1.655
2009	0.736	0.003	0.005	NA	NA	0.007	0.453	NA	2.152

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	mg I-Teq	Mg					kg		
2010	0.445	0.003	0.005	NA	NA	0.008	0.274	NA	1.302
2011	0.232	0.003	0.005	NA	NA	0.007	0.143	NA	0.679
trend 1990-2011, %	**NA**	**-68.99**	**-69.5**	**NA**	**NA**	**-69.3**	**NA**	**NA**	**NA**

3.3.6.2. Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions from these transport sectors are calculated by multiplying the statistical fuel consumption (Table 3.52) by respective emission factors. Default emission factors for the main pollutants and heavy metals are taken from the EMEP/EEA guidebook and are presented in Tables 3.47-3.49.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.52) by emission factors (Table 3.50). SO_2 emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO_2. Equation (1) can be applied to the industrial, commercial, household/gardening and agricultural sectors, while equation (2) is solely for the national fishing sector:

$$E_{SO2} = 2 \times k \times FC \quad (1)$$

$$E_{SO2} = 20 \times S \times FC \quad (2)$$

where:

E_{SO2} – emissions of SO_2

k – weight related sulphur content in fuel (kg/kg fuel)

S – percentage sulphur content in fuel (%)

FC – fuel consumption

Pb emissions are estimated by assuming that 75% of the lead contained in gasoline is emitted into the air. Equation:

$$E_{Pb} = 0.75 \times k \times FC$$

Table 3.47. Emission factors for other mobile sources (kg/t)

NFR	Fuel	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1.A.2.f.ii 1.A.4.a.ii 1.A.4.b.ii 1.A.4.c.ii	Diesel	32.792	3.385	0.008	2.086	2.086	2.086	10.722
	Gasoline: 2-stroke	2.765	242.197	0.003	3.762	3.762	3.762	620.793
	Gasoline: 4-stroke	7.117	17.602	0.004	0.157	0.157	0.157	770.368
1.A.4.c.ii	Diesel/ Light fuel oil	35.043	3.366	0.008	1.738	1.738	1.738	10.939
1.A.4.c.iii	Diesel/ Light fuel oil	78.500	2.800	-	1.400	1.500	1.500	7.400
	Gasoline	9.400	181.500	-	9.500	9.500	9.500	573.900

Table 3.48. Emission factors for heavy metals (g/t)

NFR	Fuel	Cd	Hg	As	Cu	Cr	Ni	Se	Zn
1.A.2.f.ii 1.A.4.a.ii	Gasoline	0.010	-	-	0.050	1.700	0.070	0.010	1.000
1.A.4.b.ii 1.A.4.c.ii	Diesel/ Light fuel oil	0.010	-	-	0.050	1.700	0.070	0.010	1.000
1.A.4.c.iii	Diesel/ Light fuel oil	0.010	0.030	0.040	0.088	0.050	1.000	0.100	1.200

Table 3.49. Emission factors for POPs

NFR	Fuel	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	HCB	PCBs
		TEQµg /t	g/t				mg/t	mg/t
1.A.2.f.ii 1.A.4.a.ii	Gasoline	-	0.040	0.040	-	-	-	-
1.A.4.b.ii 1.A.4.c.ii	Diesel/ Light fuel oil	-	0.030	0.050	-	-	-	-
1.A.4.c.iii	Diesel/ Light fuel oil	0.130	-	-	-	-	0.080	0.380

Table 3.50. Sulphur content of fuel (by weight %)

NFR	Fuel	1990	2000	2001	2003	2004	2005	2006	2009	2010
1.A.2.f.ii 1.A.4.a.ii	Gasoline	0.1	0.1	0.05	0.015	0.013	0.005	0.002	0.002	0.002
1.A.4.b.ii	Diesel	0.5	0.5	0.05	0.035	0.030	0.005	0.004	0.002	0.002
1.A.4.c.ii 1.A.4.c.iii	Light fuel oil	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1

Table 3.51. Lead content in fuel

NFR	Fuel	Unit	1990	2000	2004
1.A.2.f.ii 1.A.4.a.ii 1.A.4.b.ii 1.A.4.c.ii 1.A.4.c.iii	Gasoline	g/l	0.150	0.013	0.005
1.A.4.c.iii	Diesel/ Light fuel oil	g/t	0.130	0.130	0.130

Table 3.52. Total fuel consumption in other mobile sectors in the period 1990-2011

	Diesel	Light fuel oil	Gasoline	Total
1990	288.050	9.000	32.840	329.890
1991	293.000	8.000	22.950	323.950
1992	183.140	7.000	21.020	211.160
1993	158.300	6.104	12.110	176.514
1994	124.550	4.184	3.020	131.754
1995	59.750	3.255	5.040	68.045
1996	76.540	4.353	5.910	86.803
1997	70.750	3.840	6.090	80.680
1998	63.236	7.814	6.385	77.435
1999	32.264	7.881	5.393	45.538
2000	31.351	15.969	6.296	53.616
2001	24.243	24.519	6.214	54.976
2002	46.062	51.852	7.418	105.332
2003	78.115	33.564	11.040	122.719
2004	80.022	23.641	8.424	112.087
2005	76.926	21.672	4.694	103.292
2006	84.979	16.609	5.129	106.717
2007	88.831	15.682	5.556	110.069
2008	86.522	16.667	4.185	107.374
2009	87.679	5.139	5.880	98.698
2010	95.519	10.891	5.063	111.473
2011	89.851	16.425	4.203	110.479

3.3.6.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.6.4. Source-specific planned improvements

Separate emission calculations for 1.A.4.c.iii sector for the period 1990-2002. These emissions are included under the 1.A.4.c.ii sector in this submission.

More detailed emission calculations for other non-road machinery sectors that are based on the Tier 2 method. The improvements to be carried out in the inventory methodology will depend on how possible it is to attain detailed information from Statistics Estonia and other authorities.

3.3.7. International maritime navigation (1.A.3.d.i (i))

3.3.7.1. Source category description

This source category covers vessels of all flags that are engaged in international water-borne navigation. Emissions from international navigation are reported as memo items and are not included in the national totals.

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have increased approximately 0.3%, 20.9% and 8.4% compared to 1990. Sulphur oxide emissions have decreased 39.2% due to stricter rules for sulphur content in fuels used by ships. Detailed emission data are provided in Tables 3.53-3.55.

Deviations of time series can be explained by changing statistical fuel consumption in the international navigation sector (Figure 3.33).

Recalculations

All the PCB emissions are recalculated for the period 1990-2010. An overview of the updated data is given in Chapter 10.

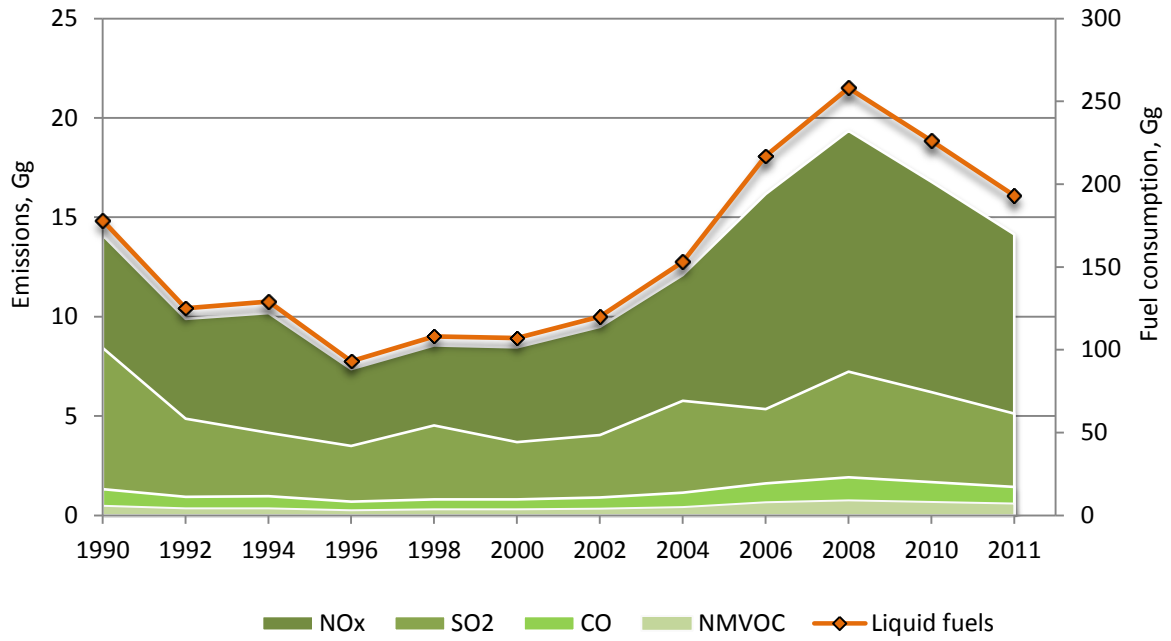

Figure 3.33. NO_x, NMVOC, SO_x and CO emissions from the international navigation sector in the period 1990-2011

Table 3.53. Emissions from the international maritime navigation sector (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	14.094	0.483	8.424	NE	NR	NR	0.977	1.317
1991	16.627	0.570	9.888	NE	NR	NR	1.147	1.554
1992	9.878	0.342	4.858	NE	NR	NR	0.573	0.925
1993	12.075	0.420	5.094	NE	NR	NR	0.610	1.132
1994	10.179	0.355	4.150	NE	NR	NR	0.499	0.955
1995	7.105	0.247	3.100	NE	NR	NR	0.370	0.666
1996	7.347	0.255	3.482	NE	NR	NR	0.412	0.688
1997	8.064	0.279	4.144	NE	NR	NR	0.487	0.755
1998	8.540	0.295	4.512	NE	NR	NR	0.529	0.799
1999	8.931	0.309	4.474	NE	NR	NR	0.527	0.836
2000	8.452	0.293	3.678	NE	0.423	0.466	0.466	0.792
2001	8.053	0.280	3.258	NE	0.382	0.421	0.421	0.755
2002	9.477	0.329	4.030	NE	0.466	0.514	0.514	0.888
2003	9.005	0.312	3.956	NE	0.454	0.500	0.500	0.844
2004	12.093	0.418	5.762	NE	0.647	0.714	0.714	1.132
2005	8.603	0.393	4.338	NE	0.542	0.566	0.566	0.903
2006	16.174	0.652	5.340	NE	1.077	1.159	1.159	1.606
2007	18.999	0.742	6.784	NE	1.331	1.441	1.441	1.872
2008	19.335	0.746	7.220	NE	1.395	1.511	1.511	1.909
2009	17.135	0.676	6.510	NE	1.266	1.368	1.368	1.702
2010	16.774	0.673	6.192	NE	1.225	1.322	1.322	1.672
2011	14.132	0.584	5.118	NE	1.028	1.102	1.102	1.428
trend 1990-2011, %	**0.3**	**20.9**	**-39.2**	**NE**	**143.2**	**136.6**	**12.7**	**8.4**

Table 3.54. Emissions of heavy metals from the international maritime navigation sector in the period 1990-2011 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	0.031	0.003	0.004	0.104	0.110	0.213	4.859	0.034	0.214
1991	0.036	0.004	0.005	0.122	0.129	0.250	5.697	0.040	0.252
1992	0.020	0.002	0.003	0.057	0.061	0.140	2.667	0.022	0.150
1993	0.024	0.002	0.004	0.058	0.062	0.165	2.664	0.024	0.184
1994	0.020	0.002	0.003	0.047	0.050	0.138	2.144	0.020	0.155
1995	0.014	0.001	0.002	0.036	0.038	0.098	1.640	0.015	0.108
1996	0.015	0.002	0.002	0.041	0.044	0.103	1.891	0.016	0.112
1997	0.017	0.002	0.002	0.050	0.053	0.116	2.303	0.018	0.122
1998	0.018	0.002	0.002	0.054	0.058	0.124	2.526	0.019	0.130
1999	0.018	0.002	0.003	0.053	0.057	0.128	2.469	0.020	0.136
2000	0.017	0.002	0.003	0.046	0.049	0.118	2.122	0.018	0.128
2001	0.016	0.002	0.002	0.041	0.043	0.111	1.869	0.016	0.122
2002	0.019	0.002	0.003	0.050	0.054	0.132	2.321	0.020	0.144
2003	0.018	0.002	0.003	0.049	0.053	0.126	2.284	0.019	0.137
2004	0.025	0.003	0.004	0.072	0.077	0.173	3.346	0.027	0.184
2005	0.020	0.002	0.003	0.054	0.058	0.136	2.509	0.021	0.146
2006	0.037	0.004	0.005	0.119	0.126	0.255	5.549	0.041	0.260
2007	0.044	0.005	0.005	0.152	0.161	0.305	7.135	0.050	0.304
2008	0.045	0.005	0.005	0.163	0.172	0.315	7.636	0.052	0.310
2009	0.041	0.004	0.005	0.147	0.156	0.282	6.895	0.047	0.276
2010	0.040	0.004	0.005	0.140	0.149	0.275	6.581	0.045	0.271
2011	0.034	0.004	0.004	0.116	0.123	0.232	5.432	0.038	0.232
trend 1990-2011, %	**9.3**	**10.0**	**7.1**	**11.7**	**11.6**	**9.3**	**11.8**	**10.1**	**8.4**

Table 3.55. Emissions of POPs from the international maritime navigation in the period 1990-2011

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					kg		
1990	0.074	NE	NE	NE	NE	NE	0.023	NE	0.096
1991	0.087	NE	NE	NE	NE	NE	0.027	NE	0.113
1992	0.044	NE	NE	NE	NE	NE	0.015	NE	0.063
1993	0.047	NE	NE	NE	NE	NE	0.017	NE	0.074
1994	0.039	NE	NE	NE	NE	NE	0.014	NE	0.061
1995	0.029	NE	NE	NE	NE	NE	0.010	NE	0.044
1996	0.032	NE	NE	NE	NE	NE	0.011	NE	0.046
1997	0.037	NE	NE	NE	NE	NE	0.012	NE	0.052
1998	0.041	NE	NE	NE	NE	NE	0.013	NE	0.056
1999	0.041	NE	NE	NE	NE	NE	0.014	NE	0.057
2000	0.036	NE	NE	NE	NE	NE	0.012	NE	0.053
2001	0.033	NE	NE	NE	NE	NE	0.012	NE	0.050
2002	0.040	NE	NE	NE	NE	NE	0.014	NE	0.059
2003	0.039	NE	NE	NE	NE	NE	0.013	NE	0.057
2004	0.055	NE	NE	NE	NE	NE	0.018	NE	0.078
2005	0.042	NE	NE	NE	NE	NE	0.014	NE	0.061
2006	0.087	NE	NE	NE	NE	NE	0.028	NE	0.115
2007	0.108	NE	NE	NE	NE	NE	0.034	NE	0.138
2008	0.114	NE	NE	NE	NE	NE	0.035	NE	0.143
2009	0.103	NE	NE	NE	NE	NE	0.031	NE	0.128
2010	0.099	NE	NE	NE	NE	NE	0.030	NE	0.125
2011	0.083	NE	NE	NE	NE	NE	0.026	NE	0.105
trend 1990-2011, %	**10.8**	**NE**	**NE**	**NE**	**NE**	**NE**	**9.8**	**NE**	**9.5**

3.3.7.2. Methodological issues

All the emission calculations are based on the Tier 1 method for the period 1990-2004. Detailed activity data (annual number of vessels per vessel category) is available from 2005. Therefore, emissions calculations from hotelling and maneuvering the ships are included in the submission from 2005.

Cruise emissions are calculated according to the Tier 1 method, where the statistical fuel consumption (Table 3.59) is multiplied by respective emission factors (Table 3.56-3.57). Default emission factors for the main pollutants and heavy metals are taken from the EMEP/EEA guidebook.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.59) by emission factors (Table 3.58). SO_2 emissions are estimated according to the assumption that all sulphur in the fuel is completely transformed into SO_2.

Equation:

$$E_{SO2} = 20 \times k \times FC$$

Table 3.56. Emission factors for the international maritime navigation sector (kg/t)

	NO_x	NMVOC	$PM_{2.5}$	PM_{10}	TSP	CO
Bunker fuel oil	79.3	2.7	5.6	6.2	6.2	7.4
Marine diesel oil	78.5	2.8	1.4	1.5	1.5	7.4

Table 3.57. Emission factors for heavy metals and PAHs

	Pb	Cd	Cu	Cr	As	Hg	Ni	Se	Zn	PCDD/F	HCB	PCB's
	g/t									TEQ µg/t	mg/t	
Bunker fuel oil	0.18	0.02	1.25	0.72	0.68	0.002	32	0.21	1.2	0.47	0.14	0.570
Marine diesel oil	0.13	0.01	0.88	0.05	0.04	0.030	1	0.10	1.2	0.13	0.08	0.038

Table 3.58. Sulphur content of fuel (by weight %)

	1990	2000	2006	2010
Marine diesel oil	0.5	0.2		0.1
Bunker fuel oil	2.7		1.5	

Table 3.59. Fuel consumption in the international maritime navigation sector (Gg)

	Bunker fuel oil	Marine diesel oil
1990	151	27
1991	177	33
1992	82	43
1993	81	72
1994	65	64
1995	50	40
1996	58	35
1997	71	31
1998	78	30
1999	76	37
2000	65	42
2001	57	45
2002	71	49
2003	70	44
2004	103	50
2005	77	45
2006	172	45
2007	222	31
2008	238	20
2009	215	15
2010	205	21
2011	169	24

3.3.7.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

3.3.7.4. Source-specific planned improvements

No source-specific improvements are planned.

3.4. Fugitive emissions (NFR 1.B)

3.4.1. Overview of the sector

Under fugitive emissions from fuels, Estonia reports on NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, NH_3, NO_x and SO_2 emissions from the following activities:

Table 3.60. Fugitive emissions activities

NFR	Source	Description	Emissions reported
1.B	**Fugitive emissions from fuel**		
	1.a Fugitive emission from solid fuels: Coal mining and handling	Includes emissions from open oil shale mining activity, mainly explosive works. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO
	1.b Fugitive emission from solid fuels: Solid fuel transformation	Includes emissions from coke oven. Only point sources data.	NO_x, SO_x, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, Cr
	2.a.i Exploration, production, transport	Includes emissions from loading of liquid fossil fuel. Only point sources data.	NMVOC
	2.a.iv Refining / storage	Includes emissions from product process and storage and handling in oil shale oil industry. Only point sources data.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO
	2.a.v Distribution of oil products	Includes emissions from liquid fuel distribution. Data of point and diffuse sources.	NMVOC
	2.b Natural gas	Includes emissions from gas distribution networks. Only diffuse sources data.	NMVOC
	2.c Venting and flaring	Waste gas incineration. Only two point sources data.	NO_x, SO_x, NMVOC, TSP, CO

NMVOC emissions from this sector contribute about 7% to total national emissions and have decreased by 11.9% up to 2011 compared to 1990, but have increased by 19.9% compared to 2010 due to increasing emissions from terminals (Figure 3.34 and Table 3.61). Emissions of other pollutants are very small compared to the emissions from the other sectors.

Figure 3.34

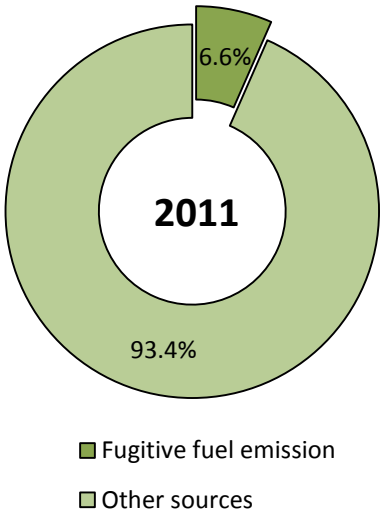

Figure 3.35

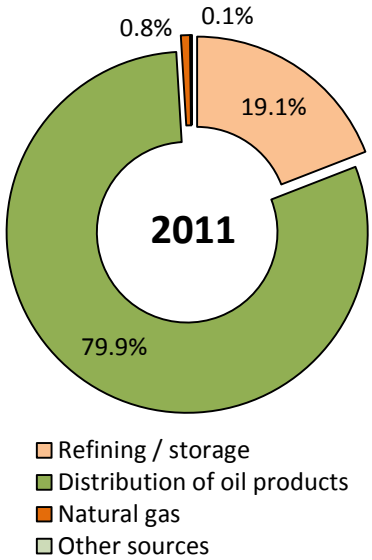

Figure 3.34. NMVOC emission distribution in 2011

Figure 3.35. NMVOC emission distribution within the fuel fugitive emission sector in 2011

Figure 3.35 shows that the distribution of oil products is a main source of NMVOC emissions in the fuel fugitive emissions sector (79.9%).

Table 3.61. Fugitive emission in the period 1990-2011 (Gg)

	NMVOC	$PM_{2.5}$	PM_{10}	TSP	NO_x	CO	NH_3	SO_2
1990	2.474	NR	NR	NR				
1991	2.239	NR	NR	NR				
1992	1.275	NR	NR	NR				
1993	1.275	NR	NR	NR				
1994	1.583	NR	NR	NR				
1995	1.632	NR	NR	NR				
1996	1.911	NR	NR	NR				
1997	2.721	NR	NR	NR				
1998	2.380	NR	NR	NR				
1999	2.740	NR	NR	NR				
2000	4.326	0.010	0.050	0.110	0.010	0.200		
2001	5.197	0.010	0.060	0.170	0.010	0.180		
2002	4.649	0.010	0.080	0.160	0.010	0.270		
2003	4.404	0.010	0.097	0.198	0.010	0.350		
2004	5.184	0.010	0.070	0.140	0.000	0.260	0.010	
2005	4.284	0.010	0.090	0.180	0.010	0.170	0.050	
2006	3.516	0.010	0.110	0.220	0.010	0.250	0.060	
2007	1.922	0.010	0.090	0.180	0.010	0.220	0.090	0.010
2008	1.593	0.020	0.105	0.202	0.017	0.276	0.102	0.013
2009	1.684	0.062	0.158	0.267	0.036	0.168	0.089	0.026
2010	1.818	0.069	0.188	0.309	0.035	0.188	0.115	0.018

	NMVOC	$PM_{2.5}$	PM_{10}	TSP	NO_x	CO	NH_3	SO_2
2011	2.179	0.087	0.211	0.351	0.032	0.813	0.175	0.076
trend 1990-2011, %	**-11.9**	**770.0**	**322.0**	**219.1**	**220.0**	**306.5**	**1650.0**	**660.0**

The emission data for 1.B.1.a Fugitive emission from solid fuels: Coal mining and handling, 1.B.2.a.iv Refining/storage and 1.B.2.c Venting and flaring are obtained from the point sources database. Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

3.4.2. Distribution of oil products (NFR 1.B.2.a.v)

3.4.2.1. Source category description

In the past, emissions from this source category have contributed significantly to total anthropogenic NMVOC emissions. However, European Directive 94/63/EC (EU, 1994) has mandated vapour collection and recovery during the loading of gasoline transport equipment (i.e. tank trucks, rail tank cars and barges) and during the discharge of tank trucks into storage at service stations. It has also imposed emission controls on all gasoline storage tanks at terminals, dispatch stations and depots. The result of these controls has been a very significant reduction in NMVOC emissions from this sector in the EU.

Emissions of NMVOCs into the atmosphere occur in nearly every element of the oil product distribution chain. The vast majority of emissions occur during the storage and handling of gasoline due to its much higher volatility compared to other fuels such as gasoil, kerosene, etc.

In Estonia, oil terminals and service stations must have permits when the total loading turnover exceeds 2000 m^3 per year[3]. That means only the smallest service stations are regarded as diffuse sources. Emissions from oil terminals are based on the facilities data. 17 terminals presented reports on emissions in 2011. In the table below, NMVOC emissions from gasoline distribution and terminals are presented.

Table 3.62. NMVOC emissions from liquid fuel distribution in the period 1990-2011 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline distribution	2.055	1.820	0.896	0.924	1.124	0.971	1.100	1.199	1.159	1.100	1.108
Terminals	0.323	0.323	0.323	0.323	0.418	0.625	0.771	1.483	1.184	1.594	3.157
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gasoline distribution	1.122	0.856	0.657	0.628	0.467	0.482	0.514	0.508	0.467	0.447	0.478
Terminals	4.012	3.645	3.695	3.910	3.199	2.626	1.200	0.629	0.799	0.644	1.265

[3] Emission levels of pollutants and capacities of plants used, beyond which an ambient air pollution and special pollution permit are required. Regulation No. 101 of the Minister of Environment of 2 August 2004

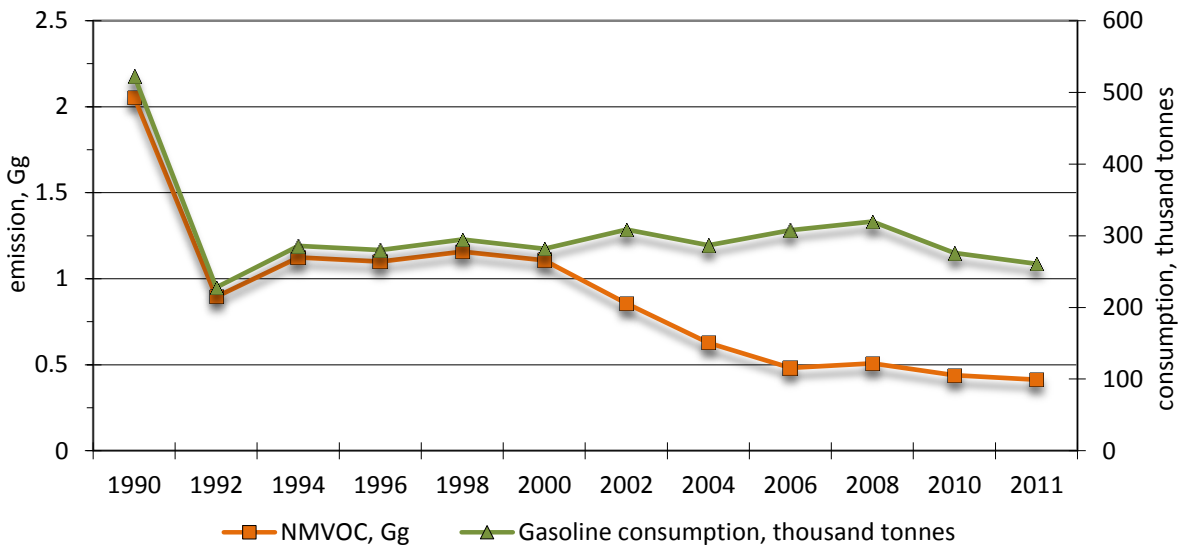

Figure 3.36. NMVOC emission and gasoline distribution in the period 1990-2011

European Directive 94/63/EC has mandated vapour collection and recovery for the discharge of tank trucks into storage at service stations (Stage 1.B). In Estonia, the regulation on implementation of the requirements of the EU Directive 94/63/EC came into force in 1998.

The timetable for the implementation of Stage 1.B vapour collection and recovery equipment according the requirements is the following:

- from 1 January 2001 for existing service stations with a turnover over 1000 m^3 and all others situated in densely populated or industrial areas,
- from January 2004 for service stations with a turnover over 500 m^3,
- from January 2005 for service stations with a turnover over 100 m^3.

It is likely that the majority of the non-permitted gasoline stations have a turnover between 100 and 2000 m^3. Since 2005, these must have vapour collection and recovery equipment.

3.4.2.2. Methodological issues

EMEP/CORINAIR methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in the period 1990-2004.

From 2005, facilities data are used in emission estimates (about 86% from total gasoline distribution in 2011). Facilities are obligate to use the national method for NMVOC emission calculation Naftasaaduste laadimisel välisõhku eralduvate lenduvate orgaaniliste ühendite heitkoguste määramismeetodid - Elektrooniline Riigi Teataja

In the period 2005-2011, activity data relating to point sources is available and activity data for emission calculations from diffuse sources is calculated using the following method:

Gasoline distribution in diffuse sources = total gasoline consumption – gasoline distribution in point sources

Emission factors for diffuse sources

As the situation regarding the requirements of vapour recovery equipment has changed over the years, different emission factors are used for different periods.

1) For the period 1990-2000, the emission factor from Corinair 2007 is applied (3930 g NMVOC/Mg of total gasoline handled);
    - For 2001 – 3350 g/Mg
    - For 2002 – 2770 g/Mg
    - For 2003–2004 – 2190 g/Mg
2) For the period 2005-2010, the Tier 2 technology specific emission factors for Service Stations from the EMEP/EEA Guidebook 2009 is applied. As the majority of the emissions at service stations are from gasoline storage and refuelling (compared to emissions from gasoil), emission factors are only provided for gasoline.

Abatement

In the previous chapter, the Stage 1.B abatement technology requirement is described. The resulting emission can be calculated by replacing the technology specific emission factor with an abated emission factor as given in the formula:

$$EF_{\text{technology, abated}} = (1-\eta_{\text{abatement}}) \times EF_{\text{technology, unabated}}$$

The Abatement efficiencies ($\eta_{\text{abatement}}$) for source category 1.B.2.a.v Distribution of oil products, Service stations, Storage tank filling from the EMEP/EEA Guidebook 2009 is applied (default value is 95%).

The emission factors depend on the True Vapour Pressure (TVP). This pressure is the vapour pressure at loading, and it depends on the loading temperature. The definition of the TVP is as follows:

$$TVP = RVP\ 10^{AT+B}$$

where A=0.000007047 RVP+0.0132 and B=0.0002311 RVP-0.5236, T is the temperature (in °C) and RVP is the Reid Vapour Pressure (in kPa).

The annual average loading temperature at terminals can be assumed to equal the average annual ambient temperature.

The annual average temperature in Estonia is equal to 5 ˚C[4].

The RVP for gasoline (gasoline 95) in Estonia according to the Register of Fuel Monitoring in the period 2005-2008 is presented in the following table.

[4] www.emhi.ee

Table 3.63. Annual average RVP of gasoline 95 in Estonia in the period 2005-2008

Year	Annual average RVP, kPa
2008	75.3
2007	74.8
2006	75.8
2005	72.3
Average	**74.6**

RVP for gasoline is up to 74.6 kPa.

$$TVP = 74.6 \times 10^{(0.000007047 \times 74.6+0.0132)*5+(0.0002311 \times 74.6-0.5236)} = 27.2 \text{ kPa}$$

Consequently, an average true vapour pressure for gasoline is 27.2 kPa (5 ˚C).

One integrated emission factor representing all activities in the small service station is calculated for emission calculations.

Table 3.64. Total emission factor for emissions from gasoline handling in service stations

Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products					
Category	**Emission source**	**NMVOC emission factor, g/m^3 throughput/kPa TVP**	**Abatement efficiency ($\eta_{abatement}$), %**	**True Vapour Pressure (TVP), kPa**	**NMVOC emission factor for gasoline, g/m^3 throughput**
Gasoline in service stations	Storage tank Filling with no Stage 1.B	24	95%	27.2	33
	Storage tank Breathing	3	-	27.2	82
	Automobile refuelling with no emission controls in operation	37	-	27.2	1006
	Automobile refuelling Drips and minor spillage	2	-	27.2	54
	Emission factor for all the activities total	**66**	**-**	-	**1175**

Activity data

Activity data on the subject of gasoline consumption is available from Statistics Estonia (Table 3.65).

Table 3.65. Consumption of motor gasoline in the period 1990-2011 (thousand tonnes)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline consumption	523	463	228	235	286	247	280	305	295	280	282
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gasoline consumption	335	309	300	287	290	308	323	320	293	276	261

3.4.2.3. Sources-specific QA/QC and verification

Statistical quality checking related to the assessment of emission, activity data and trends has been carried out.

3.4.2.4. Sources-specific planned improvements

No source-specific improvements are planned.

3.4.3. Natural gas (NFR 1.B.2.b)

3.4.3.1. Source category description

The term “fugitive emissions” is broadly applied here to mean all greenhouse gas emissions from gas systems, except contributions from fuel combustion. Natural gas systems comprise all infrastructure required to produce, collect, process or refine and deliver natural gas and petroleum products to the market. The system begins at the wellhead, or oil and gas source, and ends at the final sales point to the consumer.

The sources of fugitive emissions on gas systems include, but are not limited to, equipment leaks, evaporation and flashing losses, venting, flaring, incineration and accidental releases (e.g., pipeline dig-ins, well blow-outs and spills). While some of these emission sources are engineered or intentional (e.g., tank, seal and process vents, and flare systems), and therefore relatively well characterized, the quantity and composition of the emissions is generally subject to significant uncertainty.

Natural gas is imported into Estonia from Russia and from the Inčukalns underground gas storage in Latvia (Figure 3.37).

AS Eesti Gaas has two gas metering stations on the border of Estonia, where the volumes of imported gas are measured. Gas is distributed to customers through gas pipelines, distribution stations and gas pressure reducing stations.

Figure 3.37. Map of high-pressure gas distribution pipelines in Estonia

The gas pipeline passes through ten counties: Ida-Viru, Lääne-Viru, Harju, Rapla, Jõgeva, Tartu, Põlva, Võru, Viljandi and Pärnu. There are gas consumers in every county.

The construction of the natural gas pipeline to the towns of Pärnu and Sindi was completed in 2006. The natural gas pipelines also reached customers in the county town of Rapla and the town of Püssi.[5]

Table 3.66. NMVOC emissions from gas distribution (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NMVOC	0.096	0.096	0.056	0.028	0.041	0.036	0.040	0.039	0.037	0.036	0.031
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NMVOC	0.033	0.028	0.032	0.036	0.028	0.028	0.028	0.027	0.018	0.019	0.018

[5] Eesti Gaas. Annual Report 2006

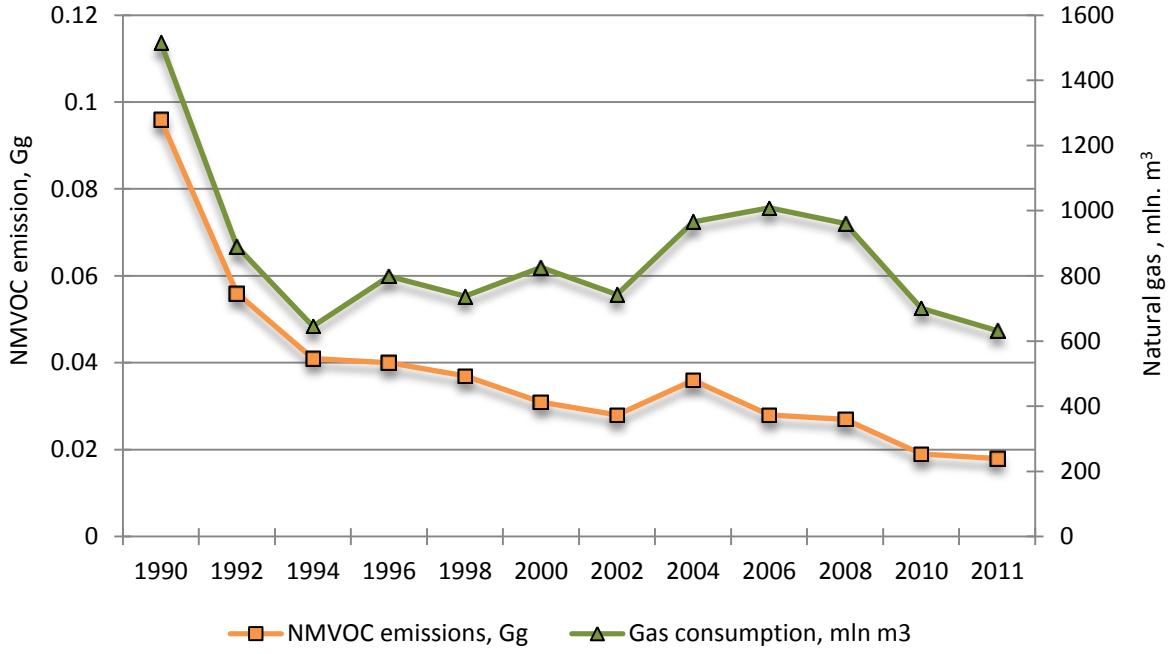

Figure 3.38. NMVOC emission from natural gas distribution

3.4.3.2. Methodological issues

Emission factors

The EMEP/EEA air pollutant emission inventory guidebook (2009) does not provide calculation methodology for NMVOC calculations from gas distribution. Therefore, the IPCC Guidelines for National Greenhouse Gas Inventories (2006) is used.

Tier 1 emission factors are used (Equation 1).

The activity rate for this sector is natural gas consumption. Unit: million m^3

Emission factor unit: Gg per 10^6 of marketable gas/Utility sales.

The available default emission factors are presented below in Table 3.67. While some types of fugitive emissions correlate poorly with, or are unrelated to, throughput on an individual source basis (e.g. fugitive equipment leaks), the correlations with throughput become more reasonable when large populations of sources are considered. Furthermore, throughput statistics are the most consistently available activity data for use in Tier 1 calculations.

Table 3.67. Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations

Category	Sub-category	Emission source	IPCC Code	Developed countries		Developing countries and countries with economies in transition		Units of measure
				NMVOC		NMVOC		
				Value	Uncertainty value (% of value)	Value	Uncertainty value (% of value)	
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b.iii.4	7,0E-06	+-100%	7,0E-06 to 1,6E-05	-40 to +250%	Gg per 10^6 m^3 of marketable gas
		Venting	1.B.2.b.i	4,6E-06	+-75%	4,6E-06 to 1,1E-05	-40 to +250%	Gg per 10^6 m^3 of marketable gas
Gas Distribution	All	All	1.B.2.b.iii.5	1,6E-05	-20 to +500%	1,6E-05 to 3,6E-5	-20 to +500%	Gg per 10^6 m^3 of utility sales

The Estonian economy up to 2004 can be classified as an economy in transition. The emission factors are chosen accordingly. For the transition period from 1990 to 2004, the emission factor for countries with economies in transition is used. It is expected that the emissions have decreased equally within this period.

Table 3.68. Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations for different years

Category	Sub-category	Emission source	IPCC Code	NMVOC				
				1990	1995	2000	2005-2011	Units of measure
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b.iii.4	1.6E-05	1.3E-05	9.6E-06	7.0E-06	Gg per 10^6 m^3 of marketable gas
		Venting	1.B.2.b.i	1.1E-05	8.7E-06	6.4E-06	4.6E-06	Gg per 10^6 m^3 of marketable gas
Gas Distribution	All	All	1.B.2.b.iii.5	3.6E-05	2.9E-05	2.2E-05	1.6E-05	Gg per 10^6 m^3 of utility sales
Total	-	-	-	**6.3E-05**	**5.0E-05**	**3.8E-05**	**2.8E-05**	**Gg per 10^6 m^3 of utility sales**

Activity data

Activity data on the subject of annual natural gas consumption are available from Statistics Estonia.

Table 3.69. Gas consumption in the period 1990-2011 (mln m^3)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gas consumption	1516	1521	890	441	646	723	799	778	738	719	826
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Gas consumption	887	743	847	966	997	1009	1003	961	653	701	632

3.4.3.3. Sources-specific QA/QC and verification

Statistical quality checking related to the assessment of emission, activity data and trends has been carried out.

3.4.3.4. Sources-specific planned improvements

The next planned improvement is to provide uncertainty analysis.

4. INDUSTRIAL PROCESSES (NFR 2)

4.1. Overview of sector

4.1.1. Description

The main activities in the industrial processes sector in Estonia are the paper, wood and chemical industries as well as the production of mineral products and food. The industry has undergone major changes since 1990. The industrial sector's share of total emissions is no longer as significant as it used to be. This is mainly due to a decrease in production volume; also, some enterprises have ceased operating (phosphor fertilizers, benzene and toluene).

The Estonian inventory of air pollutants from industrial processes presently includes emissions from the chemical, pulp, paper, metal and mineral products industries, as listed in Table 4.1.

Table 4.1. Industrial processes reporting activities

NFR	Source		Description	Emissions reported
2.A	**Mineral Products**			
	2.A.1	Cement production	Includes emissions from cement production. Data reported by one operator.	TSP, PM_{10}, $PM_{2.5}$
	2.A.2	Lime production	Includes emissions from lime production. Data reported by one operator.	TSP, PM_{10}, $PM_{2.5}$
	2.A.3	Limestone and dolomite use	Includes emissions from limestone and dolomite use. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$
	2.A.6	Road paving with asphalt	Includes emissions from road paving with asphalt.	NMVOC
	2.A.7.a	Quarrying and mining of minerals other than coal	Includes emissions from quarring and mining of limstone and dolomite. Data reported by operators.	NO_X, SO_X, TSP, PM_{10}, $PM_{2.5}$, CO
	2.A.7.b	Construction and demolition	Includes emissions from construction and demolition.	TSP, PM_{10}, $PM_{2.5}$
	2.A.7.c	Storage, handling and transport of mineral products	Emissions from this sector are allocated to 2.G.	IE
	2.A.7.d	Other Mineral products	Includes emissions from class production. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$
2.B	**Chemical industry**			
	2.B.1	Ammonia production	Includes emission from ammonia production. Data reported by one operator.	NO_X, NMVOC, NH_3, SO_X, CO
	2.B.5.a	Other chemical industry	Includes emission from urea and formaldehyde production. Data reported by two operators.	NO_X, NMVOC, NH_3, SO_X, TSP, PM_{10}, $PM_{2.5}$, CO
	2.B.5.b	Storage, handling and transport of chemical products	Includes emission from storage, handling and transport of chemical products. Data reported by operators.	NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$

NFR	Source		Description	Emissions reported
2.C	**Metal Production**			
	2.C.1	Iron and steel production	Includes emission from Iron and steel production. Data reported by operators.	NO_X, NMVOC, NH_3, SO_X, TSP, PM_{10}, $PM_{2.5}$, CO, Cr, Ni, Zn
	2.C.3	Aluminium production	Includes emission from secondary aluminium production. Data reported by operators.	NO_X, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO
	2.C.5.a	Copper production	Includes emission from secondary copper production. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$
	2.C.5.b	Lead production	Includes emission from lead battery and accumulators recycling plant. Data reported by operators.	NO_X, NH_3, SO_X, TSP, PM_{10}, $PM_{2.5}$, CO, Pb
	2.C.5.d	Zinc production	Includes emission from zinc plating. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$, Zn
	2.C.5.e	Other metal production	Includes emission from galvanizing and electroplating. Data reported by operators.	NO_X, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, Cr, Cu , Ni, Zn
2.D	**Pulp, paper and food industries**			
	2.D.1	Pulp and paper	Includes emission from pulp and paper production. Data reported by two operators.	NO_X, NMVOC, SO_x, TSP, PM_{10}, $PM_{2.5}$, CO
	2.D.2	Food and drink	Includes emission from the food and drink industry. Data reported by operators, includes statistical data also.	NO_X, NMVOC, SO_x, TSP, PM_{10}, $PM_{2.5}$, CO
	2.D.3	Wood processing	Includes emission from wood processing. Data reported by operators.	NO_X, NMVOC, SO_x, TSP, PM_{10}, $PM_{2.5}$
2.F	2.F	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	Includes emission from consumption of POPs and heavy metals.	NMVOC, NH_3
2.G	2.G	Other production, consumption, storage, transportation or handling of bulk products	Includes emission from storage and handling of peat, bulk, etc. Data reported by operators.	NO_X, NMVOC, NH_3, SO_X, TSP, PM_{10}, $PM_{2.5}$, CO

Emissions data from the manufacturing industry are based on the facilities data (Tier 3 method) and only NMVOC emissions from the food industry and from road paving with asphalt are calculated as diffuse sources on the basis of statistical data and the Guidebook emission factors (Tier 2 and Tier 1 method).

PM_{10} and $PM_{2.5}$ emissions from constructions and demolition are also calculated as diffuse sources (Tier 1 method).

The share of industry sources into total emissions in 2011 was: TSP – 2%, NMVOC – 2.8%, PM_{10} – 1%. The shares of other pollutants are not so significant. The emissions of NMVOC, NH_3 and NO_x have decreased in comparison with 1990 by 94%, 82.5% and 67.2%, respectively. The emissions of NO_x and NH3 increased in 2011 compared to 2010 by 67.9%

and 31.7% in the results of the decrease in paper and metal production for the same period. Other emissions from industry have not changed much in 2011 compared to 2010.

The trend of NMVOC and PM emissions in these categories are given in Figure 4.1.-4.2. The emissions from the industrial sector are presented in Table 4.2.

Table 4.2. Pollutant emissions from the industrial sector in the period 1990-2011

	NO_x	NMVOC	SO_x	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb
	Gg								Mg
1990	0.190	15.335	0	0.530	NR	NR	0.940	0.340	0
1991	0.100	13.894	0	0.460	NR	NR	0.100	0.300	0
1992	0.090	9.600	0	0.440	NR	NR	0.470	0.300	0
1993	0.050	4.405	0	0.120	NR	NR	0.150	0.010	0
1994	0.190	3.513	0	0.220	NR	NR	0.610	0.040	0
1995	0.070	4.377	0	0.240	NR	NR	0.490	0	0
1996	0.150	3.191	0	0.160	NR	NR	0.280	0	0
1997	0.150	3.142	0	0.120	NR	NR	0.140	0.010	0
1998	0.140	2.400	0	0.100	NR	NR	0.080	0.020	0
1999	0.190	1.457	0	0.140	NR	NR	0.180	0	0
2000	0.200	2.080	0.040	0.120	0.123	0.383	1.095	0.530	0.010
2001	0.340	1.449	0.080	0.140	0.153	0.481	1.362	0.510	0.010
2002	0.130	1.513	0.160	0.110	0.184	0.602	1.743	0.280	0.010
2003	0.161	1.932	0.150	0.120	0.205	0.656	1.848	0.290	0
2004	0.360	1.846	0.130	0.120	0.240	0.800	2.279	0.360	0
2005	0.180	1.573	0.130	0.200	0.219	0.727	2.053	0.340	0
2006	0.270	1.303	0.120	0.157	0.170	0.825	2.199	0.380	0.001
2007	0.250	1.072	0.020	0.138	0.222	0.771	2.211	0.440	0.001
2008	0.298	0.959	0.022	0.181	0.245	0.779	2.215	0.481	0.001
2009	0.058	0.881	0.025	0.083	0.210	0.609	1.460	0.424	0.006
2010	0.037	0.861	0.029	0.070	0.157	0.435	1.338	0.461	0.014
2011	0.062	0.919	0.022	0.093	0.185	0.417	1.006	0.420	0.011
trend 1990-2011, %	**-67.3**	**-94.0**		**-82.5**	**50.6**	**8.9**	**7.0**	**23.6**	

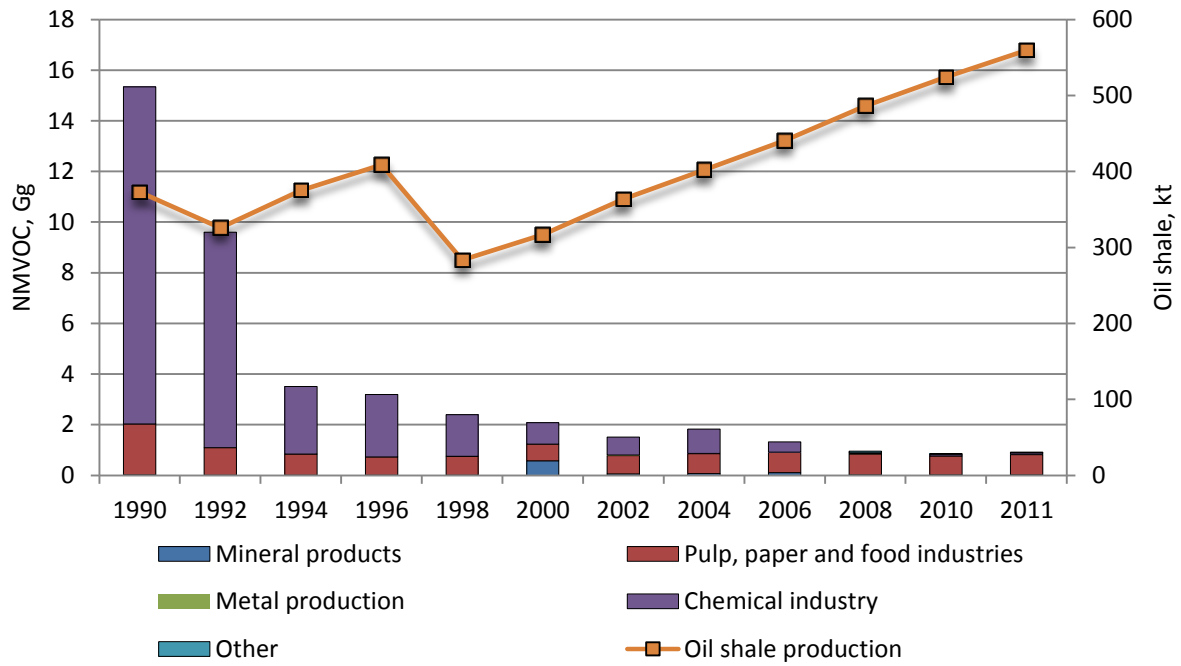

Figure 4.1. NMVOC emissions and oil shale production from the industrial sector in the period 1990-2011

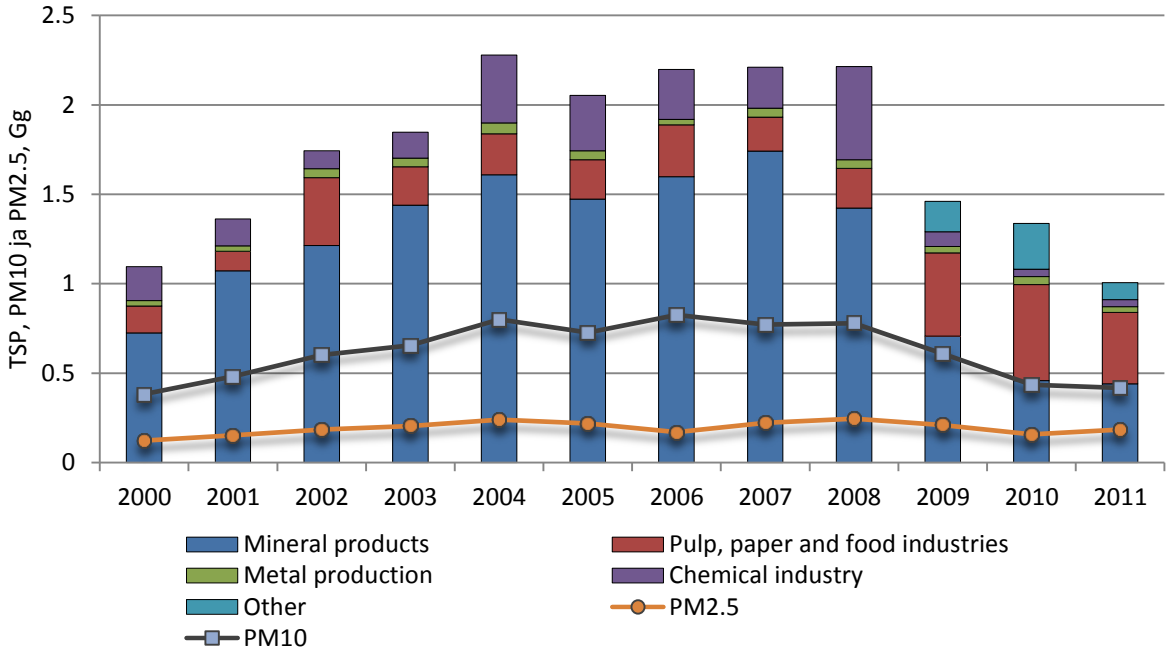

Figure 4.2. PM emissions from the industrial sector in the period 2000-2011

4.2. Mineral Products (NFR 2.A)

4.2.1. Sources category description

This chapter includes activities data and emissions from the following processes:

- Cement production
- Lime production
- Limestone and dolomite use
- Quarrying and mining of minerals other than coal
- Road paving with asphalt
- Construction and demolition
- Storage, handling and transport of mineral products
- Other mineral products

In Estonia, the only enterprise that produces cement is Kunda Nordic Tsement AS. Cement is produced by the standard wet process. The clinker burning process takes place in three rotary kilns. Crushed limestone is blended with prepared clay (raw material contains calcium, aluminium, iron and silica oxides) and heated to about 1450 ˚C in a kiln. The ingredients react and turn into an intermediate product called clinker, which is then further mixed with gypsum and, in some cases, limestone, blast furnace slag or fly ash and ground into a fine powder that is cement, the binding agent of concrete. The production process is energy-intensive, resulting in the emission of CO_2, SO_x, NO_x and dust. During the period 1993-2000, cement manufacturing in Kunda was thoroughly modernized. The main goal was to eliminate dust pollution from clinker kilns and cement mills and they were provided with filters required for exhaust cleaning. In 1999, the company closed the local electricity and heat production plant, which operated on natural gas. (Sustainability report 2007. Kunda Nordic Tsement AS, 2007).

There are two facilities for the lime production, one of which annually presents a report on emissions (Nordkalk AS). Other company production volumes are very small. In Estonia, Nordkalk excavates Silurian dolomite from the Kurevere quarry. The chemical composition of this 400 million year old dolomite makes it good for fertiliser and other industrial applications as well as for soil improvement.

The quarrying and mining of minerals in Estonia includes limestone and dolomite extraction as well as crushed stone production.

Emissions from the mineral product industry are presented in Table 4.3.

Table 4.3. Pollutant emissions from mineral products in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0	0.027			NR	NR	0	0
1991	0	0.023			NR	NR	0	0
1992	0	0.003	0	0	NR	NR	0	0
1993	0	0.006	0	0	NR	NR	0	0
1994	0	0.006	0	0	NR	NR	0	0
1995	0	0.008	0	0	NR	NR	0	0
1996	0	0.008	0	0	NR	NR	0	0
1997	0	0.007	0	0	NR	NR	0	0
1998	0	0.008	0	0	NR	NR	0	0
1999	0	0.011	0	0	NR	NR	0	0
2000	0	0.581	0	0.010	0.073	0.253	0.725	0.040
2001	0.010	0.019	0.0100	0.010	0.113	0.361	1.072	0.040
2002	0	0.058	0	0.010	0.124	0.412	1.213	0
2003	0	0.104	0	0.010	0.151	0.499	1.439	0.010
2004	0.010	0.070	0	0	0.160	0.560	1.609	0.010
2005	0.010	0.099	0	0	0.159	0.517	1.473	0.020
2006	0.010	0.104	0	0	0.100	0.615	1.599	0.030
2007	0.010	0.024	0	0	0.022	0.161	0.381	0
2008	0	0.024	0.0020	0	0.025	0.158	0.357	0.003
2009	0.007	0.016	0.0010	NA	0.067	0.263	0.707	0.006
2010	0.006	0.018	0.0004		0.043	0.168	0.459	0.005
2011	0.010	0.020	0.0009		0.043	0.170	0.441	0.008

4.2.2. Methodological issues

As mentioned above (overview of the industrial sector), emissions data are based on data from facilities (Tier 3 method). The operator submits data concerning the facility as a whole, as well as separately on sources of emissions by SNAP codes. Basically, all emissions from the mineral industry are included in the combustion activity – NFR 1.A.2.f.i, excluding fugitive emissions from excavations and storage and handling activities. In recent years, the mineral product enterprises have not been the key sources of pollution, because very large efforts were made for the reduction of pollutant emissions. The emission of dust from Kunda Nordic Tsement during the period 1990-2009 was reduced by 99.7%.

The enterprise has been presenting data regarding heavy metal emissions since 2004 on the basis of measurements; therefore, emissions for the period 1990-2003 have been calculated on the basis of national emissions factors and clinker production data Tselluloosi ja tsemendi tootmisel välisõhku eralduvate saasteainete heitkoguste määramismeetodid – Elektrooniline Riigi Teataja.

The dioxin emissions from the mineral industry (cement, lime and brick) have been calculated on the basis of productions and the UNEP "Standardized Toolkit for Identification

of Dioxin and Furan Releases" emissions factors. For cement production, Toolkit EF was used from 1990 to 1996, and from 1997 to 2007 calculations were carried out on the basis of results from the "Dioxin in Candidate Countries" project, in which frameworks for the measurements of dioxins from technological equipment have been spent. Now, Kunda Nordic is obliged to spend measurements twice a year and report on dioxin emissions. It is necessary to notice that the measured dioxin emissions are much less than the emissions calculated on the basis of the emissions factor. Dioxin emissions are also reported under NFR 1.

Table 4.4. Clinker production and heavy metal emission factors

	Clinker, thousand tonnes	Heavy metals EF, g/t of clinker					
		Pb	Cd	Hg	Cu	Ni	Zn
1990	790.0	78.125	4.060	0.088	2.687	0.313	18.000
1991	773.0	78.125	4.060	0.088	2.687	0.313	18.000
1992	517.0	78.125	4.060	0.088	2.687	0.313	18.000
1993	378.0	78.125	4.060	0.088	2.687	0.313	18.000
1994	540.0	78.125	4.060	0.088	2.687	0.313	18.000
1995	571.0	43.750	2.275	0.049	1.505	0.175	10.080
1996	590.0	12.500	0.650	0.014	0.430	0.050	2.880
1997	651.0	0.780	0.040	0.004	0.030	0.003	0.180
1998	659.0	0.780	0.040	0.004	0.030	0.003	0.180
1999	590.0	0.780	0.040	0.004	0.030	0.003	0.180
2000	620.0	0.780	0.040	0.004	0.030	0.003	0.180
2001	629.0	0.780	0.040	0.004	0.030	0.003	0.180
2002	590.0	0.780	0.040	0.004	0.030	0.003	0.180
2003	560.0	0.780	0.040	0.004	0.030	0.003	0.180
2004	623.0						
2005	636.0						
2006	705.0						
2007	1043.0						
2008	1040.0						
2009	448.5						
2010	536.7						
2011	719.0						

Table 4.5. Dioxin emission factors for the cement industry

	Cement			Lime			Bricks and tiles		
	production, tonnes	EF, µg I-TEQ/t	emission, g	production, tonnes	EF, µg I-TEQ/t	emission, g	production, tonnes	EF, µg I-TEQ/t	emission, g
1990	938,000	0.060	0.563	185,000	0.07	0.0130	541,401	0.2	0.108
1991	905,000	0.060	0.543	207,000	0.07	0.0140	592,206	0.2	
1992	483,000	0.060	0.290	92,000	0.07	0.0060	350,444	0.2	0.071
1993	354,000	0.060	0.212	21,000	0.07	0.0010	139,217	0.2	
1994	402,500	0.060	0.242	18,000	0.07	0.0010	128,283	0.2	0.026
1995	417,600	0.060	0.251	16,800	0.07	0.0010	81,343	0.2	
1996	387,700	0.060	0.233	17,400	0.07	0.0010	68,009	0.2	0.014
1997	422,500	0.070	0.030	19,500	0.07	0.0010	62,674	0.2	
1998	321,300	0.070	0.022	32,100	0.07	0.0020	54,674	0.2	0.011
1999	357,700	0.070	0.025	23,300	0.07	0.0020	46,139	0.2	
2000	329,100	0.070	0.023	21,200	0.07	0.0010	45,072	0.2	0.009
2001	404,600	0.070	0.028	20,000	0.07	0,0010	54,140	0.2	
2002	465,900	0.070	0.033	21,200	0.07	0.0010	61,608	0.2	0.012
2003	506,300	0.070	0.035	32,000	0.07	0.0020	63,741	0.2	0.013
2004	506,300	0.070	0,035	32,000	0.07	0.0020	63,741	0.2	0.003
2005	NA	0.070	NE	37,200	0.07	0.0020		0.2	NE
2006	848,900	0.099	0.059	39,700	0.07	0.0030	82,667	0.2	0.016
2007	936,200	0.070	0.065	43,500	0.07	0.0030	143,485	0.2	0.029
2008	806,100	0.003	0.056	59,400	0.07	0.0040	113,081	0.2	0.023
2009	326,000	0.003	0.023	30,200	0.07	0.0040	38,938	0.2	0.007
2010	536,700	0.004	0.037	27,200	0.07	0.0019	56,500	0.2	0.011
2011	719,002	0.004	0.037	36,100	0.07	0.0019	84,544	0.2	0.011

Emission calculations from road paving with asphalt (2.A.6) and constructions and demolition (2.A.7.b) sectors are based on the Tier 1 method from the renewed Guidebook, as mentioned above.

The default emission factors for road paving with asphalt are constructed based on an assessment of the available emission factors from a detailed review of the hot mix industry (US EPA, 2004). The emission factor represents an average between batch mix and drum mix hot mix asphalt plants. The Tier 1 method uses readily available statistical data and default emission factors (Table 4.6).

Table 4.6. NMVOC emission factors for road paving with asphalt and PM emission factors for construction and demolition

NFR	Unit	NMVOC	PM_{10}	$PM_{2.5}$	TSP
2.A.7.b Construction and demolition	$kg/m^2/year$		0.0812	0.00812	0.162
2.A.6 Road Paving with Asphalt	g/Mg asphalt	16			

There are also PM emission factors for road paving with asphalt in the new guidebook, but the results of these calculations were assessing sector share to high. Therefore, in this submission year, they are not taken into account.

Activity data

Information regarding asphalt production and laying is available from the Estonian Asphalt Pavement Association (www.asfaldiliit.ee) for the years 1990-2011 (Table 4.7). According to the Asphalt Pavement Association, all production companies but not all asphalt laying companies are members of the association. The value of the asphalt produced is higher than the quantity of laid asphalt. For that reason, asphalt production values are used for emission calculations from road paving with asphalt.

Table 4.7. Activity data for NMVOC emission calculations from asphalt production in the period 1990-2011 (tonnes)

	Produced Asphalt Mixtures
1990	1,711,000
1991	1,433,000
1992	167,000
1993	359,000
1994	345,000
1995	475,000
1996	472,000
1997	419,000
1998	509,000
1999	707,000
2000	667,000
2001	568,000
2002	1,132,000
2003	865,000
2004	1,103,000
2005	1,164,000
2006	1,481,908
2007	1,486,572
2008	1,506,846
2009	1,174,624
2010	1,118,187
2011	1,277,793

Information regarding constructions is available from Statistics Estonia (www.stat.ee) for the years 2000-2011 (Table 4.8). The historical data (1990-1999) for TSP calculations are not available. There is also no statistical information regarding the demolition of buildings, so only data pertaining to construction were used.

Table 4.8. Activity data for PM emission calculations from the construction sector in the period 2000-2011 (m^2 floor area)

	Dwelling	Non-residential building
2000	78,862.5	324,243.6
2001	70,701.1	309,140.8
2002	112,661.9	399,996.3
2003	217,048.5	639,150.8
2004	277,072.3	952,474.1
2005	325,565.0	743,899.4
2006	391,999.5	896,644.2
2007	566,674.9	920,778.8
2008	458,415.2	1,004,572.0
2009	304,982.2	797,777.0
2010	237,818.0	425,393.0
2011	205,922.7	326,307.0

4.3. Chemical industry (NFR 2.B)

4.3.1. Sources category description

The Estonian chemical industry has been linked to the oil shale industry, but other chemical industry branches are also being developed (Economic survey of Estonia 2008). More than half of the chemical industry is located in Ida-Viru County, and one third of the workforce is in Tallinn and Harjumaa County. The largest companies are VKG Oil AS, Kiviõli Keemiatööstus OÜ, Eesti Energia Õlitööstus AS (all three produce the shale oil), VKG Resins (adhesive resins), Nitrofert AS (is the only producer of fertilizers in Estonia, whose major activity is processing natural gas into ammonia and prilled urea) and enterprises manufacturing foams, benzoic acid, sodium benzoate and other products. Emissions from paint and varnish production are located under the Solvent use chapter.

Estonia's only producer of fertiliser, Nitrofert AS, ceased production in February 2009.

The share of NMVOC emissions from the chemical industry in total country emissions was about 22% in 1990, and 0,2% in 2011 (Figure 4.3). The main reason for this is a decrease in the manufacturing of chemical production at shale oil enterprises. Emissions from the chemical industry sector are presented in Table 4.9.

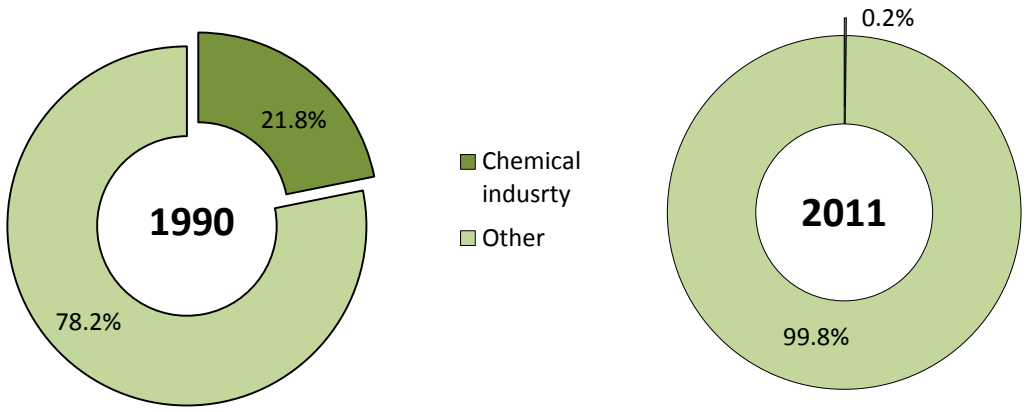

Figure 4.3. Distribution of NMVOC emissions by activities in 1990 and 2011

Table 4.9. Emissions from the chemical industry in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.190	13.300	0	0.370	NR	NR	0.940	0.340
1991	0.100	12.330	0	0.300	NR	NR	0.100	0.300
1992	0.090	8.500	0	0.280	NR	NR	0.470	0.300
1993	0.050	3.500	0	0.080	NR	NR	0.150	0.010
1994	0.190	2.670	0	0.140	NR	NR	0.610	0.040
1995	0.070	3.530	0	0.140	NR	NR	0.490	0
1996	0.150	2.460	0	0.070	NR	NR	0.280	0
1997	0.150	2.390	0	0.060	NR	NR	0.140	0.010
1998	0.140	1.650	0	0.060	NR	NR	0.080	0.020
1999	0.190	0.790	0	0.090	NR	NR	0.180	0
2000	0.190	0.840	0	0.040	0.020	0.060	0.190	0.340
2001	0.310	0.770	0.010	0.030	0.020	0.050	0.150	0.320
2002	0.100	0.710	0	0.020	0.010	0.030	0.100	0.230
2003	0.130	1.065	0.010	0.050	0.016	0.048	0.146	0.270
2004	0.320	0.960	0.010	0.080	0.040	0.120	0.380	0.330
2005	0.160	0.720	0	0.130	0.030	0.100	0.310	0.290
2006	0.230	0.410	0	0.060	0.030	0.090	0.280	0.330
2007	0.200	0.120	0	0.071	0.020	0.070	0.230	0.360
2008	0.255	0.041	0.001	0.132	0.057	0.172	0.522	0.398
2009	0.025	0.068	0	0.012	0.009	0.027	0.083	0.364
2010	0	0.071	0	0.010	0.005	0.014	0.042	0.405
2011	0	0.073	0	0.017	0.004	0.013	0.038	0.374
trend 1990-2011, %		**-99.45**		**-95.53**	**-78.94**	**-78.94**	**-95.93**	**9.86**

4.3.2. Methodological issues

All the largest facilities as well as the facilities in which emissions exceed thresholds established by the decision of the Minister of the Environment are obliged to deliver annual reports on emissions. Therefore, all the data pertaining to emissions presented to this section are based on the data of the enterprises (Tier 3 method). Emissions data are based on measurements or calculation methods. For some enterprises, such as oil shale chemistry, part of the emissions is included in the energy sector (SNAP 010406 and 010407 – coke furnaces and coal gasification or liquefaction).

Production in the Estonian chemical industry is given in Table 4.10.

Table 4.10. Main chemicals and fuel production in the period 1990-2011 (kt)

	Ammonia	Oil shale	Benzene	Toluene	Coke
1990	294	..	91.5	40.1	..
1991	270	..	..	..	..
1992	140	..	..	..	..
1993	55	..	..	..	..
1994	180	..	..	..	..
1995	201	..	49.3	21.1	..
1996	203	..	34.3	11.2	..
1997	206	..	37.5	10.8	..
1998	211	..	23.8	4.6	..
1999	199	..	14.5	4.5	..
2000	177	169.3	13.5	4.6	23.0
2001	183	281.7	6.5	1.5	27.0
2002	47	301.8	0	0	30.0
2003	98	317.6	0	0	30.0
2004	202	340.0	0	0	35.6
2005	213	367.4	0	0	38.7
2006	211	389.2	0	0	40.0
2007	202	436.6	0	0	39.7
2008	209	444.8	0	0	34.6
2009	..	489.3	0	0	21.4
2010	..	524.3	0	0	22.4
2011	..	559.9	0	0	24.4

4.4. Metal Production (NFR 2.C)

4.4.1. Sources category description

The metal industry is concentrated in Tallinn and its surroundings (more than half of work premises) and Ida-Viru County. The larger companies include AS Kohimo, AS Viljandi Metall, Cargotec Estonia AS, OÜ BLRT Marketex, AS (metal structures), ArcelorMittal Tallinn OÜ (galvanized steel), Ruukki Products AS, AS Saku Metall (building structures), Eesti Energia Tehnoloogiatööstus AS (formerly AS Energoremont – products and services for power plants), AS Hanza Tarkon, AS Favor, OÜ BLRT Masinaehitus, Metalliset Eesti AS (metalworking), Metaprint AS (metallic container production) and AS Demidov Industries (aluminium alloy).

Emissions from the metal industry are presented in Table 4.11.

Table 4.11. Emissions from the metal production sector in the period 1990-2011 (Gg)

	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0	0	0.160	NR	NR	0	0
1991	0	0	0.160	NR	NR	0	0
1992	0	0	0.160	NR	NR	0	0
1993	0	0	0.040	NR	NR	0	0
1994	0	0	0.080	NR	NR	0	0
1995	0	0	0.100	NR	NR	0	0
1996	0	0	0.090	NR	NR	0	0
1997	0	0	0.060	NR	NR	0	0
1998	0	0	0.040	NR	NR	0	0
1999	0	0	0.050	NR	NR	0	0
2000	0	0.010	0.040	0.010	0.020	0.030	0.010
2001	0.010	0.010	0.080	0.010	0.030	0.030	0.010
2002	0.010	0.020	0.060	0.010	0.040	0.050	0.010
2003	0.011	0.015	0.050	0.014	0.038	0.048	0.010
2004	0.010	0.010	0.030	0.020	0.050	0.060	0.020
2005	0.010	0.010	0.060	0.010	0.040	0.050	0.010
2006	0.030	0.010	0.080	0.010	0.030	0.030	0.020
2007	0.020	0.010	0.060	0.010	0.040	0.050	0.020
2008	0.015	0.008	0.034	0.021	0.028	0.048	0.023
2009	0.008	0.004	0.066	0.017	0.022	0.035	0.012
2010	0.013	0.006	0.052	0.021	0.020	0.044	0.009
2011	0.014	0.008	0.070	0.016	0.021	0.033	0.009

4.4.2. Methodological issues

All the largest facilities as well as the facilities in which emissions exceed thresholds established by the decision of the Minister of the Environment are obliged to deliver annual reports on emissions. Therefore, all the data pertaining to emissions presented to this section are based on the data of the enterprises (Tier 3 method). Emissions data are based on measurements or calculation methods.

4.5. Pulp, paper and food industries (NFR 2.D)

4.5.1. Sources category description

This chapter includes the pollutant emissions from pulp and paper, food and drink and wood, furniture.

The pulp and paper industry is an industry with a long tradition, as it was established in Estonia as far back as the 17th century. In the period 2002-2008, the output of the paper industry grew two fold. The paper industry is a heavily concentrated industry in Estonia. Horizon Tselluloosi ja Paberi AS is the largest paper and cardboard producer. Horizon produces a wide range of good quality paper products for the packaging industry (Economic survey of Estonia 2008). The product range is all based on 100% virgin long fibre softwood pulp – the raw material that has brought Nordic sack craft qualities to the fore globally. Horizon only manufactures unbleached varieties. Estonian Cell AS, an aspen pulp factory in Kunda (established in 2006), is the largest pulp producer.

The wood industry is one of largest industries. The product mix of the wood industry is comprehensive, ranging from sawn timber production and processing to the manufacturing of log homes, windows and doors.

The food industry is also one of the biggest industries in Estonia in terms of production volume. During the period 2002-2008, the output of the food industry increased by almost 50%. The economic crisis, however, has also affected this sector. The emissions from this sector are presented in Table 4.12.

Table 4.12. Pollutant emissions from the pulp, paper and food industries in the period 1990-2011 (Gg)

	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP	CO
1990		2.008		NR	NR	NR	
1991		1.541		NR	NR	NR	
1992		1.097		NR	NR	NR	
1993		0.899		NR	NR	NR	
1994		0.837		NR	NR	NR	
1995		0.839		NR	NR	NR	
1996		0.723		NR	NR	NR	
1997		0.745		NR	NR	NR	
1998		0.742		NR	NR	NR	
1999		0.656		NR	NR	NR	
2000	0.010	0.649	0.040	0.020	0.050	0.150	0.140
2001	0.010	0.650	0.060	0.010	0.040	0.110	0.140
2002	0.020	0.725	0.160	0.040	0.120	0.380	0.040
2003	0.020	0.748	0.140	0.024	0.071	0.215	0
2004	0.020	0.788	0.120	0.020	0.070	0.230	0
2005	0	0.744	0.130	0.020	0.070	0.220	0.020
2006	0	0.799	0.120	0.030	0.090	0.290	0

	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP	CO
2007	0.010	0.848	0.020	0.020	0.060	0.190	0.020
2008	0.018	0.823	0.018	0.024	0.073	0.221	0.028
2009	0.017	0.767	0.024	0.098	0.240	0.466	0.027
2010	0.018	0.743	0.028	0.059	0.177	0.538	0.028
2011	0.038	0.798	0.020	0.112	0.184	0.398	0.015

4.5.2. Methodological issues

Emissions data from these branches of industry are based on facilities data (Tier 3 method) and only NMVOC emissions from the food industry are calculated as diffuse sources on the basis of statistical data and renewed Guidebook default emission factors (Tier 2 method).

Emissions from food manufacturing include all processes in the food production chain, which occur after the slaughtering of animals and the harvesting of crops. Emissions from drinks manufacturing include the production of alcoholic beverages, especially wine, beer and spirits. Emissions from the production of other alcoholic drinks are not covered.

It is recommended to use the product-based default emission factors (not background emission factors), since relevant activity statistics for these factors are more likely to be available.

Emission factors presented in this section are based on the following assumptions:

- 0.15 tonne of grain is required to produce 1 tonne of beer (Passant, 1993).
- Malt whiskies are typically matured for ten years. Grain whiskies are typically matured for six years. It is assumed that brandy is matured for three years and that other spirits are not matured.
- Beer is considered to be typically 4% alcohol by volume and to weigh 1 tonne per m^3.
- If no better data is available, spirits are assumed to be 40% alcohol by volume.
- Alcohol (ethanol) has a density of 789 kg/m^3.

Tier 2 emission factors are used for emission calculations. The relevant emission factors are given in the tables below (Table 4.13). The emission factor for rye bread and white bread production is the same (EF 5 kg/Mg NMVOC bread). Statistical data for white bread production (shortened process, emission factor 2 kg/Mg NMVOC bread), wholemeal bread production (EF 3 kg/Mg NMVOC bread) and light rye bread production (EF 3 kg/Mg NMVOC bread) is not available.

For spirits, the emission factor 0.4 kg/hl alcohol is chosen, since Estonia mainly produces vodka, the production of which does not involve maturation processes.

There are also some permitted fish processing companies (mainly smoking) that report NMVOC emissions. Some permit applications were studied (MasekoNord and Spratfil in Harju county) and it was found that NMVOC emission originates from smoke generators as a result of incomplete combustion and not from fish processing itself. Therefore, these emissions are different from the calculated NMVOC emission, which primarily occur from

the cooking of meat, fish and poultry, releasing mainly fats and oils and their degradation products.

Table 4.13. NMVOC emission factors for the food and drink industries

Product group (food and drink)	Emission factor	Unit
Bread	4.5	kg/Mg bread
Cakes, biscuits and breakfast cereals	1	kg/Mg product
Meat, fish and poultry etc. frying/curing	0.3	kg/Mg product
Meat processed	0.3	kg/Mg product
Fish processed	0.3	kg/Mg product
Margarine and solid cooking fats	10	kg/Mg product
Solid cooking fats	10	kg/Mg product
Margarine	10	kg/Mg feed
Animal feed	1	kg/Mg product
Wine	0.08	kg/hl wine
Beer	0.035	kg/hl beer
Other sprits	0.4	kg/hl alcohol
Crude spirits	0.4	kg/hl alcohol
Distilled spirits	0.4	kg/hl alcohol

Activity data

Information regarding food and drink production is available from Statistics Estonia (www.stat.ee) for the years 1990-2011 (Tables 4.14-4.15).

Table 4.14. Activity data for the food industries in the period 1990-2011 (thousand tonnes)

	Bread and pastry	Flour confectionery	Meat total (slaughter weight)	Fish total	Solid cooking fats	Margarine	Concentrated feeding stuffs
1990	151.0	14.9	182.5			6.6	851.8
1991	149.4	10.4	151.8			5.6	631.6
1992	138.6	5.0	107.9	132.00		0	303.5
1993	111.7	4.2	83.7	133.00		0.6	200.7
1994	109.3	5.5	69.4	120.80		0.1	184.6
1995	99.7	5.0	67.7	132.00	3.6	0.1	162.8
1996	93.9	5.6	58.6	108.70	4.8	0.1	97.6
1997	86.8	5.2	53.4	123.90	7.0		131.3
1998	81.6	4.3	60.0	119.30	7.2		151.7
1999	77.3	4.6	61.1	111.90	3.5		131.8
2000	76.5	4.4	53.3	113.40	0.8		133.3
2001	76.3	6.0	57.3	103.40	0.9		150.2
2002	77.2	7.4	68.3	101.00	0.9		167.1
2003	72.4	7.9	67.5	79.40	1.0		199.5
2004	72.8	9.0	71.3	84.50	1.6		207.3
2005	72.4	..	67.1	99.30	1.2		177.0
2006	74.4	9.4	69.4	90.60	..	..	208.9
2007	78.8	9.7	70.5	98.50	..	..	214.2
2008	77.6	8.9	74.6	101.70	..	..	229.5
2009	74.1	7.1	76.0	98.20	..	..	203.1
2010	73.7	8.4	75.4	95.95	..	..	203.0
2011	76.4	9.4	80.6	81.30	..	..	205.1

Table 4.15. Activity data for the drinks industries in the period 1990-2011 (thousand hl)

	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
1990	37.0	769.0	82.0	147.0
1991	50.9	675.5	83.4	160.5
1992	20.5	425.7	70.7	120.9
1993	13.0	419.3	94.1	168.4
1994	12.8	476.9	76.1	123.0
1995	14.0	499.6	91.0	176.0
1996	22.0	459.0	79.0	96.0
1997	21.5	543.0	77.0	109.0
1998	31.0	744.0	59.0	102.0
1999	24.0	957.0	32.0	66.0
2000	32.6	950.1	20.4	86.4
2001	30.4	1,015.2	24.1	115.2
2002	34.3	1,044.1	33.1	142.4
2003	34.5	1,040.2	38.3	173.1
2004	60.7	1,202.8	40.0	187.9
2005	88.8	1,342.5	37.1	167.9
2006	77.5	1,431.1	61.6	183.1
2007	53.5	1,411.6	39.3	216.0
2008	38.8	1,281.8	15.5	202.8
2009	40.4	1,223.0	1.3	186.6
2010	64.7	1,291.7	0.1	150.7
2011	73.3	1,358.8	13.3	169.2

4.6. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

Data from operators have been checked by the EEB and also by the EEIC.

4.7. Sources-specific planned improvements

- To allocate the historical emission from wood and furniture industries from NFR 2.A.7.d and 2.G and to include in NFR 2.D.3 Wood processing. This process demands certain efforts as corrections are necessary for carrying this out in a national point sources database.
- To provide uncertainty analysis.

5. SOLVENT AND OTHER PRODUCT USE (NFR 3)

5.1. Overview of the sector

5.1.1. Description

This chapter describes emissions from solvents and other product use. The use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC) when emitted into the atmosphere. In addition to solvents, this sector also includes the emissions of particles from product use.

In 2009-2010, the Estonian Environment Information Centre outsourced an expert opinion of the estimation of NMVOC emissions from diffuse sources, including NMVOC emissions from solvent and other product use. The most common method of estimating NMVOC emissions is the use of emissions factors. The emissions are estimated based on the production or activity level of the source from which an emission level is calculated using existing emission factors. The main database of emission factors is the EMEP/EEA air pollutant emission inventory guidebook (2009).

This sector covers emissions from solvent and other product use: Paint application (NFR 3.A), Degreasing and dry-cleaning (NFR 3.B), Chemical products, manufacturing and processing (NFR 3.C) and Other solvent use (NFR 3.D).

Air pollutants under NFR 3 in the Estonian inventory are presented in Table 5.1.

Table 5.1. Activities and emissions reported from the solvent and other product use sector in 2011

NFR	Source	Description	Emissions reported
3.A	**Paint application**		
	1. Decorative coating application	Includes emissions from paint application in construction and buildings and domestic use.	NMVOC
	2. Industrial coating application	Includes emissions from paint application in car repairing, boat building, wood coating and other industrial paint application.	NMVOC, NO_x, TSP, PM_{10}, $PM_{2.5}$, CO
	3. Other coating application	Emissions from this sector are allocated to 3A1 since separation is not possible with current information.	NMVOC (IE)
3.B	**Degreasing and dry cleaning**		
	1. Degreasing	Includes emissions from degreasing (vapour and cold cleaning), electronic components manufacturing and other industrial cleaning.	NMVOC, TSP, PM_{10}, $PM_{2.5}$, Pb, Cr, Cu
	2. Dry cleaning	Includes emissions from dry cleaning.	NMVOC
3.C	**Chemical products**		
	1. Chemical products	Includes emissions from polyurethane, polystyrene foam and rubber processing, paints, inks and glues manufacturing, textile finishing, leather tanning and other use of solvents.	NMVOC, NH_3, SO_x, TSP, PM_{10}, $PM_{2.5}$, CO, Cr, Zn

NFR	Source	Description	Emissions reported
3.D	**Other product use**		
	1. Printing	Emissions from solvents in printing houses.	NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO
	2. Domestic solvent use including fungisides	NMVOC emissions from domestic solvent use.	NMVOC
	3. Other product use	Includes emissions from oil extraction, application of glues and adhesives, preservation of wood, use of tobacco and other solvent use.	NMVOC, NO_x, SO_x, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, As, Cr, Cu, PCDD/PCDF, PAHs (Total)

5.1.2. Quantitative overview of NMVOCs

In 2011, the solvent and other product use sector was the largest pollution source of NMVOC emissions in Estonia after the non-industrial combustion and it accounted for over 19% of total NMVOC emissions. The largest share was for decorative coating application at 26.7%, with the others being domestic solvent use at 21.1%, degreasing 16.3%, industrial coating application 13.6%, other product use 11.5%, printing 5.4%, chemical products 4.9% and dry cleaning 0.3% (Figure 5.1).

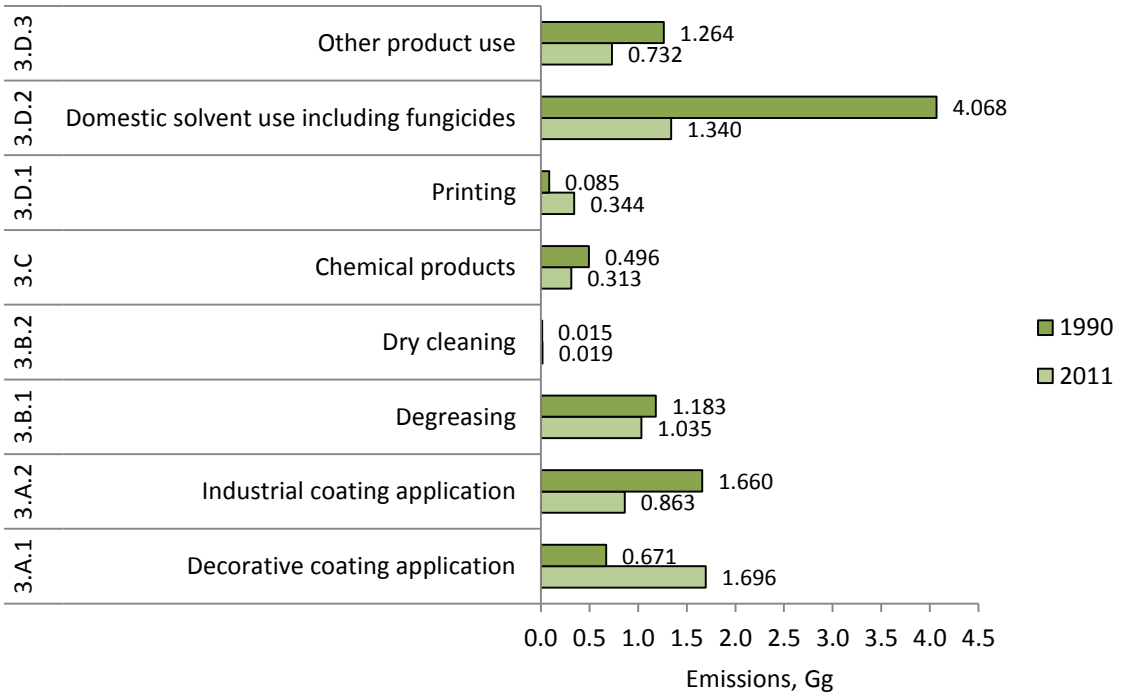

Figure 5.1. NMVOC emissions by sectors in 1990 and 2011

There has been a decrease in trends in NMVOC emissions from solvent and other product use in recent years. Since 1990, NMVOC emissions have decreased in the NFR 3 sector by 32.8% (Figure 5.2). The trend in emissions is determined, in order of importance, by categories 3.A (Paint Application) and 3.D (Other Product Use). Two major categories where the decreasing of NMVOC emissions has occurred in recent years include paint application (3.A.1) and other product use (3.D.3). The fluctuation of NMVOC emissions in the period 1990-2011 has mostly occurred due to the welfare of the economic state of the country. The

decrease in emissions between 1991 and 1993 was due to the renewed independece of the Estonian Republic and the cessation of large-scale production that was distinctive to the Soviet Union. Between 1993 and 1998, the economic growth induced the growing usage of NMVOC containing paints in decorative and industrial coating applications. At the end of 1998, the world was struck by an economic crisis that affected the construction sector and this had a knock-on effect on the usage of decorative coatings. From 2001, the economy began to grow again until 2008, when the world suffered its worst ever economic depression. As a result, by the year 2010, NMVOC emissions fell 40% in comparison with 2006 (Figure 5.3). In 2011 there was a slight increase in NMVOC emissions by 10.9%, which means that the bottom of the emissions has been reached and henceforward the emissions will start to rise again. In 2004 and 2005 Estonia adopted directives 1999/13/EC and 2004/42/EC into its legislation, but it seems that the economic growth at the time did not have a significant affect on decrease in NMVOC emissions and they grew steadily until the economic depression. One reason why the possible positive effect of the legislation did not manifest on the graph is because the emissions from the point sources that are calculated more precisely by the facilities than the emissions from the diffuse sources, represent only about 20% of total NMVOC emissions.

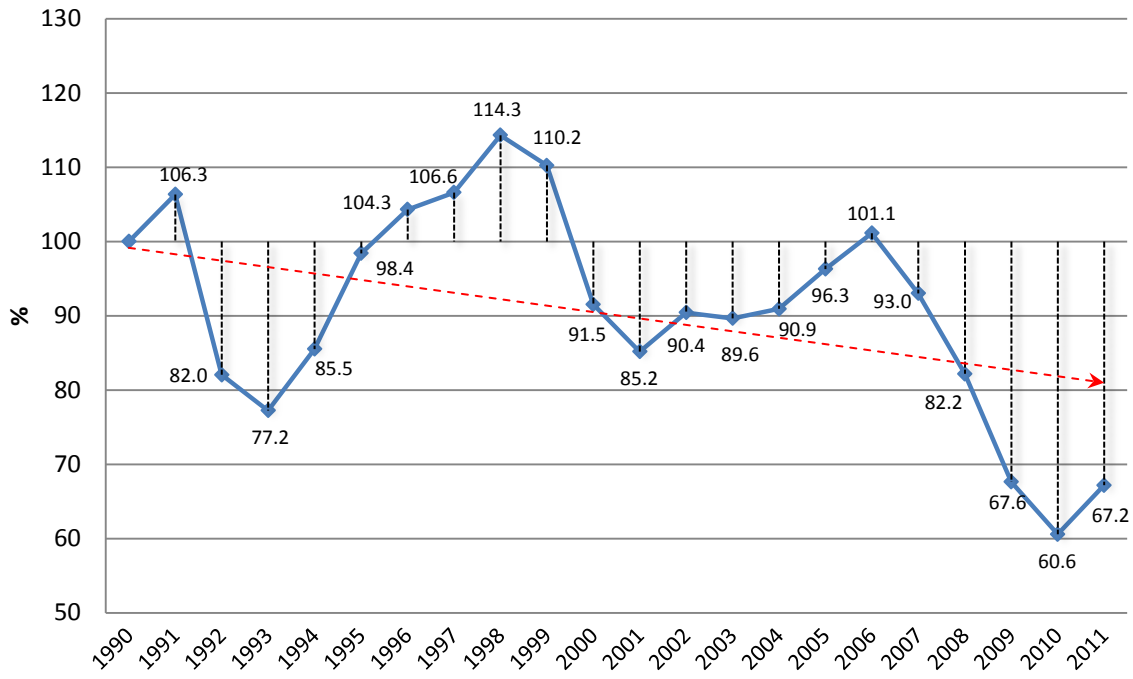

Figure 5.2. The dynamics of NMVOC emissions from the solvent and other product use sector in the period 1990-2011 (base year is 1990)

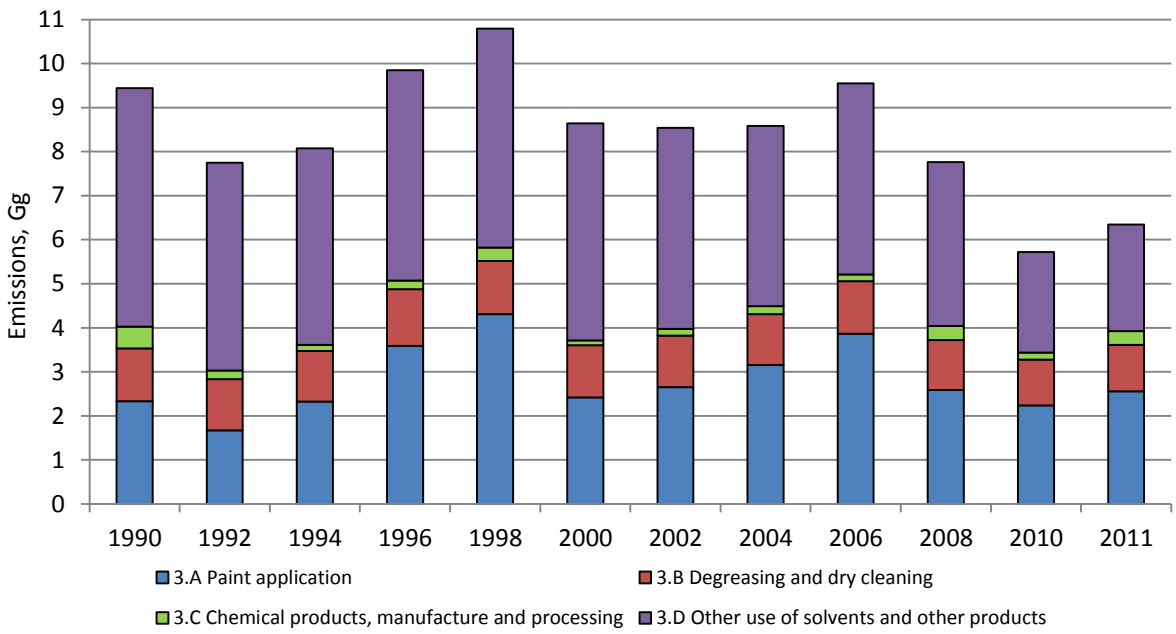

Figure 5.3. NMVOC emissions from the solvent and other product use sector in the period 1990-2011

Table 5.2. NMVOC emissions in the period 1990-2011 reported under NFR 3 (Gg)

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3.A.1	0.671	0.730	0.968	0.989	1.794	2.153	2.740	3.108	3.031	3.063	1.913
3.A.2	1.660	2.017	0.705	0.550	0.529	1.010	0.851	0.898	1.281	0.974	0.505
3.A.3	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
3.B.1	1.183	1.169	1.149	1.124	1.136	1.157	1.258	1.223	1.178	1.173	1.139
3.B.2	0.015	0.012	0.011	0.012	0.018	0.025	0.030	0.005	0.024	0.050	0.050
3.C	0.496	0.615	0.201	0.135	0.135	0.250	0.197	0.192	0.307	0.217	0.107
3.D.1	0.085	0.071	0.058	0.062	0.097	0.136	0.132	0.190	0.209	0.250	0.263
3.D.2	4.068	4.060	4.027	3.914	3.825	3.751	3.691	3.642	3.608	3.572	3.554
3.D.3	1.264	1.365	0.628	0.505	0.540	0.810	0.949	0.808	1.154	1.111	1.111

[1] Included in 3.A.1

Sector	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3.A.1	1.811	2.037	2.220	2.522	2.891	2.953	2.747	1.639	1.434	1.470	1.696
3.A.2	0.447	0.617	0.558	0.623	0.733	0.914	1.017	0.950	0.622	0.765	0.863
3.A.3	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
3.B.1	1.097	1.118	1.096	1.093	1.093	1.124	1.094	1.084	1.008	1.029	1.035
3.B.2	0.047	0.056	0.064	0.064	0.062	0.065	0.054	0.051	0.022	0.012	0.019
3.C	0.113	0.151	0.127	0.184	0.125	0.158	0.265	0.314	0.497	0.164	0.313
3.D.1	0.306	0.334	0.412	0.583	0.774	0.666	0.491	0.773	0.228	0.354	0.344
3.D.2	3.103	2.654	2.224	1.783	1.348	1.345	1.342	1.341	1.340	1.340	1.340
3.D.3	1.113	1.574	1.763	1.728	2.065	2.323	1.772	1.607	1.233	0.587	0.732

[1] Included in 3.A.1

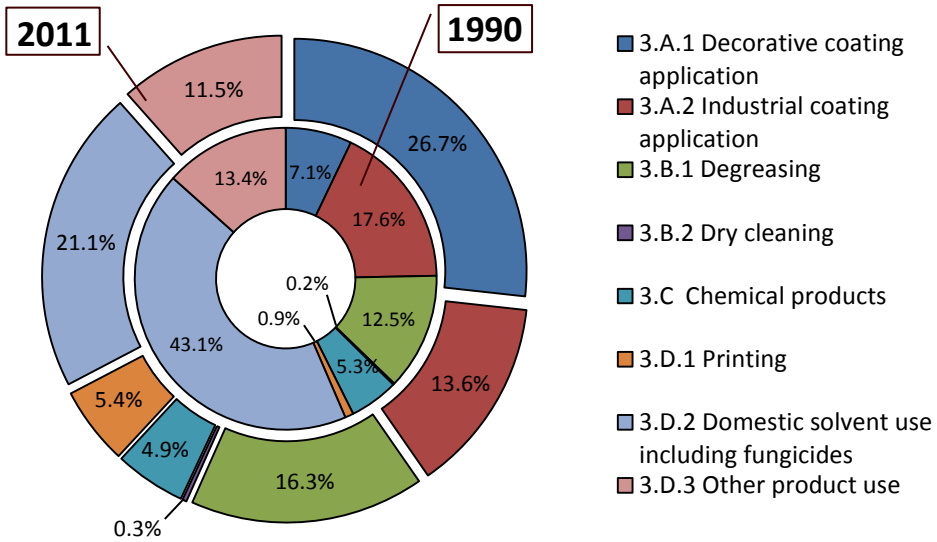

Figure 5.4. The share of NMVOC emissions in 1990 and 2011 by NFR 3 subcategory codes

5.1.3. Methods

NMVOC emission estimations from solvent and other product use are based on several data sources and methods. Emissions from point sources are gathered from the web-based air emissions data system for point sources (OSIS) and the emissions for diffuse sources are calculated from the data received from Statistics Estonia using international emission factors and expert opinions. Information sources for the NMVOC inventory by different sub-categories are presented in the next table together with emission sources not included in the inventory.

Table 5.3. Information sources for the NMVOC inventory under NFR 3

NFR	Product group	SNAP	Activity where used	Reference	NMVOC emission factors
3.A.1	Decorative coating application: Solvents in paints	060103	Construction and buildings	Statistics Estonia and expert estimate	150 g/kg of paint applied*
		060104	Domestic use	Statistics Estonia and expert estimate	
3.A.2	Industrial coating application: Solvents in paints	060101	Manufacture of automobiles	Reported by operators (not occured in 2009)	
		060102	Car repairing	Expert estimate; reported by operators	400 g/kg paint applied*
		060105	Coil coating	Included in 3.A.1	
		060106	Boat building	Reported by operators	
		060107	Wood coating	Reported by operators	
		060108	Other industrial paint application	Reported by operators	
3.A.3	Other coating application: Solvents in paints	060109	Other non-industrial paint application	Included in 3.A.1	

NFR	Product group	SNAP	Activity where used	Reference	NMVOC emission factors
3.B.1	Degreasing: Solvents in products	060200	Degreasing (vapour and cold cleaning)	Statistics Estonia	460 g/kg cleaning products (vapour)*; 0.7 kg/person/year (cold)*
		060201	Metal degreasing (regarded as vapour cleaning)	Reported by operators	
		060203	Electronic components manufacturing	Reported by operators	
		060204	Other industrial cleaning	Reported by operators	
3.B.2	Dry cleaning: Chlorinated solvents in products	060202	Dry cleaning	Statistics Estonia; reported by operators	400 g/kg solvent use*
3.C	Solvents in chemical products manufacture and processing	060301	Polyester processing	Not included	
		060302	Polyvinylchloride processing	Not included	
		060303	Polyurethane processing	Reported by operators	
		060304	Polystyrene foam processing	Reported by operators	
		060305	Rubber processing	Reported by operators	
		060306	Pharmaceutical products manufacturing	Not included	
		060307	Paints manufacturing	Reported by operators	
		060308	Inks manufacturing	Reported by operators	
		060309	Glues manufacturing	Reported by operators	
		060310	Asphalt blowing	Not included	
		060311	Adhesive, magnetic tapes, films and photographs manufacturing	Not included	
		060312	Textile finishing	Reported by operators	
		060313	Leather tanning	Reported by operators	
		060314	Other	Reported by operators	
3.D.1	Solvents in printing houses	060403	Printing industry	Statistics Estonia; reported by operators	500 g/kg ink*
3.D.2	Personal care, household cleaning agents, motor & vehicle cleaning agents, adhesives and sealants	060408	Domestic solvent use (other than paint application)	Statistics Estonia	1 kg/person/year*

NFR	Product group	SNAP	Activity where used	Reference	NMVOC emission factors
3.D.3	Solvents in other product use	060401	Glass wool enduction	Not included	
		060402	Mineral wool enduction	Not included	
		060404	Fat, edible and non edible oil extraction	Reported by operators	
		060405	Application of glues and adhesives	Statistics Estonia; reported by operators	780 g/kg adhesives*
		060406	Preservation of wood	Reported by operators	
		060407	Underseal treatment and conservation of vehicles	Not included (emissions are considered negligible since 2005)	
		060409	Vehicles dewaxing	Not included (emissions are negligible)	
		060411	Domestic use of pharmaceutical products	Not included	
		060412	Other (preservation of seeds,…)	Reported by operators	
		060602	Use of tobacco	Statistics Estonia	4.8 g/t tobacco*

*EF's for diffuse sources

Emissions that are other than NMVOC are taken from the OSIS database (reported by operators).

The facilities that are obliged to have an ambient air pollution permit or IPPC permit submit their annual air emissions and activity data into OSIS database by point sources. The ambient air pollution permit is required for facilities where total NMVOC emissions are 0.1 tonnes or more.

The data that is collected in the annual air emissions report for the solvent use are:

- Class – solvent, varnish, adhesive, paint or other preparation that don't fall under any other previously named categories, such as hardeners, stains, resins, etc.;
- Type – water based (WB) or solvent based (SB);
- Total NMVOC content of the used chemical in mass%;
- Activity or technological process by EMTAK (Estonian classification of economic activities) and SNAP codes where the reported chemical has been used;
- The annual consumption of solvent or solvent containing preparation in tonnes per year;
- Emissions of pollutants by the used solvent or solvent containing preparation – CAS number, name of the substance, maximum emissions in grammes per second, NMVOC emissions in tonnes per year;
- The number of a source of pollution on a plan or map of the facility.

5.2. Paint Application (NFR 3.A)

5.2.1. Source category description

The use of paint is a major source of NMVOC emissions; they comprise about 9% of total NMVOC emissions in the CORINAIR90 inventory. This number may have changed over time, but it is certain that paint use is still one of the main sources of NMVOC. The use of paints is generally not considered relevant for emissions of particulate matter or heavy metals and POPs.

Most paints contain organic solvent, which must be removed by evaporation after the paint has been applied to a surface in order for the paint to dry or 'cure'. Unless captured and either recovered or destroyed, these solvents can be considered to be emitted into the atmosphere. Some organic solvent may be added to coatings before application and will also be emitted. Further solvent that is used for cleaning coating equipment is also emitted.

The proportion of organic solvent in paints can vary considerably. Traditional solvent borne paints contain approximately 50% organic solvents and 50% solids. In addition, more solvent may be added to further dilute the paint before application. High solids and water borne paints both contain less organic solvent, typically less than 30%, while powder coatings and solvent free liquid coatings contain no solvent at all.

The most important pollutant released from painting activities is NMVOC. Particulate matter can also be emitted where spraying is used as an application technique; however, many spraying operations are carried out in spray booths fitted with some type of particulate arrestment device. As mentioned earlier, heavy metal compounds, used as pigments, could be emitted into the air; however, no emission factors are available.

Due to the wide range of paint applications and the even larger number of paint formulations that are available, there must be considerable scope for uncertainty in emission factors. Due to developments in paint formulation, the emission factors may only be valid for a short period. Therefore, improved emission factors are especially required for controlled processes.

Another aspect is the variation of paint types. This requires good activity data, which may not be present, particularly with the increasing use of alternatives to high solvent paints.

By 2011, NMVOC emissions from this sector had increased by 9.8% compared to 1990.

5.2.1.1. Decorative coating application (3.A.1)

This section refers to two sub-categories of paint application:

- Paint application: construction and buildings (SNAP activity 060103)

This category refers to the use of paints for architectural application by construction enterprises and professional painters.

- Paint application: domestic use (SNAP activity 060104)

This category refers to the use of paints for architectural or furniture applications by private consumers. It is good practice not to include other domestic solvent use. However, it is sometimes difficult to distinguish between solvents used for thinning paints and solvents used for cleaning.

5.2.1.2. Industrial coating application (3.A.2)

This section describes the following sub-categories of paint application:

1) manufacture of automobiles (SNAP activity 060101);
2) car repairing (SNAP activity 060102);
3) coil coating (SNAP activity 060105);
4) boat building (SNAP activity 060106);
5) wood (SNAP activity 060107)
6) and other industrial paint application (SNAP activity 060108).

Most of the sub-categories are expected to be covered by air pollution permits. The only sector that is not expected to be covered by air pollution permits is car repairing.

5.2.1.3. Other coating application (3.A.3)

This category refers to the use of high performance protective and/or anti corrosive paints applied to structural steel, concrete and other substrates together with any other non-industrial coatings that are not covered by any of the other SNAP codes described in the "Paint application" section. The sector includes coatings for offshore drilling rigs, production platforms and similar structures as well as road marking paints and non-decorative floor paints. Most paint is applied in-situ by brushing, rolling or spraying, although a significant proportion of new-construction steelwork may be coated in-store.

It is estimated that this sector is not very important and emissions are estimated with 3.A.1 (decorative coating application). It is also very complicated to distribute paint use between 3.A.1 and 3.A.3.

5.2.2. Methodological issues

The Tier 1 default emission factors have been taken from the online version of the GAINS model (IIASA, 2008). A (rounded) weighted average emission factor over all the countries in the model have been derived from dividing total NMVOC emissions by total paint use. Data for the year 2000 has been used in order to estimate an average emission factor to describe the situation; however, care should be taken when applying this emission factor. Due to EU directive 2004/42/EC, which came into force on 1 January 2007, it is no longer permitted to bring decorative or vehicle refinishing paint products to the market with a VOC content that exceeds the maximum for those product categories in EU Member States. For non-EU

countries, however, emissions may be significantly higher than the estimate provided here. This has been taken into account in the 95% confidence intervals. These are expert judgements based on former values and the more specific implied emission factors from GAINS.

Emissions from the industrial coating application sector have been significantly reduced by the introduction of the European Solvents Directive (1999/13/EC).

In Estonia, directive 2004/42/EC was implemented in 2005 and came into force in 2007 (I stage) and 2010 (II stage). The Solvents Emissions Directive (1999/13/EC) was implemented in 2004 and came into force in 2004 (2007 for existing installations).

5.2.2.1. Decorative coating application (3.A.1)

For the years 2000-2009, EMEP Guidebook 2009 Tier 1 emission factor 150 g/kg paint applied is used for calculations. The following equation is applied:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

$E_{pollutant}$ = the emission of the specified pollutant

$AR_{production}$ = the activity rate for the paint application (consumption of paint)

$EF_{pollutant}$ = the emission factor for this pollutant

For the years 1990-1999, Corinair (2000) emission factors are used for calculations. As this guidebook provides different emission factors for solvent borne and water borne paints, an averaged emission factor is calculated by taking into account the proportion of solvent borne and water borne paints used.

The NMVOC emission factor for decorative solvent borne paints (all) is 300-400 g/kg of paint (average 350 g/kg is used) and for water borne paints is 33 g/kg of paints.

Precise division by solvent borne and water borne paint production is not known. The ratio is estimated by production for the year 2000, when approximately 55% of paint produced was solvent borne and 45% was water borne. By also taking import and export data into account, it was estimated that 56% of decorative paint used in 1995 was solvent borne and 46% of paint was water borne.

The weighted average emission factor for the years 1990-1999 can be calculated as follows:

(58% x 350 g/kg + 42% x 33 g/kg) / 100% = 211 g/kg of paint

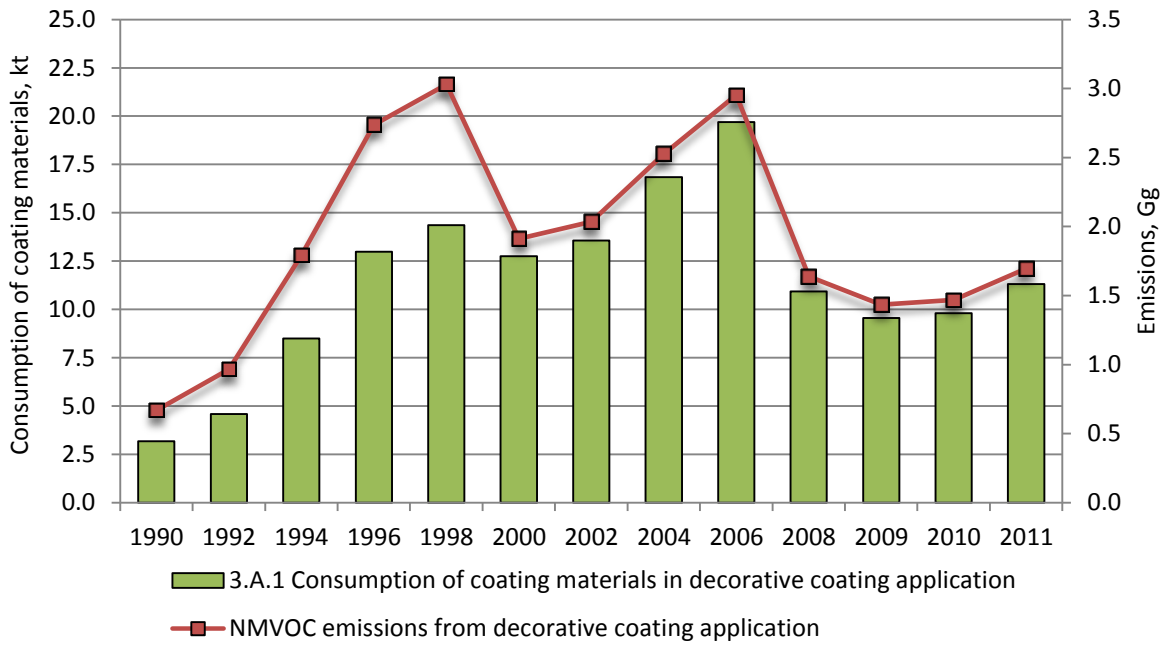

Figure 5.5. Consumption of coating materials and NMVOC emissions from decorative coating application in the period 1990-2011

5.2.2.2. Industrial coating application (3.A.2)

For the years 2000-2011, EMEP Guidebook 2009 Tier 1 emission factor 400 g/kg paint applied is used for calculations. The following equation is applied:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

$E_{pollutant}$ = the emission of the specified pollutant

$AR_{production}$ = the activity rate for the paint application (consumption of paint)

$EF_{pollutant}$ = the emission factor for this pollutant

For years 1990-1999, Corinair (2000) emission factor is used for calculations.

Different emission factors are proposed for vehicle refinishing (in the 280-700 g/kg range of paint, no abatement included). The emission factor 600 g/kg of paint is chosen as three different factors are similar to this value.

Since 2006, detailed NMVOC emissions from point sources with activity data are reported by operators and collected into the OSIS database by SNAP codes.

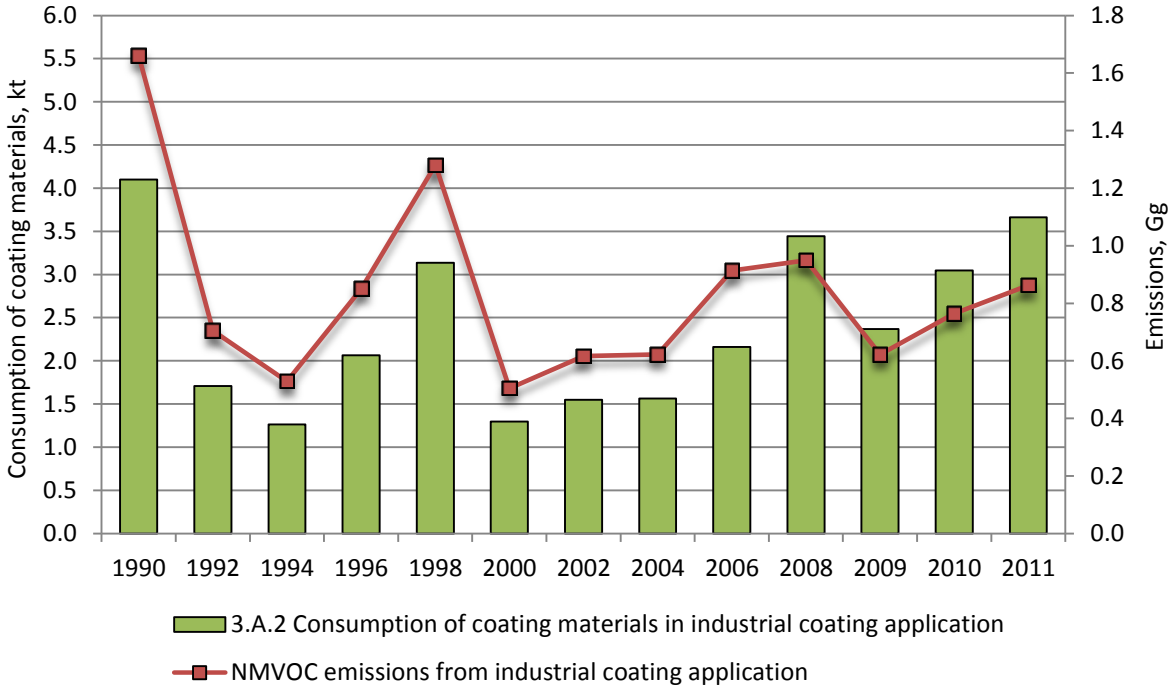

Figure 5.6. Consumption of coating materials and NMVOC emissions from industrial coating application in the period 1990-2011

The huge drop in paint consumption and NMVOC emissions in 1992 (Figure 5.6) was due to the renewed independence of the Estonian Republic and the cessation of large-scale production that was distinctive to the Soviet Union. There was a huge restructuring in industry and many of the big enterprises went bankrupt and were shut down because of inefficient operation.

NMVOC emissions and activity data in Figure 5.6 are based on data that are presented in Table 5.5.

5.2.2.3. Activity data

The quantity of paints and lacquers used in total in Estonia is estimated according to the import and export data (CN codes 3208, 3209 and 3210) and production data (total amount of paints and lacquers) from Statistics Estonia.

Data related to import and export are not available for the years 1990-1994; therefore, these amounts were calculated using the change of the current prices in that time in industrial production of chemicals and chemical products.

Some paint is used by point sources (permitted companies) and most of the remaining paint is used for decorative coating application (3.A.1). Also, some of the paint is used for car repairing (3.A.2).

There is no statistical information regarding the amount of paint used for car repairing. Therefore, expert opinion was sought from a representative of the Association of Estonian Automobile Sales and Maintenance Companies “repair unit”.

The expert opinion was received from Benefit AS, which is the leading car body and car paint shops technology and materials supplier in Estonia. The total amount of paint used for car repairing in Estonia is estimated to have risen from 100 tonnes in 1990 up to 193.6 tonnes in 2011. As this is a rough estimate, the annual growth is estimated to be equal.

The paint use for decorative coating application is estimated in the following way:

Paint used for decorative coating application = total paint use – paint used by all point sources – paint used by car repairing (diffuse part)

It is unknown how much paint has been used by permitted companies between 1990 and 2005. Therefore, a reverse calculation is carried out, taking into account the emission factor for industrial coating application (400 g/kg NMVOC paint applied).

Sub-sectors have moved under NFR codes 3.A.1 and 3.A.2. Therefore, all reported emissions from point sources are estimated to be from industrial coating applications (3.A.2).

Data regarding paint use in point sources is available in the OSIS database for the years 2006-2011.

Decorative paint is used by construction enterprises, professional painters (SNAP 060103) and private consumers (SNAP 060104) (Table 5.4).

In order to divide paint between these groups, paint production companies and construction stores were contacted.

The main paint production companies were not able to give an answer to this question. Some of them do not have a direct sales department.

Also, large construction stores were contacted and in interviews it was found that:

- Sales division by companies and private customers depends on the marketing policy of the store,
- A change in the division between 1995 and 2011 also depends on the marketing policy,
- In the years 2004-2007, an increase of paint use was mainly caused by the rapid increase in developments and construction; the increased use of paint was mainly caused by professional painters and construction companies.

As a result of the discussions, it is estimated that up to 60% of paint can be assigned to professional painters and the remaining 40% to private customers.

In the period from 2001 to 2007, there was a lot of development and construction in Estonia and it is estimated that the private use of paints was similar to the amount used in 2000.

Therefore, the following assumptions were made:

- For the years 1990-2003 and 2008-2011, it is estimated that up to 60% of paint went to professional painters and the remaining 40% to private customers;
- Consumption among private consumers in 2005-2007 is assumed to be equal to consumption in 2000, and the remaining part is deemed used by professional painters and construction companies. 2004 is a transitional year between 2003 and 2005.

Table 5.4. NMVOC emissions and the consumption of coating materials from paint application by SNAP codes in the period 1990-2011 (NFR 3.A.1)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060103	NMVOC emissions	Gg	0.402	0.438	0.581	0.594	1.076	1.292	1.644	1.865	1.819	1.838	1.148
	Activity data	kt	1.908	2.076	2.752	2.813	5.101	6.122	7.790	8.838	8.620	8.710	7.654
060104	NMVOC emissions	Gg	0.268	0.292	0.387	0.396	0.718	0.861	1.096	1.243	1.213	1.225	0.765
	Activity data	kt	1.272	1.384	1.835	1.876	3.401	4.081	5.194	5.892	5.747	5.807	5.102

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060103	NMVOC emissions	Gg	1.090	1.221	1.332	1.688	2.126	2.188	1.982	0.983	0.861	0.882	1.018
	Activity data	kt	7.266	8.139	8.881	11.250	14.169	14.588	13.213	6.554	5.737	5.880	6.786
060104	NMVOC emissions	Gg	0.727	0.814	0.888	0.840	0.765	0.765	0.765	0.655	0.574	0.588	0.679
	Activity data	kt	4.844	5.426	5.920	5.600	5.100	5.100	5.100	4.370	3.825	3.920	4.524

Table 5.5. NMVOC emissions and consumption of coating materials from paint application by SNAP codes in the period 1990-2011 (NFR 3.A.2)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060100	NMVOC emissions	Gg	1.575	1.955	0.639	0.428	0.430	0.795	0.626	0.610	0.976	0.689	
	Activity data	kt	3.938	4.887	1.598	1.071	1.076	1.989	1.565	1.526	2.439	1.721	
060102	NMVOC emissions	Gg	0.060	0.063	0.065	0.068	0.071	0.073	0.076	0.078	0.081	0.084	0.058
	Activity data	kt	0.100	0.104	0.109	0.113	0.118	0.122	0.126	0.131	0.135	0.140	0.178
060106	NMVOC emissions	Gg											0.117
	Activity data	kt											0.292
060107	NMVOC emissions	Gg				0.054	0.027	0.047	0.037	0.097	0.110	0.088	0.119
	Activity data	kt				0.135	0.067	0.119	0.093	0.243	0.276	0.220	0.298
060108	NMVOC emissions	Gg	0.025				0.001	0.094	0.112	0.112	0.113	0.113	0.211
	Activity data	kt	0.063				0.004	0.236	0.280	0.280	0.284	0.284	0.528

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060101	NMVOC emissions	Gg					0.002	0.003	0.002				
	Activity data	kt					0.004	0.006	0.002				
060102	NMVOC emissions	Gg	0.059	0.061	0.063	0.065	0.066	0.068	0.072	0.073	0.075	0.076	0.077
	Activity data	kt	0.175	0.161	0.164	0.170	0.169	0.170	0.178	0.183	0.187	0.191	0.196
060106	NMVOC emissions	Gg	0.116	0.080	0.082	0.137	0.131	0.171	0.357	0.335	0.160	0.157	0.135
	Activity data	kt	0.290	0.201	0.206	0.342	0.329	0.505	1.126	1.024	0.477	0.575	0.470
060107	NMVOC emissions	Gg	0.218	0.244	0.184	0.209	0.184	0.407	0.439	0.369	0.302	0.409	0.463
	Activity data	kt	0.544	0.611	0.461	0.523	0.459	0.828	1.191	1.188	1.362	1.552	2.056
060108	NMVOC emissions	Gg	0.054	0.231	0.229	0.212	0.350	0.265	0.147	0.173	0.085	0.123	0.188
	Activity data	kt	0.136	0.577	0.572	0.530	0.874	0.650	0.659	1.050	0.343	0.730	0.938

NMVOC emissions given in Table 5.5 are collected from point sources. Emissions for the period 1990-1999 are received from facilities on paper reports and emissions for the period 2000-2005 were submitted into the CollectER database by an air specialist, but they are also based on the paper reports received from facilities and since 2006 detailed emissions and activity data are reported electronically by facilities directly into the OSIS database.

5.2.3. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends has been carried out. Calculated emissions and emission data from the OSIS database have been compared to the previous years in order to detect calculation errors, errors in the reported data or in allocation. The reasons behind any fluctuation in the emission figures have been studied. The data reported and entered into the OSIS database by operators is firstly checked by specialists from the EEB and then by the specialists in the EEIC.

5.2.4. Source-specific planned improvements

Some corrections and recalculations of the NMVOC emissions for the years 1990-1999 are planned. Primarily, they will concern the emissions currently under SNAP 060100. They need to be distributed under the correct SNAP code. Also, the emissions under the SNAP codes 060107 and 060108 need to be reviewed for that period.

5.3. Degreasing and dry cleaning (NFR 3.B)

5.3.1. Source category description

5.3.1.1. Degreasing (NFR 3.B.1)

The metalworking industries are the major users of solvent degreasing. Solvent degreasing is also used in industries such as printing and in the production of chemicals, plastics, rubber, textiles, glass, paper, and electric power. Also, repair stations for transportation vehicles use solvent cleaning on occasion.

The contribution of metal degreasing to total NMVOC emissions (including natural sources) is about 1.8% in CORINAIR countries (CORINAIR 1990 inventory). In addition, metal degreasing could be a significant source of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (ETC/AEM-CITEPA-RISOE, 1997).

Metal degreasing by using organic solvents takes place in either open top or closed tanks. The open top tanks, however, have been phased out in the European Union due to the Solvents Emissions Directive 1999/13/EC. Only small facilities, which use no more than 1 or 2 tonnes of solvent per year (depending on the risk profile of the solvent), are still permitted to use open top tanks. Closed tanks offer much better opportunities for the recycling of solvents.

In 2011, NMVOC emissions from the NFR 3.B sector had decreased by 12.5% in comparison to the year 1990.

5.3.1.1.1. Vapour cleaning

The most common organic solvents for vapour cleaning are:

- methylene chloride (MC)
- tetrachloroethylene (PER)
- trichloroethylene (TRI)
- xylenes (XYL)

The use of CFC in the past is now displaced by HFCs or PFCs. The use of 1,1,1,-trichloroethane (TCA) has been banned since the Montreal Protocol and replaced by trichloroethylene (TRI). Further details about the calculation of the emissions can be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006). The application of methylene chloride, tetrachloroethylene and trichloroethylene normally requires a closed cleaning machine.

5.3.1.1.2. Cold cleaning

The two basic types of cold cleaners are maintenance and manufacturing. Cold cleaners are batch loaded, non-boiling solvent degreasers, usually providing the simplest and least

expensive method of metal cleaning. Maintenance cold cleaners are smaller, more numerous, and generally use petroleum solvents as mineral spirits (petroleum distillates and Stoddard solvents).

Cold cleaner operations include spraying, brushing, flushing, and immersion. In a typical maintenance cleaner, dirty parts are cleaned manually by first spraying and then soaking in the tank. After cleaning, the parts are either suspended over the tank to drain or are placed on an external rack that directs the drained solvent back into the cleaner. The cover is intended to be closed whenever parts are not being handled in the cleaner. Typical manufacturing cold cleaners vary widely in design, but there are two basic tank designs: the simple spray sink and the dip tank. Of these, the dip tank provides more thorough cleaning through immersion, and often cleaning efficiency is improved by agitation. Small cold cleaning operations may be numerous in urban areas.

5.3.1.2. Dry cleaning (NFR 3.B.2)

Dry Cleaning refers to any process to remove contamination from furs, leather, down leathers, textiles or other objects made of fibres, using organic solvents.

Emissions arise from evaporative losses of solvent, primarily from the final drying of the clothes, known as deodorisation. Emissions may also arise from the disposal of wastes from the process.

The most widespread solvent used in dry cleaning, accounting for about 90% of total consumption, is tetrachloroethene (also called tetrachloroethylene or perchloroethylene (PER)). The most significant pollutants from dry cleaning are NMVOCs, including chlorinated solvents. Heavy metal and POP emissions are unlikely to be significant.

5.3.2. Methodological issues

5.3.2.1. Degreasing

The Tier 1 methodology for emissions from degreasing is based on solvent sales data, in combination with assumptions about the distribution over the different environmental compartments (emissions to air, water, soil and conversion to waste).

If total solvent sales are not known, the following two approaches are applied.

1) vapour cleaning – consumption of most common organic solvents for vapour cleaning (according to the EMEP Guidebook 2009) are considered for emission calculations;

2) cold cleaning – emission from the rest of vapour cleaning is estimated by different emission factors by inhabitant.

5.3.2.1.1. Emission factor for vapour cleaning

Tier 1 emission factor 460 g/kg cleaning products are used for calculations. The following equation is applied:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

$E_{pollutant}$ = the emission of the specified pollutant

$AR_{production}$ = the activity rate for the paint application (consumption of paint)

$EF_{pollutant}$ = the emission factor for this pollutant

5.3.2.1.2. Emission factor for cold cleaning

The emission factor used for cold cleaning is 0.7 kg/kg, which is an expert estimate by the VTT Technical Research Centre of Finland[6].

5.3.2.1.3. Activity data

Vapour cleaning operations

Consumption of the most common organic solvents for vapour cleaning methylene chloride (MC), tetrachloroethylene (PER), trichloroethylene (TRI) and xylenes (XYL) is used as a basis for emission calculations from vapour cleaning.

As PER is also used for dry cleaning, this is not included as a degreaser.

The consumption of organic solvents is estimated by the import and export data from Statistics Estonia (by relevant CN codes). Data regarding import and export is not available for the years 1990-1994; therefore, these amounts were calculated by the change of percentage of the current prices in the industrial production of chemicals and chemical products in that period. There is no information available regarding production for the years 1990-2005. The OSIS database provides some information regarding xylenes production between 2006 and 2011.

Cold cleaning operations

The basic activity statistics for using the Finnish emission factor are national population figures.

Data regarding population by counties is available from Statistics Estonia.

[6] SYKE (2011). Air Pollutant Emissions in Finland 1980-2009. Informative Inventory Report. p 252.

5.3.2.1.4. Results

Part of the facilities report NMVOC emissions from degreasing operations as point sources. These are taken into account in the calculations of vapour cleaning operations.

Between 2006 and 2011, activity data regarding solvent use for degreasing in point sources was gathered in the OSIS database.

For the years 2006-2011, activity data for calculations is calculated as follows:

Solvent use in diffuse sources = total solvent use – solvent use in point sources

There were some companies reporting emissions between 1995 and 2005, but no activity data is available. Emissions from point sources are subtracted from the total calculated VOC emission.

Table 5.6. NMVOC emissions and the consumption of solvents from degreasing by SNAP codes in the period 1990-2011 (NFR 3.B.1)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060200	NMVOC emissions **(vapour cleaning)**	Gg	0.084	0.071	0.061	0.067	0.102	0.143	0.260	0.239	0.203	0.207	0.178
	Activity data	kt	0.183	0.155	0.132	0.145	0.223	0.312	0.566	0.519	0.440	0.451	0.387
060200	NMVOC emissions **(cold cleaning)**	Gg	1.099	1.097	1.088	1.058	1.034	1.014	0.998	0.984	0.975	0.965	0.960
	Activity data	mln. inhab.	1.571	1.568	1.555	1.511	1.477	1.448	1.425	1.406	1.393	1.379	1.372
060203	NMVOC emissions	Gg											0.001
	Activity data	kt											0.001

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060200	NMVOC emissions **(vapour cleaning)**	Gg	0.137	0.160	0.142	0.141	0.146	0.157	0.128	0.099	0.046	0.058	0.057
	Activity data	kt	0.298	0.347	0.308	0.306	0.318	0.342	0.277	0.216	0.099	0.127	0.124
060200	NMVOC emissions **(cold cleaning)**	Gg	0.957	0.953	0.949	0.946	0.943	0.941	0.940	0.939	0.938	0.938	0.938
	Activity data	mln. inhab.	1.367	1.361	1.356	1.351	1.348	1.345	1.342	1.341	1.340	1.340	1.340
060201	NMVOC emissions	Gg	0.001	0.003	0.002	0.003	0.000	0.002	0.005	0.001	0.006	0.011	0.007
	Activity data	kt	0.002	0.006	0.005	0.007	0.001	0.003	0.006	0.001	0.007	0.012	0.008
060203	NMVOC emissions	Gg	0.002	0.002	0.002	0.003	0.003	0.018	0.009	0.013	0.005	0.005	0.005
	Activity data	kt	0.004	0.005	0.005	0.006	0.006	0.056	0.021	0.026	0.008	0.008	0.008
060204	NMVOC emissions	Gg	0.001	0.000	0.001	0.000	0.001	0.005	0.013	0.032	0.012	0.016	0.027
	Activity data	kt	0.001	0.001	0.001	0.000	0.001	0.006	0.014	0.038	0.018	0.020	0.028

For the SNAP code 060201, emissions and solvent consumption are based on the reported data from the point sources for the period 2001-2011. For the SNAP code 060202 for the years 2000 and 2001, only statistical data is used and for 2002 to 2011 both statistical and reported data is used. For the SNAP codes 060203 and 060204, only data reported for point sources is used for the period 2000-2011.

5.3.2.2. Dry Cleaning

In the Tier 1 approach, the emissions are estimated from solvent consumption data. Most of the solvent is recycled, but some is lost to the environment. This needs to be replaced and it can be assumed that the quantity of solvent, which is used for replacement, is equivalent to the quantity emitted plus the quantity taken away with the sludge.

Solvent emissions directly from the cleaning machine into the air represent about 80% of the solvent consumption (i.e. 80% of solvent used for the replacement of lost solvent) for open-circuit equipment and a little more than 40% for a closed-circuit machine. Open-circuit equipment, however, is no longer used within the EU following the European Solvents Directive coming into force. The remainder of the lost solvent is released to the environment in still residues or retained on cleaned clothes, but for the simpler methodology, it can be assumed that this eventually finds its way into the atmosphere (Passant, 1993; UBA, 1989). Also, a significant amount of the solvent goes back to the producers and to the recyclers, along with the sludge.

Solvent consumption data may be available from the industry and can be compared with a per capita emission factor. In addition, the proportion of solvent lost directly from the machine can also be estimated.

The Tier 1 default emission factors for NMVOC emissions from dry cleaning are a weighted average, calculated from the sum of all activity and emission data from the GAINS model (IIASA, 2008) – 40 g/kg textile treated.

5.3.2.2.1. Situation in Estonia

For the market situation, a description interview with the representative of the main dry cleaning service provider was carried out – SOL Estonia. SOL Estonia operates eight dry cleaning facilities in Tallinn, Pärnu, Kunda and Tartu.

Main findings:

- in Estonia, closed-circuit equipment are mainly used for dry cleaning,
- closed-circuit equipment was the main practice as far back as the 1990s,
- the main cleaning agent is PER (tetrachloroethylene/perchloroethylene),
- solvent waste (used solvent) is collected and given to hazardous waste companies,
- the quantity of cleaned textile is registered by cleaned items (for example, the number of cleaned coats or curtains), not by mass units.

In addition, four dry cleaning facilities were questioned by phone and by e-mail.

Questions and answers are given in the table below.

Table 5.7. The results of the interviews with the dry cleaning operators

Question	Answers			
	Virumaa Puhastus	***Euroclean***	***Pernau Pesumaja***	***Rea Pesumaja***
Technology used?	Closed-circuit machines	Closed-circuit machines (automatic programs)	Closed-circuit machines with activated carbon	Closed-circuit machines
Cleaning agent used?	PER	PER	PER	PER
Quantity of cleaning agent?	30 kg per year	400 kg per year	165 kg per year	1,070 kg per year
Quantity of cleaned textiles?	ca. 2,000 kg	do not have statistics	Register by pieces (app. equal to 6.2 tonnes)	Register by pieces
Waste management?	collected	Collected and given to hazardous waste company	Collected and given to hazardous waste company	Collected and given to hazardous waste company

5.3.2.2.2. Activity data

As the quantity of textile treated is very difficult to estimate because even dry cleaning shops do not have statistics for it, solvent consumption is taken as a basis for NMVOC calculations.

Solvent emissions direct from the cleaning machine into the air represent about 80% of solvent consumption (i.e. 80% of solvent used for the replacement of lost solvent) for open-circuit equipment and a little more than 40% for a closed-circuit machine.

All dry cleaning facilities questioned have closed-circuit equipment and use PER as a cleaning agent.

Used solvent goes to hazardous waste companies.

The quantity of PER used in Estonia can be estimated by import and export data. Data regarding import and export are not available for the years 1990-1994; therefore, these amounts were calculated by the change in percentage of the current prices in industrial production of chemicals and chemical products in that period.

According to OSIS, no production of tetrachloroethylene/perchloroethylene is reported for the years 2006-2010.

According to OSIS, a portion of PER emissions is reported as emissions from point sources. This is also subtracted to determine the amount of PER emissions from diffuse sources.

5.3.2.2.3. Results

Perchloroethylene might also be used in degreasing process. It is difficult to divide the consumption of PER between dry cleaning and degreasing. That is the reason why all PER used in Estonia is deemed used for dry cleaning purposes.

The emission factor for degreasing is also 460 g/kg cleaning products, which equals about 40%. The emission factor for dry cleaning is 400 g/kg solvent use.

Table 5.8. NMVOC emissions and the consumption of solvents from dry cleaning by SNAP codes in the period 1990-2011 (NFR 3.B.2)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060202	NMVOC emissions	Gg	0.015	0.012	0.011	0.012	0.018	0.025	0.030	0.005	0.024	0.050	0.050
	Activity data	kt	0.036	0.031	0.026	0.029	0.044	0.062	0.076	0.012	0.060	0.124	0.126

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060202	NMVOC emissions	Gg	0.047	0.056	0.064	0.064	0.062	0.065	0.054	0.051	0.022	0.012	0.019
	Activity data	kt	0.117	0.131	0.152	0.153	0.149	0.158	0.131	0.124	0.052	0.026	0.042

5.3.3. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends has been carried out. Calculated emissions and emission data from the OSIS database have been compared to previous years in order to detect calculation errors, errors in the reported data or in allocation. The reasons behind any fluctuation in the emission figures have been studied. The data reported and entered into the OSIS database by operators is firstly checked by specialists from the EEB and then by specialists from the EEIC.

5.3.4. Source-specific planned improvements

No major improvements are planned for the next submission.

5.4. Chemical Products Manufacturing and Processing (NFR 3.C)

5.4.1. Source category description

This chapter covers emissions from the use of chemical products. These include many activities such as paints, inks, glues and adhesives manufacturing, polyurethane and polystyrene foam processing, tyre production, fat, edible and non-edible oil extraction and more. However, many of these activities are considered insignificant. For example, total NMVOC emissions from these activities contributed just 0.95% to total national NMVOC emissions in 2011 and only 4.9% to the whole NRF 3 sector.

By 2011, NMVOC emissions from the NFR 3.C sector have decreased 36.8% compared to the year 1990.

5.4.2. Methodological issues

This sector includes emissions from polyurethane, polystyrene foam and rubber processing, paints, inks and glues manufacturing, textile finishing, leather tanning and other chemical products manufacturing or processing activities under SNAP 060314. All emission estimates for the years 2006-2011 from the NFR 3.C sector are based on emission data reported by operators in the OSIS database, and because of that they are divided by different SNAP codes. At present, only total NMVOC emissions for the years 1990-2005 are known without any activity data. Also, for some activities, the activity data are unknown for the period 2006-2011.

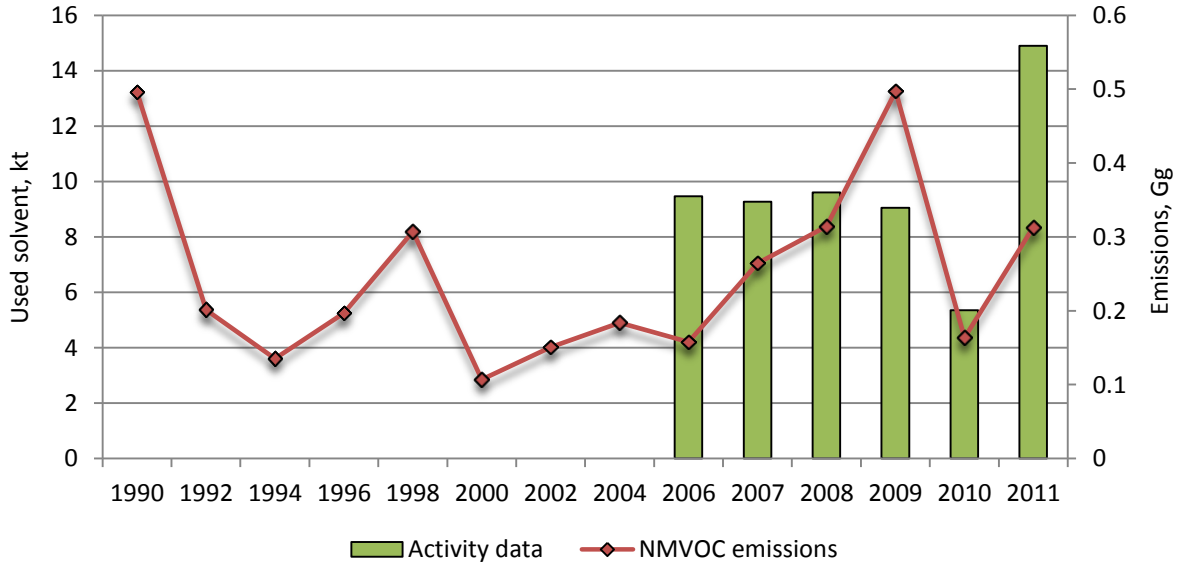

Figure 5.7. Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period 1990-2011

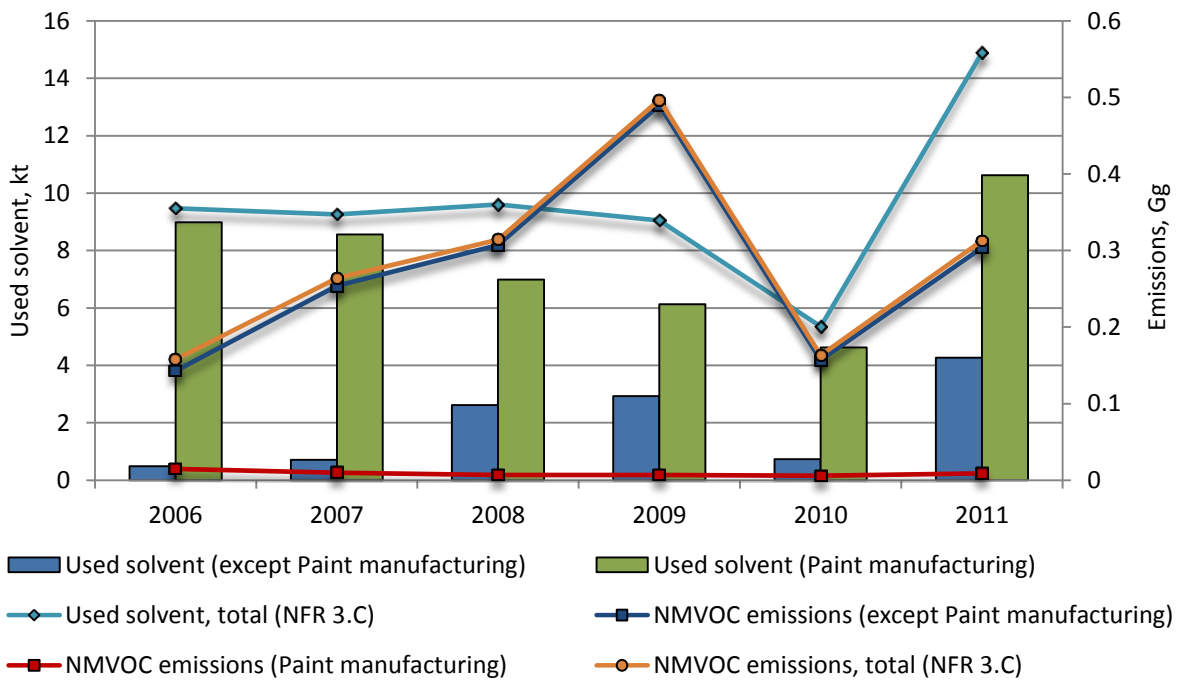

Figure 5.8. Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period 2006-2011

Figure 1.8 explains quite well Figure 1.7 why NMVOC emissions still grew from 2006 to 2009, although the amount of used solvent stayed through that period almost the same. It is clear that the dynamics of emissions are dependent of the changes in used solvent within the sector NFR 3.C, except the solvent used in paint manufacturing. It is because the emissions in paint manufacturing are marginal and do not affect the dynamics of total NMVOC emissions in that sector.

NMVOC emissions for the period 1990 to 2005 came only from point sources, but the activity data for that period is not available.

Table 5.9. NMVOC emissions and the consumption of solvents from chemical products manufacturing or processing by SNAP codes in the period 1990-2011 (NFR 3.C)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060300	NMVOC emissions	Gg	0.496	0.615	0.201	0.135	0.135	0.250	0.197	0.192	0.307	0.217	0.107
	Activity data	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060300	NMVOC emissions	Gg	0.113	0.151	0.127	0.184	0.125						
	Activity data	kt	NA	NA	NA	NA	NA						
060303	NMVOC emissions	Gg						0.001	0.000	0.004	0.006	0.008	0.013
	Activity data	kt						NA	0.001	0.001	0.004	0.005	3.421
060304	NMVOC emissions	Gg						0.079	0.123	0.109	0.043	0.052	0.062
	Activity data	kt						0.136	0.089	2.165	1.680	0.073	0.106
060305	NMVOC emissions	Gg						0.032	0.019	0.008	0.006	0.014	0.019
	Activity data	kt						0.022	0.326	0.014	0.021	0.010	0.019

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060307	NMVOC emissions	Gg						0.015	0.010	0.007	0.007	0.006	0.009
	Activity data	kt						8.987	8.560	6.988	6.126	4.628	10.628
060308	NMVOC emissions	Gg							0.001	0.001	0.000	0.000	
	Activity data	kt							0.041	0.053	0.026	0.026	
060309	NMVOC emissions	Gg						0.002	0.002	0.001	0.000	0.000	0.000
	Activity data	kt						0.088	NA	NA	0.001	0.001	NA
060312	NMVOC emissions	Gg						0.002	0.000	0.000	0.000	0.000	0.000
	Activity data	kt						NA	NA	NA	NA	NA	NA
060313	NMVOC emissions	Gg						0.000	0.000	0.000	0.000	0.000	0.000
	Activity data	kt						0.001	0.001	0.003	0.008	0.014	0.013
060314	NMVOC emissions	Gg						0.026	0.111	0.186	0.434	0.082	0.210
	Activity data	kt						0.236	0.248	0.383	1.187	0.601	0.714

5.4.3. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends has been carried out. Emission data from the OSIS database have been compared to the previous years in order to detect calculation errors, errors in the reported data or in allocation. Reasons behind any fluctuation in the emission figures have been studied. The data reported and entered into the OSIS database by operators is firstly checked by specialists from the EEB and then by specialists from the EEIC.

5.4.4. Source-specific planned improvements

As some activities are not included in this inventory (by the SNAP codes 060301, 060302, 060306, 060310, 060311), there is a need to conduct research on whether the emissions from these activities are important for this inventory or if they exist in Estonia at all. Also, there is a need to review NMVOC emissions for the years 1990-2005 and study the possibility to obtain the activity data for these emissions.

5.5. Other (NFR 3.D)

5.5.1. Source category description

This sector includes activities like printing (3.D.1), domestic solvent use (other than paint application) (3.D.2) and other product use (3.D.3) such as the application of glues and adhesives, preservation of wood, underseal treatment and conservation of vehicles, and use of tobacco.

5.5.1.1. Printing (NFR 3.D.1)

Printing involves the use of inks, which may contain a proportion of organic solvents. These inks may then be subsequently diluted before use. Different inks have different proportions of organic solvents and require dilution to different extents. Printing can also require the use of cleaning solvents and organic dampeners. Ink solvents, diluents, cleaners and dampeners may all make a significant contribution to emissions from industrial printing and involve the application of inks using presses.

In the EMEP/EEA guidebook, the following printing categories are identified:

- Heat set offset printing

According to the RAINS model, at EU-25 level for 2000, NMVOC emissions from heat set accounted for 40 kt representing 0.38% of the total NMVOC emissions. The total activity was 123.59 kt with an average emission factor of 3239 g NMVOC/kg, which shows that this industry has already reduced some emissions (EGTEI, 2005).

- Publication packaging

At EU-25 level for 2000 (according to the RAINS model), NMVOC emissions accounted for 61 kt representing 0.58% of the total NMVOC emissions. The total activity was 191.48 kt of ink, with an average emission of 0.32 kg NMVOC/kg non-diluted ink, which means that this industry has already reduced emissions significantly (EGTEI, 2005).

- Rotogravure & Flexography

At EU-25 level for 2000 (according to the RAINS model), NMVOC emissions accounted for 127.56 kt representing 1.2% of total NMVOC emissions. The total activity was 91.69 kt of non-diluted ink and an average emission of 1.4 kg NMVOC/kg non-diluted ink (EGTEI, 2005).

The emissions of NMVOCs from printing have been significantly reduced following the introduction of the Solvents Emissions Directive 1999/13/EC in March 1999. Larger facilities are now required to control their emissions in such a way that the emission limit value in the residual gas does not exceed a maximum concentration. The threshold is 15 ton/year for heat set offset and flexography/rotogravure in packaging and 25 ton/year for publication gravure (for the latter installations below, the thresholds are not likely to exist).

Situation in Estonia

The Association of Estonian Printing Industry collects information from 100 printing facilities in Estonia. Based on their main field of activity, these are divided into four groups: printing houses for periodicals, books, etiquettes and labels, and advertisements.

The total number of printing houses is decreasing, and smaller facilities in particular will close down. The total capacity exceeds local market needs and any increase is connected with export.

5.5.1.2. Domestic solvent use (NFR 3.D.2)

Emissions occur due to the evaporation of NMVOCs contained in the products during their use. For most products, all of the NMVOC will be emitted to the atmosphere. However, in some products, the NMVOC will be mainly lost to waste water.

5.5.1.3. Other product use (NFR 3.D.3)

5.5.1.3.1. Fat, edible and non-edible oil extraction

This activity includes solvent extraction of edible oils from oilseeds and the drying of leftover seeds before resale as animal feed.

If the oil content of the seed is high, such as in olives, the majority of the oil is pressed out mechanically. Where the oil content is lower or the remaining oil is to be taken from material that has already been pressed, solvent extraction is used.

Hexane has become a preferred solvent for extraction. In extracting oil from seeds, the cleaned and prepared seeds are washed several times in warm solvent. The remaining seed residue is treated with steam to capture the solvent and oil that remain in it.

The oil is separated from the oil-enriched wash solvent and from the steamed-out solvent. The solvent is recovered and re-used. The oil is further refined.

5.5.1.3.2. Preservation of wood

This activity encompasses industrial processes for the impregnation with or immersion of timber in organic solvent based preservatives, creosote or water based preservatives. Wood preservatives may be supplied for both industrial and domestic use. This activity covers only industrial use and does not include the domestic use of wood preservatives, which is covered under NFR source category 3.D.2, Domestic solvent use. Most of the information currently available on emissions relates to the industrial use of wood preservatives. This section is not intended to cover the surface coating of timber with paints, varnishes or lacquer.

5.5.1.3.3. Vehicles dewaxing

Some new cars have a protective covering applied to their bodies after painting to provide protection during transport. For example in the UK, this is usually only done on cars destined for export. Removal of the coating is usually only done at import centres. In continental Europe, cars are transported long distances on land as well as being imported from overseas, so the driving forces affecting the use of such coatings may be different.

Transport protection coverings are not applied to the whole car body, but only to regions of the body considered vulnerable to damage during transport. The pattern of application varies from one manufacturer to another. Some manufacturers do only the bumper, some only do the driver's door, while some do the horizontal surfaces and some do the sides as well.

There are a number of methods for applying coverings for protection during transport. Traditionally, a hydrocarbon wax was used, which had to be removed using a mixture of hot water, kerosene and detergent. Recently, two alternative methods have been introduced. The first of these is a water-soluble wax, which can be removed with hot water alone without the need for kerosene. The second is a self-adhesive polyethylene film called 'Wrap Guard'. This can be peeled off by hand and disposed of as ordinary commercial waste. Most European car manufacturers are currently either already using self-adhesive polyethylene film or are evaluating it. It is expected that within a few years all European manufacturers will be using self-adhesive polyethylene film as their only method of applying transportation protective coverings, as has been the case in the US for the past number of years.

5.5.1.3.4. Treatment of vehicles

This section addresses the application of protective coatings to the undersides of cars. It is only a very small source of emissions and can be considered negligible nowadays.

Before the early 1980s, car manufacturers did not apply any coating to the underside of their cars. If a car owner wanted to protect his car against rust and stone chip damage, he had to pay to have his car 'undersealed' at a garage or workshop. This involved the application of a bituminous coating. The market for this service is no longer very large in much of Western Europe. It may still occur in Eastern Europe, in countries that have cold climatic conditions, and in the restoration and maintenance of vintage cars, but this activity is likely to be relatively small.

5.5.1.3.5. Industrial application of adhesives

Sectors using adhesives are very diverse as well as production processes and application techniques.

Relevant sectors are the production of adhesive tapes, composite foils, the transportation sector (passenger cars, commercial vehicles, mobile homes, rail vehicles and aircrafts), the

manufacture of shoes and leather goods, and the wood material and furniture industry (EGTEI, 2003).

In 2011, NMVOC emissions from the NFR 3.D sector have decreased by 55.4% compared to the year 1990.

5.5.2. Methodological issues

5.5.2.1. Printing Industry (3.D.1)

Tier 1 emission factor is used for calculations, which is 500 g/kg ink consumed (IIASA, 2008). The following equation is applied:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

$E_{pollutant}$ = the emission of the specified pollutant

$AR_{production}$ = the activity rate for the paint application (consumption of paint)

$EF_{pollutant}$ = the emission factor for this pollutant

It involves either the use of solvent consumption data or combining ink consumption with emission factors for the industry. Unless the solvent consumption data is used, the use of water based or low solvent inks as well as the extent of controls such as incineration are not considered.

An approach combining ink consumption with emission factor is applied.

The emission factor has been estimated to be constant over the period. According to the revenues of the printing sector, the major part of printing is done for advertisements and the press. From Corinair[7], it can be concluded that the following techniques are applied (with relevant emission factors) for press and edition/publication:

- cold set web offset – 54 kg/t (g/kg) ink consumed
- heat set web offset – 82 kg/t (g/kg) ink consumed
- rotogravure – 425 kg/t (g/kg) ink consumed

As these stay below the current emission factor, it is not changed over the period.

5.5.2.1.1. Activity Data

The quantity of ink (CN code 3215) used in Estonia can be estimated by the import and export data from Statistics Estonia. Data regarding import and export are not available for the years 1990-1995; therefore, these amounts were calculated by the change in percentage

[7] Atmospheric Emission Inventory Guidebook. Second Edition. EEA 2000

of the current prices in the industrial production of chemicals and chemical products in that period.

5.5.2.1.2. Results

A number of printing facilities is permitted.

Between 2006 and 2011, activity data regarding ink use in point sources is collected in the OSIS database.

For the years 2006 to 2011, activity data for calculations are calculated as follows:

Ink use in diffuse sources = total ink use – ink use in point sources

In 2005, according to CollectER, five companies were reporting as point sources. No activity data is available. Emissions from point sources are subtracted from total calculated NMVOC emissions.

Table 5.10. NMVOC emissions and the consumption of solvents from printing industry by SNAP code in the period 1990-2011 (NFR 3.D.1)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060403	NMVOC emissions	Gg	0.085	0.071	0.058	0.062	0.097	0.136	0.132	0.190	0.209	0.250	0.263
	Activity data	kt	0.171	0.142	0.117	0.124	0.194	0.271	0.264	0.379	0.418	0.500	0.525

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060403	NMVOC emissions	Gg	0.306	0.334	0.412	0.583	0.774	0.666	0.491	0.773	0.228	0.354	0.344
	Activity data	kt	0.611	0.668	0.823	1.165	1.547	1.762	2.090	2.330	1.708	2.150	2.062

5.5.2.2. Domestic solvent use including fungicides (3.D.2)

The Tier 1 method uses a single emission factor expressed on a per-person basis to derive an emission estimate for the activity by multiplying the emission factor by population.

Tier 1 emission factors are used for calculations. The following equation is applied:

$$E_{pollutant} = AR_{production} \times EF_{pollutant}$$

where:

$E_{pollutant}$ = the emission of the specified pollutant

$AR_{production}$ = the activity rate for the paint application (consumption of paint)

$EF_{pollutant}$ = the emission factor for this pollutant

The default emission factor for this source category is presented in the following table. It has been derived from an assessment of the emission factors presented in the GAINS model

(IIASA, 2008). It represents a weighted average of the emission factor from this model for all the countries considered in 2000.

As the Solvents Emissions Directive 1999/13/EC came into force in 2004 in Estonia, a different emission factor is used for the years 1990, 1995 and 2000.

The emission factor according to Corinair (2007) is 2590 g (VOC) person^{-1}year^{-1}. This equals to 2.59 kg/person/year.

5.5.2.2.1. Activity Data

The basic activity statistics for using the Tier 1 emission factor are national population figures.

Table 5.11. NMVOC emissions from domestic solvent use (other than paint application) and the population of Estonia by SNAP code in the period 1990-2011 (NFR 3.D.2)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060408	NMVOC emissions	Gg	4.068	4.060	4.027	3.914	3.825	3.751	3.691	3.642	3.608	3.572	3.554
	Activity data	mln. inhab.	1.571	1.568	1.555	1.511	1.477	1.448	1.425	1.406	1.393	1.379	1.372

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060408	NMVOC emissions	Gg	3.103	2.654	2.224	1.783	1.348	1.345	1.342	1.341	1.340	1.340	1.340
	Activity data	mln. inhab.	1.367	1.361	1.356	1.351	1.348	1.345	1.342	1.341	1.340	1.340	1.340

5.5.2.3. Other product use (3.D.3)

5.5.2.3.1. Glass and Mineral wool enduction (SNAP 060401, 060402)

Not included in the emissions inventory due to the lack of information, if these activities have been conducted in Estonia.

5.5.2.3.2. Fat, edible and non-edible oil extraction (SNAP 060404)

The major type of seed used for oil production in Estonia is rape. Some smaller units also press oil out from other seeds, such as flax.

The main oil extracting company in Estonia is Werol Industries plc.

An interview was carried out with a representative of the company, which determined that the company does not use solvents for oil extraction.

At Werol Industries, they use mechanical hot pressing for oil extraction. That leaves 8%-10% of oil in rape cake. The technology has been in use since the factory was opened in 1999.

The second biggest oil producer is Oru Vegetable Oil Industry. The oil is only pressed out mechanically. The production began in 1985, but no solvents have ever been employed.

It was found out that some small farms also produce small amounts of oil: Kaarli farm in Väike-Maarja, Raismiku farm in Vändra and in Mooste). The oil is mechanical cold pressed.

As the solvents are not used in oil production in Estonia, the NMVOC emissions that have occurred in the process are of natural origin and are reported by operators who are adhering to environmental permit.

5.5.2.3.3. Application of glues and adhesives (SNAP 060405)

Tier 2 emission factor is used for calculations – 780 g/kg adhesive.

Activity data

Solvent borne adhesives have the CN code 35069100 (adhesives based on polymers of heading 3901 to 3913 or on rubber (excl. products suitable for use as glues or adhesives put up for retail sale as glues or adhesives, with a net weight of ≤ 1 kg)).

As this sector does not cover the domestic use of glues and adhesives, glues and adhesives for retail sale are not included.

The quantity of industrially used adhesives is estimated by import, export and production data (CN code 35069100). Import and export data is available from Statistics Estonia. Production data is available from the OSIS database for the years 2006-2011. At present, there is no information available regarding adhesive production between 1990 and 1999.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2011, activity data regarding adhesives use in point sources is collected in the OSIS database (SNAP 060405).

For the years 2006-2011, activity data for calculations is calculated as following:

Adhesives use in diffuse sources = total adhesive use – adhesive use in point sources

In 2000-2005, according to CollectER, some companies were reporting as point sources. No activity data is available. Emissions from point sources are subtracted from total calculated NMVOC emissions.

5.5.2.3.4. Preservation of wood (SNAP 060406)

The Estonian Forest Industries Association was questioned regarding wood preservation.

Most of the preservation operations are carried out using waterborne preservatives. Before it was banned in 2004, CCA was used. CCA is a waterborne preservative. Some creosote and shale oil was used in the past. Nowadays, creosote is not believed to be used and, therefore, wood treated with creosote is imported.

In 2005, all wood impregnation companies in Estonia were listed by the Estonian Forest Industries Association.

The amount of wood impregnated accounted for ca. 135,000 tm (theoretical cubic meter of wood). The biggest wood impregnation companies were the following (only water borne preservatives were used):

- Hansacom OÜ – 33,000 m^3
- Kestvuspuit AS – 30,000 m^3
- Imprest AS – 15,000 m^3
- Kehra Puutööstus OÜ – 8,000 m^3
- Natural AS – 5,000 m^3

Solvent borne preservatives are used by some companies that produce windows, doors and log houses.

The major solvent borne supplier VBH was contacted, and it was found out that companies that use solvent borne preservatives use more than five tonnes a year. This is the threshold for an air pollution permit. Therefore, it is estimated that these installations are covered with permits (point sources) and are not subject to diffuse emissions.

5.5.2.3.5. Underseal treatment and conservation of vehicles (SNAP 060407)

There is no statistical information regarding the treatment of vehicles. Therefore, expert opinion was sought from a representative of the Association of Estonian Automobile Sales and Maintenance Companies “repair unit”. Expert opinion was received from Benefit AS, which is the leading car body and car paint shops technology and materials supplier.

Between 1990 and 2000, treatment with bituminous materials was widespread, but there are no statistics available. Nowadays, treatment with bituminous coating is negligible, and treatment is done by special polymers, if needed.

So, NMVOC emissions from this activity are calculated for the years 1990 to 2004, and emissions from the treatment of vehicles are considered negligible since 2005.

The Tier 2 emission factor is used for calculations – 0.2 kg/person/year.

As the number of cars in Estonia per inhabitant was smaller than the number of cars per inhabitant in the European Union, a reduction coefficient for the emission factor is applied.

Table 5.12. Motorisation rate - cars per 1,000 inhabitants[8]

Year	Number of vehicles per 1000 inhabitants		Coefficient, %
	Estonia	EU-15	
1990	153	386	40%
1991	167	386	43%
1992	182	401	45%
1993	210	413	51%
1994	229	420	55%
1995	265	427	62%
1996	285	435	66%
1997	304	436	70%
1998	324	451	72%
1999	333	461	72%
2000	338	472	72%

It means that for example in 1995 the number of cars per inhabitant accounted for 62% of the average European Union country value and in 2000 for 72%. Information for 1990 was not found and it was taken equal with the year 1991.

The customized emission factors were calculated by the following example:

Year 1995: 0.2 x 62% = 0.124 kg/person/year

Year 2000: 0.2 x 72% = 0.143 kg/person/year

Considering that NMVOC emissions from vehicles treatment since 2005 are considered negligible, then the emission factors for the years 2001-2004 are not calculated using the previous method and are reduced 10% per year from the year 2000.

5.5.2.3.6. Vehicles dewaxing (SNAP 060409)

The Association of Estonian Automobile Sales and Maintenance Companies and Toyota Baltic plc were interviewed in 2010 regarding this activity.

It was found that at least no dewaxing operations have been carried out in at least the last five years. If required, paint protection is provided by using (polyethylene) film. Waxing is only used in very rare cases, such as special deliveries by sea transport from long distances.

In the period from 1995 to 2005, dewaxing was carried out in rare cases, i.e. special delivery directly from Japan. For these cases, it is not known if dewaxing was carried out in Finland or in Estonia. It is very difficult to obtain relevant data. Most of the dewaxing operations of imported cars are conducted in a treatment centre that is located in the port of Hanko in Finland.

[8] EUROSTAT - http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc340&plugin=0

According to the gathered information, NMVOC emissions from this source are considered to be approximately zero and historical emissions are considered negligible.

5.5.2.3.7. Domestic use of pharmaceutical products (SNAP 060411)

Not included in this inventory due to lack of methodology and emission factor.

5.5.2.3.8. Other (SNAP 060412)

NMVOC emissions and activity data for the years 2000-2011 are gathered from OSIS and CollectER databases, and are reported by operators.

5.5.2.3.9. Use of tobacco (SNAP 060602)

The Tier 2 emission factor is used for calculations – 4.8 g/ton tobacco.

The quantity of tobacco combusted (smoked) in Estonia is estimated by the import and export data (CN code 2402) available from Statistics Estonia.

Data regarding import and export and production is not available for the years 1990-1994.

Tobacco products were produced in Estonia until 1996; as a result, the production amounts for the years 1990-1994 are considered equal with consumption.

Table 5.13. NMVOC emissions from chemical products manufacturing or processing and the activity data by SNAP codes in the period 1990-2011 (NFR 3.D.3)

SNAP code		Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
060400	NMVOC emissions	Gg	0.817	1.014	0.332	0.224	0.223	0.412	0.325	0.316	0.506	0.357	
	Activity data	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
060405	NMVOC emissions	Gg	0.324	0.215	0.155	0.127	0.155	0.218	0.438	0.296	0.448	0.556	0.907
	Activity data	kt	0.415	0.275	0.198	0.163	0.199	0.279	0.562	0.379	0.574	0.712	1.162
060406	NMVOC emissions	Gg											0.00050
	Activity data	kt											NA
060407	NMVOC emissions	Gg	0.124	0.136	0.141	0.154	0.161	0.180	0.187	0.195	0.201	0.199	0.196
	Activity data	mln. inhab.	1.571	1.568	1.555	1.511	1.477	1.448	1.425	1.406	1.393	1.379	1.372
060412	NMVOC emissions	Gg											0.008
	Activity data	kt											NA
060602	NMVOC emissions	Gg	0.00002	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
	Activity data	kt	3.494	3.001	1.493	2.207	1.919	1.784	1.686	2.667	1.576	1.756	1.630

SNAP code		Unit	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
060404	NMVOC emissions	Gg		0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.001	0.001
	Activity data	kt		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
060405	NMVOC emissions	Gg	0.928	1.385	1.601	1.609	2.060	2.291	1.751	1.578	1.205	0.561	0.698
	Activity data	kt	1.189	1.776	2.052	2.063	2.641	3.365	3.968	2.516	1.944	1.238	1.475
060406	NMVOC emissions	Gg	0.00193	0.00014			0.00001	0.00306	0.01457	0.00736	0.01376	0.01143	0.01075
	Activity data	kt	NA	NA			NA	0.069	0.029	0.017	0.026	0.018	0.022
060407	NMVOC emissions	Gg	0.176	0.157	0.136	0.116							
	Activity data	mln. inhab.	1.367	1.361	1.356	1.351							
060412	NMVOC emissions	Gg	0.008	0.030	0.025	0.001	0.003	0.028	0.005	0.020	0.013	0.012	0.022
	Activity data	kt	NA	NA	NA	NA	NA	0.238	0.289	0.353	0.052	0.069	0.081
060602	NMVOC emissions	Gg	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00000	0.00001
	Activity data	kt	1.628	1.928	1.958	1.948	2.088	2.047	2.958	1.286	1.987	1.024	1.561

5.5.3. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends has been carried out. Calculated emissions and emission data from the OSIS database have been compared to the previous years in order to detect calculation errors, errors in the reported data or in allocation. Reasons behind any fluctuation in the emission figures have been studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the EEB and then by specialists in the EEIC.

5.5.4. Source-specific planned improvements

As some activities are not included in this inventory, there is a need to conduct research to determine whether emissions from these activities are important for this inventory. Also, there is a need to review the NMVOC emissions for the years 1990-1999 and study the possibility to obtain activity data for these emissions.

6. AGRICULTURE (NFR 4)

6.1. Overview of the sector

6.1.1. Sources category description

The Estonian inventory of air pollutants from agriculture presently includes emissions from animal husbandry and the application of fertilizers as listed in Table 6.1.

Table 6.1. Reporting activities for the agriculture sector

NFR	Source	Description	Emissions reported
4.B.1.a	Cattle dairy	Includes emissions from dairy cows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.1.b	Cattle non-dairy	Includes emissions from young cattle, beef cattle and suckling cows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.3	Sheep	Includes emissions from sheep and goats	NO_x, NMVOC, NH_3
4.B.4	Goats	Emissions from this sector are allocated to 4.B.4	IE
4.B.6	Horses	Includes emissions from horses	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$
4.B.8	Swine	Includes emissions from fattening pigs and sows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.9.a	Laying hens	Includes emissions from laying hens	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.9.b	Broilers	Includes emissions from broilers	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.9.d	Other poultry	Includes emission from cocks, ducks, geese and turkeys	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.D.1.a	Synthetic N-fertilizers	Includes emissions from application of nitrogen fertilizers and field preparation	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$

The share of agriculture sources in total emissions in 2011 was: NO_x – 3.1%, NH_3 – 93.5%, NMVOC – 11.1%, PM_{10} – 2.3%. The share of other pollutants was not so significant. The emissions of NO_x, NH_3 and NMVOC have decreased compared to 1990 by 44%, 65% and 60% and the trend of the emissions of these categories is given in Figure 6.1. The emissions from the agricultural sector are presented in Table 6.2.

The decrease in air pollution is mainly the result of rapid economic changes in the 1990s.

Total emissions from agriculture have not changed much in 2011 compared to 2010.

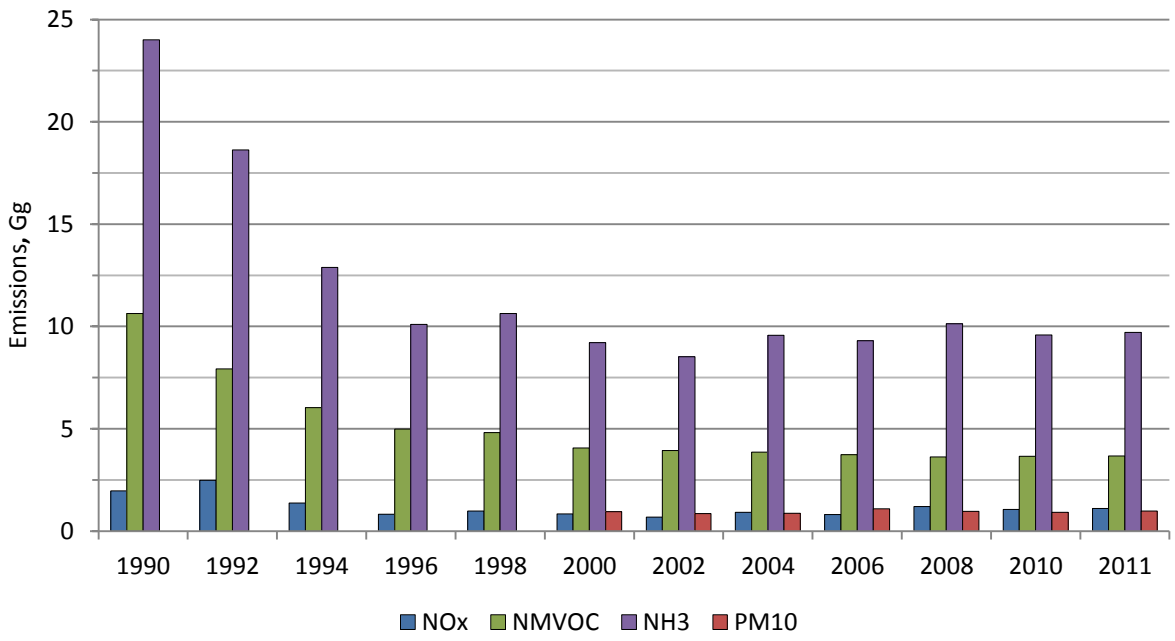

Figure 6.1. NO_x, NH_3, NMVOC and PM_{10} emissions from the agriculture sector in the period 1990-2011 (Gg)

Table 6.2. Total emissions from the agriculture sector in the period 1990-2011 (Gg)

	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}
1990	1.966	10.633	24.000	NR	NR
1991	1.612	9.647	21.271	NR	NR
1992	2.475	7.928	18.621	NR	NR
1993	1.456	6.404	13.867	NR	NR
1994	1.365	6.028	12.878	NR	NR
1995	0.966	5.401	11.146	NR	NR
1996	0.830	4.991	10.098	NR	NR
1997	0.891	4.991	10.490	NR	NR
1998	0.976	4.819	10.630	NR	NR
1999	0.836	4.143	9.146	NR	NR
2000	0.841	4.057	9.212	0.101	0.949
2001	0.727	4.107	9.212	0.096	0.804
2002	0.687	3.932	8.514	0.096	0.848
2003	0.788	3.916	9.363	0.095	0.827
2004	0.913	3.853	9.571	0.096	0.864
2005	0.778	3.789	9.138	0.101	1.050
2006	0.807	3.727	9.299	0.102	1.083
2007	0.975	3.797	9.578	0.106	1.188
2008	1.201	3.621	10.130	0.096	0.965
2009	0.992	3.605	9.365	0.092	0.890
2010	1.062	3.656	9.591	0.096	0.917
2011	1.109	3.674	9.709	0.098	0.974
trend 1990-2011, %	**-43.6**	**-65.4**	**-59.5**	**-3.0**	**2.7**

The largest part of NH3 emissions comes from manure management – 74%, and 26% is from use of synthetic fertilizers (Figure 6.2). The main polluter of PM10 is agricultural crop operations – 74% (Figure 6.3).

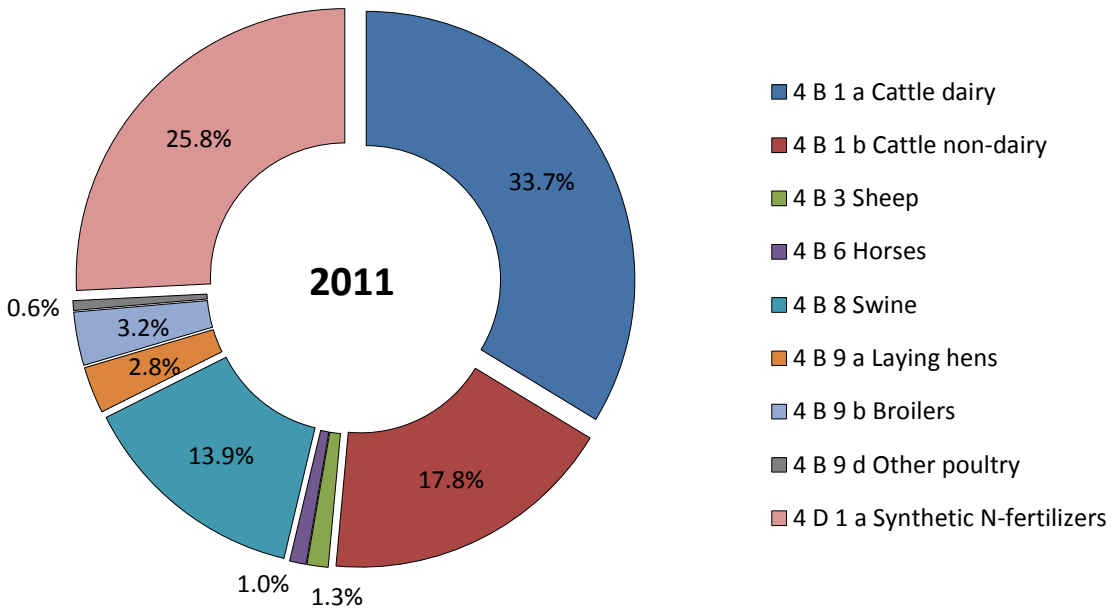

Figure 6.2. NH_3 emission distributions by the agriculture sector activities in 2011

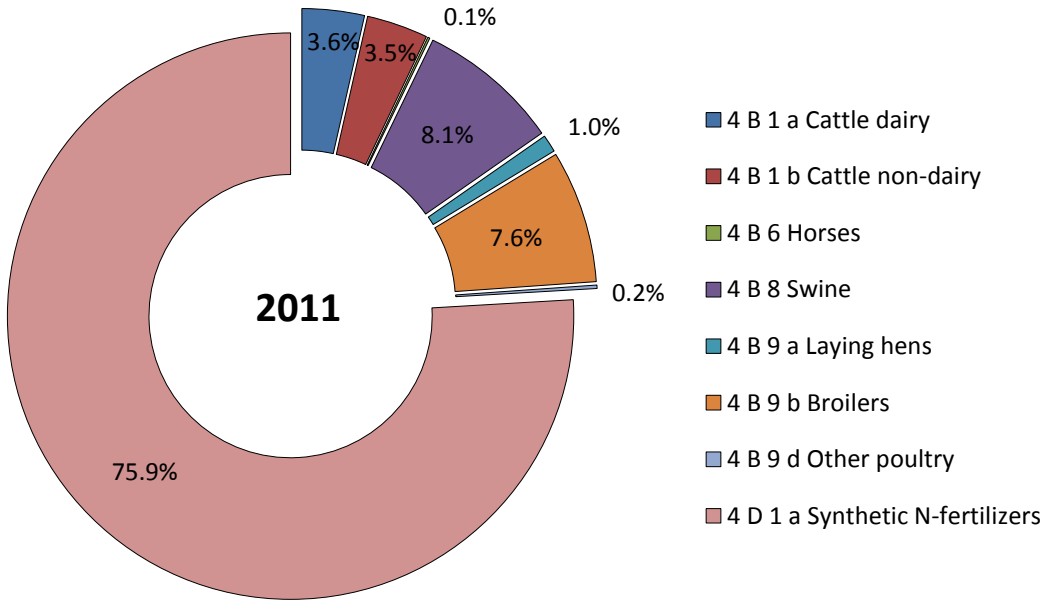

Figure 6.3. PM_{10} emissions from livestock and agricultural soils in 2011

6.2. Manure Management (NFR 4.B)

6.2.1. Source category description

Manure management is the main source of NH_3 emissions in Estonia. The share of manure management in total emissions in 2011 was 69.4%. The sector covers the management of manure from domestic livestock. Estonia reports emissions from the manure management of cattle, swine, horses, goats, sheep and poultry.

In addition to NH_3, NO_x, NMVOC, TSP, PM_{10} and $PM_{2.5}$ are generated from manure management.

All the emission time series are presented in Tables 6.3-6.7.

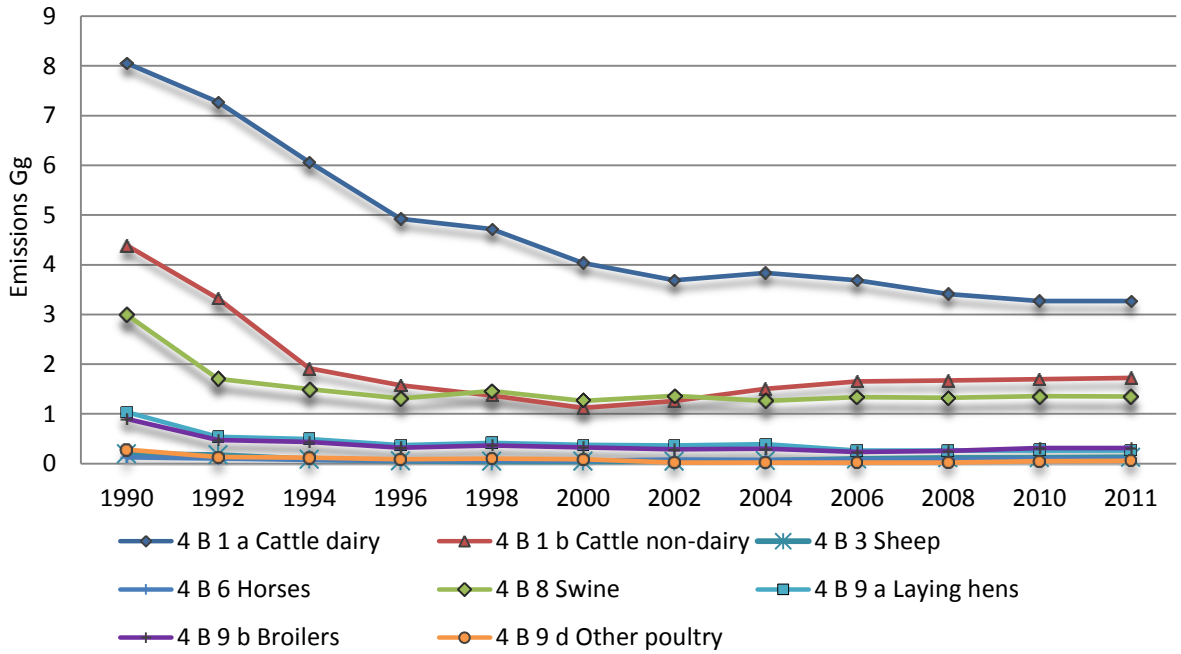

Figure 6.4. NH_3 emissions from manure management in the period 1990-2011

During the period 1990-2011, the emission of NH3 decreased 60% (Figure 6.4). The reduction in air pollution was mainly due to the rapid economic changes in agriculture in the 1990s.

Total emissions from manure management have not changed much in 2011 compared to 2010.

Table 6.3. Total emissions of NO_x from manure management in the period 1990-2011 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	0.043	0.045	0.001	0.001	0.001	0.006	0.004	0.001
1991	0.041	0.042	0.001	0.001	0.000	0.005	0.003	0.001
1992	0.039	0.034	0.001	0.001	0.000	0.003	0.002	0.001
1993	0.035	0.022	0.000	0.001	0.000	0.003	0.002	0.001

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1994	0.033	0.020	0.000	0.001	0.000	0.003	0.002	0.001
1995	0.029	0.017	0.000	0.001	0.000	0.003	0.002	0.000
1996	0.026	0.016	0.000	0.001	0.000	0.002	0.001	0.000
1997	0.025	0.015	0.000	0.001	0.000	0.003	0.002	0.000
1998	0.022	0.014	0.000	0.001	0.000	0.003	0.002	0.000
1999	0.018	0.012	0.000	0.001	0.000	0.002	0.002	0.000
2000	0.016	0.011	0.000	0.001	0.000	0.002	0.001	0.000
2001	0.015	0.010	0.000	0.001	0.000	0.003	0.001	0.000
2002	0.013	0.009	0.000	0.001	0.000	0.002	0.001	0.000
2003	0.012	0.008	0.000	0.001	0.000	0.002	0.001	0.000
2004	0.011	0.006	0.000	0.001	0.000	0.002	0.001	0.000
2005	0.010	0.005	0.000	0.001	0.000	0.002	0.001	0.000
2006	0.009	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2007	0.008	0.004	0.000	0.001	0.000	0.003	0.001	0.000
2008	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2009	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2010	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2011	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
trend 1990-2011, %	**-82.1**	**-90.6**	**-37.0**	**-24.4**	**-50.4**	**-73.6**	**-65.3**	**-79.7**

Table 6.4. Total emissions of NMVOC from manure management in the period 1990-2011(Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	3.818	3.531	0.028	1.937	0.647	0.409	0.265
1991	3.594	3.286	0.029	1.642	0.548	0.349	0.199
1992	3.446	2.673	0.025	1.107	0.338	0.215	0.123
1993	3.083	1.750	0.017	0.916	0.319	0.203	0.116
1994	2.875	1.540	0.012	0.981	0.310	0.197	0.113
1995	2.521	1.369	0.010	0.924	0.288	0.183	0.105
1996	2.334	1.268	0.008	0.921	0.230	0.146	0.084
1997	2.281	1.168	0.007	1.019	0.258	0.164	0.094
1998	2.157	1.102	0.006	1.032	0.261	0.166	0.095
1999	1.882	0.954	0.006	0.814	0.244	0.155	0.089
2000	1.782	0.901	0.006	0.899	0.234	0.149	0.085
2001	1.749	0.976	0.006	0.921	0.283	0.131	0.041
2002	1.572	1.023	0.007	0.946	0.229	0.131	0.023
2003	1.588	1.039	0.007	0.919	0.235	0.115	0.014
2004	1.584	0.986	0.008	0.877	0.242	0.135	0.019
2005	1.534	1.012	0.010	0.887	0.215	0.109	0.022
2006	1.474	1.009	0.013	0.933	0.164	0.106	0.027
2007	1.401	1.018	0.015	1.011	0.255	0.086	0.012
2008	1.365	1.018	0.016	0.909	0.165	0.117	0.030
2009	1.315	1.021	0.016	0.903	0.199	0.110	0.040
2010	1.312	1.035	0.017	0.934	0.173	0.142	0.044
2011	1.308	1.052	0.018	0.931	0.171	0.142	0.054
trend 1990-2011, %	**-65.7**	**-70.2**	**-36.9**	**-52.0**	**-73.6**	**-65.3**	**-79.7**

Table 6.5. Total emissions of NH_3 from manure management in the period 1990-2011 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	8.056	4.389	0.196	0.127	2.995	1.035	0.899	0.279
1991	7.585	4.085	0.200	0.115	2.528	0.877	0.768	0.210
1992	7.273	3.323	0.174	0.098	1.707	0.541	0.474	0.130
1993	6.506	2.176	0.117	0.077	1.395	0.511	0.447	0.123
1994	6.067	1.915	0.086	0.074	1.498	0.496	0.434	0.119
1995	5.321	1.702	0.070	0.068	1.422	0.461	0.404	0.111
1996	4.925	1.577	0.055	0.062	1.309	0.368	0.322	0.088
1997	4.902	1.453	0.050	0.062	1.432	0.412	0.361	0.099
1998	4.720	1.370	0.043	0.058	1.462	0.418	0.365	0.100
1999	4.192	1.186	0.043	0.058	1.171	0.390	0.341	0.094
2000	4.037	1.121	0.045	0.062	1.273	0.375	0.328	0.090
2001	4.032	1.324	0.045	0.081	1.300	0.452	0.288	0.043
2002	3.685	1.261	0.047	0.078	1.360	0.367	0.287	0.025
2003	3.785	1.528	0.048	0.086	1.320	0.376	0.252	0.015
2004	3.838	1.506	0.057	0.075	1.262	0.388	0.298	0.020
2005	3.775	1.602	0.073	0.071	1.282	0.344	0.241	0.023
2006	3.686	1.656	0.092	0.073	1.339	0.262	0.234	0.028
2007	3.502	1.669	0.107	0.078	1.485	0.407	0.188	0.013
2008	3.414	1.669	0.115	0.078	1.322	0.264	0.258	0.032
2009	3.288	1.675	0.113	0.080	1.311	0.319	0.243	0.042
2010	3.281	1.697	0.116	0.101	1.357	0.276	0.312	0.046
2011	3.271	1.725	0.123	0.096	1.348	0.273	0.312	0.057
trend 1990-2011, %	**-59.4**	**-60.7**	**-36.9**	**-24.4**	**-55.0**	**-73.6**	**-65.3**	**-79.7**

Table 6.6. Total emissions of $PM_{2.5}$ from manure management in the period 2000-2011 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
2000	0.030	0.019	0.001	0.011	0.002	0.010	0.0004
2001	0.030	0.021	0.001	0.012	0.002	0.009	0.0002
2002	0.027	0.022	0.001	0.013	0.002	0.009	0.0001
2003	0.027	0.022	0.001	0.012	0.002	0.008	0.0001
2004	0.027	0.021	0.001	0.012	0.002	0.009	0.0001
2005	0.026	0.022	0.001	0.012	0.001	0.008	0.0001
2006	0.025	0.022	0.001	0.012	0.001	0.007	0.0001
2007	0.024	0.022	0.001	0.014	0.002	0.006	0.0001
2008	0.023	0.022	0.001	0.012	0.001	0.008	0.0001
2009	0.022	0.022	0.001	0.012	0.001	0.008	0.0002
2010	0.022	0.022	0.001	0.013	0.001	0.010	0.0002
2011	0.022	0.023	0.001	0.013	0.001	0.010	0.0002
trend 1990-2011, %	**-26.6**	**16.7**	**54.8**	**10.4**	**-27.1**	**-4.8**	**-37.0**

Table 6.7. Total emissions of PM_{10} from manure management in the period 2000-2011 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
2000	0.047	0.029	0.001	0.072	0.013	0.078	0.003
2001	0.046	0.032	0.001	0.073	0.016	0.068	0.001
2002	0.042	0.033	0.001	0.079	0.013	0.068	0.001
2003	0.042	0.034	0.001	0.077	0.013	0.060	0.000
2004	0.042	0.032	0.001	0.073	0.014	0.070	0.001
2005	0.041	0.033	0.001	0.075	0.012	0.057	0.001
2006	0.039	0.033	0.001	0.078	0.009	0.055	0.001
2007	0.037	0.033	0.001	0.089	0.014	0.045	0.000
2008	0.036	0.033	0.001	0.078	0.009	0.061	0.001
2009	0.035	0.033	0.001	0.077	0.011	0.057	0.001
2010	0.035	0.034	0.001	0.080	0.010	0.074	0.002
2011	0.035	0.034	0.001	0.079	0.010	0.074	0.002
trend 1990-2011, %	**-26.6**	**16.7**	**54.8**	**10.2**	**-27.1**	**-4.8**	**-37.0**

6.2.2. Methodological issues

Emission calculations from manure management based on the Tier 1 method from the renewed Guidebook.

The Tier 1 method uses readily available statistical data and default emission factors. The Tier 1 default emission factors also assume an average or typical process description.

The Tier 1 approach uses the general equation:

$$E = AR_{Population\ Size} \times EF,$$

where,

$AR_{Population\ Size}$ = activity rate for specific activity

EF = emission factor for this process, technology

Emissions from manure are calculated separately for each animal category and within each animal category; separately for slurry or solid manure management system depends on the animal category (Table 6.9). According to the new guidebook, there are different emission factors for solid and slurry manure type (Table 6.8). The share of cattle dairy manure management in Estonia is 50% solid and 50% slurry and based on an article by Allan Kaasik (Saasteainete kasvuhoonegaside emissioon loomakasvatusest. Kaasik, Allan 2007, Tõulooma-kasvatus, 2, 21–24).

The share of manure management from cattle non-dairy is 70% slurry and 30% solid.

There are no default emission factors for TSP in the renewed Guidebook, so the calculated TSP emission factors were the used proportion between PM_{10} and TSP in the old Guidebook (new PM_{10} EF*100% / the proportion of an old PM_{10} EF of old TSP EF).

Table 6.8. NO_x, NH_3, NMVOC and PM emission factors for manure management

NFR	NO_x slurry	NO_x solid	NMVOC	NH_3 slurry	NH_3 solid	$PM_{2.5}$	PM_{10}	TSP
	kg/capita							
Cattle dairy	0.007	0.154	13.600	39.300	28.700	0.230	0.360	0.799
Cattle non-dairy	0.002	0.094	7.400	13.400	9.200	0.160	0.240	0.533
Sheep and goats		0.005	0.200		1.400			
Horses		0.131			14.800	0.120	0.180	
Fattening pigs	0.001		3.900	6.700		0.080	0.500	1.111
Sows	0.004		13.300	15.800		0.090	0.580	1.288
Laying hens		0.003	0.300		0.480	0.002	0.017	0.038
Broilers		0.001	0.100		0.220	0.007	0.052	0.115
Other poultry		0.004	0.900		0.950	0.004	0.032	0.068

Activity data

Information regarding the numbers of livestock in agriculture is available from Statistics Estonia (www.stat.ee) for the years 1990-2011.

Table 6.9. Number of livestock (1,000 head)

	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry
1990	280.7	477.1	139.8	8.6	336.0	47.1	2,157.0	4,085.3	294.2
1991	264.3	444.0	142.8	7.8	279.5	41.5	1,827.6	3,489.2	221.5
1992	253.4	361.2	124.3	6.6	189.4	27.7	1,128.0	2,153.4	136.7
1993	226.7	236.5	83.3	5.2	148.5	25.3	1,064.6	2,032.5	129.0
1994	211.4	208.1	61.5	5.0	160.9	26.6	1,032.8	1,971.7	125.2
1995	185.4	185.0	49.8	4.6	157.1	23.4	960.7	1,834.1	116.5
1996	171.6	171.4	39.2	4.2	104.4	38.6	767.2	1,464.7	93.0
1997	167.7	157.9	35.6	4.2	107.2	45.2	858.7	1,639.2	104.1
1998	158.6	148.9	30.8	3.9	114.2	44.1	869.8	1,660.5	105.4
1999	138.4	128.9	30.9	3.9	98.8	32.2	812.4	1,550.9	98.5
2000	131.0	121.8	32.2	4.2	99.0	38.6	780.9	1,490.8	94.7
2001	128.6	131.9	32.4	5.5	99.5	40.1	941.7	1,307.7	45.5
2002	115.6	138.3	33.8	5.3	114.1	37.7	764.6	1,305.9	25.8
2003	116.8	140.4	34.3	5.8	110.7	36.6	783.4	1,146.3	15.5
2004	116.5	133.3	41.0	5.1	106.6	34.7	808.0	1,353.6	21.4
2005	112.8	136.7	52.4	4.8	110.4	34.3	716.8	1,093.5	24.5
2006	108.4	136.4	66.0	4.9	111.7	37.4	546.4	1,062.7	29.6
2007	103.0	137.5	76.4	5.3	137.4	35.7	848.6	856.7	13.5
2008	100.4	137.5	81.8	5.3	116.9	34.1	550.1	1,173.7	33.5
2009	96.7	138.0	80.4	5.4	115.2	34.1	664.8	1,103.5	43.9
2010	96.5	139.8	82.7	6.8	119.7	35.1	575.2	1,419.4	48.8
2011	96.2	142.1	88.2	6.5	117.2	35.6	568.9	1,404.4	59.6

6.3. Agricultural Soils (NFR 4.D)

6.3.1. Source category description

Direct NH_3 emissions from fertilizers and particle emissions from grain fields are reported under NFR 4.D.1.a. The share of agricultural soils in total NH_3 emissions in 2011 was 24%.

In addition to NH_3, NO_x, NMVOC, PM_{10} and $PM_{2.5}$ are generated from this sector.

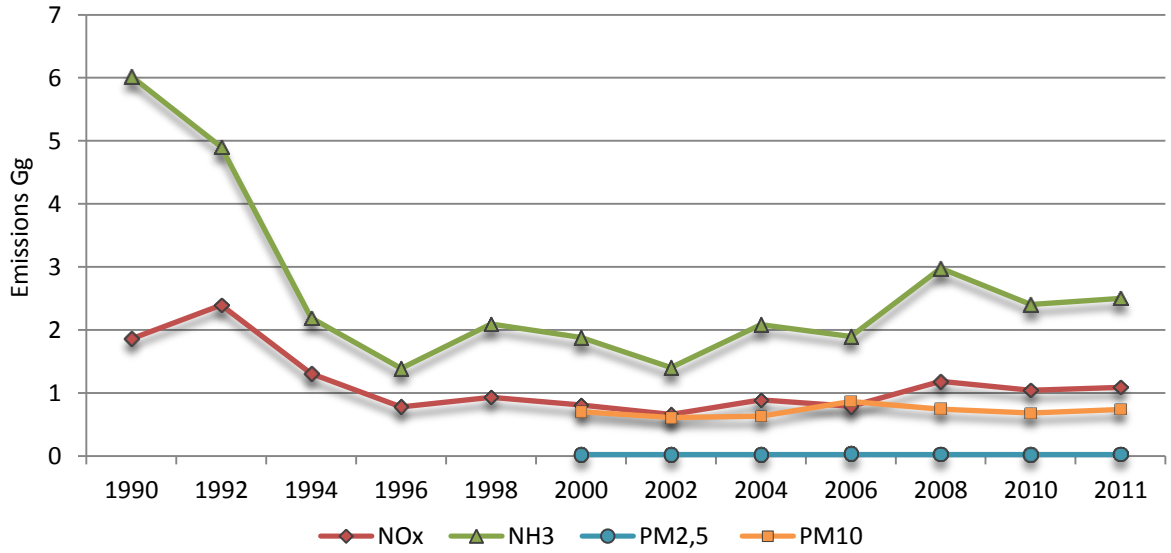

Figure 6.5. NO_x, NH_3, PM_{10} and $PM_{2.5}$ emissions from agricultural soils in the period 1990-2011

During the period 1990-2011, the emission of NH3 decreased 43.9% (Figure 6.5), mainly due to changes in Estonian agriculture. All the emission time series are presented in Table 6.10.

Total emissions from agricultural soils have not changed much in 2011 compared to 2010.

Table 6.10. Total emissions from agricultural soils in the period 1990-2011 (Gg)

Year	NO_x	NH_3	$PM_{2.5}$	PM_{10}
1990	1.864	6.023	NR	NR
1991	1.517	4.902	NR	NR
1992	2.395	4.902	NR	NR
1993	1.391	2.516	NR	NR
1994	1.306	2.190	NR	NR
1995	0.913	1.588	NR	NR
1996	0.782	1.391	NR	NR
1997	0.846	1.720	NR	NR
1998	0.934	2.094	NR	NR
1999	0.800	1.671	NR	NR
2000	0.808	1.881	0.027	0.706
2001	0.697	1.647	0.022	0.567
2002	0.661	1.403	0.024	0.612
2003	0.764	1.953	0.023	0.601

Year	NO_x	NH_3	$PM_{2.5}$	PM_{10}
2004	0.891	2.086	0.024	0.631
2005	0.759	1.687	0.032	0.830
2006	0.790	1.899	0.033	0.867
2007	0.958	2.098	0.037	0.968
2008	1.184	2.978	0.029	0.745
2009	0.975	2.296	0.026	0.674
2010	1.046	2.405	0.026	0.682
2011	1.092	2.503	0.028	0.740
trend 1990-2011, %	**-41.4**	**-58.4**	**4.8**	**4.8**

6.3.2. Methodological issues

Emission calculations from agricultural soils based on the Tier 1 method from the renewed Guidebook. The Tier 1 method uses readily available statistical data (Table 6.11) and default emission factors (Table 6.12).

Table 6.11. NO_x, NH_3, NMVOC and PM emission factors for agricultural soils

Pollutant	Unit	Value
NO_x	kg kg-1 fertilizer-N applied	0.026
NMVOC	kg kg-1 fertilizer-N applied	5.96E-09
NH_3	kg kg-1 fertilizer-N applied	0.084
$PM_{2.5}$	g/ha	0.06
PM_{10}	g/ha	1.56

Activity Data

Information regarding synthetic N-fertilizer use and the area covered by these crops is available from Statistics Estonia (www.stat.ee) for the years 1990-2011.

Table 6.12. Synthetic N-fertilizer use and the area covered by these crops in the period 1990-2011

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1990	71,700	
1991	58,360	
1992	92,099	952,103
1993	53,515	545,833
1994	50,222	517,607
1995	35,127	415,952
1996	30,072	355,638
1997	32,545	422,690

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1998	35,921	478,345
1999	30,772	421,067
2000	31,079	452,538
2001	26,793	363,504
2002	25,414	392,196
2003	29,372	384,951
2004	34,254	404,309
2005	29,184	532,319
2006	30,384	556,083
2007	36,854	620,449
2008	45,542	477,786
2009	37,519	432,051
2010	40,217	437,302
2011	41,995	474,102

6.4. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

6.5. Sources-specific planned improvements

- For improving data quality to introduce other Tier 2 or Tier 3 methods for emissions estimating which is based on detailed activities data and emission factors.
- To provide uncertainty analysis.

7. LAND USE AND LAND-USE CHANGE (NFR 5)

7.1. Overview of the sector

The emissions are not included in the present inventory.

8. WASTE (NFR 6)

8.1. Overview of the sector

8.1.1. Sources category description

Emissions from solid waste disposal on land (landfills), waste water treatment, waste incineration and other waste sources are included in this category. Emissions from the NFR of the waste sector are based on point sources (facilities) while area sources data are included for some sectors (6.B, 6.D).

Table 8.1. Reported emissions for the waste sector (NFR 6)

NFR	Source	Description	Emissions reported
6.A	Solid waste disposal on land	Includes emissions from landfill on the base of four operators reports. Only point sources data.	NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO
6.B	Waste-water handling	Point sources data includes emissions 9 waste water treatment plants. Additionally the calculation of emissions from diffuse sources.	NO_x, NMVOC, SO_x, NH_3, CO
6.C.a	Clinical waste incineration	Only one operator is reported data about hospital waste inceneration. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, CO, HM (emissions located in NFR 6.c.b) PCDD/PCDF (expert estimation)
6.C.b	Industrial waste incineration	Includes emission from flaring in chemical industry, sluge and waste oil incineration. Data from 5 operators.	NO_x, NMVOC, SO_x, NH_3, TSP, CO, Cu, PCDD/PCDF
6.C.d	Cremation	Includes data from 2 operators	NO_x, NMVOC, SO_x, NH_3, TSP, CO
6.D	Other	Includes data from 2 point sources, one from them of compost production. Additionally the calculation of emissions from diffuse sources.	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb Cd, Hg, As, Cr, Cu, PCDD/PCDF

Emissions from point sources are taken from the OSIS database and the emissions for diffuse sources are calculated from the data received from Statistics Estonia, Estonian Rescue Service and the waste management system. The emission factors given in EMEP/EEA guidebook and expert opinions are used in the additional calculations.

8.2. Solid waste disposal on land (NFR 6.A)

8.2.1. Sources category description

This chapter includes emissions from solid waste disposal on land. This sector, however, is only a minor source of air pollutant emissions. Small quantities of non-methane volatile organic compounds, ammonia, particulate matter and carbon monoxide may be emitted.

8.2.2. Methodological issues

All the emissions are based on operator reports (there were 4 operators in 2011). Data is available from 2000.

Table 8.2. Emissions from solid waste disposal on land in the period 2000-2011

	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg	Mg				Gg
2000	0.250	NA	NR	NR	NA	NA
2001	NA	NA	NR	NR	NA	NA
2002	NA	NA	NR	NR	NA	NA
2003	0.020	NA	NR	NR	NA	NA
2004	NA	NA	NR	NR	NA	NA
2005	0.000	NA	NA	NA	0.000	NA
2006	NA	NA	NA	NA	NA	NA
2007	NA	NA	NA	NA	NA	NA
2008	NA	NA	0.070	0.139	0.278	NA
2009	0.024	0.038	NA	NA	0.011	0.024
2010	NA	0.025	NA	NA	0.058	NA
2011	NA	0.025	NA	0.242	0.774	NA

8.2.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

8.2.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Emission calculations from landfills by using data from the waste management system.

8.3. Waste water handling (NFR 6.B)

8.3.1. Sources category description

This chapter covers emissions from waste water handling. In general, emissions of NO_x, NMVOC, SO_x, NH_3 and CO occur from waste water treatment plants, but are largely insignificant in terms of total national emissions.

8.3.2. Methodological issues

Emissions from waste water handling are based on data from facilities (there were 8 operators in 2011).

In addition to the facility data, NMVOC emissions are based on the Tier 1 method, whereby emissions are calculated using a default emission factor (NMVOC 15 mg/m^3 waste water). In this calculation, data from Statistics Estonia were used. Data are available from 1994.

Table 8.3. Emissions from waste water handling in the period 1994-2011

	NO_x	NMVOC	SO_x	NH_3	CO
	Mg	Gg	Mg		Gg
1994	NA	0.029	NA	NA	NA
1995	NA	0.028	NA	NA	NA
1996	NA	0.025	NA	NA	NA
1997	NA	0.025	NA	NA	NA
1998	NA	0.025	NA	NA	NA
1999	NA	0.023	NA	NA	NA
2000	NA	0.022	NA	NA	NA
2001	NA	0.023	NA	NA	NA
2002	NA	0.021	NA	NA	NA
2003	NA	0.024	NA	NA	NA
2004	NA	0.027	NA	NA	NA
2005	NA	0.024	NA	NA	NA
2006	NA	0.024	NA	NA	NA
2007	NA	0.028	NA	NA	NA
2008	1.234	0.025	0.124	0.979	0.001
2009	0.444	0.022	0.124	1.074	0.006
2010	0.441	0.029	0.126	0.426	NA
2011	0.444	0.029	0.124	0.229	NA

8.3.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

8.3.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Emission calculations from waste water treatment by using data from the waste management system. Also, specify data for latrines.

8.4. Waste incineration (NFR 6.C)

8.4.1. Sources category description

This sector includes the volume reduction, by combustion. In Estonia, the following waste treatments take place: cremation, clinical and industrial waste incineration.

8.4.2. Methodological issues

Emissions from the waste incineration sector are based on data from facilities (there were 14 operators in 2011). Emissions are calculated by operators on the basis of measurements, and the combined method (measurements plus calculations) is also used.

In addition to the facility data, PCDD/PCDF emissions from clinical and industrial waste incineration are calculated. In these calculations, data from the waste data management system were used.

UNEP Standardized Toolkit emission factors were used in the calculation of dioxin emissions from clinical and industrial waste incineration:

- Clinical waste incineration 525 µg/Mg of waste
- Industrial waste incineration 350 µg/Mg of waste

Table 8.4. Emissions from waste incineration in the period 1990-2011

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg				Mg			Gg
1990	NA	NA	NA	NA	NR	NR	NA	NA
1991	NA	NA	NA	NA	NR	NR	NA	NA
1992	NA	NA	NA	NA	NR	NR	NA	NA
1993	NA	NA	NA	NA	NR	NR	NA	NA
1994	NA	NA	NA	NA	NR	NR	NA	NA
1995	NA	NA	NA	NA	NR	NR	NA	NA
1996	NA	NA	NA	NA	NR	NR	NA	NA
1997	NA	NA	NA	NA	NR	NR	NA	NA
1998	NA	NA	NA	NA	NR	NR	NA	NA
1999	NA	NA	NA	NA	NR	NR	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA
2003	NA	NA	0.010	NA	NA	NA	4.000	0.020
2004	NA	0.010	0.050	NA	NA	NA	NA	NA
2005	NA	0.010	0.020	NA	NA	NA	NA	NA
2006	NA	NA	NA	NA	NA	NA	NA	NA
2007	NA	NA	0.010	NA	NA	NA	NA	NA
2008	0.007	0.000445	0.005	NA	NA	NA	0.098	0.003
2009	0.016	0.011	0.017	0.002	NA	NA	0.149	0.013
2010	0.016	0.015	0.010	0.002	NA	NA	0.212	0.015
2011	0.014	0.038	0.010	0.002	0.324	0.402	0.637	0.015

	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/F	PAHs	PCBs
	kg	g		kg		Mg	kg		g I-Teq	kg	
1990	NA	NA	NA	NA	NA	NA	NA	NA	0.470	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA	NA	0.470	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA	NA	0.460	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA	NA	0.450	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA	NA	0.440	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA	NA	0.430	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA	NA	0.430	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA	NA	0.620	NA	NA
1998	NA	NA	NA	NA	NA	NA	NA	NA	0.560	NA	NA
1999	NA	NA	NA	NA	NA	NA	NA	NA	0.290	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA	0.400	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA	0.360	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA	0.620	NA	NA
2003	NA	NA	NA	NA	NA	NA	NA	NA	0.483	NA	0.001
2004	0.240	NA	NA	NA	NA	NA	NA	NA	0.660	NA	NA
2005	0.270	NA	NA	NA	NA	NA	NA	NA	0.640	NA	NA
2006	0.210	NA	NA	NA	NA	NA	NA	NA	0.050	NA	NA
2007	NA	NA	NA	NA	NA	NA	NA	NA	0.300	NA	NA
2008	NA	NA	NA	NA	NA	0.000	NA	NA	0.455	NA	NA
2009	NA	NA	NA	NA	NA	0.024	NA	NA	0.582	NA	NA
2010	NA	NA	NA	NA	NA	0.009	NA	NA	0.321	NA	NA
2011	0.048	0.200	0.100	0.029	0.010	0.009	0.019	0.029	0.361	0.085	NA

8.4.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

8.4.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations, if necessary.

8.5. Other waste (NFR 6.D)

8.5.1. Sources category description

This chapter covers emissions from other waste, which includes data from facilities (there were 6 operators in 2011) and from the following activities: compost production, slurry spreading, car fires, detached and undetached house fires, apartment and industrial building fires.

8.5.2. Methodological issues

Emissions from the other waste sector are based on date from facilities and additional calculations.

In addition to the facility data, emissions of ammonia, particulate matter, heavy metals and dioxins are calculated according to the Tier 2 method giving default emission factors. In this calculation, data from Statistics Estonia and the Estonian Rescue Service were used.

Table 8.5. Emissions from other waste in the period 1990-2011

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Mg	Gg	Mg	Gg				Mg
1990	NA	NA	NA	0.002	NR	NR	NA	NA
1991	NA	NA	NA	0.002	NR	NR	NA	NA
1992	NA	NA	NA	0.002	NR	NR	NA	NA
1993	NA	NA	NA	0.002	NR	NR	NA	NA
1994	NA	NA	NA	0.002	NR	NR	NA	NA
1995	NA	NA	NA	0.002	NR	NR	NA	NA
1996	NA	NA	NA	0.008	NR	NR	NA	NA
1997	NA	NA	NA	0.016	NR	NR	NA	NA
1998	NA	NA	NA	0.002	NR	NR	0.001	NA
1999	NA	NA	NA	0.003	NR	NR	0.001	NA
2000	NA	NA	NA	0.006	0.001	0.001	0.001	NA
2001	NA	NA	NA	0.009	0.001	0.001	0.001	NA
2002	NA	NA	NA	0.024	0.001	0.001	0.001	NA
2003	NA	NA	NA	0.072	0.001	0.001	0.001	NA
2004	NA	NA	NA	0.097	0.001	0.001	0.001	NA
2005	NA	NA	NA	0.115	0.001	0.001	0.001	NA
2006	NA	NA	NA	0.161	0.001	0.001	0.001	NA
2007	NA	NA	NA	0.187	0.001	0.001	0.001	NA
2008	NA	0.005	NA	0.165	0.001	0.001	0.001	NA
2009	NA	0.004	NA	0.159	0.001	0.001	0.001	NA
2010	0.475	0.005	NA	0.188	0.001	0.001	0.001	0.475
2011	1.329	0.006	0.068	0.130	0.001	0.001	0.001	1.444

	Pb	Cd	Hg	As	Cr	Cu	PCDD/F
	g	kg					g I-Teq
1990	NA	NA	NA	NA	NA	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA
1998	0.611	0.001	0.001	0.002	0.002	0.004	0.002
1999	0.609	0.001	0.001	0.002	0.002	0.004	0.002
2000	0.583	0.001	0.001	0.002	0.002	0.004	0.002
2001	0.589	0.001	0.001	0.002	0.002	0.004	0.002
2002	0.607	0.001	0.001	0.002	0.002	0.004	0.002
2003	0.533	0.001	0.001	0.002	0.002	0.004	0.002
2004	0.470	0.001	0.001	0.002	0.001	0.003	0.002
2005	0496	0.001	0.001	0.002	0.002	0.004	0.002
2006	0.503	0.001	0.001	0.002	0.002	0.004	0.002
2007	0.449	0.001	0.001	0.001	0.001	0.003	0.002
2008	0.403	0.001	0.001	0.001	0.001	0.003	0.001
2009	0.376	0.001	0.001	0.001	0.001	0.003	0.001
2010	0.288	0.001	0.001	0.001	0.001	0.002	0.001
2011	0.264	0.001	0.001	0.001	0.001	0.002	0.001

8.5.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

8.5.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations if necessary.

9. OTHER AND NATURAL EMISSIONS (7.A, 7.B, 11.A, 11.B, 11.C)

9.1. Overview of the sector

9.1.1. Sources category description

The Estonian inventory of air pollutants from natural emissions includes NMVOC emission from non-managed deciduous/coniferous forests and managed deciduous/coniferous forests as well as emissions of grassland and other low vegetation including crops (NFR 11 C).

These emissions are reported as memo items and are not included in the national total amount of pollutant emissions.

The emissions from 7A, 7B, 11A and 11B are not included in the present inventory.

9.2. Other natural sources (NFR 11.C)

9.2.1. Sources category description

The Estonian inventory of air pollutants from natural emissions includes NMVOC emission from non-managed deciduous/coniferous forests and managed deciduous/coniferous forests as well as emissions of grassland and other low vegetation including crops. The emissions from the agricultural sector are presented in Table 9.1.

Table 9.1. NMVOC emission from the other natural sources in the period 1990-2010 (Gg)

Year	Managed and non-managed forests	Permanent grasslands and cereal fields	Total
1990	31.55	3.890	**35.44**
1995	31.59	3.135	**34.73**
2000	36.30	3.316	**39.62**
2005	35.60	2.877	**38.47**
2010*	36.39	2.934	**39.32**

*for calculating 2010 emissions, the year 2008 activity data was used

9.2.2. Methodological issues

All methodologies for calculating biogenic emissions essentially involve multiplying an emissions factor for a type of vegetation by a statistic giving the amount of vegetation in the country or grid square. Two major alternatives for this are:

- to perform these calculations at a genera or preferably species specific level (applied for forests in this report), or

- to perform the calculations for different ecosystem types (applied for grassland and crops).

Based on the EMEP/EEA air pollutant emission inventory guidebook (2009), in conclusion, total VOC emissions per year from these activities can be calculated based on the following equation:

$$\begin{aligned}\text{Emission of VOC per vegetation type} &= F \times A \\ &= (\varepsilon \times D \times \Gamma) \times A \\ &= D.A.\left[\Gamma - iso \times \varepsilon_{iso} + \Gamma - mts/ovoc \times \left(\varepsilon_{mts} + \varepsilon_{ovoc}\right)\right]\end{aligned}$$

where:

- A (m²) - area used per vegetation type;
- D (g/m²) - foliar biomass density per vegetation type;
- Γ- the integrated value of a unitless environmental correction factor over the growing season of the vegetation concerned;
- ε-iso (µg/g.h)- isoprenes standard emission potential[9] per vegetation type;
- ε-mts (µg/g.h)- monoterpenes standard emission potential[9] per vegetation type;
- ε-ovoc (µg/g.h)- other VOC standard emission potential[9] per vegetation type.

Average data on Γ, D and ε for European trees and other vegetation are given in the EMEP/EEA air pollutant emission inventory guidebook (2009).

Using meteorological data from the EMEP MSC-W models the integrated values, Γ-iso and Γ-mts, have been calculated for both six monthly (May-October) and 12 monthly growing seasons, as averages over Estonia:

- Γ-mts = Γ-ovoc - 565 hours (6-month) and 669 hours (12-month)
- Γ-iso - 422 hours (6-month) and 491 hours (12-month).

Table 9.2 gives an overview of the input parameters for trees and ecosystem types used to calculate emission factors. There are also emission factors for Estonia included in the table.

[9] Emission potential at 30 °C and PAR(photosynthetically active radiation) = 1000 µmol.m^{-2}.s^{-1}

Table 9.2. Standard emission potentials and biomass densities for European trees (EMEP/EEA, 2009)

Common name	Latin name	Type[1]	Biomass density D, g/m²	Isoprenes ε-iso, µg/g*h	Monoter-penes ε-mts, µg/g*h	o-VOC ε-ovoc, µg/g*h	Emission factor, t/km²
Pine	Pinus sylvestris	e	700	0	1.5	1.5	1.41
Spruce	Picea abies	e	1400	1	1.5	1.5	3.50
Birch	Betula	d	320	0	0.2	1.5	0.31
Asp	Populus		320	60	0	1.5	8.37
Common Alder	Alnus	d	320	0	1.5	1.5	0.54
Ash	Fraxinus	d	320	0	0	1.5	0.27
Oak	Quercus robur	d	320	60	0.2	1.5	8.41
Grassland (meadows/ pastures)	-	-	400	0	0.1	1.5	0.36
Grass related crops	-	-	800	0.002	0.1	1.5	0.72

[1] d = deciduous; e = evergreen

Activity data

The area used per vegetation type can be obtained from Statistics Estonia. For the years 1990 and 1995, information on forest land is not available; therefore, the information from the Yearbook FORESTS (2008) was used. From this reference, the available information about the closest years – 1988 and 1994 – was applied accordingly for the years 1990 and 1995. For 2010, the Yearbook FOREST (2008) was used as the closest year. The distribution of forest land area by dominant tree species in counties is performed using information from the Forest register (Centre of Forest Protection and Silviculture).

Statistics about agricultural lands obtained from Statistics Estonia contain information on crop fields and cereal field area for years 1990–2008. These data were used for calculating total emissions. Information on permanent grasslands is available for the years 2005–2008. There is no information in the Statistical database for the years 1990–2000. In calculating total emissions, areas were calculated using data from CORINE Land Cover 1990 and 2000.

Table 9.3. Activity data used for NMVOC emission calculation in the period 1990–2010, thousand ha

Forest land area by dominant tree species	1990	1995	2000	2005	2010*
Area of pine-woods	749.6	731.7	724.0	682.0	706.6
Area of spruce-woods	454.2	457.6	370.5	370.4	362.9
Area of birch-woods	540.4	585.3	649.4	654.0	646.8
Area of aspen-woods	30.1	31.5	114.0	109.9	116.7
Area of common alder-woods	28.9	28.2	61.6	65.0	67.5
Area of grey alder-woods	90.1	82.9	164.0	178.6	199.6
Area of other stands	23.1	20.6	31.0	31.3	38.4

*for calculating 2010 emissions, the year 2008 activity data was used

Table 9.4. Activity data used for NMVOC emission calculation in the period 1990–2010, thousand ha

Forest land area by dominant tree species	1990	1995	2000	2005	2010*
Area of cereals	397.0	304.3	329.3	282.1	309.3
Area of permanent grasslands	278.9	257.9	257.9	231.0	196.6

*for calculating 2010 emissions, the year 2008 activity data was used

9.3. Source-specific QA/QC and verification

Common statistical quality checking related to the assessment of trends has been carried out.

9.4. Sources-specific planned improvements

10. RECALCULATIONS AND IMPROVEMENTS

The latest recalculations in the emission inventory were done for the time period from 1990 to 2010. The reason for the recalculations is specified in the Summary.

The main objective of recalculation is to improve the emissions inventory and the quality of reports.

The following changes have been carried out in comparison with last year's report.

10.1. Energy sector (NFR 1)

10.1.1. Stationary combustion in energy sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2011 and 2012 are made by using exact calculation numbers.

1.A.1.c Manufacture of solid fuels and other energy industries

NMVOC emissions have been recalculated for the period 1990-2010. Data are changed on the basis of the recalculations, made by the operator of shale oil production (Eesti Energia Narva Õlitööstus AS). Earlier NMVOC emissions contained also methane.

Table 10.1. The differences in manufacture of solid fuels and other energy industries NMVOC emissions between 2011 and 2012 submissions (Gg)

	Old	Recalc.	Difference, %
1990	0.780	0.702	-10.0
1991	0.780	0.718	-8.0
1992	0.730	0.663	-9.2
1993	0.820	0.455	-44.5
1994	0.630	0.314	-50.1
1995	0.690	0.368	-46.6
1996	0.750	0.458	-38.9
1997	0.680	0.386	-43.2
1998	0.570	0.331	-42.0
1999	0.820	0.238	-71.0
2000	1.270	0.163	-87.2
2001	0.850	0.242	-71.6
2002	1.100	0.365	-66.8
2003	1.630	0.412	-74.7
2004	1.090	0.369	-66.1
2005	1.380	0.394	-71.5
2006	0.880	0.118	-86.6
2007	1.140	0.137	-88.0
2008	1.291	0.049	-96.2

	Old	Recalc.	Difference, %
2009	1.429	0.071	-95.0
2010	2.386	0.063	-97.4

1.A.4.b.i Residential: Stationary plants

Emissions of all pollutants have been recalculated for the 2010. Recalculations concern using corrected activity data (the amount of pellets was considered twice in 2010 year submission).

Table 10.2. The differences in Residential stationary plants emissions between the 2011 and 2012 submissions

	Unit	Old	Recalc.	Difference, %
NO_x	Gg	1.665	1.605	-3.6
NMVOC	Gg	18.353	17.623	-4.0
SO_x	Gg	0.426	0.419	-1.7
NH_3	Gg	0.074	0.071	-4.0
$PM_{2.5}$	Gg	13.105	12.583	-4.0
PM_{10}	Gg	13.105	12.583	-4.0
TSP	Gg	14.975	14.379	-4.0
CO	Gg	114.629	110.084	-4.0
Pb	Mg	0.768	0.744	-3.1
Cd	Mg	0.019	0.018	-3.9
Hg	Mg	0.020	0.019	-3.7
As	Mg	0.019	0.018	-3.9
Cr	Mg	0.061	0.059	-3.7
Cu	Mg	0.173	0.167	-3.9
Ni	Mg	0.118	0.115	-2.5
Zn	Mg	2.465	2.368	-3.9
PCDD/ PCDF	g	1.880	1.800	-4.3
benzo(a) pyrene	Mg	3.957	3.801	-4.0
benzo(b) fluoranthene	Mg	4.165	4.001	-3.9
benzo(k) fluoranthene	Mg	2.447	2.350	-4.0
indeno (1,2,3-cd) pyrene	Mg	2.629	2.525	-4.0
PAHs, total	Mg	13.198	12.676	-4.0
HCB	kg	0.120	0.110	-8.3
PCBs	kg	6.960	6.820	-2.0

10.1.2. Transport sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2011 and 2012 are made by using exact calculation numbers.

1.A.2.f.ii Mobile Combustion in manufacturing industries and construction

Emissions of SO_x and NH_3 have been recalculated for the period 1990-2010.

Recalculations concern using corrected sulphur content in fuel and including NH_3 emissions from gasoline combustion in industrial sector.

The differences in the industrial machinery emissions between the 2011 and 2012 submissions are presented in Table 10.3.

Table 10.3. The differences in industrial machinery emissions between the 2011 and 2012 submissions

	SO_x			NH_3		
	Old, Gg	Recalc., Gg	Difference, %	Old, Gg	Recalc., Gg	Difference, %
1990	1.632	1.632	0.000	1.320	1.296	1.852
1991	1.668	1.668	0.000	1.344	1.328	1.205
1992	0.906	0.906	0.000	0.732	0.720	1.667
1993	0.827	0.827	0.000	0.669	0.657	1.826
1994	0.834	0.834	0.000	0.669	0.665	0.602
1995	0.195	0.195	0.000	0.158	0.154	2.597
1996	0.376	0.376	0.000	0.303	0.299	1.338
1997	0.350	0.350	0.000	0.283	0.279	1.434
1998	0.292	0.292	0.000	0.239	0.231	3.463
1999	0.171	0.171	0.000	0.139	0.135	2.963
2000	0.128	0.128	0.000	0.124	0.120	3.333
2001	0.055	0.055	0.000	0.164	0.164	0.000
2002	0.047	0.047	0.000	0.174	0.170	2.353
2003	0.032	0.032	0.000	0.256	0.240	6.667
2004	0.016	0.016	0.000	0.212	0.208	1.923
2005	0.003	0.003	0.000	0.212	0.208	1.923
2006	0.003	0.003	0.800	0.252	0.248	1.613
2007	0.003	0.003	0.932	0.260	0.256	1.562
2008	0.002	0.002	0.000	0.232	0.232	0.000
2009	0.001	0.001	101.550	0.204	0.200	2.000
2010	0.015	0.014	5.333	0.252	0.248	1.613

1.A.3.a.ii.(i) Civil aviation (Domestic, LTO)

All the NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO emissions have been recalculated for the period 1990-2010.

Recalculations concern using corrected emission factors for some specific aircraft types.

The differences in the civil aviation (LTO) emissions between the 2011 and 2012 submissions are presented in Table 10.4.

Table 10.4. The differences in civil aviation (LTO) emissions between the 2011 and 2012 submissions (%)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	1.399	0.731	0.394	6.250	6.250	6.250	0.088	1.399
1991	1.399	0.731	0.394	6.250	6.250	6.250	0.088	1.399
1992	1.527	0.732	0.000	20.000	20.000	20.000	0.081	1.527
1993	1.530	0.860	1.149	0.000	0.000	0.000	0.096	1.530
1994	1.359	0.871	0.000	0.000	0.000	0.000	0.087	1.359
1995	1.478	0.781	0.741	14.286	14.286	14.286	0.086	1.478
1996	1.522	0.852	0.571	0.000	0.000	0.000	0.091	1.522
1997	1.423	0.845	0.610	11.111	11.111	11.111	0.086	1.423
1998	1.486	0.836	0.559	0.000	0.000	0.000	0.093	1.486
1999	1.468	0.816	0.588	0.000	0.000	0.000	0.093	1.468
2000	-2.100	-1.724	-0.741	0.000	0.000	0.000	-0.165	-2.100
2001	-2.640	-2.076	-0.641	-9.091	-9.091	-9.091	-0.274	-2.640
2002	-0.787	-0.588	-0.355	-4.167	-4.167	-4.167	-0.061	-0.787
2003	-4.844	-3.898	-1.278	-5.882	-5.882	-5.882	-5.598	-4.844
2004	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.000
2005	-0.936	-1.898	-0.704	-7.692	-7.692	-7.692	-3.406	-0.936
2006	-2.477	-0.463	-0.340	0.000	0.000	0.000	0.034	-2.477
2007	-4.430	-0.070	-4.380	0.000	0.000	0.000	-0.260	-4.430
2008	-11.771	0.726	-12.733	0.000	0.000	0.000	-0.746	-11.771
2009	-34.366	3.443	-42.458	0.000	0.000	0.000	-2.538	-34.366
2010	-36.204	3.787	-44.444	0.000	0.000	0.000	-2.803	-36.204

1.A.3.a.i.(i) International aviation (LTO)

All the NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP and CO emissions have been recalculated for the period 2000-2010.

Recalculations concern using corrected emission factors for some specific aircraft types.

The differences in the domestic aviation (cruise) emissions between the 2011 and 2012 submissions are presented in Table 10.5.

Table 10.5. The differences in international aviation (LTO) emissions between the 2011 and 2012 submissions (%)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
2000	-0.853	0.230	-1.468	0.000	0.000	0.000	-0.594	-0.853
2001	-0.660	0.291	-1.174	0.000	0.000	0.000	-0.463	-0.660
2002	-0.161	0.046	-0.306	0.000	0.000	0.000	-0.116	-0.161
2003	-0.048	-0.216	-0.101	0.000	0.000	0.000	-1.024	-0.048
2004	-0.013	0.011	-0.037	0.000	0.000	0.000	-0.010	-0.013
2005	-0.016	-0.112	-0.027	0.000	0.000	0.000	-0.450	-0.016

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
2006	-0.777	0.010	-0.041	0.000	0.000	0.000	0.463	-0.777
2007	-0.508	0.402	-0.944	0.000	0.000	0.000	-0.493	-0.508
2008	-1.311	1.668	-2.621	0.108	0.108	0.108	-1.100	-1.311
2009	-2.258	2.098	-4.358	0.169	0.169	0.169	-2.507	-2.258
2010	-2.089	1.668	-3.994	0.000	0.000	0.000	-2.079	-2.089

1.A.3.b Road transport

All the NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Zn, Diox, PAHs emissions are recalculated for the period 2008-2010.

Explanations for improvements and recalculations in the road transport sector:

- Small correction in the calculations: activity data are correctly divided between road transport subsectors and correction in annual mileage driven in small extent.

The differences in road transport emissions between the submissions for 2011 and 2012 are presented in Table 10.6.

Table 10.6. The differences in road transport emissions between the 2011 and 2012 submissions (%)

	NOx	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
2008	-0.048	-0.043	0.000	-0.008	-2.051	-1.697	-1.400	-0.035
2009	-0.101	-0.016	-0.009	0.002	-0.013	0.002	0.019	0.037
2010	-0.049	-0.018	0.000	-0.024	-0.659	-0.504	-0.321	0.108

	Pb	Cd	Cr	Cu	Ni	Zn	PCDD/F	PAHs
2008	-0.016	-0.013	-0.083	-0.098	-0.073	-0.061	0.002	-0.410
2009	0.009	0.000	0-049	0.058	0.041	0.016	0.013	0.063
2010	0.013	0.014	0-025	0.031	0.015	-0.009	0.033	-0.371

1.A.3.c Railways

SO_2 emissions have been recalculated for 2010.

Explanation for recalculations in the railway sector:

- Correction of sulphur content in fuels.

The differences in railway emissions between the 2011 and 2012 submissions are presented in Table 10.7.

Table 10.7. The differences in railway emissions between the 2011 and 2012 submissions

SO_x			
	Old, Gg	Recalc., Gg	Difference, %
2010	0.0701	0.0703	0.222

1.A.3.d.ii National navigation (Shipping)

Some pollutant (NO_x, NMVOC, $PM_{2.5}$, PM_{10}, TSP, CO) emissions have been recalculated for the period 1990-2010.

Explanations for recalculations in the national navigation sector:

- Updated emission factors in the EMEP/EEA Guidebook

The differences in national navigation emissions between the 2011 and 2012 submissions are presented in Table 10.8.

Table 10.8. The differences in navigation emissions between the 2011 and 2012 submissions (%)

	NO_x	NMVOC	$PM_{2.5}$	PM_{10}	TSP	CO
1990	3.538	3.804	NR	NR	4.002	2.868
1991	3.538	3.804	NR	NR	4.002	2.868
1992	3.538	3.804	NR	NR	4.002	2.868
1993	3.538	3.804	NR	NR	4.002	2.868
1994	3.538	3.804	NR	NR	4.002	2.868
1995	3.538	3.804	NR	NR	4.002	2.868
1996	3.538	3.804	NR	NR	4.002	2.868
1997	3.538	3.804	NR	NR	4.002	2.868
1998	3.538	3.804	NR	NR	4.002	2.868
1999	3.538	3.804	NR	NR	4.002	2.868
2000	3.538	3.804	4.002	4.002	4.002	2.868
2001	3.538	3.804	4.002	4.002	4.002	2.868
2002	3.538	3.804	4.002	4.002	4.002	2.868
2003	3.538	3.804	4.002	4.002	4.002	2.868
2004	3.538	3.804	4.002	4.002	4.002	2.868
2005	3.538	3.804	4.002	4.002	4.002	2.868
2006	3.538	3.804	4.002	4.002	4.002	2.868
2007	3.538	3.804	4.002	4.002	4.002	2.868
2008	3.538	3.804	4.002	4.002	4.002	2.868
2009	3.538	3.804	4.002	4.002	4.002	2.868
2010	3.538	3.804	4.002	4.002	4.002	2.868

1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

SO_2 emissions have been recalculated for the period 2006-2010.

Explanations for recalculations in the agricultural sector:

- Correction of sulphur content in fuels.

The differences in agricultural machinery emissions between the 2011 and 2012 submissions are presented in Table 10.9.

Table 10.9. The differences in agricultural machinery emissions between the 2010 and 2011 submissions (%)

SO_x			
	Old, Mg	Recalc., Mg	Difference, %
2006	67.307	67.313	0.008
2007	61.947	61.960	0.020
2008	64.808	64.810	0.003
2009	13.371	14.367	7.447
2010	0.003	6.188	178135.023

1.A.3.a.ii(ii) Civil aviation (Domestic, Cruise)

All the emissions have been recalculated for the years 1990-2003 and 2005-2009.

Recalculations concern using corrected fuel consumption data.

The differences in the civil aviation (cruise) emissions between the 2011 and 2012 submissions are presented in Table 10.10.

Table 10.10. The differences in civil aviation (cruise) emissions between the 2011 and 2012 submissions (%)

	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP	CO
1990	-0.179	-0.658	-0.198	NR	NR	0.000	-0.165
1991	-0.179	-0.658	-0.198	NR	NR	0.000	-0.165
1992	-0.173	-1.961	-0.198	NR	NR	0.000	-0.198
1993	-0.086	0.000	-0.089	NR	NR	0.000	-0.089
1994	-0.134	0.000	-0.138	NR	NR	0.000	-0.138
1995	-0.160	0.000	-0.206	NR	NR	-0.513	-0.154
1996	-0.237	0.000	-0.244	NR	NR	-0.610	-0.244
1997	-0.193	0.000	-0.210	NR	NR	-0.524	-0.157
1998	-0.330	0.000	-0.324	NR	NR	-0.806	-0.324
1999	-0.288	0.000	-0.297	NR	NR	-0.741	-0.297
2000	0.397	0.000	0.472	0.787	0.787	0.787	0.393
2001	0.579	1.667	0.662	0.826	0.826	0.826	0.579
2002	0.467	0.000	0.418	0.000	0.000	0.000	0.524

	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP	CO
2003	1.955	2.439	1.966	2.469	2.469	2.469	1.963
2005	1.234	0.000	1.271	2.128	2.128	2.128	1.271
2006	2.090	0.000	2.273	0.000	0.000	0.000	1.695
2007	7.807	8.333	7.692	8.696	8.696	8.696	7.692
2008	8.038	8.108	8.065	8.108	8.108	8.108	8.065
2009	70.807	68.750	71.154	70.968	70.968	70.968	70.607
2010	75.739	75.000	75.316	71.875	71.875	71.875	75.873

1.A.3.a.i.(ii) International aviation (Cruise)

All the emissions have been recalculated for the period 2000-2010.

Recalculations concern using corrected fuel consumption data.

The differences in the international aviation (cruise) emissions between the 2011 and 2012 submissions are presented in Table 10.11.

Table 10.11. The differences in international aviation (cruise) emissions between the 2011 and 2012 submissions (%)

	NO_x	NMVOC	SO_x	$PM_{2,5}$	PM_{10}	TSP	CO
2000	0.223	0.224	0.224	0.207	0.207	0.207	0.220
2001	0.246	0.236	0.245	0.253	0.253	0.253	0.246
2002	0.049	0.056	0.049	0.070	0.070	0.070	0.051
2003	0.022	0.030	0.022	0.037	0.037	0.037	0.027
2005	0.004	0.009	0.004	0.000	0.000	0.000	0.004
2004	0.005	0.005	0.005	0.000	0.000	0.000	0.005
2006	0.010	0.009	0.013	0.000	0.000	0.000	0.008
2007	0.153	0.156	0.151	0.151	0.151	0.151	0.151
2008	1.207	1.212	1.205	1.224	1.224	1.224	1.207
2009	0.923	0.924	0.924	0.912	0.912	0.912	0.925
2010	0.694	0.691	0.691	0.691	0.691	0.691	0.694

1.A.3.d.i.(i) International maritime navigation

All the PCB emissions are recalculated for the period 1990-2010.

Explanations for recalculations in the international maritime sector:

- Recalculations concern using corrected emission factors for PCB emission calculations.

The differences in international maritime navigation sector emissions between the 2011 and 2012 submissions are presented in Table 10.12.

Table 10.12. The differences in international maritime emissions between the 2011 and 2012 submissions (%)

PCBs			
	Old, kg	Recalc., kg	Difference, %
1990	0.087	0.096	10.6
1991	0.102	0.113	11.0
1992	0.048	0.063	30.4
1993	0.049	0.074	50.3
1994	0.039	0.061	55.4
1995	0.030	0.044	45.6
1996	0.034	0.046	34.8
1997	0.042	0.052	25.5
1998	0.046	0.056	22.5
1999	0.045	0.057	28.3
2000	0.039	0.053	37.2
2001	0.034	0.050	45.0
2002	0.042	0.059	39.6
2003	0.042	0.057	36.2
2004	0.061	0.078	28.2
2005	0.046	0.061	33.8
2006	0.100	0.115	15.4
2007	0.128	0.138	8.3
2008	0.136	0.143	5.0
2009	0.123	0.128	4.2
2010	0.123	0.125	1.9

10.2. Solvent and Other Product Use (NFR 3)

There has been made some minor recalculations of NMVOC emissions in the period 2006-2010 due to the corrections in activity data and NMVOC emissions misallocations under several SNAP codes.

Table 10.13. The 2013 submission of NMVOC emissions and the difference in comparison to the 2012 submission

		3.A.1	3.A.2	3.B.1	3.B.2	3.C	3.D.1	3.D.3	Total NMVOC
2006	Old, Gg	2.952	0.753	1.122	0.065	0.226	0.669	2.818	9.950
	Recalc., Gg	2.953	0.914	1.124	0.065	0.158	0.666	2.323	9.547
	Difference, %	**0.03**	**21.44**	**0.17**	**-0.51**	**-30.32**	**-0.47**	**-17.56**	**-4.05**
2007	Old, Gg	2.842	0.768	1.090		0.384	0.401	3.025	9.906
	Recalc., Gg	2.747	1.017	1.094		0.265	0.491	1.772	8.783
	Difference, %	**-3.34**	**32.38**	**0.39**		**-31.15**	**22.53**	**-41.40**	**-11.34**
2008	Old, Gg	1.691	0.951	1.084		0.468	0.674	1.611	7.871
	Recalc., Gg	1.639	0.950	1.084		0.314	0.773	1.607	7.759
	Difference, %	**-3.09**	**-0.10**	**-0.01**		**-32.86**	**14.69**	**-0.23**	**-1.42**
2009	Old, Gg	1.503	0.623			0.291	0.229	1.236	6.252
	Recalc., Gg	1.434	0.622			0.497	0.228	1.233	6.385
	Difference, %	**-4.58**	**-0.06**			**71.11**	**-0.46**	**-0.26**	**2.13**
2010	Old, Gg	1.610	0.767	1.028		0.135	0.354	0.592	5.837
	Recalc., Gg	1.470	0.765	1.029		0.164	0.354	0.587	5.719
	Difference, %	**-8.72**	**-0.29**	**0.09**		**21.60**	**0.06**	**-0.92**	**-2.02**

10.3. Waste sector (NFR 6)

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2011 and 2012 are made by using exact calculation numbers.

6.D Other waste(s)

NH_3 emissions have been recalculated for the year 2010.

Explanations for recalculations in the waste sector:

- Correction of activity data (amount of compost production from waste).

The differences in waste sector NH3 emissions between the 2011 and 2012 submissions are presented in Table 10.5.

Table 10.14. The differences in waste sector NH_3 emissions between the 2011 and 2012 submissions

NH_3			
	Old, Mg	**Recalc., Mg**	**Difference, %**
2010	0.190	0.188	-1.056

11. PROJECTION

Estonian emission projections for substances regulated by the LRTAP Gothenburg Protocol and additionally PM_{10} were compiled in early 2012. In some cases these projections exceed the emission reduction commitments agreed with the Gothenburg Protocol because final agreements were made after compilation of the projections. The projections will be updated and latest obligations of Estonia will be taken into account during 2013.

Table 11.1. National emission ceilings for 2010 and emission projections for 2015 and 2020

Pollutant	National emissions ceiling for 2010 (Gg)	Emission projections for 2015 (Gg)	Emission projections for 2020 (Gg)
SO_2	100	51.78	51.97
NO_x	60	32.70	31.84
NMVOC	49	39.53	40.71
NH_3	29	9.69	9.95
PM_{10}	NA	21.22	21.25
$PM_{2.5}$	NA	18.34	18.62

12. GRIDDED EMISSIONS

12.1. Overview of the gridded emissions

12.1.1. Description of gridded emissions

The updated GRID emissions for 1990, 1995, 2000, 2005 for each GNFR (aggregated sectors) code and GRID data by GNFR for the 2010 were submitted on 1 March 2012. Emission data are disaggregated to the extended EMEP grid with a resolution of 50 km x 50 km.

Table 12.1 lists the aggregated sectors used for reporting emission data and pollutants on grid based on the Estonian inventories.

Table 12.1. Activities and emissions reported for GRID data

GNFR	Emissions reported	Notes
A_PublicPower	NO_x, SO_x, NMVOC, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB, PCB	PM for 2000, 2005 and 2010; NH_3 for 2010
B_IndustrialComb	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB, PCB	PM for 2000, 2005 and 2010; NH_3 for 2010
C_SmallComb	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB, PCB	PM for 2000, 2005 and 2010;
D_IndProcess	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg	PM for 2000, 2005 and 2010; HM for 2010
E_Fugitive	NOx, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO	For 1990 and 1995 only NMVOC; PM for 2000, 2005 and 2010;
F_Solvents	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs,	PM for 2000, 2005 and 2010;
G_RoadRail	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB, PCB	PM for 2000, 2005 and 2010; Hg, HCB and PCB for 1990, 1995 and 2000
H_Shipping	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB, PCB	Pb, Hg, PCDD/PCDF, HCB, PCB and PM for 2000, 2005 and 2010
I_OffRoadMob	NO_x, SO_x, NMVOC, NH_3, , PM_{10}, $PM_{2.5}$, CO, Pb, Cd, PAHs	PM for 2000, 2005 and 2010
J_AviLTO	NO_x, SO_x, NMVOC, PM_{10}, $PM_{2.5}$, CO	PM for 2000, 2005 and 2010
L_OtherWasteDisp	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF,	For 1990 and 1995 only NH_3; PM for 2000, 2005 and 2010
M_WasteWater	NO_x, SO_x, NMVOC, NH_3	NO_x, SO_x, and NH_3 for 2010
N_WasteIncin	NO_x, SO_x, NMVOC, NH_3, CO,PCDD/PCDF	SO_x, NMVOC, NH_3, CO for 2005 and 2010; NO_x for 2010
O_AgriLivestock	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$	PM for 2000, 2005 and 2010
P_AgriOther	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$	PM for 2000, 2005 and 2010
S_Natural	NMVOC	

12.1.2. Methodological issues

The disaggregation of emissions is similar to Estonia's emissions inventory structure.

The disaggregation of emissions for the 1990, 1995, 2000 and 2005 is based on data pertaining to the large point sources and diffuse sources. The disaggregation of emissions for 2010 is based on data pertaining to the point sources (ca. 1700 in 2010) and diffuse sources.

LPS data for 1990, 1995, 2000 and 2005 and point sources data for 2010 were allocated directly to the grid by using their x and y coordinates. The diffuse data were distributed by using mainly different statistical data from Statistics Estonia (Table 12.2). Also the distributions of point sources data in 2010 were used for previous years, where it was reasonable.

Table 12.2. Distribution of point- and diffuse sources by aggregated sectors

GNFR	Description	Distribution of diffuse sources
A_PublicPower	Point and diffuse sources	Fuel consumption data by county; distributions of point sources data in 2010
B_IndustrialComb	Point and diffuse sources	Fuel consumption data by county; distributions of point sources data in 2010
C_SmallComb	Point and diffuse sources	Fuel consumption data by county; population density
D_IndProcess	Point and diffuse sources	Construction data by county; distributions of point sources data in 2010
E_Fugitive	Point and diffuse sources	Petrol and natural gas distribution by county; distributions of point sources data in 2010
F_Solvents	Point and diffuse sources	Population density; distributions of point sources data in 2010
G_RoadRail	Diffuse sources	Number of vehicles by county; the length of the railway and main roads (by grids)
H_Shipping	Diffuse sources	Ferry traffic data by county
I_OffRoadMob	Diffuse sources	Number of vehicles by county
J_AviLTO	Emissions by Airports	
L_OtherWasteDisp	Point and diffuse sources	Number of fires by county; distributions of point sources data in 2010
M_WasteWater	Point and diffuse sources	Amounts of sewage by county; distributions of point sources data in 2010
N_WasteIncin	Point sources	
O_AgriLivestock	Diffuse sources	Livestock data by county; CORINE Land Cover
P_AgriOther	Diffuse sources	Data about application of nitrogen fertilizers and field preparation by county; CORINE Land Cover
S_Natural	Diffuse sources	Information on forest land by county; CORINE Land Cover

13. EMISSIONS FROM LARGE POINT SOURCES (LPS)

13.1. Overview of the LPS emissions

13.1.1. Description of LPS emissions

The emissions data from the Large Point Sources is presented for the year 2010 for each GNFR (aggregated sectors) code and was submitted into Eionet's Central Data Repository on 1 March 2012. Later on some changes were made and the updated data will be presented together with the IIR on 15 March 2012. The analysis of LPS emissions is carried out on the basis of the corrected data.

Table 13.1 lists the number of LPS by GNFR sectors used for reporting LPS emissions and reported pollutants, how many facilities there are in each sector, the number of E-PRTR facilities and the height classes. Each LPS emission has been aggregated by GNFR sectors and stack height classes. For identification of LPS, the principle of pollutant emission thresholds has originally been used and then for this LPS all other pollutants are presented on the reporting table IV.3b. It should be noted that for some facilities there is a difference in the data under E-PRTR and the present Guideline. For example, E-PRTR report does not include emissions from the combustion activity for the Kiviõli Keemiatööstus OÜ, because the heat input for that combustion installation is less than 50 megawatts. But since emissions for some pollutants exceeded the emission thresholds, the data was included in LPS table. The big difference between the number of LPS and E-PRTR facilities in agriculture sector is explained by the fact that the majority of farms are raising cattle (non-Annex 1 activity).

Table 13.1. Activities and pollutants under LPS

GNFR	Emissions reported	Number of LPS facilities	Number of E-PRTR facilities	Height class
A_PublicPower	NO_x, SO_x, NMVOC, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB	10	7	1,2,3,4,5
B_IndustrialComb	NO_x, SO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, PCDD/PCDF, PAHs, HCB, PCB	8	5	1,2
D_IndProcess	NH_3	1	1	1
E_Fugitive	NO_x, SO_x, NMVOC, NH_3, CO	6	4	1
F_Solvents	NMVOC	1	-	1
O_AgriLivestock	NO_x, NMVOC, NH_3	88	17	1

As can be seen on the Figure 13.1, the share of some pollutants from LPS in total emissions is very large: for SO_2 – 97%, Pb – 93.4%, Cd – 90.6%, Hg – 95.4%, NO_x and PM_{10} – 39%. The share of other substances from LPS is not so significant.

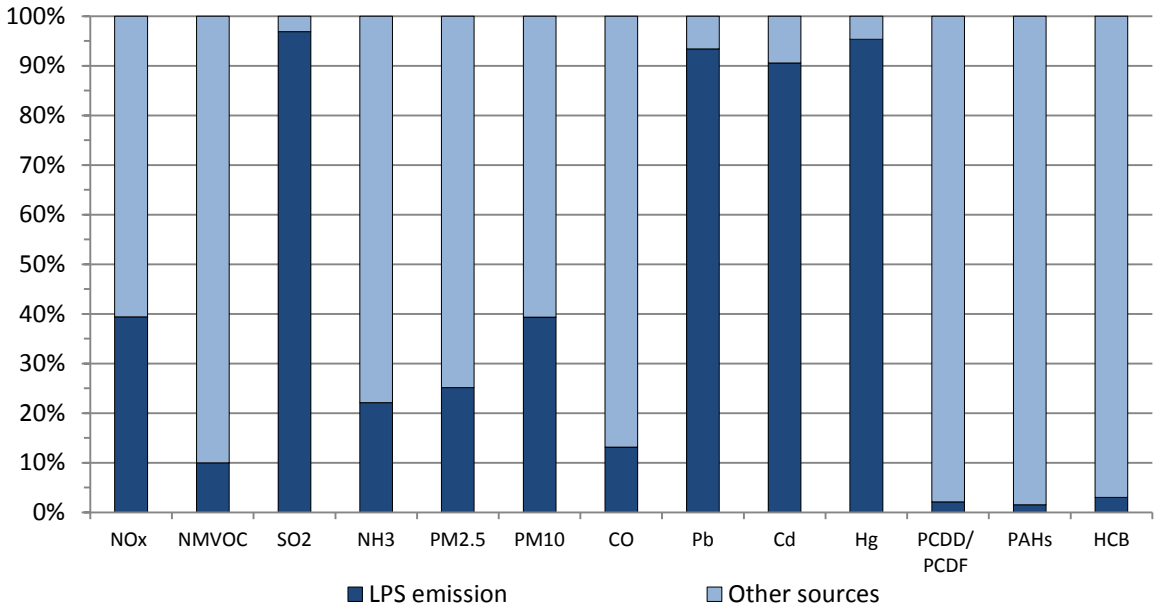

Figure 13.1. The contribution of LPS emission in total country emission

The figure 13.2 and 13.3 illustrates the contribution of LPS emissions inside A_PublicPower and B_IndustrialCombustion sectors. For other sectors the LPS contribution to total emissions is not so significant.

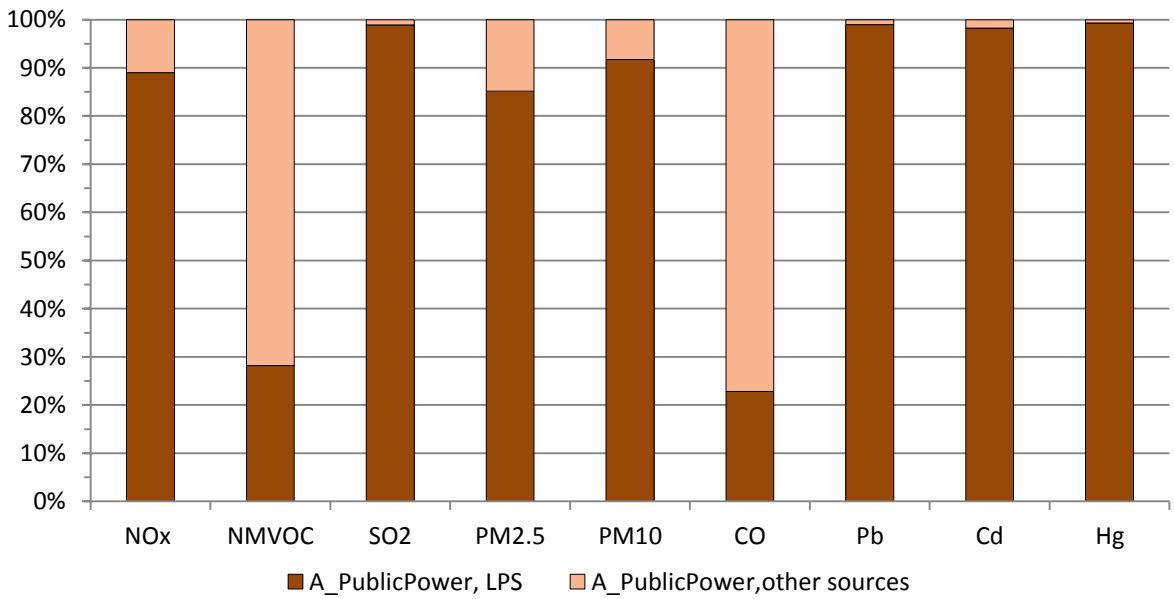

Figure 13.2. The contribution LPS emission into A_PublicPower sector

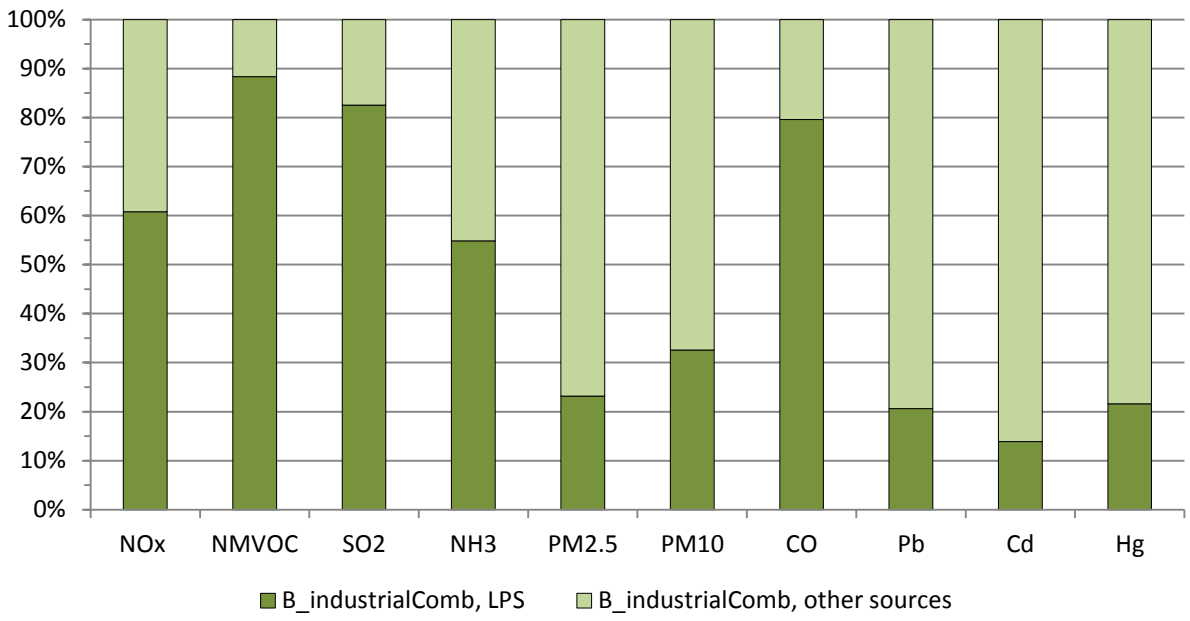

Figure 13.3. The contribution LPS emission into B_IndustrialCombustion sector

ANNEX I

Key sources categories level assessment

Table 1. Key source categories for NO_x emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**14.7398**	**41.3%**
1 A 3 b iii Road transport:, Heavy duty vehicles	**5.7003**	**57.3%**
1 A 3 b i Road transport: Passenger cars	**3.3720**	**66.8%**
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	**2.1377**	**72.8%**
1 A 2 f i Stationary combustion in manufacturing industries and construction	**1.8203**	**77.9%**
1 A 3 c Railways	**1.7816**	**82.9%**
1 A 4 b i Residential: Stationary plants	1.4160	86.9%
4 D 1 a Synthetic N-fertilizers	1.0919	89.9%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.6886	91.9%
1 A 3 b ii Road transport: Light duty vehicles	0.6856	93.8%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.4242	95.0%
1 A 4 a i Commercial / institutional: Stationary	0.3807	96.0%
1 A 1 c Manufacture of solid fuels and other energy industries	0.3600	97.0%
1 A 4 a ii Commercial / institutional: Mobile	0.2028	97.6%
1 A 3 d ii National navigation (Shipping)	0.1920	98.1%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.1405	98.5%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1089	98.8%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0874	99.1%
1 A 3 a i (i) International aviation (LTO)	0.0849	99.3%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0523	99.5%
2 D 1 Pulp and paper	0.0382	99.6%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0266	99.7%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0239	99.7%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0176	99.8%
2 C 1 Iron and steel production	0.0142	99.8%
6 C b Industrial waste incineration (d)	0.0138	99.9%
2 A 7 a Quarrying and mining of minerals other than coal	0.0095	99.9%
4 B 1 a Cattle dairy	0.0077	99.9%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0071	99.9%
1 A 1 b Petroleum refining	0.0062	99.9%
1 B 2 a iv Refining / storage	0.0044	100.0%
4 B 1 b Cattle non-dairy	0.0042	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0025	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0020	100.0%
4 B 9 a Laying hens	0.0017	100.0%
4 B 9 b Broilers	0.0014	100.0%
6 D Other waste(e)	0.0013	100.0%
4 B 6 Horses	0.0009	100.0%
1 B 2 c Venting and flaring	0.0005	100.0%
6 B Waste-water handling	0.0004	100.0%
4 B 3 Sheep	0.0004	100.0%
6 C c Municipal waste incineration (d)	0.0004	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0003	100.0%
4 B 8 Swine	0.0003	100.0%

NFR code	2011 (Gg)	Cumulative Total
4 B 9 d Other poultry	0.0002	100.0%
2 C 5 e Other metal production	0.0001	100.0%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0001	100.0%
2 D 2 Food and drink	0.0000	100.0%
2 D 3 Wood processing	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
2 B 5 a Other chemical industry	0.0000	100.0%

Table 2. Key source categories for NMVOC emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**15.2961**	**46.2%**
1 B 2 a v Distribution of oil products	**1.7422**	**51.5%**
1 A 3 b i Road transport: Passenger cars	**1.7310**	**56.7%**
3 A 1 Decorative coating application	**1.6964**	**61.9%**
3 D 2 Domestic solvent use including fungicides	**1.3402**	**65.9%**
4 B 1 a Cattle dairy	**1.3083**	**69.9%**
4 B 1 b Cattle non-dairy	**1.0515**	**73.0%**
3 B 1 Degreasing	**1.0351**	**76.2%**
4 B 8 Swine	**0.9306**	**79.0%**
3 A 2 Industrial coating application	**0.8630**	**81.6%**
2 D 2 Food and drink	0.7662	83.9%
3 D 3 Other product use	0.7323	86.1%
1 A 2 f i Stationary combustion in manufacturing industries and construction	0.5409	87.8%
1 A 4 b ii Residential: Household and gardening (mobile)	0.4780	89.2%
1 B 2 a iv Refining / storage	0.4162	90.5%
1 A 1 a Public electricity and heat production	0.4014	91.7%
3 D 1 Printing	0.3440	92.7%
1 A 3 b v Road transport: Gasoline evaporation	0.3324	93.7%
3 C Chemical products	0.3133	94.7%
1 A 3 b iii Road transport: Heavy duty vehicles	0.2312	95.4%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.2053	96.0%
4 B 9 a Laying hens	0.1707	96.5%
1 A 3 c Railways	0.1581	97.0%
4 B 9 b Broilers	0.1419	97.4%
1 A 3 b ii Road transport: Light duty vehicles	0.0883	97.7%
1 A 4 a i Commercial / institutional: Stationary	0.0801	97.9%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0754	98.1%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0711	98.4%
2 B 5 b Storage, handling and transport of chemical products	0.0610	98.5%
1 A 4 a ii Commercial / institutional: Mobile	0.0606	98.7%
4 B 9 d Other poultry	0.0536	98.9%
1 A 3 d ii National navigation (Shipping)	0.0373	99.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0372	99.1%
6 B Waste-water handling	0.0290	99.2%
6 C b Industrial waste incineration (d)	0.0278	99.3%
2 A 6 Road paving with asphalt	0.0204	99.3%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0197	99.4%
2 D 1 Pulp and paper	0.0191	99.5%
3 B 2 Dry cleaning	0.0185	99.5%
1 B 2 b Natural gas	0.0180	99.6%
4 B 3 Sheep	0.0176	99.6%

NFR code	2011 (Gg)	Cumulative Total
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0151	99.7%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0127	99.7%
2 D 3 Wood processing	0.0126	99.8%
2 B 5 a Other chemical industry	0.0118	99.8%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0114	99.8%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0106	99.9%
6 C d Cremation	0.0104	99.9%
1 A 3 a i (i) International aviation (LTO)	0.0099	99.9%
2 C 1 Iron and steel production	0.0074	99.9%
6 D Other waste(e)	0.0060	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0046	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0031	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0026	100.0%
1 B 2 c Venting and flaring	0.0024	100.0%
2 C 5 e Other metal production	0.0009	100.0%
1 A 1 b Petroleum refining	0.0004	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0002	100.0%
2 F Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	0.0001	100.0%
2 C 3 Aluminium production	0.0001	100.0%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0000	100.0%
6 C c Municipal waste incineration (d)	0.0000	100.0%
4 D 1 a Synthetic N-fertilizers	0.0000	100.0%

Table 3. Key source categories for SO_x emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**66.2424**	**91.1%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	4.3173	97.1%
1 A 1 c Manufacture of solid fuels and other energy industries	1.1474	98.6%
1 A 4 b i Residential: Stationary plants	0.4747	99.3%
1 A 4 a i Commercial / institutional: Stationary	0.1457	99.5%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1003	99.6%
1 A 3 c Railways	0.0680	99.7%
1 B 2 a iv Refining / storage	0.0543	99.8%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0249	99.8%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0206	99.9%
2 D 1 Pulp and paper	0.0200	99.9%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0167	99.9%
1 A 3 d ii National navigation (Shipping)	0.0100	99.9%
6 C b Industrial waste incineration (d)	0.0095	99.9%
1 A 3 a i (i) International aviation (LTO)	0.0080	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0058	100.0%
1 A 3 b i Road transport: Passenger cars	0.0046	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0036	100.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0033	100.0%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0030	100.0%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0026	100.0%

NFR code	2011 (Gg)	Cumulative Total
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0018	100.0%
1 B 2 c Venting and flaring	0.0012	100.0%
2 A 7 a Quarrying and mining of minerals other than coal	0.0009	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0008	100.0%
1 A 3 b ii Road transport: Light duty vehicles	0.0007	100.0%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0005	100.0%
3 D 3 Other product use	0.0005	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0002	100.0%
6 B Waste-water handling	0.0001	100.0%
6 C c Municipal waste incineration (d)	0.0001	100.0%
2 C 5 e Other metal production	0.0001	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0001	100.0%
6 D Other waste(e)	0.0001	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0001	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0001	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0000	100.0%
2 C 1 Iron and steel production	0.0000	100.0%
2 D 3 Wood processing	0.0000	100.0%
2 B 5 a Other chemical industry	0.0000	100.0%
2 D 2 Food and drink	0.0000	100.0%
2 C 5 b Lead production	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

Table 4. Key source categories for NH_3 emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
4 B 1 a Cattle dairy	**3.2708**	**31.5%**
4 D 1 a Synthetic N-fertilizers	**2.5035**	**55.6%**
4 B 1 b Cattle non-dairy	**1.7251**	**72.2%**
4 B 8 Swine	**1.3477**	**85.2%**
4 B 9 b Broilers	0.3122	88.2%
4 B 9 a Laying hens	0.2731	90.9%
1 A 3 b i Road transport: Passenger cars	0.1991	92.8%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.1752	94.5%
6 D Other waste(e)	0.1304	95.7%
4 B 3 Sheep	0.1235	96.9%
4 B 6 Horses	0.0962	97.8%
2 C 5 e Other metal production	0.0699	98.5%
1 A 4 b i Residential: Stationary plants	0.0618	99.1%
4 B 9 d Other poultry	0.0566	99.6%
2 B 5 a Other chemical industry	0.0101	99.7%
2 B 5 b Storage, handling and transport of chemical products	0.0065	99.8%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0058	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0048	99.9%
1 A 3 b iii Road transport: Heavy duty vehicles	0.0031	99.9%
3 C Chemical products	0.0027	100.0%
6 C d Cremation	0.0017	100.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0005	100.0%
2 F Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	0.0004	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0003	100.0%
1 A 3 c Railways	0.0002	100.0%
6 B Waste-water handling	0.0002	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0002	100.0%

NFR code	2011 (Gg)	Cumulative Total
1 A 1 c Manufacture of solid fuels and other energy industries	0.0002	100.0%
6 C b Industrial waste incineration (d)	0.0001	100.0%
2 C 1 Iron and steel production	0.0001	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0001	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0001	100.0%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0000	100.0%
1 A 3 d ii National navigation (Shipping)	0.0000	100.0%
6 A Solid waste disposal on land	0.0000	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0000	100.0%
1 B 2 a iv Refining / storage	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
2 D 3 Wood processing	0.0000	100.0%
1 A 1 a Public electricity and heat production	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0000	100.0%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0000	100.0%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0000	100.0%
1 A 4 a i Commercial / institutional: Stationary	0.0000	100.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0000	100.0%
1 B 2 c Venting and flaring		100.0%

Table 5. Key source categories for $PM_{2.5}$ emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**11.7116**	**44.3%**
1 A 4 b i Residential: Stationary plants	**10.9256**	**85.5%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	1.7716	92.2%
1 A 4 a i Commercial / institutional: Stationary	0.4022	93.8%
1 A 1 c Manufacture of solid fuels and other energy industries	0.2197	94.6%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1584	95.2%
1 A 3 b i Road transport: Passenger cars	0.1472	95.7%
1 A 3 b iii Road transport: Heavy duty vehicles	0.1129	96.2%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1060	96.6%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.0925	96.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0837	97.2%
2 D 1 Pulp and paper	0.0808	97.5%
1 B 2 a iv Refining / storage	0.0735	97.8%
1 A 3 b vii Road transport: Automobile road abrasion	0.0520	98.0%
3 D 3 Other product use	0.0504	98.2%
1 A 3 b ii Road transport: Light duty vehicles	0.0480	98.4%
1 A 3 c Railways	0.0466	98.6%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0438	98.7%
2 A 7 a Quarrying and mining of minerals other than coal	0.0350	98.9%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0327	99.0%
4 D 1 a Synthetic N-fertilizers	0.0284	99.1%
2 D 3 Wood processing	0.0273	99.2%

NFR code	2011 (Gg)	Cumulative Total
1 A 3 d ii National navigation (Shipping)	0.0230	99.3%
4 B 1 b Cattle non-dairy	0.0227	99.4%
4 B 1 a Cattle dairy	0.0221	99.5%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0205	99.5%
1 A 4 a ii Commercial / institutional: Mobile	0.0135	99.6%
4 B 8 Swine	0.0126	99.6%
2 C 1 Iron and steel production	0.0122	99.7%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0120	99.7%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0104	99.8%
4 B 9 b Broilers	0.0099	99.8%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0094	99.8%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0085	99.9%
2 A 7 b Construction and demolition	0.0043	99.9%
3 A 2 Industrial coating application	0.0043	99.9%
2 B 5 a Other chemical industry	0.0038	99.9%
2 D 2 Food and drink	0.0036	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0028	99.9%
2 A 3 Limestone and dolomite use	0.0026	100.0%
2 C 3 Aluminium production	0.0020	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0015	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0014	100.0%
2 C 5 e Other metal production	0.0012	100.0%
4 B 9 a Laying hens	0.0011	100.0%
6 D Other waste(e)	0.0011	100.0%
2 A 1 Cement production	0.0009	100.0%
4 B 6 Horses	0.0008	100.0%
1 A 3 a i (i) International aviation (LTO)	0.0006	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0005	100.0%
2 B 5 b Storage, handling and transport of chemical products	0.0004	100.0%
1 B 2 c Venting and flaring	0.0003	100.0%
6 C b Industrial waste incineration (d)	0.0003	100.0%
2 C 5 d Zinc production	0.0003	100.0%
4 B 9 d Other poultry	0.0002	100.0%
2 A 2 Lime production	0.0002	100.0%
2 A 6 Road paving with asphalt	0.0001	100.0%
3 B 1 Degreasing	0.0000	100.0%
2 C 5 b Lead production	0.0000	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0000	100.0%
2 C 5 a Copper production	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

Table 6. Key source categories for PM_{10} emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**25.0825**	**60.0%**
1 A 4 b i Residential: Stationary plants	**10.9256**	**86.2%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	2.0287	91.1%
4 D 1 a Synthetic N-fertilizers	0.7396	92.8%
1 A 4 a i Commercial / institutional: Stationary	0.4688	94.0%
1 A 1 c Manufacture of solid fuels and other energy industries	0.4365	95.0%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1843	95.4%

NFR code	2011 (Gg)	Cumulative Total
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.1727	95.9%
1 A 3 b i Road transport: Passenger cars	0.1472	96.2%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.1176	96.5%
2 A 7 a Quarrying and mining of minerals other than coal	0.1146	96.8%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.1129	97.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1060	97.3%
1 A 3 b vii Road transport: Automobile road abrasion	0.0956	97.5%
2 D 1 Pulp and paper	0.0917	97.7%
1 B 2 a iv Refining / storage	0.0910	98.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0857	98.2%
2 D 3 Wood processing	0.0818	98.4%
4 B 8 Swine	0.0792	98.5%
4 B 9 b Broilers	0.0738	98.7%
3 D 3 Other product use	0.0504	98.8%
1 A 3 c Railways	0.0490	99.0%
1 A 3 b ii Road transport: Light duty vehicles	0.0480	99.1%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0438	99.2%
2 A 7 b Construction and demolition	0.0432	99.3%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0413	99.4%
4 B 1 a Cattle dairy	0.0346	99.5%
4 B 1 b Cattle non-dairy	0.0341	99.5%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0291	99.6%
1 A 3 d ii National navigation (Shipping)	0.0230	99.7%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0219	99.7%
2 C 1 Iron and steel production	0.0167	99.8%
1 A 4 a ii Commercial / institutional: Mobile	0.0135	99.8%
2 B 5 a Other chemical industry	0.0114	99.8%
2 D 2 Food and drink	0.0109	99.8%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0107	99.9%
4 B 9 a Laying hens	0.0097	99.9%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0094	99.9%
2 A 3 Limestone and dolomite use	0.0078	99.9%
3 A 2 Industrial coating application	0.0043	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0030	100.0%
2 A 1 Cement production	0.0026	100.0%
2 C 3 Aluminium production	0.0025	100.0%
4 B 9 d Other poultry	0.0019	100.0%
2 C 5 e Other metal production	0.0016	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0015	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0014	100.0%
2 B 5 b Storage, handling and transport of chemical products	0.0013	100.0%
4 B 6 Horses	0.0012	100.0%
2 A 2 Lime production	0.0011	100.0%
6 D Other waste(e)	0.0011	100.0%
1 A 3 a i (i) International aviation (LTO)	0.0006	100.0%
2 A 6 Road paving with asphalt	0.0006	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0005	100.0%
6 C b Industrial waste incineration (d)	0.0004	100.0%
1 B 2 c Venting and flaring	0.0004	100.0%
2 C 5 d Zinc production	0.0004	100.0%
6 A Solid waste disposal on land	0.0002	100.0%
3 B 1 Degreasing	0.0000	100.0%

NFR code	2011 (Gg)	Cumulative Total
2 C 5 b Lead production	0.0000	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0000	100.0%
2 C 5 a Copper production	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

Table 7. Key source categories for TSP emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**29.2271**	**59.2%**
1 A 4 b i Residential: Stationary plants	**12.4845**	**84.6%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	2.3523	89.3%
4 D 1 a Synthetic N-fertilizers	0.7396	90.8%
1 A 4 a i Commercial / institutional: Stationary	0.6034	92.0%
1 A 1 c Manufacture of solid fuels and other energy industries	0.5727	93.2%
2 A 7 a Quarrying and mining of minerals other than coal	0.3184	93.8%
2 D 3 Wood processing	0.2398	94.3%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.2392	94.8%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.2254	95.3%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.2116	95.7%
1 A 3 b vii Road transport: Automobile road abrasion	0.1912	96.1%
4 B 8 Swine	0.1761	96.4%
4 B 9 b Broilers	0.1638	96.8%
1 A 3 b i Road transport: Passenger cars	0.1472	97.1%
2 D 1 Pulp and paper	0.1249	97.3%
1 A 3 b iii Road transport: Heavy duty vehicles	0.1129	97.6%
1 B 2 a iv Refining / storage	0.1097	97.8%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1060	98.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0965	98.2%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0951	98.4%
2 A 7 b Construction and demolition	0.0862	98.6%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0817	98.7%
4 B 1 a Cattle dairy	0.0769	98.9%
4 B 1 b Cattle non-dairy	0.0757	99.0%
3 D 3 Other product use	0.0540	99.1%
1 A 3 c Railways	0.0517	99.2%
1 A 3 b ii Road transport: Light duty vehicles	0.0480	99.3%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0438	99.4%
2 B 5 a Other chemical industry	0.0344	99.5%
2 D 2 Food and drink	0.0330	99.6%
2 C 1 Iron and steel production	0.0260	99.6%
2 A 3 Limestone and dolomite use	0.0234	99.7%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0234	99.7%
1 A 3 d ii National navigation (Shipping)	0.0230	99.8%
4 B 9 a Laying hens	0.0215	99.8%
1 A 4 a ii Commercial / institutional: Mobile	0.0135	99.8%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0132	99.9%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0094	99.9%
3 B 1 Degreasing	0.0081	99.9%
2 A 1 Cement production	0.0080	99.9%
3 A 2 Industrial coating application	0.0071	99.9%
2 C 3 Aluminium production	0.0042	99.9%

NFR code	2011 (Gg)	Cumulative Total
4 B 9 d Other poultry	0.0041	99.9%
2 B 5 b Storage, handling and transport of chemical products	0.0039	100.0%
3 C Chemical products	0.0033	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0030	100.0%
2 A 2 Lime production	0.0027	100.0%
2 A 6 Road paving with asphalt	0.0027	100.0%
2 C 5 e Other metal production	0.0026	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0016	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0015	100.0%
6 D Other waste(e)	0.0011	100.0%
6 A Solid waste disposal on land	0.0008	100.0%
1 A 3 a i (i) International aviation (LTO)	0.0006	100.0%
2 C 5 d Zinc production	0.0006	100.0%
6 C b Industrial waste incineration (d)	0.0006	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0005	100.0%
1 B 2 c Venting and flaring	0.0005	100.0%
3 D 1 Printing	0.0002	100.0%
6 C c Municipal waste incineration (d)	0.0001	100.0%
2 C 5 b Lead production	0.0000	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0000	100.0%
2 C 5 a Copper production	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

Table 8. Key source categories for CO emissions for 2011, level assessment

NFR code	2011 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**95.7728**	**64.8%**
1 A 1 c Manufacture of solid fuels and other energy industries	**16.0250**	**75.6%**
1 A 3 b i Road transport: Passenger cars	**15.5517**	**86.2%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	5.7084	90.0%
1 A 1 a Public electricity and heat production	4.7080	93.2%
1 A 4 b ii Residential: Household and gardening (mobile)	2.5709	94.9%
1 A 3 b iii Road transport:, Heavy duty vehicles	1.3334	95.9%
1 A 4 a i Commercial / institutional: Stationary	1.0654	96.6%
1 A 3 b ii Road transport: Light duty vehicles	0.8635	97.2%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.6675	97.6%
1 B 2 a iv Refining / storage	0.6312	98.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.4579	98.3%
2 B 5 a Other chemical industry	0.3735	98.6%
1 A 3 c Railways	0.3638	98.8%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.2456	99.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.2252	99.2%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.1801	99.3%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.1794	99.4%
1 A 4 a ii Commercial / institutional: Mobile	0.1680	99.5%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1452	99.6%
1 A 3 a i (i) International aviation (LTO)	0.1177	99.7%
1 A 3 d ii National navigation (Shipping)	0.0990	99.8%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0956	99.8%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0947	99.9%

NFR code	2011 (Gg)	Cumulative Total
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0475	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0333	99.9%
2 D 1 Pulp and paper	0.0153	100.0%
6 C b Industrial waste incineration (d)	0.0149	100.0%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0138	100.0%
2 A 7 a Quarrying and mining of minerals other than coal	0.0083	100.0%
2 C 1 Iron and steel production	0.0081	100.0%
1 A 1 b Petroleum refining	0.0065	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0038	100.0%
3 C Chemical products	0.0019	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0015	100.0%
6 D Other waste(e)	0.0014	100.0%
2 C 5 e Other metal production	0.0013	100.0%
1 B 2 c Venting and flaring	0.0005	100.0%
3 D 3 Other product use	0.0002	100.0%
2 D 2 Food and drink	0.0000	100.0%
6 C c Municipal waste incineration (d)	0.0000	100.0%

Table 9. Key source categories for Pb emissions for 2011, level assessment

NFR code	2011 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**36.1263**	**94.7%**
1 A 4 b i Residential: Stationary plants	0.6581	96.4%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.5229	97.8%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.2367	98.4%
1 A 3 b i Road transport: Passenger cars	0.2195	99.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.1356	99.4%
1 A 4 a i Commercial / institutional: Stationary	0.1274	99.7%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0216	99.8%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0185	99.8%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0146	99.8%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0144	99.9%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0144	99.9%
2 C 5 b Lead production	0.0103	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0094	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0042	100.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0016	100.0%
2 C 1 Iron and steel production	0.0009	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0008	100.0%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0008	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0007	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0005	100.0%
3 D 3 Other product use	0.0003	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0002	100.0%
3 C Chemical products	0.0001	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%
6 C b Industrial waste incineration (d)	0.0000	100.0%
1 B 2 a iv Refining / storage	0.0000	100.0%
2 C 5 e Other metal production	0.0000	100.0%

NFR code	2011 (Mg)	Cumulative Total
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0000	100.0%
6 D Other waste(e)	0.0000	100.0%

Table 10. Key source categories for Cd emissions for 2011, level assessment

NFR code	2011 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0.6106**	**93.3%**
1 A 4 b i Residential: Stationary plants	0.0162	95.8%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0129	97.8%
1 A 3 b i Road transport: Passenger cars	0.0040	98.4%
1 A 4 a i Commercial / institutional: Stationary	0.0039	99.0%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0019	99.3%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.0011	99.4%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0006	99.5%
1 A 3 b ii Road transport: Light duty vehicles	0.0006	99.6%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0005	99.7%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0004	99.8%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0004	99.8%
1 A 3 c Railways	0.0003	99.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0003	99.9%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0002	99.9%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0002	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0001	100.0%
1 A 3 d ii National navigation (Shipping)	0.0001	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0000	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0000	100.0%
6 D Other waste(e)	0.0000	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%
1 B 2 a iv Refining / storage	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
6 C b Industrial waste incineration (d)	0.0000	100.0%

Table 11. Key source categories for Hg emissions for 2011, level assessment

NFR code	2011 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0.6090**	**96.5%**
1 A 4 b i Residential: Stationary plants	0.0177	99.3%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0033	99.8%
1 A 4 a i Commercial / institutional: Stationary	0.0006	99.9%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0004	99.9%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0002	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0000	100.0%

NFR code	2011 (Mg)	Cumulative Total
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0000	100.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0000	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%
6 D Other waste(e)	0.0000	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
6 C b Industrial waste incineration (d)	0.0000	100.0%

Table 12. Key source categories for PCB emissions for 2011, level assessment

NFR code	2011 (kg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**6.2800**	**64.1%**
1 A 1 a Public electricity and heat production	**2.4463**	**89.0%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.8346	97.5%
1 A 4 a i Commercial / institutional: Stationary	0.1833	99.4%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0307	99.7%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0257	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0007	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 B 2 a iv Refining / storage		100.0%

Table 13. Key source categories for PCDD/PCDF emissions for 2011, level assessment

NFR code	2011 (g I-Teq)	Cumulative Total
1 A 1 a Public electricity and heat production	**3.1060**	**57.2%**
1 A 4 b i Residential: Stationary plants	**1.5700**	**86.1%**
6 C b Industrial waste incineration (d)	0.2954	91.6%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.2216	95.6%
1 A 3 b i Road transport: Passenger cars	0.1265	98.0%
6 C a Clinical waste incineration (d)	0.0661	99.2%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0144	99.5%
1 A 3 b iii Road transport: Heavy duty vehicles	0.0114	99.7%
1 A 4 a i Commercial / institutional: Stationary	0.0100	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0046	99.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0014	100.0%
6 D Other waste(e)	0.0009	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0008	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0002	100.0%
3 D 3 Other product use	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%

Table 14. Key source categories for PAHs emissions for 2011, level assessment

NFR code	2011 (Mg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**11.0529**	**77.6%**
1 A 1 a Public electricity and heat production	**2.1495**	**92.7%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.8167	98.4%

NFR code	2011 (Mg)	Cumulative Total
1 A 4 a i Commercial / institutional: Stationary	0.1198	99.3%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0313	99.5%
1 A 3 b i Road transport: Passenger cars	0.0246	99.7%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0149	99.8%
1 A 3 b iii Road transport: Heavy duty vehicles	0.0144	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0050	99.9%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0049	99.9%
1 A 3 c Railways	0.0042	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0017	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0005	100.0%
1 A 3 d ii National navigation (Shipping)	0.0004	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0003	100.0%
6 C b Industrial waste incineration (d)	0.0001	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0001	100.0%
3 D 3 Other product use	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 B 2 c Venting and flaring		100.0%

Table 15. Key source categories for HCB emissions for 2011, level assessment

NFR code	2011 (kg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**0.1000**	**56.4%**
1 A 1 a Public electricity and heat production	**0.0556**	**87.8%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0192	98.6%
1 A 4 a i Commercial / institutional: Stationary	0.0018	99.6%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0005	99.8%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0001	99.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0001	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

ANNEX II

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ANNEX III

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