Estonian Environment Information Centre

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EXECUTIVE SUMMARY

Estonia, as party to the Convention on Long-Range Transboundary Air Pollution is required to report annual emission data, projections of main pollutants, activity data and to provide Informative Inventory Report. Emission data of all pollutants for 1990-2009 and projection were submitted 15 February 2011. The first IIR were submitted in 2010.

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

The latest recalculations to emission inventory were done for the time period from 1990 to 2008. The reason on recalculations is specified in Table 0.1 below:

Table 0.1. The status of recalculations

NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1.A.3.b	Road transport	New COPERT 8.0 version; correction of activity data and sulphur/ lead content in fuels	NO_x, SO_2, NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$, CO, HM, PCDD/ PCDF, PAHs	1990-2008
1.A.3.c	Railways	Correction of sulphur contents in fuels	SO_2	1990-2008
1.A.4.a.ii	Commercial / institutional: Mobile	Correction of statistical fuel consumption	NO_x, SO_2, NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$, CO, HM, PCDD/ PCDF, PAHs	1990-2008
1.A.4.b.ii	Residential: Household and gardening (mobile)	Correction of sulphur contents in fuels	SO_2, Pb	1990-2008
1.A.4.c.ii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	New *'EMEP/EEA air pollutant emission inventory guidebook 2009'* emission factors; correction of sulphur contents in fuels	NO_x, SO_2, NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$, CO, HM, PCDD/ PCDF, PAHs	1990-2008
1.A.2.f.ii	Mobile Combustion in manufacturing industries and construction	New *'EMEP/EEA air pollutant emission inventory guidebook 2009'* emission factors; correction of sulphur contents in fuels	NO_x, SO_2, NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$, CO, HM, PCDD/ PCDF, PAHs	1990-2008
1.A.3.d.i.(i)	International maritime navigation	New *'EMEP/EEA air pollutant emission inventory guidebook 2009'* emission factors	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$, HM	1990-2008
1.B.2.a.v	Distribution of oil products	Correction of emission factor	NMVOC	1990-2008
1.B.2.b	Natural gas	Correction of emission factor	NMVOC	1990-2008
2.D.2	Food and drink	New *'EMEP/EEA air pollutant emission inventory guidebook 2009'* emission factors	NMVOC	1990-2008
3.A.1	Decorative coating application	New methodology	NMVOC	2007-2008, additionally calculated 1990-2006

3.A.2	Industrial coating application	New methodology	NMVOC	1990-2008
3.B.1	Degreasing	New methodology	NMVOC	1990-2008
3.B.2	Dry cleaning	New methodology	NMVOC	2007-2008, additionally calculated 1990-2006
3.D.1	Printing	New methodology	NMVOC	2007-2008, additionally calculated 1990-2006
3.D.2	Domestic solvent use including fungicides	Correction of emission factor	NMVOC	1990-2008
3.D.3	Other product use	New methodology	NMVOC	2007-2008, additionally calculated 1990-2006
4.B.1.a – 4.B.9.d	Livestock	New *'EMEP/EEA air pollutant emission inventory guidebook 2009'* emission factors	NH_3, TSP, PM_{10}, $PM_{2,5}$	1990-2008
4.D.1.a	Synthetic N-fertilizers	New *'EMEP/EEA air pollutant emission inventory guidebook 2009'* emission factors	NH_3, TSP, PM_{10}, $PM_{2,5}$	1990-2008

The detail explanations about recalculation sector by sector are presented in Chapter 10.

The difference in total emissions between 2010 and 2011 year submissions are presented in Table 0.2.

Table 0.2. Difference between 2010 and 2011 submissions

Year of submission	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP	Pb	Cd
1990	-2.83	0.40	2.25	-5.51	-20.67	NR	NR	-1.18	53.88	0.00
1991	-2.44	3.64	2.34	-6.23	-12.98	NR	NR	-1.11	51.49	0.01
1992	-2.11	5.37	1.82	1.83	-18.05	NR	NR	-1.10	34.26	0.04
1993	-2.45	12.00	2.27	-5.09	-13.01	NR	NR	-1.33	46.46	0.03
1994	-1.94	17.40	2.44	-4.97	-10.18	NR	NR	-1.51	48.50	0.04
1995	-1.67	13.87	2.84	-5.30	-3.97	NR	NR	-1.97	34.81	0.07
1996	0.40	12.65	2.88	-5.73	-4.25	NR	NR	-2.08	40.39	0.08
1997	0.25	15.36	3.17	-6.68	0.14	NR	NR	-2.51	16.80	0.01
1998	-4.28	12.01	3.62	-3.09	-6.77	NR	NR	-3.00	9.92	-0.05
1999	1.51	22.25	3.40	-2.33	5.33	NR	NR	-2.80	15.85	-0.06
2000	2.06	16.89	3.25	-1.83	2.21	0.78	1.90	-2.18	9.42	-0.08
2001	0.38	14.53	0.42	1.53	0.60	-0.20	0.91	-2.24	11.35	-0.04
2002	-0.03	14.19	0.42	-0.59	-0.13	-0.21	1.18	-2.84	10.69	-0.41
2003	-0.71	8.84	0.04	4.02	-3.05	-0.34	1.33	-2.94	2.43	0.08
2004	-1.47	7.75	-0.01	4.95	-1.91	-0.21	1.62	-2.86	2.22	-0.08
2005	-1.27	11.04	0.02	5.26	-0.85	-0.26	2.44	-4.06	2.35	-0.54
2006	-0.72	14.47	0.00	5.70	-1.58	-0.40	3.48	-5.15	0.78	-0.63
2007	-0.90	12.76	0.00	2.79	-1.50	-0.37	2.75	-4.39	0.64	-0.59
2008	0.03	8.65	0.05	4.98	-0.50	-0.29	2.33	-4.43	0.74	-0.69

Year of submission	Hg	As	Cr	Cu	Ni	Zn	PAHs. total	HCB	PCB
1990	-0.01	0.00	0.53	22.51	0.05	0.71	0.06	0.12	-0.02
1991	0.01	0.00	0.53	21.11	0.05	0.69	0.03	0.15	-0.03
1992	0.05	0.00	0.32	14.95	0.03	0.42	0.04	0.06	-0.01
1993	0.07	0.00	0.48	20.99	0.05	0.62	-0.14	0.08	-0.02
1994	0.07	0.00	0.60	24.34	0.07	0.76	0.03	0.05	-0.02
1995	0.05	0.00	0.58	26.42	0.08	0.78	0.01	0.02	-0.01
1996	0.08	0.00	0.59	30.94	0.09	0.86	0.01	0.03	-0.02
1997	0.05	0.00	0.67	33.57	0.11	0.92	0.73	0.02	-0.01
1998	0.02	0.00	0.63	29.04	0.05	0.75	0.00	0.01	0.00
1999	0.00	0.00	0.74	36.23	0.14	0.99	0.00	0.00	0.00
2000	0.01	0.00	0.76	40.61	0.15	-6.78	0.01	0.00	0.00
2001	0.01	0.00	0.94	47.95	0.18	1.37	0.00	0.00	0.00
2002	0.00	0.00	0.93	47.17	0.19	1.44	-0.01	0.00	0.00
2003	0.00	0.00	0.80	45.47	0.24	1.30	0.04	0.00	0.00
2004	0.00	0.00	0.83	42.67	0.17	1.21	0.00	0.00	0.00
2005	0.00	0.00	0.87	43.18	0.19	1.34	0.01	0.00	0.00
2006	0.00	0.00	1.00	48.39	0.23	1.57	-0.02	0.00	0.00
2007	0.00	0.00	0.83	43.60	0.20	1.31	-0.03	0.00	0.00
2008	0.00	0.00	0.99	48.62	0.26	1.48	-7.20	0.00	0.00

At this year submission additionally were calculated emissions from the following activities:

- 2.A.6 Road paving with asphalt (1990-2009)
- 2.A.7.b Construction and demolition (2000-2009)
- 2.D.2 Food and drink (1990-2008, were added some SNAP for this activity)
- 3.A.1 Decorative coating application (1990-2006)
- 3.B.2 Dry cleaning (1990-2006)
- 3.D.1 Printing (1990-2006)
- 3.D.3 Other product use (1990-2006)

Nevertheless, despite certain efforts on inventory improvement, are still activities from which emissions aren't estimated:

- 4.F Field burning of agricultural wastes
- 6.A Solid waste disposal on land
- 11.B Forest fires

Priorities for future inventory improvement:

- 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 about the fuel consumption in Statistical energy balance and reports of the enterprises;
- To check data from facilities in solvent use sector for the years 1990-2005.

1. INTRODUCTION

1.1 National inventory background

Estonia has ratified the Convention on Long-Range Transboundary Air Pollution in 2000 and later has joined following Protocols of Convention:

- 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 national annual emission data of pollutants for the source category and shall submit informative inventory report to the Convention Secretariat.

This report is Estonia's national Informative Inventory Report due by March 2010. The report contains information on Estonian emission inventories for years from 1990 to 2008. The inventories account 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, PCB, HCB, PAHs).

1.2 Institutional arrangements for inventory preparation

The Ambient Air Protection Act generally regulates data collection and reporting. Methods for the calculation of emissions are laid down in several regulations of Minister of the Environment. The Air Pollution Database consist data of point sources (for 2009 about 1650) and diffuse sources. Generally structure and emission calculation from the small point sources and area sources are based on EMEP/CORINAIR methodology.

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

The important aim of the inventory is to test the effectiveness of governmental environmental policies and to provide national and international bodies with official emission data within the country. The emission data is updated every year and results are reported yearly.

1.3 The process of inventory preparation

1.4 Methods and data sources

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

The Estonian national air pollution inventory preparation can be described as an annual cycle mainly because the reporting obligation is yearly. To improve the inventory quality and to 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. The involving databases are given in Figure 3.

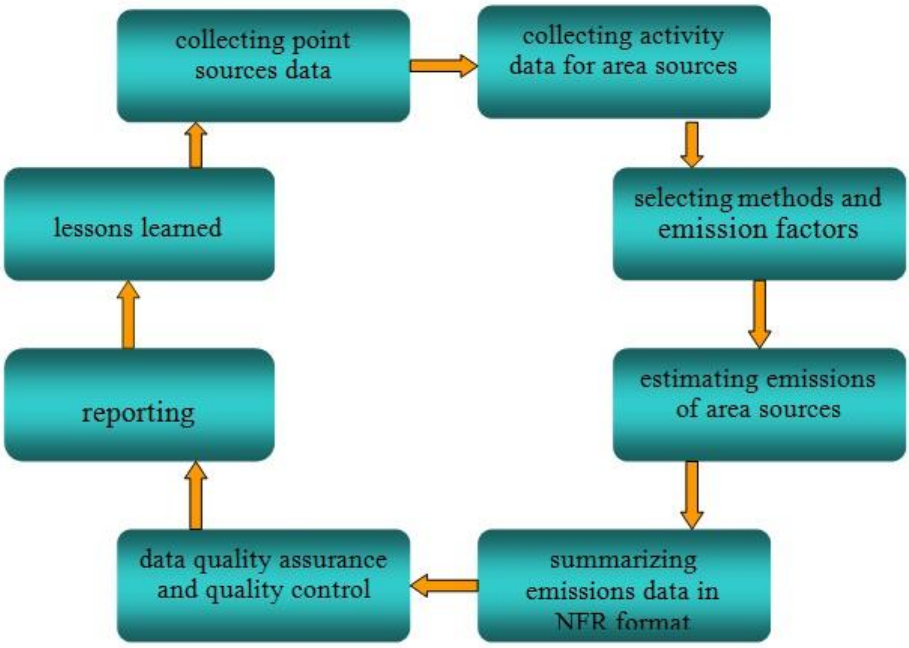

Figure 1.1. The main activities of inventory preparation

The national database contains data for point and diffuse sources of emissions. The emission inventory for the period of 1990-1999 is based on data about the large point sources and area sources. Since 2000 to 2004 the CollectER software was used to gather data (both – point and area). For gathering the information on point sources the Estonian Environment Information Centre created in 2004 a new web-interface air emission data system for the point sources (OSIS), where operators of point sources directly fill in their annual air pollution reports. If in 2000 there was data on 600 enterprises in the database, then in 2008 the number was already 1650.

The point sources information system contains data that is reported by the facilities having permit of pollution. Each facility submits data on emissions of polluting substances, data about the burnt fuel, used solvents, liquid fuels distribution and so on. Data is represented on each source of pollution and on the facility as a whole. The owner of point sources can insert their calculated or measured annual emissions directly to the system or use OSIS calculation models, which uses legally regulated estimation methodologies. The operator can also calculate emissions by using the other available methods which should be co-ordinated with the Ministry of the Environment (regulated by Air Protection Act). After entering the report into system, local department of environment confirms the report; then last step of the checking in EEIC is carried out and data is ready for use at generating of various reports.

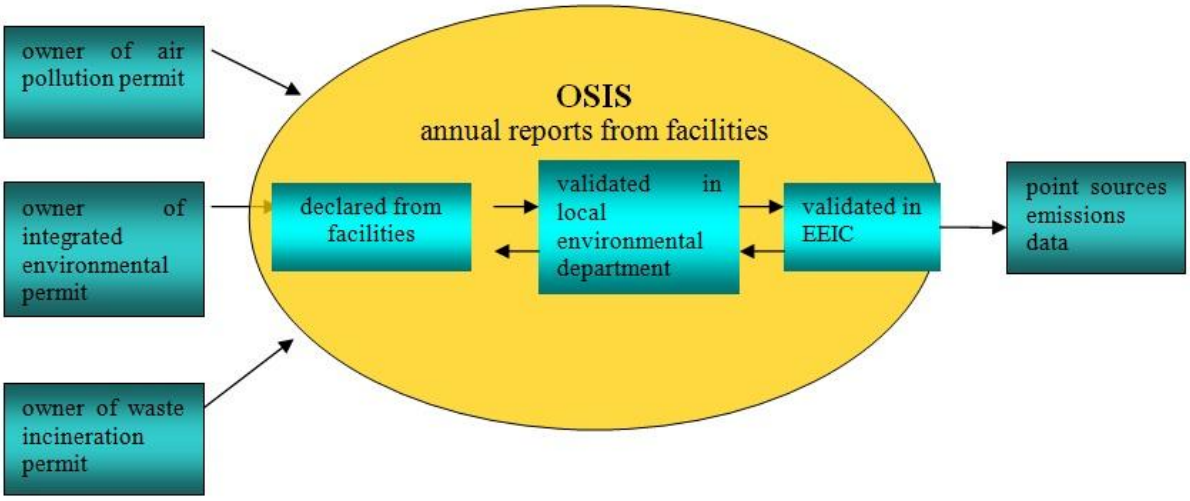

Figure 1.2. Validation of Estonian point sources data

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

For the calculation of emission from road transport we are using COPERT IV tool methodology and emission factors. Total emissions are calculated on 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). Vehicles data (passenger cars, light and duty vehicles, buses, motorcycles) and annual mileage per vehicle EEIC is obtained from the Estonian Motor Vehicle Registration Centre. Meteodata is provided by the Meteorological and Hydrological Institute and data about fuel consumption by the Statistical Office of Estonia.

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

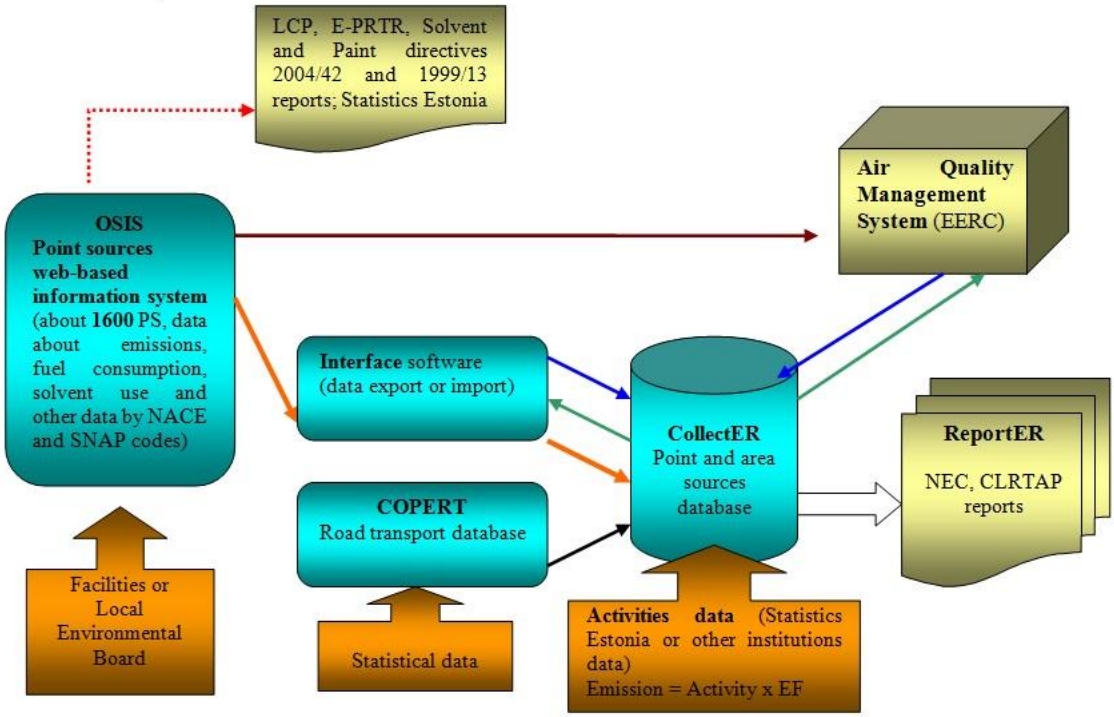

Figure 1.3. Air pollution database structure

1.5 Key Categories

This chapter presents 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, which have a significant influence on the total inventory in terms of the absolute level of emissions (certain year). The key categories are those that represent together 80% of inventory level or trend. According to the study for certain emission ("Key sources analysis and uncertainty assessment of sulphur dioxide, nitrogen oxides and ammonia emissions in Estonia" Elo Mandel, Tallinn 2009) for 2007 there are no big differences between results of level and trend assessment of key sources analysis. So for 2009 the only 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 on the page 22.

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

The combustion in residential plants (1.A.4.b.i) is also main source of NMVOC (47.17%). Additionally, the road transport (1.A.3.b.i), natural gas distribution (1.B.2.b) and public electricity and heat productions (1.A.1.a) are key sources too.

According to level assessment SO_2 emissions for 2009 from the energy sector (1.A.1.a) and stationary combustion in manufacturing industries and construction (1.A.2.f.i) are responsible for 97.32% of SO_2 emissions in 2009. Mass of these emissions comes from two oil shale power plants in east Estonia (Eesti and Balti power plants).

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

The combustion in residential plants is 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 big.

According to level assessment 63.5% of CO emissions comes from residential combustion plants (1.A.4.b.i). In addition to this road transport (1.A.3.b.i) and oil-shale industry (1.A.1.c) are also main polluters of CO. The combustion in residential sector is key also source for PCB and dioxins.

The energy (1.A.1.a) sector is main sources of heavy metals and PCB. In addition to this road transport (1.A.3.b.vi) is also main polluters of Cu.

Table 1.1. Results of key sources analysis

Pollutant	Key sources categories (sorted from high to low from left to right)										Total (%)
NOx	1.A.1.a	1.A.3.b.iii	1.A.3.b.i	1.A.4.c.ii	1.A.3.c	1.A.4.b.i					
	35.56%	17.05%	13.53%	7.05%	6.32%	5.36%					84.87%
NMVOC	1.A.4.b.i	1.A.3.b.i	3.A.1	1.A.1.c	3.D.2	4.B.1.a	1.B.2.a.v	4.B.1.b	3.B.1	4.B.8	
	47.17%	6.77%	4.14%	3.94%	3.69%	3.62%	3.49%	2.81%	2.78%	2.49%	80.91%
SOx	1.A.1.a										
	88.53%										88.53%
NH_3	4.B.1.a	4.D.1.a	4.B.1.b	4.B.8							
	33.40%	23.32%	17.02%	13.31%							87.05%
$PM_{2,5}$	1.A.4.b.i	1.A.1.a									
	65.93%	15.60%									81.52%
PM_{10}	1.A.4.b.i	1.A.1.a	1.A.2.f.i								
	52.58%	22.36%	9.35%								84.28%
TSP	1.A.4.b.i	1.A.1.a	1.A.2.f.i								
	49.58%	23.23%	10.90%								83.72%
CO	1.A.4.b.i	1.A.3.b.i	1.A.1.c								
	63.54%	12.92%	11.62%								88.08%
Pb	1.A.1.a										
	89.78%										89.78%
Cd	1.A.1.a										
	88.85%										88.85%
Hg	1.A.1.a										
	94.06%										94.06%
As	1.A.1.a										
	98.32%										98.32%
Cr	1.A.1.a										
	92.53%										92.53%
Cu	1.A.3.b.vi	1.A.1.a	1.A.3.b.i								
	34.51%	33.38%	13.73%								81.62%
Ni	1.A.1.a										
	88.28%										88.28%
Zn	1.A.1.a										
	87.60%										87.60%
DIOX	1.A.1.a	1.A.4.b.i									
	44.54%	35.97%									80.52%
benzo(a) pyrene	1.A.4.b.i										
	81.72%										81.72%
benzo(b) fluoranthene	1.A.4.b.i	1.A.1.a									
	78.00%	14.83%									92.83%
benzo(k) fluoranthene	1.A.4.b.i										
	84.17%										84.17%
Indeno(1,2,3-cd)pyrene	1.A.4.b.i										
	85.71%										85.71%
PAH total 1-4	1.A.4.b.i										
	81.69%										81.69%
HCB	1.A.4.b.i	1.A.1.a									
	63.68%	26.68%									90.36%
PCB	1.A.1.a										
	82.41%										82.41%

1.6 QA/QC and Verification methods

A quality management system has been developed to support the inventory of the air pollutant emissions. The Estonia's QA/QC plan consist of six parts:

- stakeholder engagement (stakeholders = e.g. suppliers of data, reviewers, recipients, other inventory compiling institutes),
- data collection,
- data manipulation,
- inventory compilation,
- consolidating the inventory estimates (e.g. into a single national database),
- reporting.

Estonian QA/QC plan is currently under development.

1.7 General uncertainty evaluation

The uncertainty assessment has not yet been evaluated in Estonia. A quantitative uncertainty assessment is planned to be performed 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 8.0 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 8.0 generates and fills NFR table (including notation keys NE)).
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 8.0 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 8.0 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 8.0 generates and fills NFR table (including notation keys NE)).
1.A.3.b.vi	TSP, Hg, As, PAHs, HCB, PCBs	Emissions occur, but have not been estimated due to lack of emission factors in methodology (Copert 4 version 8.0 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 8.0 generates and fills NFR table (including notation keys NE)).
4.B.6	TSP	No emission factor in new GB
3.D.3	$PM_{2.5}$, PM_{10}	Emissions occur, but have not been estimated
4.D.1.a	TSP	No emission factor in new GB
4.F	All	Will be calculated at next year submission

1.A.3.d.i.(i)	NH_3, PAHs	No emission factor in new GB
1.A.3	All	
11.B	All	Will be calculated at next year submission
7.B	All	Will be calculated at next year submission

Table 1.3. Sources included elsewhere (IE)

NFR09 code	Substance(s)	Included in NFR code
1.A.2.c	All	1 A 2 f i
1.A.2.d	All	1 A 2 f i
1.A.2.e	All	1 A 2 f i
1.A.4.c.iii	All	1.A.4.c.ii
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
2.A.7.c	TSP, PM_{10}, $PM_{2.5}$	2.G
3.A.3	NMVOC	3.A.1
4.B.4	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 about national total and sectoral emissions under LRTAP Convention since 2000s.

Estimations are available as follows:

- NO_x ,SO_2, NH_3, NMVOC, CO, TSP: 1990-2009
- PM_{10} and $PM_{2,5}$: 2000-2009
- All heavy metals: 1990-2009
- POPs: 1999-2009.

Table 2.1. Main pollutants emission in 1990-2009

Year	Emissions, Gg							
	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP
1990	71.640	70.356	273.609	24.588	226.575			277.030
1991	66.300	66.997	251.290	21.778	225.983			276.920
1992	41.223	45.138	191.662	19.100	127.100			248.520
1993	38.005	37.620	155.897	14.029	123.586			196.220
1994	40.694	41.355	150.235	13.161	149.535			174.670
1995	38.205	50.168	116.107	11.486	196.927			134.060
1996	41.619	52.681	125.139	10.377	219.316			123.330
1997	40.334	54.650	116.205	10.477	228.723			99.993
1998	37.353	46.376	104.315	10.837	181.153			88.311
1999	35.945	46.167	97.605	9.408	190.276			86.954
2000	36.804	46.389	97.211	9.504	182.608	21.188	37.322	74.564
2001	39.344	45.528	90.577	9.968	188.463	22.153	37.263	72.805
2002	40.361	44.969	86.989	9.374	181.729	22.678	33.307	52.255
2003	40.670	44.300	100.226	9.969	174.243	20.802	29.949	48.373
2004	38.050	43.894	88.232	10.152	171.204	22.011	30.122	45.665
2005	35.662	41.159	76.266	9.748	157.710	19.841	26.834	36.964
2006	34.499	39.549	69.930	9.799	143.806	15.178	20.398	27.649
2007	37.547	40.687	87.965	10.115	162.680	20.256	28.989	35.674
2008	34.403	38.305	69.365	10.729	166.772	19.966	25.391	31.411
2009	29.006	36.282	54.812	9.844	168.245	18.538	23.244	28.168
trend 1990-2009, %	-59.51	-48.43	-79.97	-59.97	-25.74	-12.51	-37.72	-89.83

Sulphur dioxide

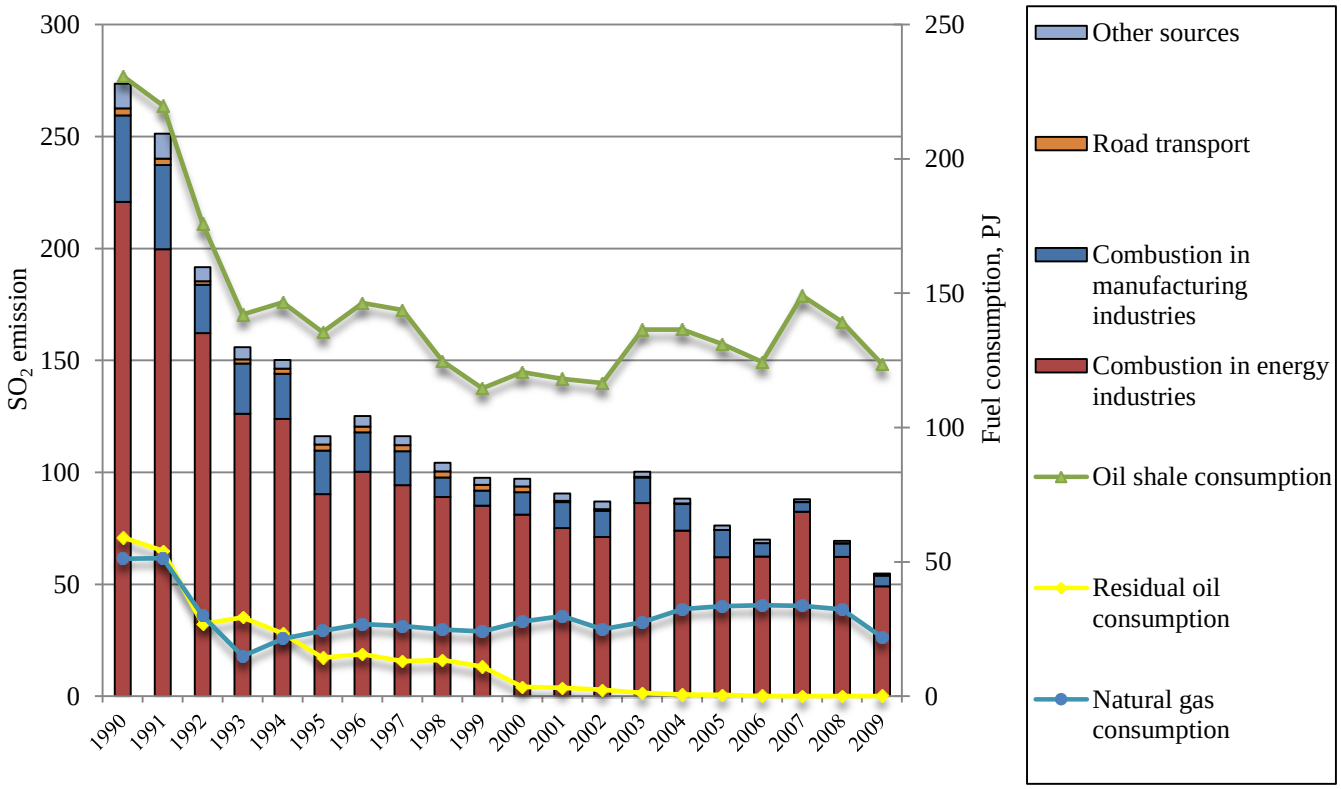

Figure 2.1. SO_2 emissions in 1990-2009

During the period 1990-2009, the emissions of sulphur dioxide has decreased by about 80%, conditioned by decline in energy production (oil shale consumption as main fuel in Estonia fell from 231 PJ in 1990 to 123.6 PJ in 2009) (Figure 2.1). The latter, in its turn, has been caused by the restructuring of the economy. Likewise, the export possibilities, regarding electricity, have also conspicuously decreased. The use of local fuels (including wood, oil shale oil) and natural gas has been constantly increasing since 1993, the relevance of heavy fuel oil, in the production of thermal energy, has reduced. Use of fuel with lower sulphur content also is the reason of decrease in SO_2 emissions (in the case of fuel for road transport and heating).

The energy sector (NFR 1.A.1.a-c) is responsible for about 89.7% of total emissions. The share of SO_2 emissions from two larger oil shale Narva Power Plants (Eesti and Balti) is about 70% of total emissions. The main reason for the drop emissions starting from the 2004 is the launch of two new boilers at the Narva PP based on circulating fluidized-bed (CFB) technology. The new boilers have reduced SO_2 emissions to practically zero. Emissions have also been considerably reduced by shutting down the old blocks.

Nitrogen oxides

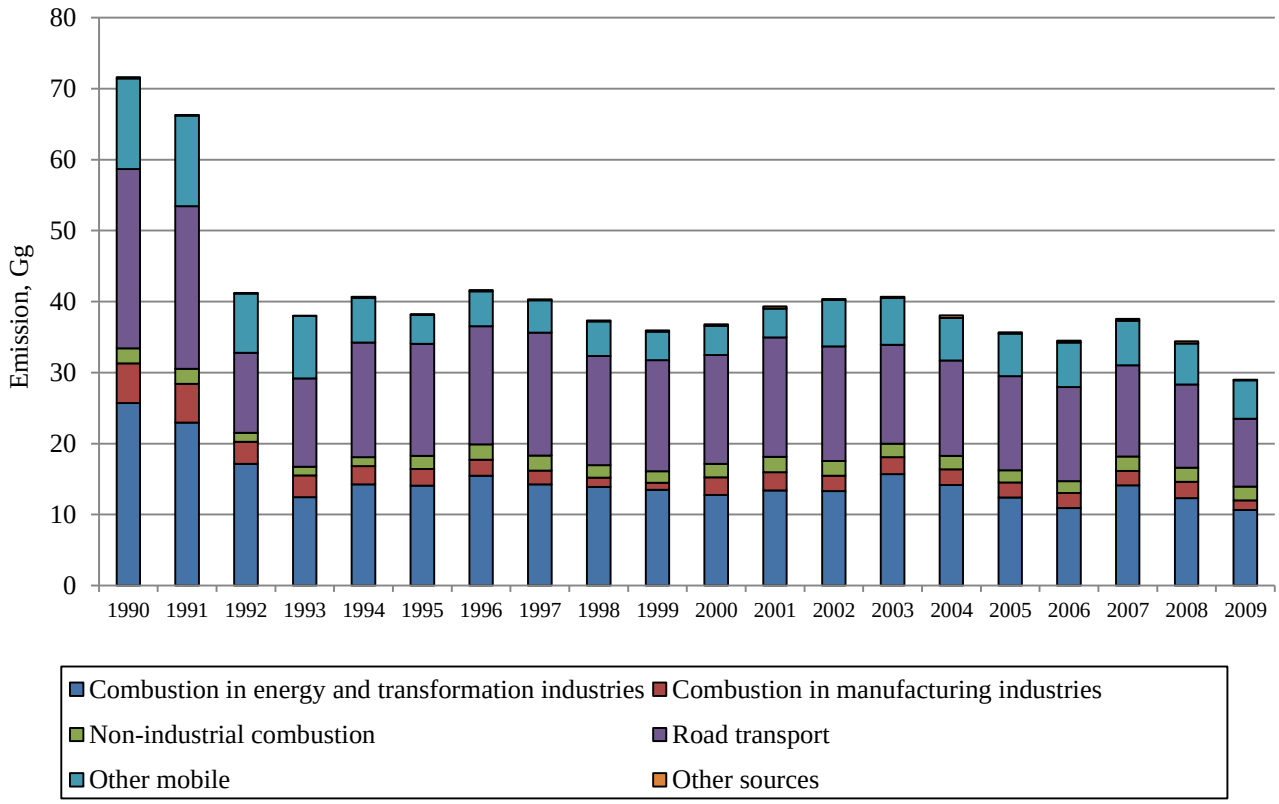

Figure 2.2. NO_x emissions in 1990-2009

Emissions of nitrogen oxides have decreased by 59.5% compared to 1990. The reduction is mainly due to fall of energy production and transport sector during the period of 1990-1993 (the consumption of gasoline by road transport have fallen at this time by 58% and diesel by 45%, The increasing share of catalyst cars at the last years also was a reasons for NO_x emissions reduction. The road transport sector and energy industry are main sources of nitrogen oxides emissions – 33% and 36.7% respectively. The share of other mobile sources is 18.6% in 2008 (Figure 2.3).

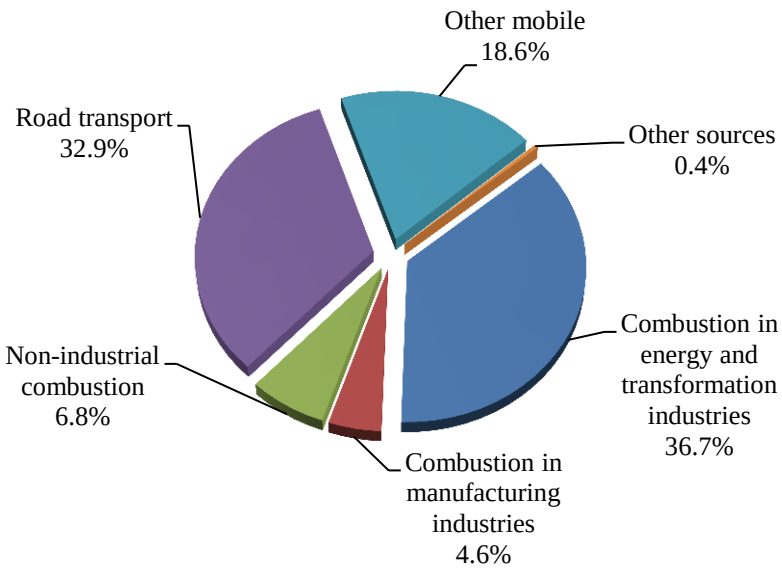

Figure 2.3. NO_x emissions by sources of pollution in 2009

Non-methane volatile compounds

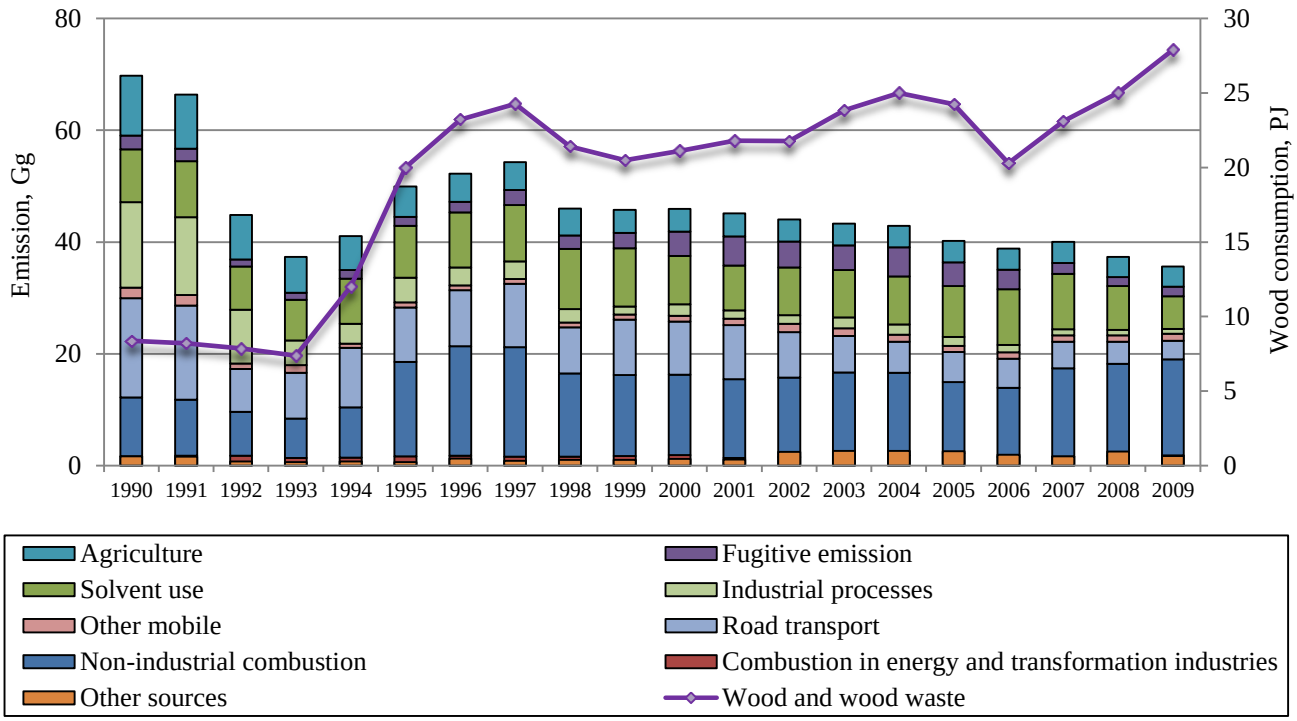

Figure 2.4. Emissions of non-methane volatile organic compounds in 1990-2009

The total non-methane volatile organic compounds emission has decreased by 48.4% from 1990 to 2009. If in 1990 the main polluters of NMVOC were road transport (25%) and industrial processes (22%), then in 2009 the dominant sources are non-industrial combustion (47%) and solvent use (16%) (Figure 2.5). The reason of this change, first of all, was decrease in use of motor fuel in transport sector and increase in a share of used diesel fuel compared to gasoline. Secondly, during 1990-2009 manufacture of chemical products fell. Emissions from non-industrial fuel combustion (mainly in households) have grown since 1995. It is caused by the increasing tendency of wood and wood waste combustion (the emission factor for these fuels is much higher than for combustion in other boilers). The growth of fugitive fuel emissions can be explained by the increase of emissions from marine terminals.

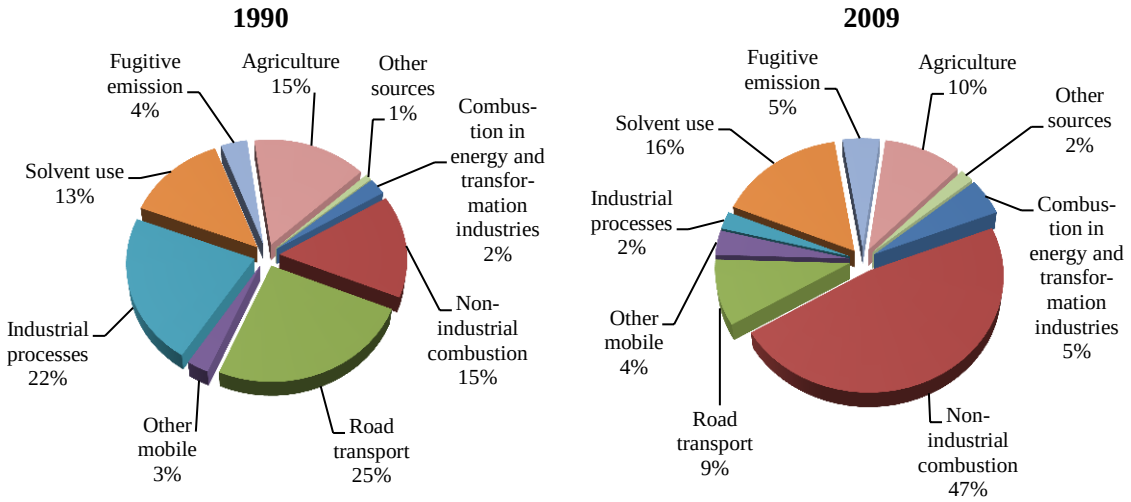

Figure 2.5. NMVOC emissions by sources of pollution in 1990 and 2009

Ammonia

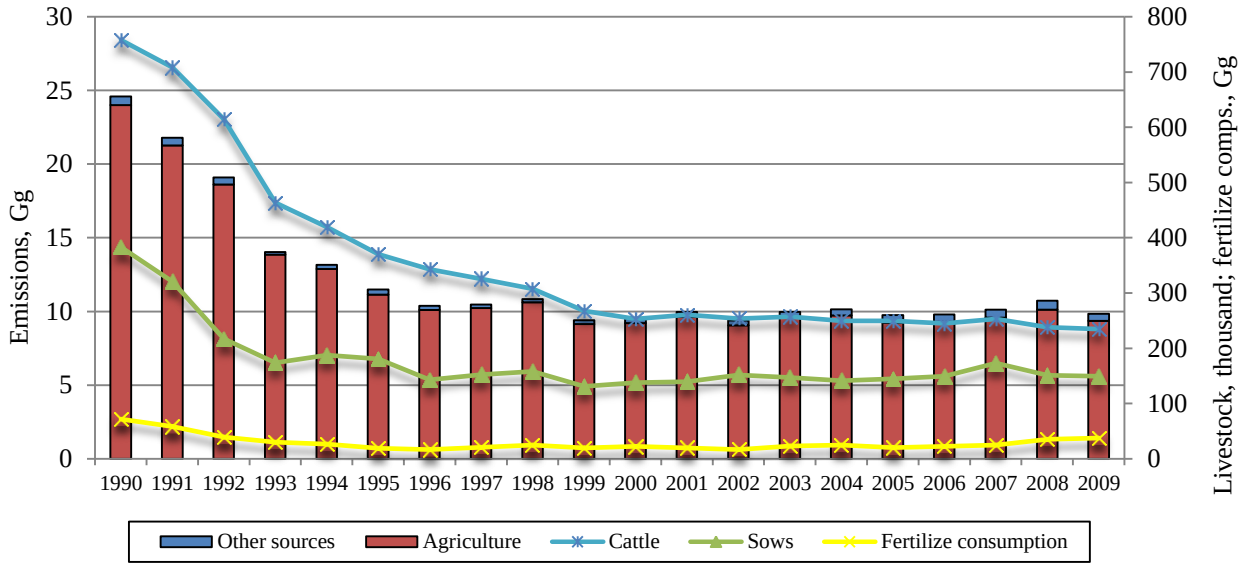

Figure 2.6. Emissions of ammonia in 1990-2009

Total NH_3 emission has decreased by 60% from 1990 to 2009 due to reduction in the number of animals and use of fertilisers (Figure 2.6). The livestock manure management and mineral fertiliser use are the main sources of pollution regarding ammonia (about 95%). The road transport gives 2.3% from total emission and has increased during the last years due to growth in catalyst car use.

Carbon monoxide

Between 1990-2009 the emissions of carbon monoxide decreased by 26%. That was, among other things, caused by the reduction in the use of vehicle fuels and recent years also by a decrease in the number of cars using petrol (Figure 2.7). In 2009 the biggest polluters of CO were combustion in non-industrial sector (about 64%) and combustion in industry (14.8%) (Figure 2.8).

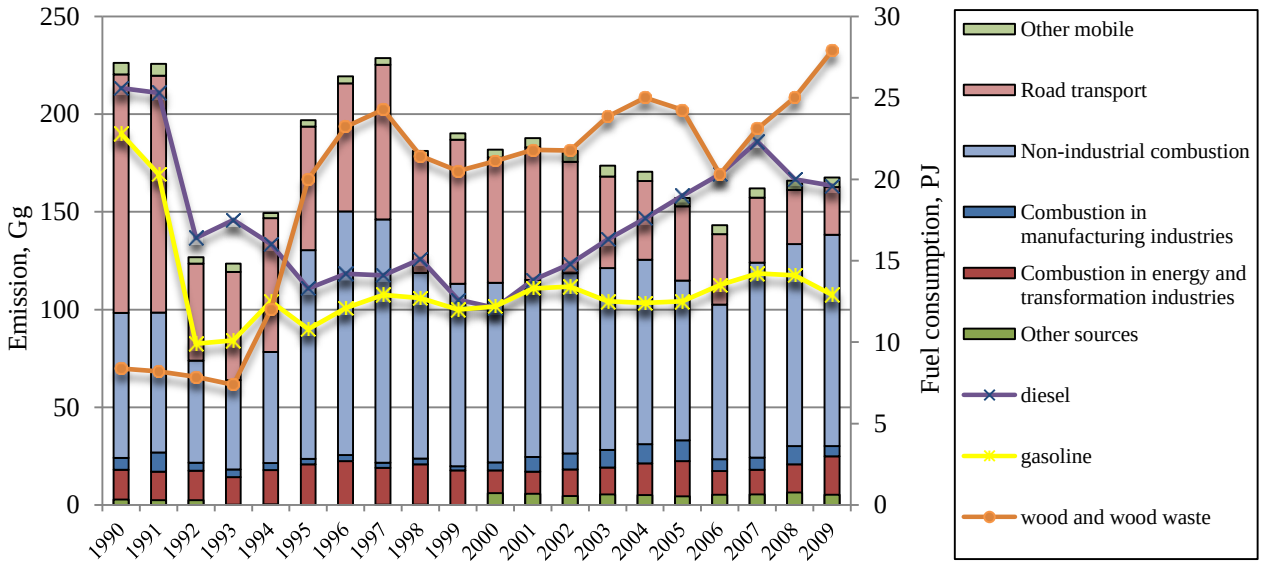

Figure 2.7. Emissions of carbon monoxide in 1990-2008

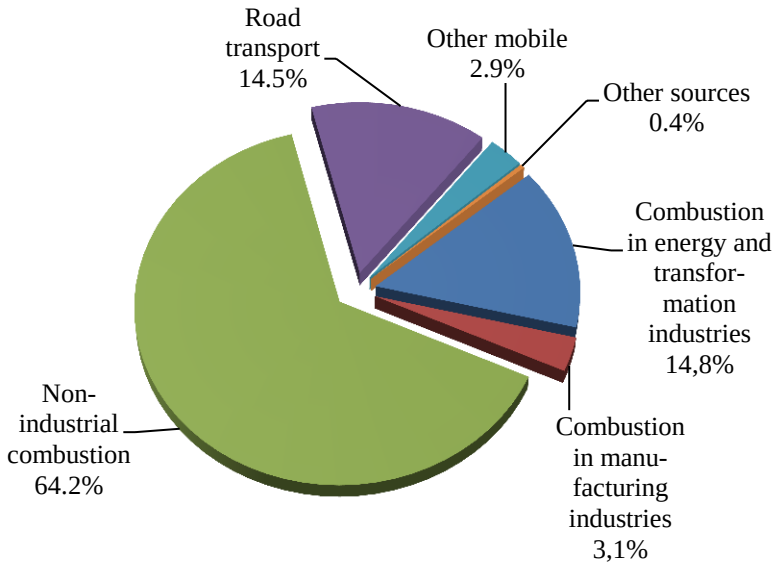

Figure 2.8. CO emissions by sources of pollution in 2009

Particulates

The emissions of TSP, $PM_{2.5}$ and PM_{10} are shown in the Figure 2.9.

In 1990-2009 TSP emission has dropped significantly – by 90%. This is due to the increase in efficiency of combustion devices and cleaning installations (especially in oil shale power plants and cement factory) as well as the decrease in electricity production.

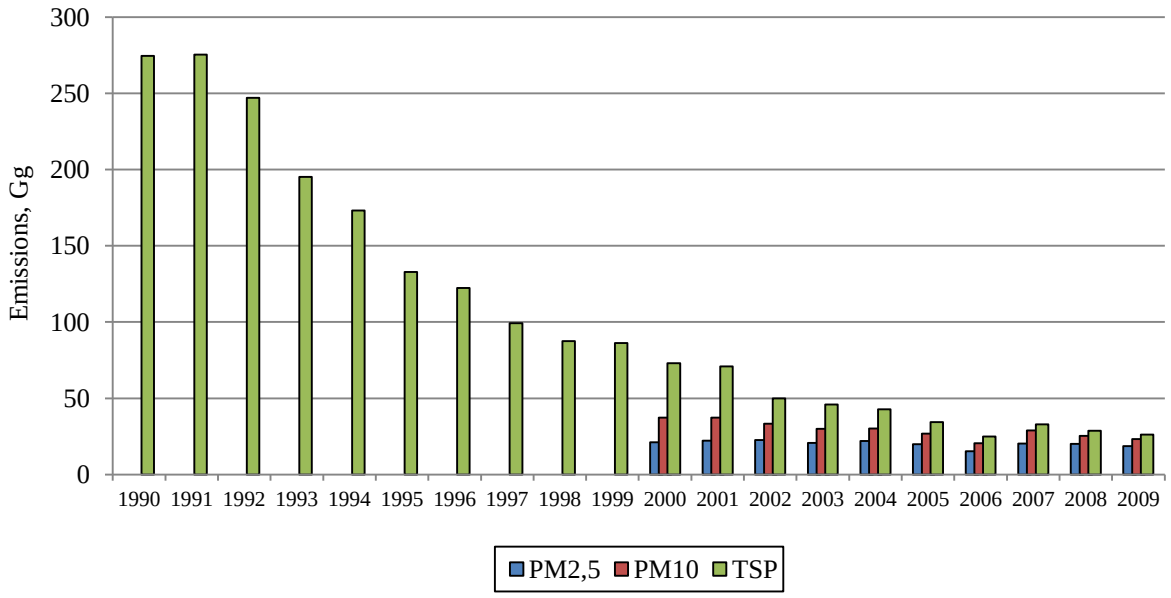

Figure 2.9. Particulates emission in 1990-2009

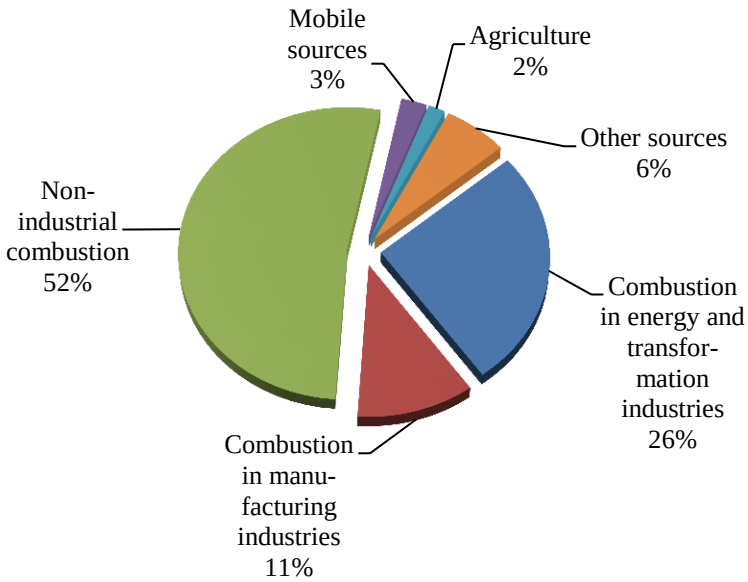

Figure 2.10. TSP emissions by sources of pollution in 2009

The primary sources of particulates emission in 2009 were non-industrial combustion – 52% (combustion of wood and wood waste) and combustion in energy and transformation industries – 26% (Figure 2.10).

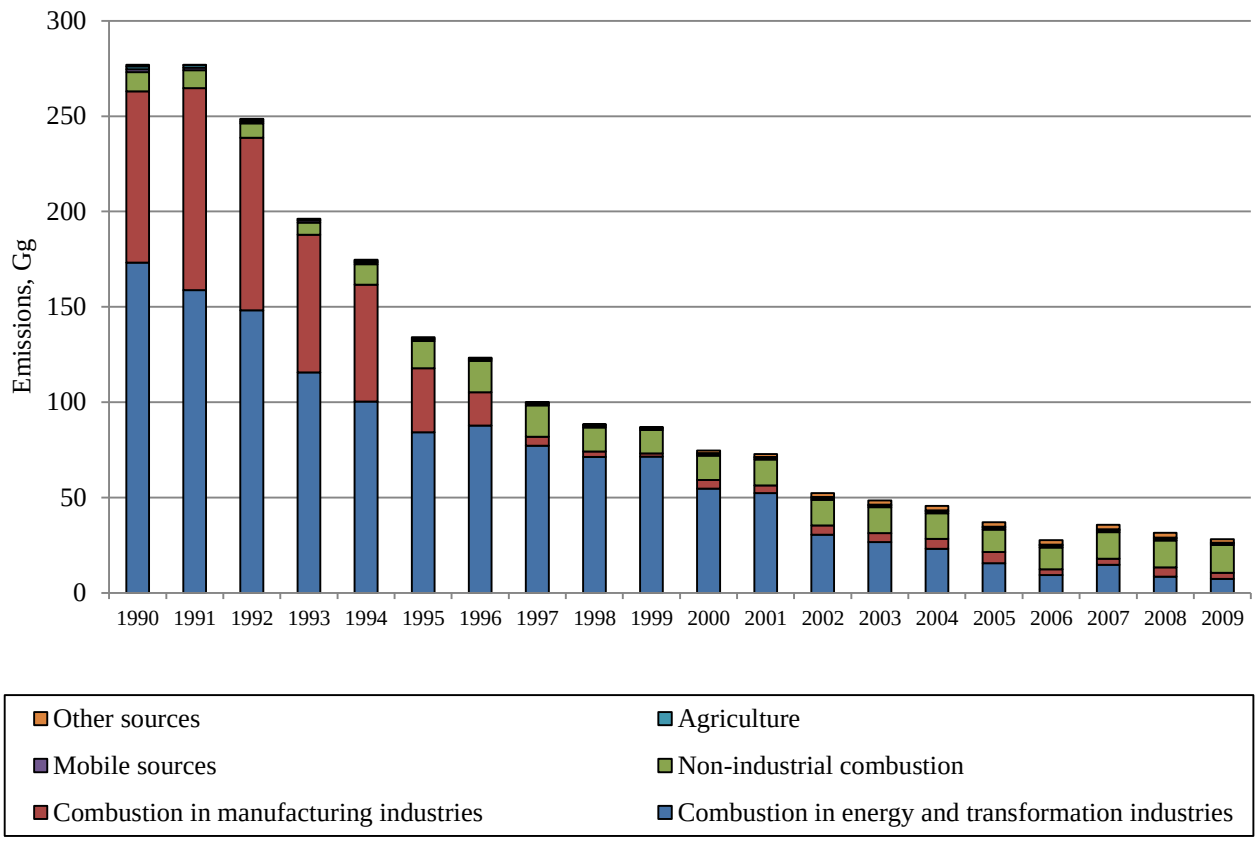

Figure 2.11. TSP emission by activities in 1990-2008

Heavy metals

Emissions of heavy metals also have dropped significantly and are shown in Table 2.2 and Figure 2.12.

Heavy metals are mainly released by combustion in energy and transformation industries and from mobile sources. Emission of lead has decreased by 86.4% due to modernization of the cleaning equipment at Narva power plant and Kunda Nordic Cement and due to the decrease of energy production. The other reason is that the use of leaded petrol was discontinued in Estonia in 2000.

Table 2.2. Heavy metals emission in 1990-2009

Year	Emissions, Mg							
	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	205.457	4.402	1.121	18.860	18.322	11.293	27.401	104.515
1991	188.138	4.201	1.021	16.451	15.976	10.435	25.963	95.703
1992	123.967	2.996	0.830	14.030	13.723	7.229	17.046	77.990
1993	102.451	2.217	0.640	10.840	10.388	6.055	14.364	60.384
1994	122.549	2.867	0.640	10.680	10.233	6.725	12.897	63.392
1995	85.031	1.956	0.600	10.070	9.674	5.843	10.527	58.053
1996	65.218	1.047	0.600	10.360	9.899	5.422	10.971	55.548
1997	45.259	1.067	0.600	10.200	9.615	5.454	9.853	55.096
1998	38.187	1.006	0.530	9.150	8.635	4.927	8.898	49.881
1999	37.895	0.946	0.500	8.710	8.238	4.825	7.679	47.752
2000	34.702	0.562	0.505	8.590	8.109	4.512	6.649	44.086
2001	34.899	0.548	0.500	8.390	7.989	4.964	6.529	43.866
2002	34.233	0.569	0.500	8.360	8.095	5.160	6.344	43.267
2003	37.098	0.628	0.580	10.110	9.541	5.457	6.824	51.885
2004	35.844	0.589	0.540	9.790	9.114	5.500	6.763	51.644
2005	34.551	0.579	0.520	9.220	8.858	5.536	6.537	48.070
2006	31.176	0.549	0.520	8.590	8.236	5.501	5.872	43.660
2007	39.779	0.680	0.650	11.080	10.480	6.245	6.832	55.255
2008	34.553	0.612	0.573	9.415	9.018	5.823	6.034	48.413
2009	27.950	0.479	0.443	7.609	7.214	5.070	4.943	39.306
trend 1990-2009. %	-86.40	-89.12	-60.48	-59.65	-60.63	-55.10	-81.96	-62.39

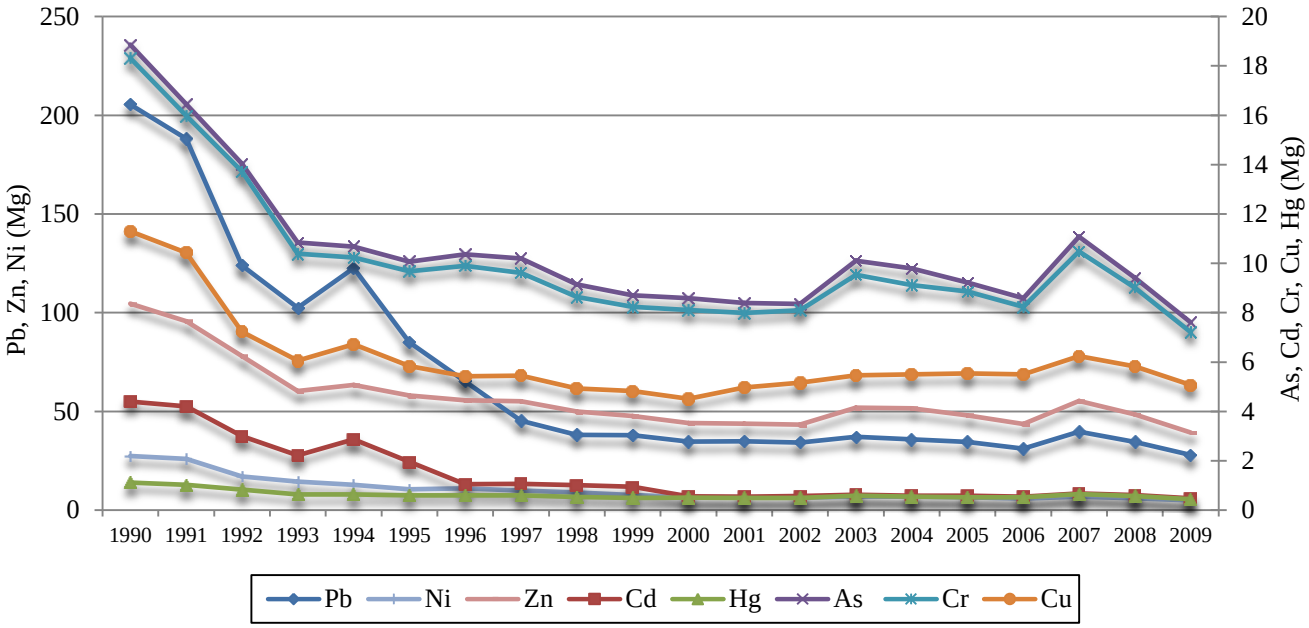

Figure 2.12. Heavy metals emissions in 1990-2009

Persistent organic pollutants

The emissions of POPs are shown in the Table 2.3 and Figure 2.13.

Table 2.3. POPs emission in 1990-2009

Year	Emissions							
	g I-Teq	Mg					kg	
	dioxines/ furanes	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1.2.3-cd) pyrene	PAHs, total	HCB	PCB
1990	5.666	3.641	4.289	2.217	2.052	12.201	0.060	90.250
1991	5.413	3.531	4.208	2.145	1.992	11.876	0.060	81.010
1992	4.296	2.552	2.911	1.538	1.475	8.476	0.050	67.240
1993	3.554	2.142	2.411	1.309	1.266	7.128	0.040	57.010
1994	3.832	2.572	2.840	1.570	1.578	8.559	0.070	53.430
1995	4.528	4.359	4.756	2.640	2.727	14.481	0.120	51.770
1996	4.928	5.040	5.558	3.080	3.178	16.856	0.140	54.450
1997	4.832	5.005	5.506	3.048	3.165	16.725	0.140	54.020
1998	3.811	3.998	4.445	2.430	2.506	13.379	0.130	48.330
1999	3.452	3.861	4.298	2.346	2.423	12.929	0.120	45.810
2000	3.397	3.757	4.164	2.269	2.366	12.557	0.130	44.800
2001	3.537	3.727	4.186	2.261	2.338	12.511	0.140	46.920
2002	3.756	3.810	4.259	2.312	2.398	12.778	0.130	46.500
2003	4.122	3.954	4.423	2.371	2.483	13.231	0.145	53.916
2004	3.809	4.150	4.668	2.482	2.568	13.867	0.160	52.390
2005	3.371	3.771	4.279	2.232	2.308	12.590	0.150	49.670
2006	2.770	3.762	3.870	2.063	2.029	11.724	0.120	45.840
2007	4.908	3.943	4.351	2.413	2.519	13.227	0.130	57.300
2008	5.181	4.209	4.621	2.536	2.679	14.046	0.147	50.875
2009	4.865	4.518	4.981	2.712	2.862	15.072	0.173	43.199
trend 1990-2009. %	-14.15	24.09	16.15	22.33	39.45	23.54	187.56	-52.13

Dioxin and PCB emissions have decreased by about 14% and 52% respectively compared to 1990. 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 energy sector, wood and wood waste combustion in domestic sector, combustion in industry (this sector includes waste combustion as fuel) and industrial waste incineration.

At the same time emissions of PAHs and HCB have increased and the reason for that is increasing biomass consumption in energy sector.

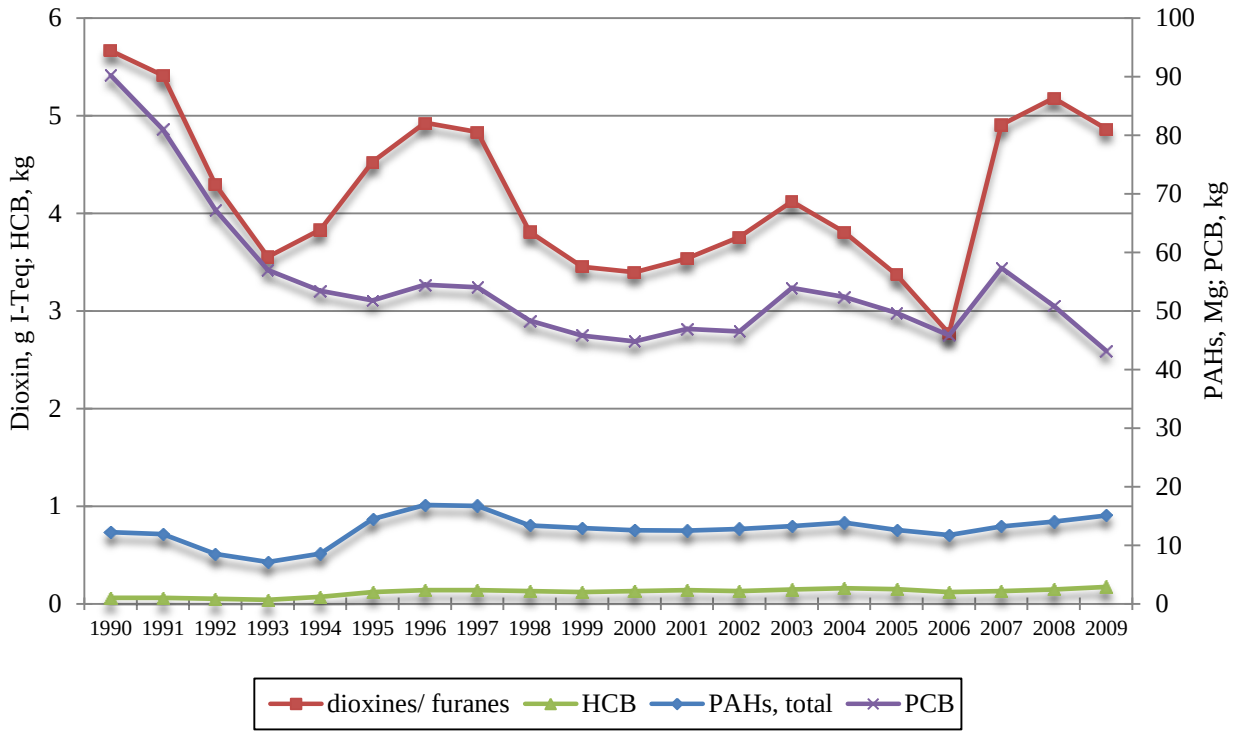

Figure 2.13. POPs emissions in 1990-2008

3. ENERGY SECTOR (NFR 1)

3.1 Overview of the sector

Energy sector is the main source of SO_2, NO_x, CO, particulates, HM and POPs in Estonia. In 2009, the energy sector contributed about 99.93% of total SO_2 emission, 99.75% of total NO_x emission, 93% of TSP, 99.96% of Pb (Figures 3.2-3.4). During the period 1990-2009, the emissions of sulphur dioxide from energy sector has decreased by approximately 80%, emissions of nitrogen oxides – about 59.5% conditioned by decline in energy production (oil shale consumption as main fuel in Estonia fell from 231 PJ in 1990 to 123.6 PJ in 2009) (Table 3.1).

Estonia is relatively rich in natural resources, both mineral and biological. Estonia is unique country whose energy production depends primarily on the use of oil-shale. In 2009, the share of domestic fuels – oil shale, wood and peat – accounted for about 77% of the primary energy supply. Imported fuels (natural gas, fuel oils, coal and motor fuels) made up 23% (Figure 3.1). Renewals formed about 14% of the primary energy supply in 2009, with wood fuel prevailing. 44.2% of the primary energy was used for the production of electricity and 17.5% for the heat generation, 17% for the production of secondary fuel, 2% as row material, 19% - for final consumption.

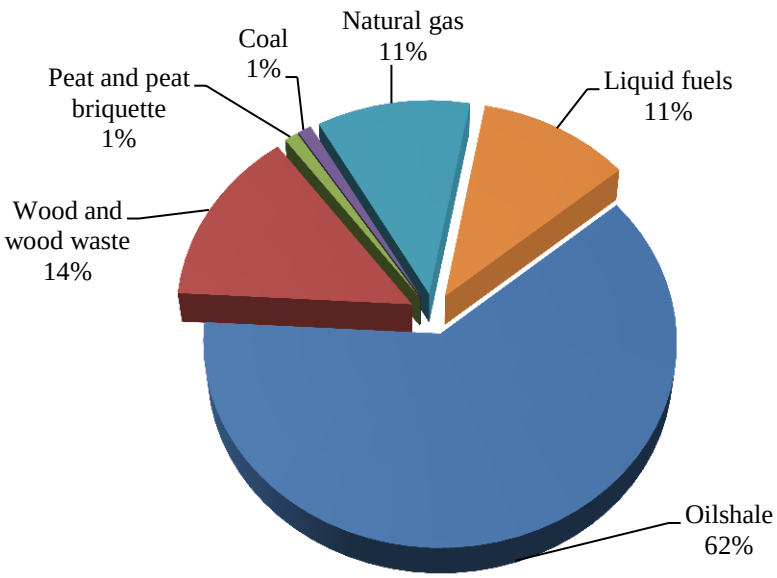

Figure 3.1. Structure of primary energy supply in Estonia in 2009

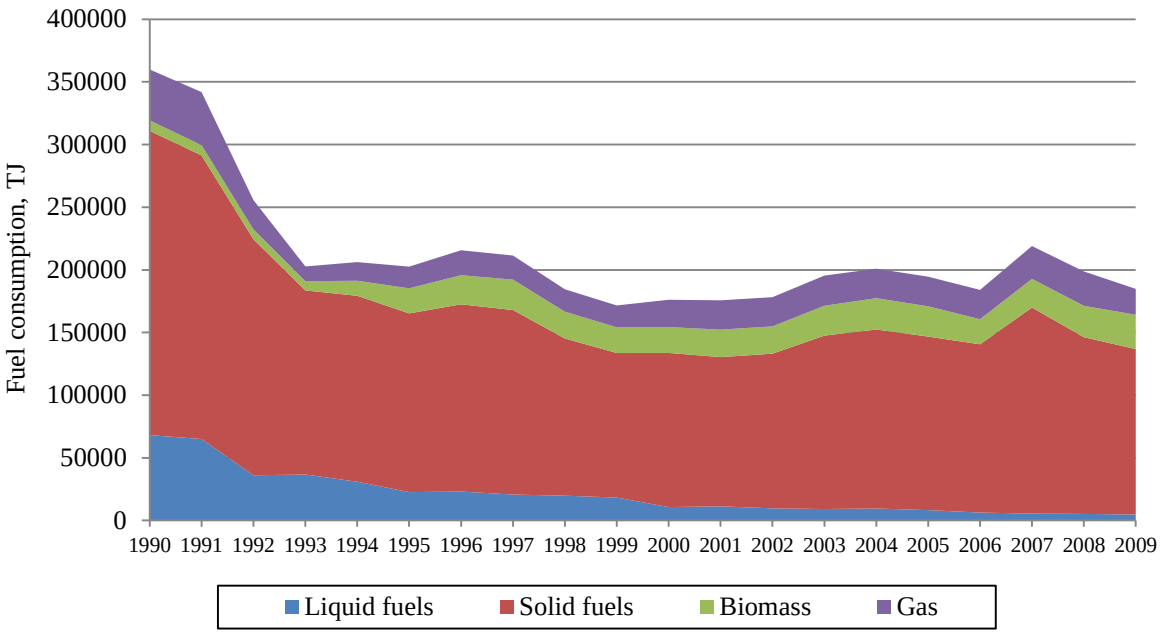

Figure 3.2. Fuel consumption in 1990-2009

The total primary energy supply decreased in 2009 by 11% compared with the previous year. In 2009, Estonian energy sector was affected by the economic recession. Decline in the production of business sector reduced the demand of the domestic market for electricity which in turn reduced the demand for oil shale production. Compared to 2008, the production of oil shale decreased by about 8%. At the same time, due to good weather conditions and stable external demand, the production of other domestic fuels increased. The production of wood fuels and peat increased. The production of wood pellets was 45% larger than in 2008. During the last ten years, shale oil has become an important export commodity in the energy market. In 2009 compared to 2008, shale oil production increased by about 10% and the exports of shale oil increased by more than a third (35%). More than half of the shale oil production was exported – mainly to the Sweden, Denmark, Netherlands and Belgium. (1) (GREENHOUSE GAS EMISSIONS IN ESTONIA 1990-2009, NATIONAL INVENTORY REPORT under the UNFCCC and the Kyoto Protocol, Tallinn 2011).

Regarding the electricity generation efficiency, the renovation of two units in Narva power plants of Eesti Energia AS, which resulted in introducing a new technology – combustion of oil shale in low-temperature circulating fluidized bed (CFB), has been essential. Renovation of the 8th unit in Eesti Power Plant was finished in November 2003. Since the beginning of 2004 the new and more efficient unit has been constantly in 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 old low-efficiency and high-polluting equipment of the first three stages in the Balti Power Plant. On 1st of June 2005, the renovated unit no. 11 in the Balti PP was launched. The two boilers of the new unit fire oil shale in circulating fluidized bed. The new units save more than 20% of fuel. The pollution level is several times lower than provided by EU environmental regulations. The successful operation of the new CFBC units allows continuing the construction of additional units.

Table 3.1. Pollutants emission from the energy sector

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg	Mg
1990	71.45	34.92	273.61	0.06	NR	NR	274.60	226.24	205.46	4.40
1991	66.20	33.39	251.29	0.05	NR	NR	275.53	225.68	188.14	4.20
1992	41.13	19.84	191.66	0.04	NR	NR	247.11	126.80	123.97	3.00
1993	37.96	19.50	155.90	0.04	NR	NR	195.28	123.58	102.45	2.22
1994	40.50	23.73	150.23	0.06	NR	NR	173.29	149.50	122.55	2.87
1995	38.14	31.09	116.11	0.10	NR	NR	132.86	196.93	85.03	1.96
1996	41.47	34.64	125.14	0.12	NR	NR	122.44	219.32	65.22	1.05
1997	40.18	36.45	116.21	0.13	NR	NR	99.22	228.71	45.26	1.07
1998	37.21	28.36	104.31	0.11	NR	NR	87.60	181.13	38.19	1.01
1999	35.76	30.15	97.61	0.12	NR	NR	86.22	190.28	37.89	0.95
2000	36.60	31.27	97.17	0.17	20.96	35.97	72.93	182.08	34.69	0.56
2001	39.00	31.93	90.50	0.20	21.90	35.96	70.91	187.94	34.89	0.55
2002	40.23	30.98	86.83	0.22	22.40	31.84	49.96	181.44	34.22	0.57
2003	40.51	29.95	100.07	0.22	20.50	28.44	46.01	173.93	37.10	0.63
2004	37.69	29.58	88.05	0.29	21.67	28.44	42.85	170.84	35.60	0.59
2005	35.48	26.67	76.12	0.31	19.52	25.03	34.41	157.35	34.28	0.58
2006	34.23	24.53	69.81	0.35	14.91	18.46	24.96	143.43	30.96	0.55
2007	37.30	25.89	87.93	0.41	19.93	27.01	32.98	162.24	39.56	0.68
2008	34.10	25.85	69.34	0.42	19.62	23.61	28.68	166.28	34.55	0.61
2009	28.93	25.49	54.77	0.39	18.24	21.72	26.21	167.78	27.94	0.48
1990-2009, %	**-59.51**	**-26.99**	**-79.98**	**576.69**	**-13.02**	**-39.61**	**-90.46**	**-25.84**	**-86.40**	**-89.12**

Year	Hg	As	Cr	Cu	Ni	Zn	Dioxines	PAH (4 total)	HCB	PCB
	Mg	Mg	Mg	Mg	Mg	Mg	g I-Teq	Mg	kg	kg
1990	1.12	18.86	18.32	11.29	27.40	104.51	5.20	12.20	0.06	90.27
1991	1.02	16.45	15.98	10.44	25.96	95.70	4.94	11.88	0.06	81.03
1992	0.83	14.03	13.72	7.23	17.05	77.99	3.84	8.48	0.05	67.25
1993	0.64	10.84	10.39	6.06	14.36	60.38	3.10	7.13	0.04	57.02
1994	0.64	10.68	10.23	6.73	12.90	63.39	3.39	8.56	0.07	53.44
1995	0.60	10.07	9.67	5.84	10.53	58.05	4.10	14.48	0.12	51.78
1996	0.60	10.36	9.90	5.42	10.97	55.55	4.50	16.86	0.14	54.46
1997	0.60	10.20	9.61	5.45	9.85	55.10	4.21	16.72	0.14	54.03
1998	0.53	9.15	8.64	4.93	8.90	49.88	3.25	13.38	0.13	48.33
1999	0.50	8.71	8.24	4.83	7.68	47.75	3.16	12.93	0.12	45.81
2000	0.51	8.59	8.10	4.50	6.65	44.07	3.00	12.56	0.13	44.80
2001	0.50	8.39	7.97	4.96	6.52	43.81	3.18	12.51	0.14	46.92
2002	0.50	8.36	8.05	5.14	6.30	43.13	3.14	12.78	0.13	46.50
2003	0.58	10.11	9.53	5.45	6.81	51.76	3.64	13.23	0.15	53.92
2004	0.54	9.79	9.11	5.50	6.76	51.64	3.15	13.87	0.16	52.39
2005	0.52	9.22	8.79	5.52	6.51	48.05	3.16	12.59	0.15	49.67
2006	0.52	8.59	8.18	5.48	5.85	43.65	2.72	11.72	0.12	45.84
2007	0.65	11.08	10.41	6.23	6.82	55.24	4.61	13.23	0.13	57.30
2008	0.57	9.42	8.94	5.82	5.99	48.41	4.72	14.05	0.15	50.87
2009	0.44	7.61	7.17	5.04	4.94	39.30	4.28	15.07	0.17	43.20
1990-2009, %	**-60.48**	**-59.65**	**-60.86**	**-55.34**	**-81.99**	**-62.39**	**-17.59**	**23.54**	**187.56**	**-52.14**

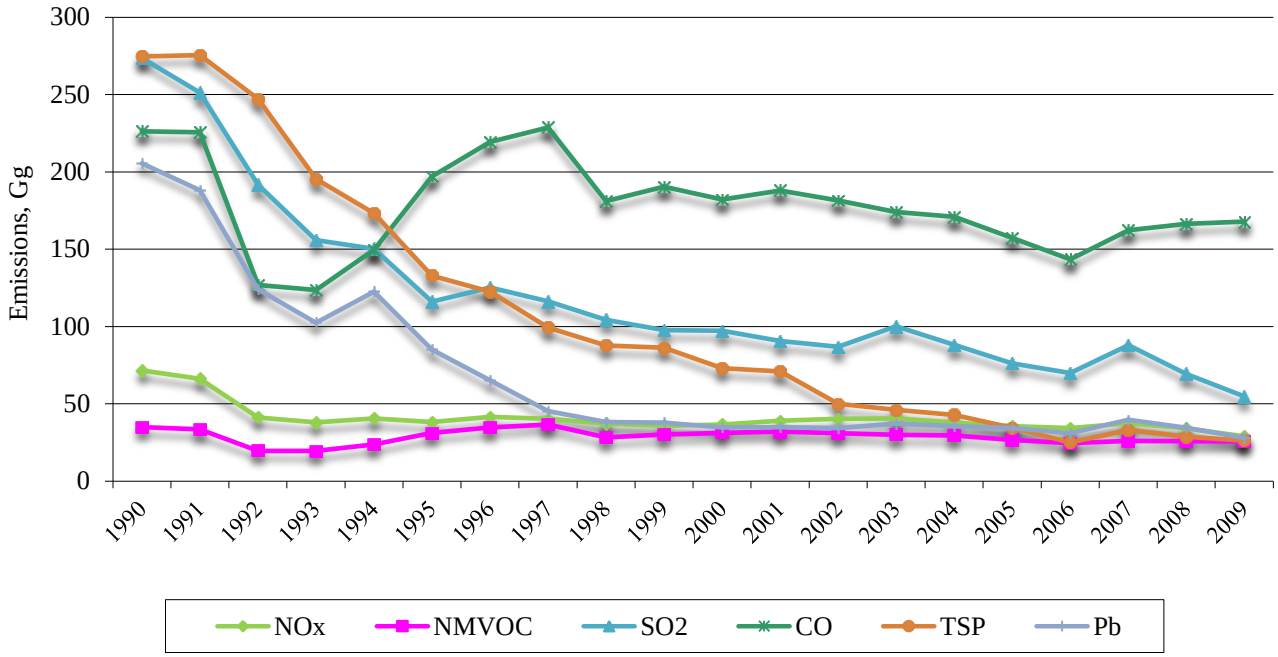

Figure 3.3. Pollutants emission from energy industry in 1990-2009

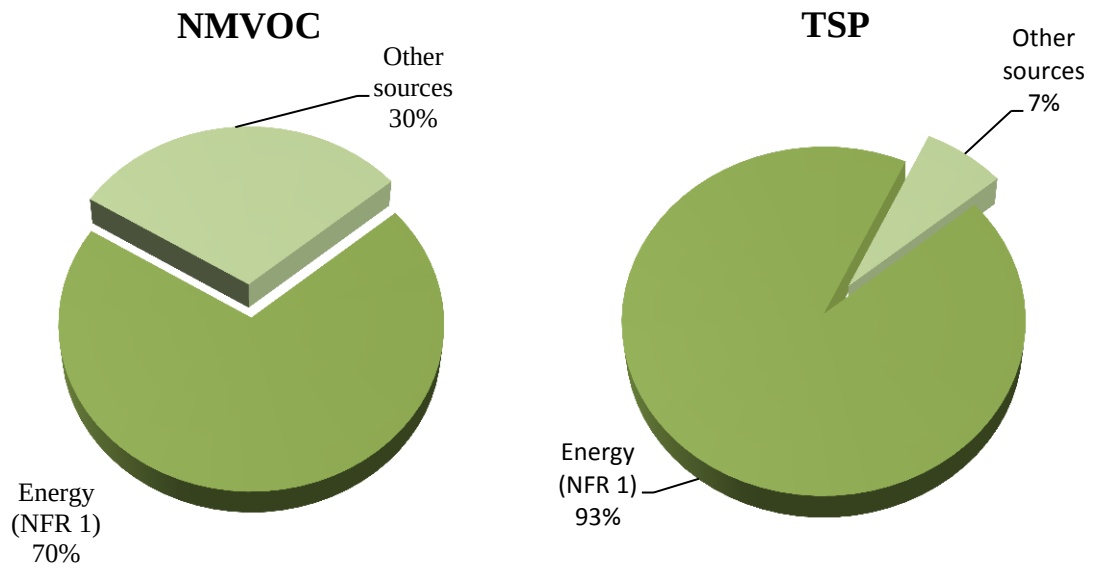

Figure 3.4. Share of NMVOC and TSP emission from energy sector in total emission in 2009

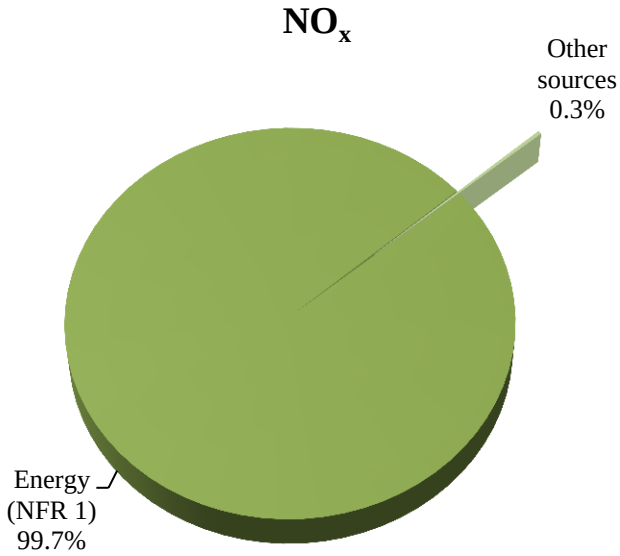

Figure 3.5. Share of NO_x emission from energy sector in total emission in 2009

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 base 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 oil shale oil 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
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 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 equipements in 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 equipements in residetial 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 equipements in 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

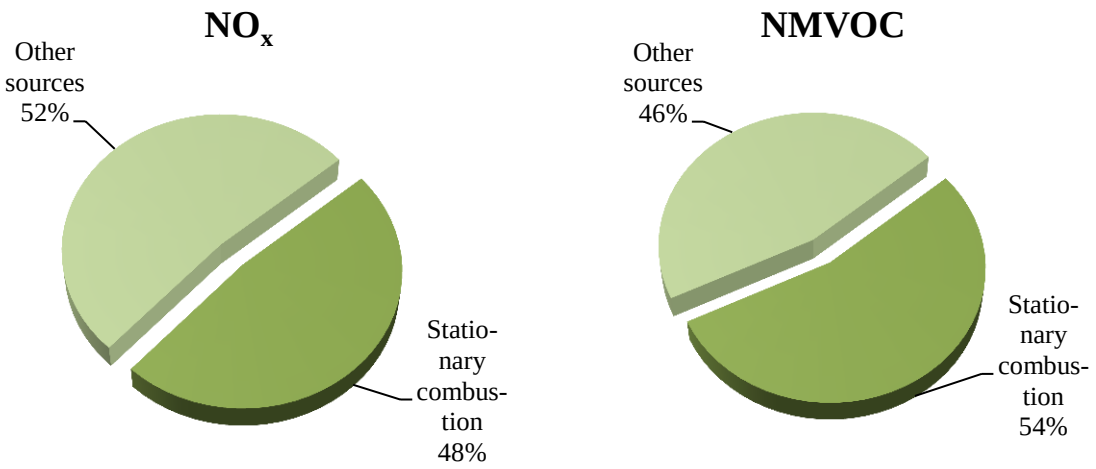

Figure 3.6. NO_x and NMVOC emissions from stationary fuel combustion and other sources in 2009

Table 3.3. Pollutants emission from stationary fuel combustion in 1990-2009

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg	Mg
1990	33.43	12.85	266.71	0.04			273.13	98.26	126.73	4.39
1991	30.51	12.41	244.67	0.03			274.09	98.52	118.44	4.19
1992	21.51	9.92	187.72	0.03			246.27	73.93	89.64	2.99
1993	16.75	8.69	151.61	0.03			194.25	63.99	67.36	2.21
1994	18.08	10.75	146.16	0.04			172.35	78.31	79.53	2.86
1995	18.28	18.79	112.46	0.07			132.00	130.35	60.65	1.95
1996	19.89	21.85	121.27	0.08			121.58	150.26	44.15	1.04
1997	18.30	21.51	112.32	0.08			98.33	146.13	36.60	1.06
1998	16.94	16.92	100.33	0.06			86.73	118.71	33.03	1.00
1999	16.12	16.63	94.09	0.06			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	13.952	19.628	54.62	0.07	17.44	20.72	25.16	138.30	26.84	0.47
1990-2009, %	**-58.3**	**52.8**	**-79.5**	**85.0**	**-13.1**	**-40.8**	**-90.8**	**40.7**	**-78.8**	**-89.3**

Year	Hg	As	Cr	Cu	Ni	Zn	Dioxines	PAH (4 total)	HCB	PCB
	Mg	Mg	Mg	Mg	Mg	Mg	g I-Teq	Mg	kg	kg
1990	1.12	18.86	18.17	7.35	27.31	102.66	4.97	12.11	0.06	90.25
1991	1.02	16.45	15.84	6.87	25.88	93.99	4.72	11.79	0.06	81.01
1992	0.83	14.03	13.65	5.31	17.00	77.08	3.74	8.43	0.05	67.24
1993	0.64	10.84	10.31	3.96	14.31	59.39	3.00	7.08	0.04	57.01
1994	0.64	10.68	10.14	4.32	12.84	62.26	3.25	8.51	0.07	53.43
1995	0.60	10.07	9.59	3.65	10.48	57.02	3.97	14.44	0.12	51.77
1996	0.60	10.36	9.81	3.10	10.92	54.45	4.35	16.81	0.14	54.45
1997	0.60	10.20	9.52	2.99	9.80	53.94	4.06	16.68	0.14	54.02
1998	0.53	9.15	8.55	2.69	8.85	48.85	3.14	13.34	0.13	48.33
1999	0.50	8.71	8.15	2.54	7.63	46.69	3.03	12.89	0.12	45.81
2000	0.51	8.59	8.01	2.18	6.60	42.99	2.86	12.52	0.13	44.80
2001	0.50	8.39	7.86	2.16	6.46	42.50	3.01	12.47	0.14	46.92
2002	0.50	8.36	7.94	2.14	6.24	41.72	2.98	12.73	0.13	46.50
2003	0.58	10.11	9.42	2.54	6.75	50.39	3.49	13.18	0.15	53.92
2004	0.54	9.79	9.00	2.52	6.70	50.24	3.00	13.82	0.16	52.39
2005	0.52	9.22	8.67	2.44	6.44	46.59	3.01	12.54	0.15	49.67
2006	0.52	8.59	8.05	2.18	5.78	42.08	2.56	11.67	0.12	45.84
2007	0.65	11.08	10.28	2.75	6.74	53.59	4.44	13.17	0.13	57.30
2008	0.57	9.42	8.81	2.39	5.92	46.79	4.55	12.98	0.15	50.87
2009	0.44	7.61	7.05	1.98	4.87	37.85	4.13	15.02	0.17	43.20
1990-2009, %	**-60.4**	**-59.7**	**-61.2**	**-73.1**	**-82.2**	**-63.1**	**-16.9**	**24.0**	**188.7**	**-52.1**

Energy related activities (without transport) are the most significant contributors to SO_2 emissions – 99.6% in 2009. The share of mobile sources in total emission is very small – 0.23% (Figure 3.7). The oil shale Power Plants contributes to total SO_2 emissions about 77%. Estonian oil shale is high-ash shale (up to 46%), low net caloric value (8.4-9 MJ/kg) and sulphur content 1.4-1.8%. Two different combustion technologies, the old pulverized combustion of oil shale and the new circulated fluidized bed combustion technology are at present used in the Estonian Power Plants.

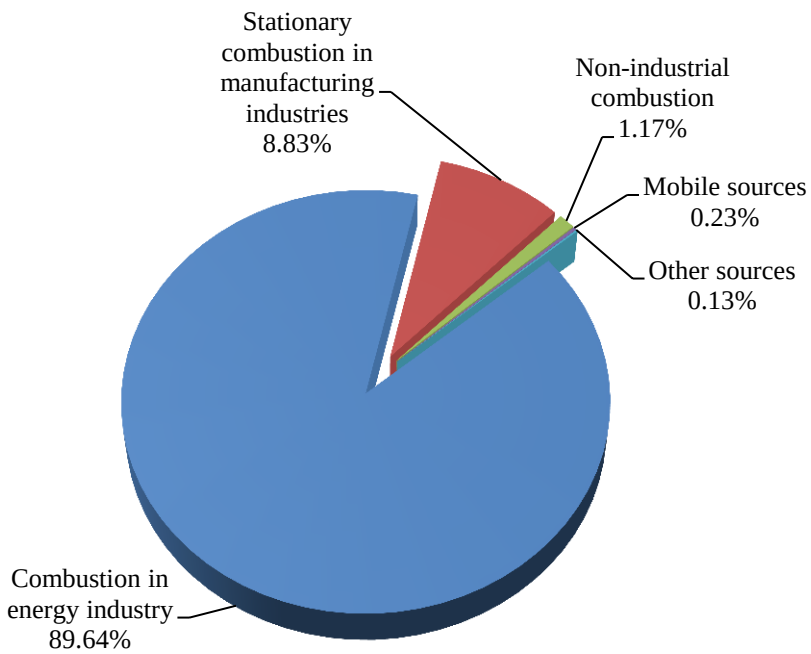

Figure 3.7. SO_2 emissions by sources of pollution in 2009

Non-industrial combustion is responsible for about 88% of total NMVOC emissions in stationary combustion and for about 60% of TSP emission (Figures 3.8, 3.10). Power and district heating plants are responsible for a 90% of SO_2 emission in stationary combustion. (Figure 3.9)

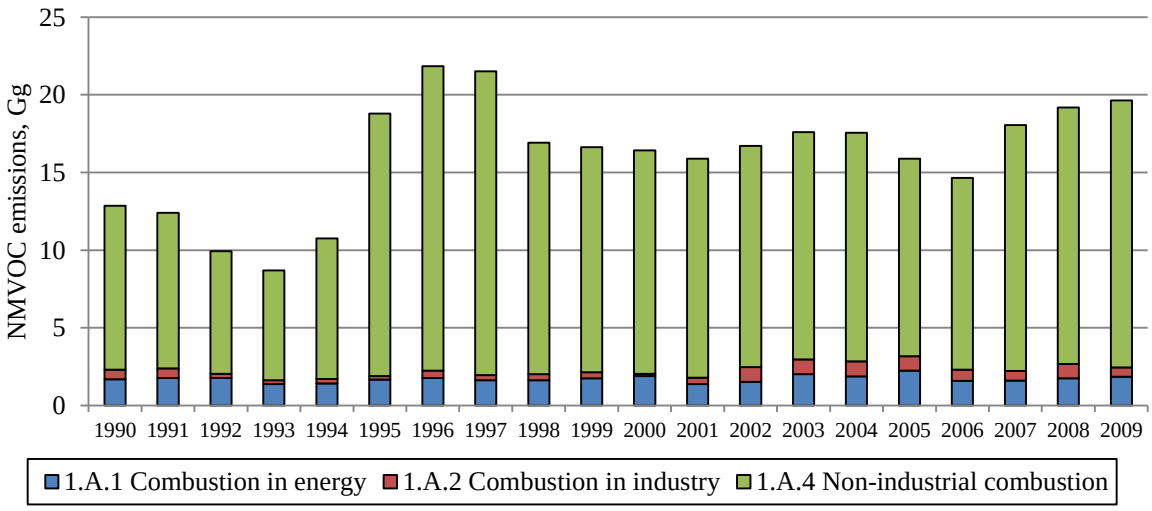

Figure 3.8. Distribution of NMVOC emission by sector in stationary combustion

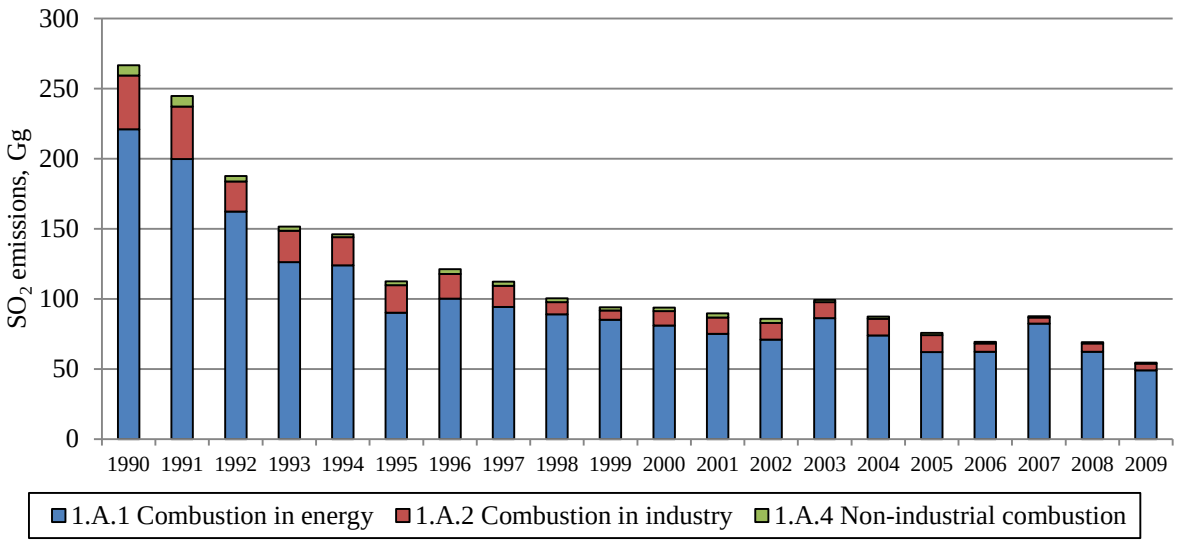

Figure 3.9. Distribution of SO_2 emission by sector in stationary combustion

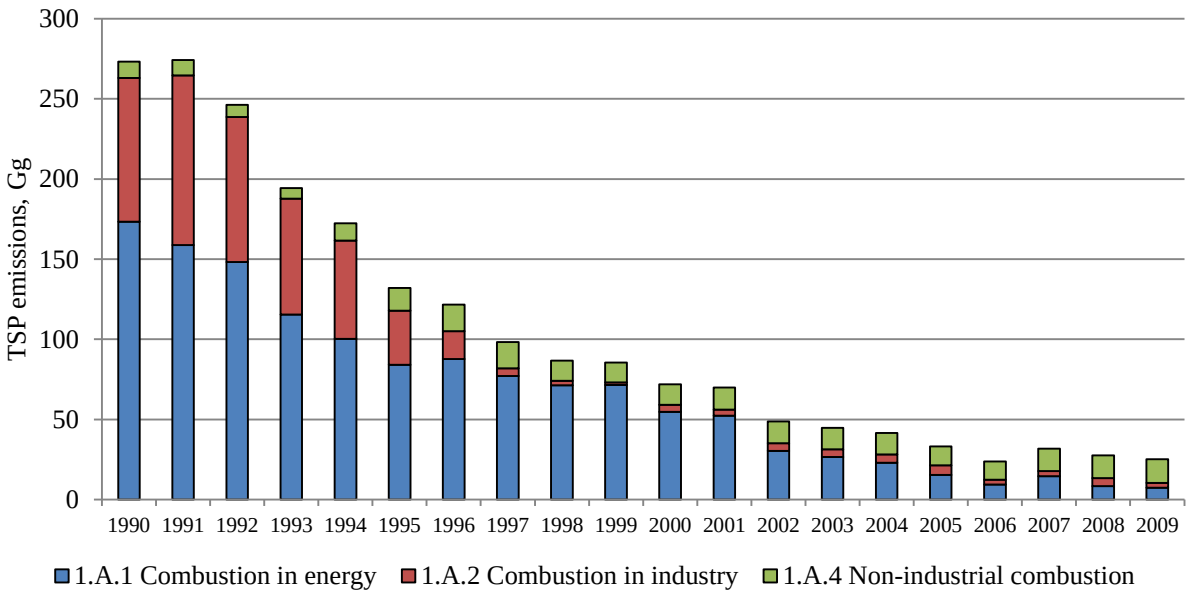

Figure 3.10. Distribution of TSP emission by sector in stationary combustion

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**, NFR 1.A.4.a.i, c.i** Non-industrial combustion plants (commercial and agriculture stationary combustion) includes pollutants emission data from point sources (PS) reported by operators and from diffuse sources.

NFR 1.A.1.b Petroleum refining (only two facilities repoted emissions from process furnace in 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 Manufacture of solid fuels includes pollutants emission data reported by three facilities of shale oil production (oil shale transformation processes; if necessary, the next IIR will provide detail description of technology). Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

Under this code also data from boilers in oil shale mining and other fuel transformation industries. Operators used measurements 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 repoted 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 includes pollutants emission data from diffuse sources.

According to the national legislation, all operators with boilers capacity beginning from 0.3 MW must prepare annual report. Report for the energy related activities contains data about type and capacity of boilers, fuels characteristic and consumption, pollutants emissions and so on.

Fuel consumption data from point sources has summarized by SNAP codes. Emissions from the diffuse sources were calculated by using data of 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 manufacturing industry is shown only under final consumption (SNAP 0303). In this case it is difficult to compare fuel data from national database (by SNAP) and Estonian Energy Balance. For the determination of fuel consumption by diffuse sources were used combined data from two tables: “Energy balance sheet” and “Consumption of fuel by branches of economy”. It is complicated way and now under decision to use for national report preparing Annual Fuel Questionnaires sent by Statistics to Eurostat.

Emissions from PS have been calculated on the base of national emission factors and fuel consumption or on the base of measurements. According to the national legislation, all large combustion plant >100 MW are obliged to carry out continuous monitoring. For other sources frequency of measurements is regulated by emission permits. National emission factors for the calculation emissions from boilers were adopted by Regulation of the Minister of the Environment on 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 metals emission factors for boilers, mg/GJ

Fuel /purification equipment	**Heavy metals EF, mg/GJ**							
	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
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:

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

B – fuel consumption,
S^r – sulphur content in fuel
η – retention of sulphur in ash

Estonia at present has no national emission factors for PM_{10} and $PM_{2.5}$. For emissions calculations from point sources were used CEPMEIP project emission factors (not directly, but share from TSP, because the some national EFs are different comparing with CEPMEIP emission factors). For a example, for oil shale Power Plant, firstly were estimated TSP emission factors on the base of emissions (operator data on the base of measurements) and

fuel used data for various boilers and then, depending of technology (high, medium or low), emissions of fine particles.

At present the national methodology is being on the co-ordination in the Ministry of the Environment.

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

Table 3.9. Pollutants emission factors for area energy sources

Pollutant	Coal	Wood, peat	Gaseous fuels	Liquid fuels	Units
SO_2	900	10	0	138	**g/GJ**
NO_x	130	80	60	70	**g/GJ**
NH_3	0	4	0	0	**g/GJ**
CO	5300	6100	30	60	**g/GJ**
NMVOC	490	980	10	15	**g/GJ**
TSP	450	800	1	8	**g/GJ**
PM_{10}	400	700	1	5	**g/GJ**
$PM_{2.5}$	400	700	1	5	**g/GJ**
As	2	1	NA	1	**mg/GJ**
Cd	2	1	NA	1	**mg/GJ**
Cr	11	3	NA	16	**mg/GJ**
Cu	22	9	NA	8	**mg/GJ**
Hg	7	1	NA	1	**mg/GJ**
Ni	13	4	NA	240	**mg/GJ**
Pb	130	40	NA	16	**mg/GJ**
Zn	220	130	NA	9	**mg/GJ**
Dioxin	70	100	1,5	10	**ng/GJ**
Benzo(a)pyrene	230	210	NA	22	**mg/GJ**
Benzo(b)fluoranthene	330	220	NA	26	**mg/GJ**
Benzo(k)fluoranthene	130	130	NA	13	**mg/GJ**
Indeno(1,2,3_cd)pyrene	110	140	NA	15	**mg/GJ**
HCB	0,0006	0,00634	NA	0	**mg/GJ**

Activity data

Discrepancies in the data on solid fuels between energy balance and point sources database are possible, the reason of this distinction in the data about the consumed oil shale, which operators are represented in Statistical Office and to Point Sources information system (OSIS) (the data in tons identical, but not in TJ).

Table 3.10. Fuel consumption in stationary fuel combustion in 1990-2009, PJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Liquid fuels	68.14	64.99	36.07	36.68	30.92	22.62	23.08	20.67	19.75	18.26
Solid fuels	242.83	226.34	188.36	146.90	148.40	142.65	149.43	147.28	125.48	115.40
Biomass	8.37	8.21	7.86	7.38	12.00	20.01	23.22	24.27	21.42	20.50
Gas	40.61	42.36	23.42	11.79	14.89	17.32	19.90	19.24	17.86	17.44
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Liquid fuels	10.69	11.28	9.67	9.13	9.53	8.26	6.31	5.46	5.22	4.75
Solid fuels	123.02	119.11	123.45	138.39	142.88	138.48	134.29	164.52	141.09	132.00
Biomass	20.63	21.94	21.77	23.85	25.01	24.22	20.05	22.85	25.02	27.42
Gas	21.80	23.37	23.33	24.07	23.54	23.58	23.37	26.18	27.41	20.67

3.2.3 Sources-specific QA/QC and verification

The several QC procedures are used in the frame of inventory preparation.

Before use data given by operators, the data of reports (the emissions, used fuel, methods of calculations) is checked. The Point Sources information system consist calculation modules on the base of national emission factor and if operator uses the calculation module it is possible to be assured that the received results are correct.

Then the data of fuel consumption is summarized by SNAP codes and compared to the Statistical energy balance data. There are difficulties at comparison of consumption of fuel on 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 QA/QC procedure.
- To make the basic decision on use of all point sources at calculation of emissions from stationary combustion. The using only large sources data are possible and remained part to count as diffuse sources. Thus there can be a problem only with particles (because part of facilities is used control equipment). For elimination of this problem is possible to calculate IEF for each fuel and to use it at 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	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)	NO_x, NMVOC, SO_2, 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 passengers and freight transport.	NO_x, NMVOC, SO_2, $PM_{2,5}$, PM_{10}, TSP, CO
1.A.3.a.i-ii.(ii)	International and Civil aviation (Cruise)	Activities include all use of aircraft consisting passengers and freight transport.	NO_x, NMVOC, SO_2, $PM_{2,5}$, 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	NO_x, NMVOC, SO_2, 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	NMVOC
1.A.3.b.vi	Automobile tyre and brake wear	PM and heavy metal emissions from automobile tyre and brake wear	$PM_{2,5}$, PM_{10}, Pb, Cd, Cr, Cu, Ni, Se, Zn,
1.A.3.b.vii	Road transport: Automobile road abrasion	PM emissions from road abrasion	$PM_{2,5}$, PM_{10}, TSP, Pb, Cd, Cr, Cu, Ni, Se, Zn,
1.A.3.c	Railways	Railway transport operated by steam and diesel locomotives	NO_x, NMVOC, SO_2, 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.	NO_x, NMVOC, SO_2, NH_3, $PM_{2,5}$, PM_{10}, TSP, CO, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
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	NO_x, NMVOC, SO_2, 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.	NO_x, NMVOC, SO_2, 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 agriculture/forestry sector (agricultural tractors, harvesters, combines etc.). This source category includes 1 A 4 c iii Agriculture/Forestry/Fishing: National fishing sector	NO_x, NMVOC, SO_2, 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.d.i.(i)	International maritime navigation	Vessels of all flags that are engaged in international water-borne navigation.	NO_x, NMVOC, SO_2, 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

The share of mobile sources in total emissions in 2009 was: NO_x – 51.5%, NMVOC –12.6%, CO – 17.4%. The share of other pollutants is not so significant. The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have decreased compared to 1990 by 60.7%, 76.6% and 77.1% respectively. The trend of the emissions of these categories is given in Figure 3.11, Tables 3.12-14.

A detailed overview of methodological issues, activity data, emission factors and emissions is given in each subsector.

All the emissions from period 1990-2008 were recalculated for: road transport, off-road machinery and navigation sectors. Main reasons for recalculations were: renewed Guidebook with new emission factors *(EMEP/EEA air pollutant emission inventory guidebook 2009)*, new COPERT version 8.0 and also corrected sulphur and lead emission factors in every transport subsector. Recalculations led to a change in total emissions and detailed overview is given in each transport subsector.

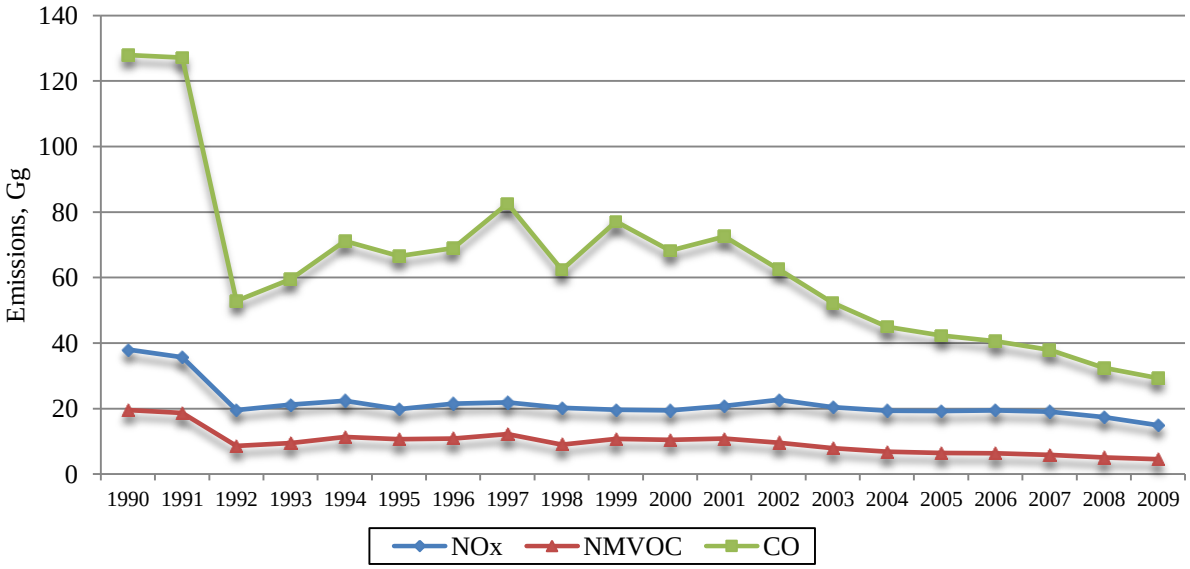

Figure 3.11. NO_x, NMVOC and CO emissions from transport sector

Table 3.12. Total emissions from transport sector in 1990-2009 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	38.020	19.592	6.899	0.018	NR	NR	1.473	127.975
1991	35.690	18.738	6.620	0.017	NR	NR	1.436	127.163
1992	19.623	8.644	3.942	0.008	NR	NR	0.839	52.870
1993	21.205	9.537	4.287	0.012	NR	NR	1.027	59.586
1994	22.424	11.393	4.075	0.023	NR	NR	0.937	71.185
1995	19.855	10.667	3.647	0.029	NR	NR	0.863	66.577
1996	21.579	10.883	3.869	0.039	NR	NR	0.857	69.056
1997	21.884	12.214	3.885	0.050	NR	NR	0.889	82.583
1998	20.273	9.059	3.985	0.047	NR	NR	0.870	62.423
1999	19.635	10.781	3.515	0.062	NR	NR	0.787	77.086
2000	19.454	10.527	3.401	0.111	0.894	0.984	0.938	68.208
2001	20.844	10.841	0.797	0.140	0.780	0.889	0.829	72.553
2002	22.671	9.627	1.109	0.146	0.968	1.081	1.019	62.619
2003	20.499	7.943	0.696	0.160	0.923	1.031	0.970	52.293
2004	19.430	6.833	0.602	0.223	0.975	1.087	1.021	45.024
2005	19.252	6.501	0.366	0.213	0.931	1.046	0.976	42.340
2006	19.519	6.370	0.330	0.240	0.935	1.059	0.983	40.586
2007	19.117	5.925	0.305	0.255	0.949	1.079	0.997	37.910
2008	17.468	5.073	0.252	0.253	0.893	1.021	0.942	32.458
2009	14.945	4.579	0.124	0.228	0.731	0.846	0.776	29.326
trend 1990-2009, %	-60.7	-76.6	-98.2	1166.7	-18.2	-14.0	-47.3	-77.1

Table 3.13. Total emissions of heavy metals from transport sector in 1990-2009 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	78.727	0.012	0.001	0.000	0.152	3.943	0.091	0.013	1.855
1991	69.698	0.011	0.001	0.001	0.137	3.565	0.085	0.012	1.713
1992	34.327	0.006	0.000	0.000	0.073	1.919	0.046	0.006	0.910
1993	35.089	0.006	0.000	0.000	0.080	2.095	0.050	0.007	0.994
1994	43.019	0.007	0.000	0.000	0.093	2.405	0.054	0.008	1.132
1995	24.377	0.006	0.000	0.000	0.085	2.191	0.048	0.007	1.029
1996	21.068	0.007	0.000	0.000	0.090	2.321	0.052	0.007	1.099
1997	8.662	0.007	0.000	0.000	0.096	2.464	0.054	0.008	1.157
1998	5.154	0.006	0.000	0.000	0.086	2.233	0.049	0.007	1.036
1999	6.422	0.006	0.000	0.000	0.089	2.287	0.050	0.007	1.065
2000	3.832	0.006	0.000	0.000	0.090	2.322	0.050	0.007	1.078
2001	4.559	0.008	0.000	0.000	0.110	2.809	0.060	0.008	1.307
2002	4.233	0.009	0.000	0.000	0.116	3.003	0.066	0.009	1.412
2003	1.788	0.008	0.000	0.000	0.112	2.909	0.065	0.009	1.378
2004	1.644	0.008	0.000	0.000	0.115	2.983	0.065	0.009	1.409
2005	1.661	0.009	0.000	0.000	0.119	3.074	0.068	0.010	1.460
2006	1.165	0.009	0.000	0.000	0.127	3.301	0.073	0.010	1.570
2007	1.228	0.010	0.000	0.000	0.135	3.483	0.076	0.011	1.657
2008	1.211	0.010	0.000	0.000	0.133	3.433	0.075	0.011	1.616
2009	1.108	0.009	0.000	0.000	0.119	3.068	0.067	0.009	1.451
trend 1990-2009, %	-98.6	-25.0	-100.0	-100.0	-21.7	-22.2	-26.4	-30.8	-21.8

Table 3.14. Total emissions of POPs from transport sector in 1990-2009

	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	Mg	Mg	Mg	Mg	kg	kg	kg
1990	0.226	0.022	0.040	0.017	0.012	0.091	0.000	NA	NA
1991	0.223	0.022	0.039	0.015	0.012	0.088	0.000	NA	NA
1992	0.096	0.012	0.022	0.008	0.005	0.047	0.000	NA	NA
1993	0.104	0.013	0.023	0.009	0.006	0.051	0.000	NA	NA
1994	0.142	0.012	0.021	0.010	0.008	0.050	0.000	NA	NA
1995	0.128	0.009	0.017	0.010	0.007	0.042	0.000	NA	NA
1996	0.148	0.010	0.019	0.010	0.008	0.047	0.000	NA	NA
1997	0.152	0.009	0.018	0.010	0.007	0.045	0.000	NA	NA
1998	0.111	0.008	0.016	0.010	0.006	0.040	0.000	NA	NA
1999	0.132	0.007	0.014	0.009	0.006	0.037	0.000	NA	NA
2000	0.137	0.007	0.014	0.009	0.006	0.037	0.000	NA	NA
2001	0.167	0.008	0.017	0.011	0.008	0.043	0.000	NA	NA
2002	0.156	0.011	0.020	0.012	0.008	0.050	0.000	NA	NA
2003	0.150	0.011	0.020	0.011	0.007	0.049	0.000	NA	NA
2004	0.149	0.011	0.019	0.012	0.008	0.049	0.000	NA	NA
2005	0.151	0.011	0.020	0.012	0.008	0.051	0.000	NA	NA
2006	0.160	0.012	0.021	0.013	0.009	0.055	0.000	NA	NA
2007	0.168	0.013	0.022	0.013	0.009	0.058	0.000	NA	NA
2008	0.169	0.012	0.021	0.013	0.009	0.055	0.000	NA	NA
2009	0.152	0.012	0.019	0.012	0.008	0.051	0.000	NA	NA
trend 1990-2009, %	-32.7	-45.5	-52.5	-29.4	-33.3	-44.0	-100.0		

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

3.3.2.1 Source category description

Road transport is the most important emission source in transport sector (Figure 3.12). This sector includes all transportation 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 driving occasionally on the roads because they are included in other sectors as off-roads (agricultural and industrial machinery etc.).

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 63.9%, 72.8% and 83.2% respectively in 2009. The lead emissions from road transport have decreased for about 98.5% since 1990 (Figure 3.17). Reduction of emissions is connected with prohibition leaded gasoline in 2000 (Figure 3.18). The share of road transport in total Pb emissions was 3.9% in 2009. In figures below (Figures 3.13-3.17) a detailed overview of NO_x, NMVOC, CO, SO_2 and Pb emission sources in road transport sector is provided. All the emission trends are presented in Tables 3.15.

Fuel consumption has changed over decades in road transport sector. During last few years the consumption of gasoline has become quite stable and diesel consumption has increased. In 1990's the gasoline consumption dominated, but starting from 2002 we can see continuous growth of diesel consumption by road transport (Figure 3.19). This trend can be explained by the fact that vehicles with gasoline engines have lost their popularity in recent years and diesel engines dominate because of their greater fuel efficiency and torque compared to gasoline engines.

Therefore the reasons for emission reductions were 41% decrease in gasoline consumption during 1990-2009 and increasing amount of new cars, which due to new technologies are designed to reduce both energy consumption and pollutant emissions.

Recalculations

All the emissions from transport sector for period 1990-2008 are recalculated. Main reasons for that are: improved new edition of COPERT program, corrected sulphur and lead content in fuels and also corrected statistical fuel consumption. An overview of updated data is given in Chapter 10.

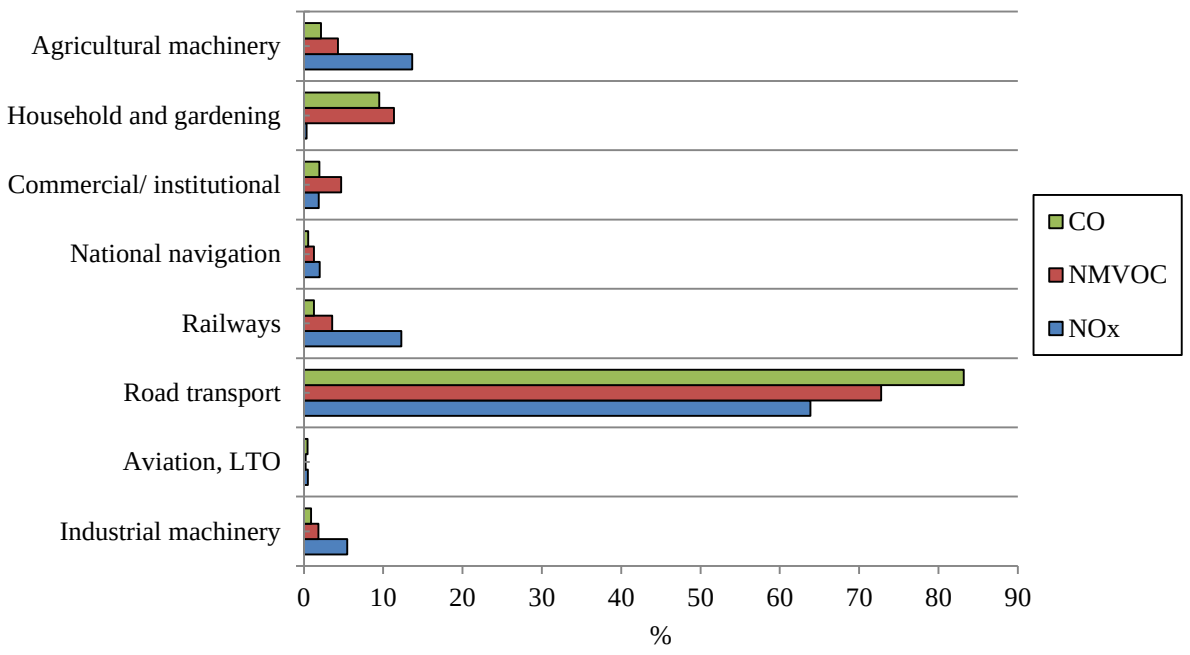

Figure 3.12. NO_x, NMVOC and CO emission share from transport sectors

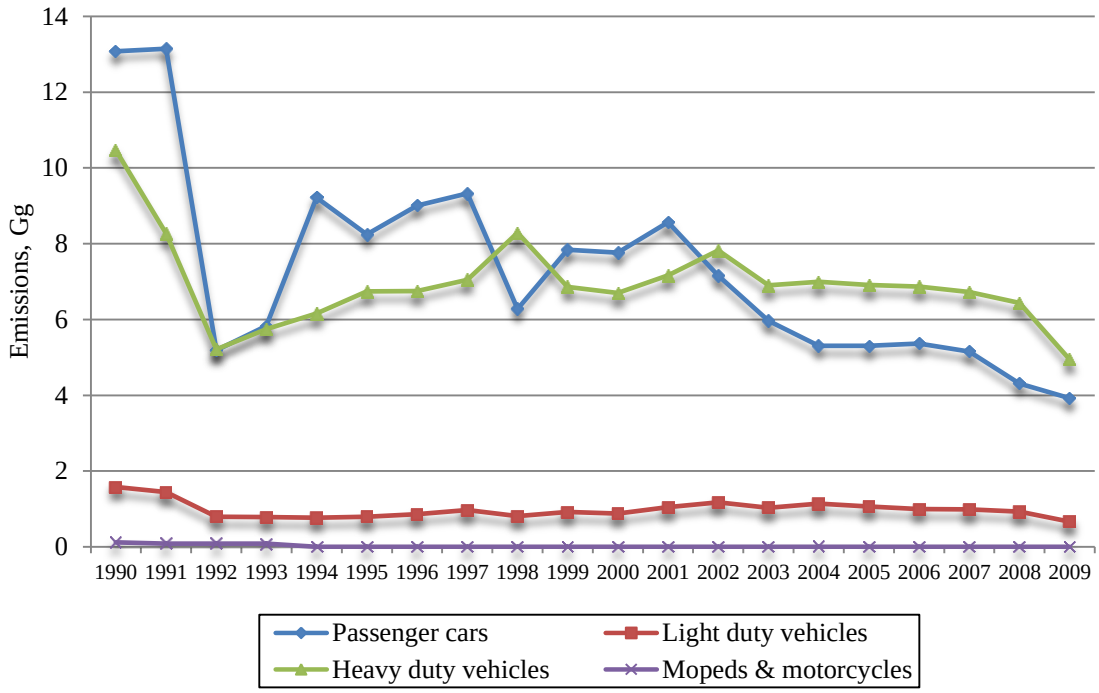

Figure 3.13. NO_x emissions from road transport

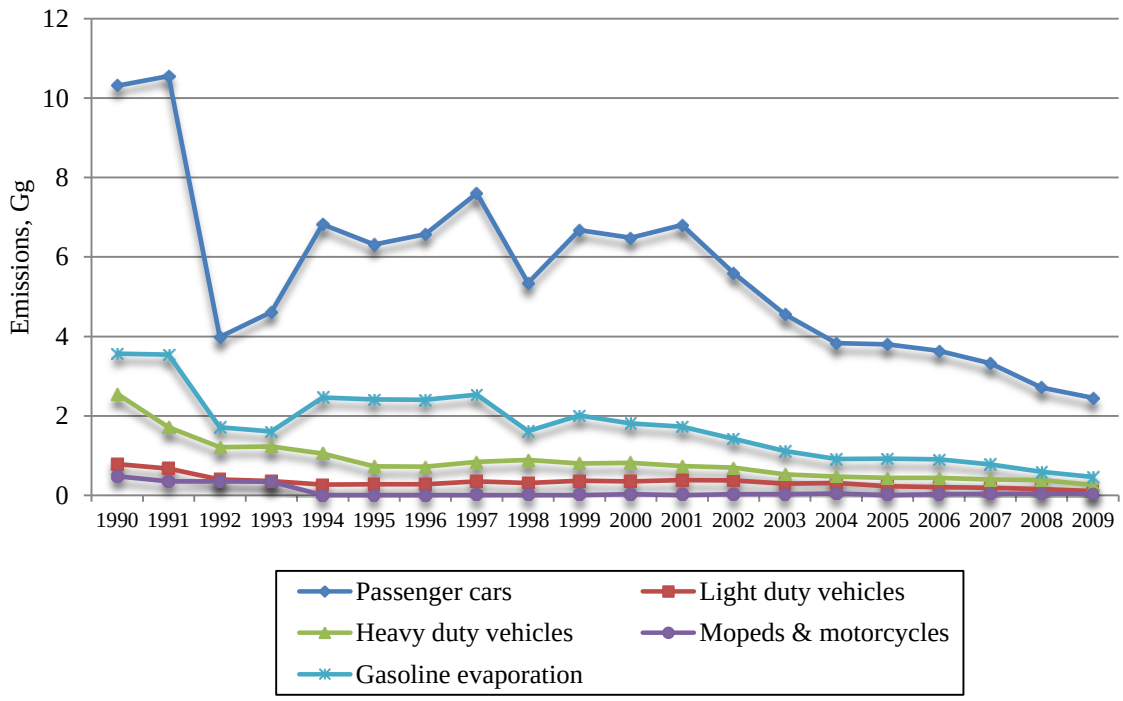

Figure 3.14. NMVOC emissions from road transport

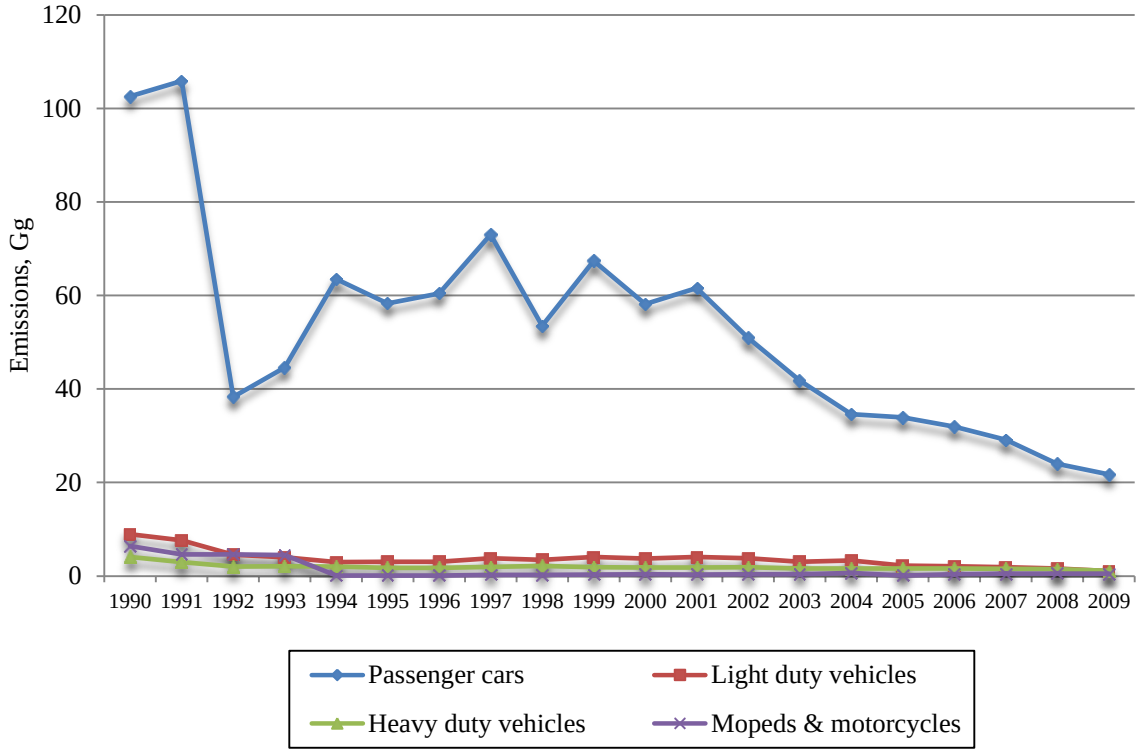

Figure 3.15. CO emissions from road transport

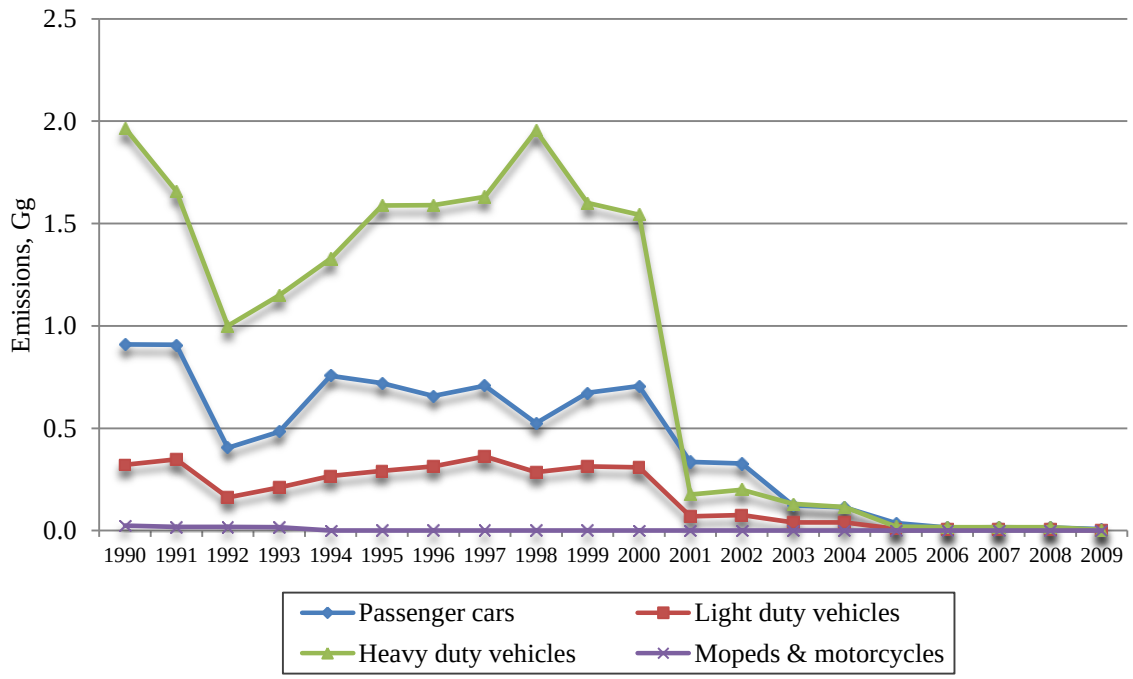

Figure 3.16. SO_2 emissions from road transport

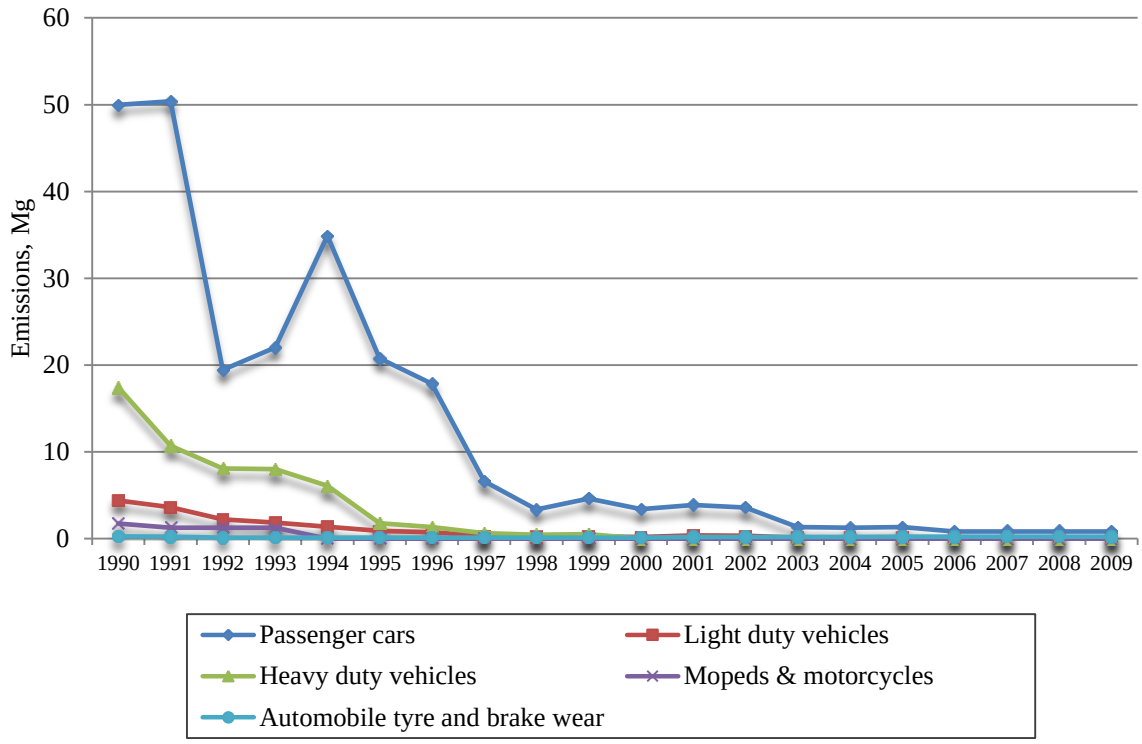

Figure 3.17. Pb emissions from road transport

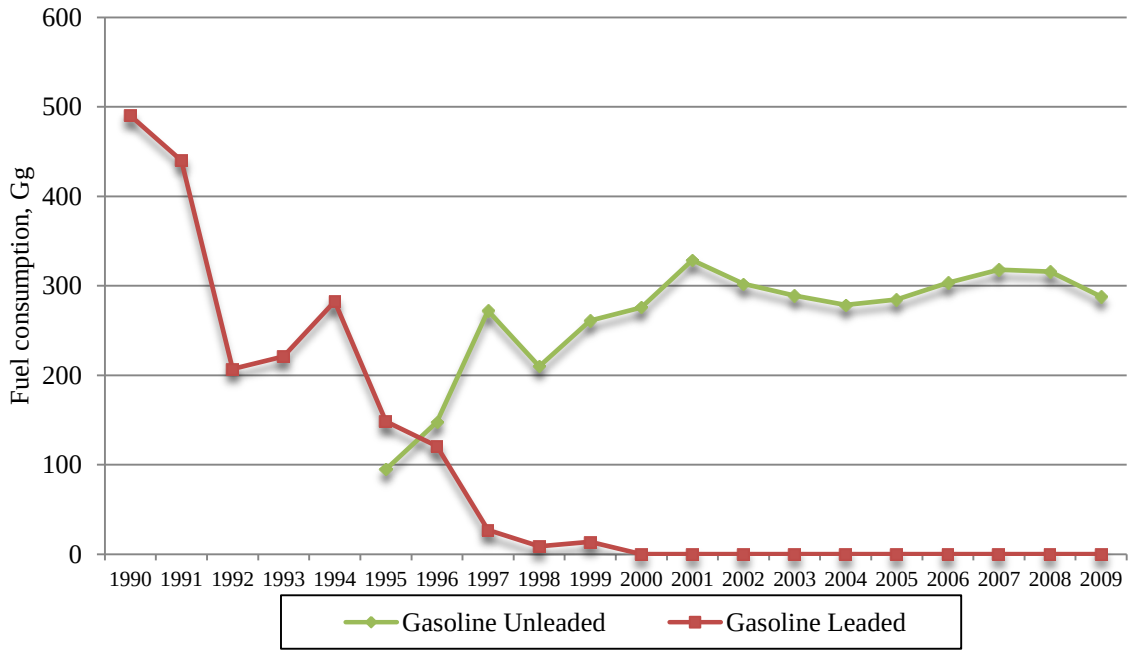

Figure 3.18. Gasoline consumption in road transport sector

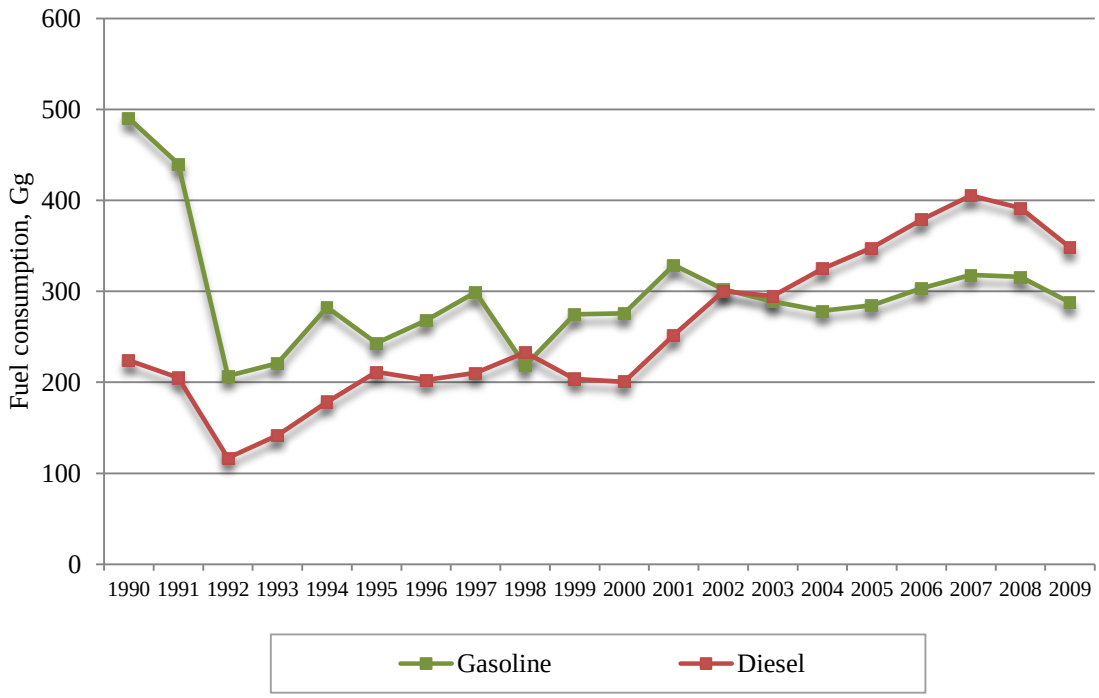

Figure 3.19. Gasoline and diesel consumption in road transport sector

Table 3.15. Emissions from road transport in 1990-2009, (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	25.250	17.708	3.220	0.015	NR	NR	0.771	122.056
1991	22.949	16.838	2.930	0.014	NR	NR	0.726	121.144
1992	11.294	7.676	1.583	0.007	NR	NR	0.395	49.562
1993	12.446	8.163	1.859	0.011	NR	NR	0.483	55.237
1994	16.147	10.630	2.350	0.022	NR	NR	0.605	68.550
1995	15.786	9.755	2.598	0.028	NR	NR	0.663	63.319
1996	16.632	10.000	2.561	0.038	NR	NR	0.602	65.492
1997	17.350	11.353	2.700	0.049	NR	NR	0.658	79.040
1998	15.387	8.191	2.765	0.046	NR	NR	0.636	59.370
1999	15.632	9.889	2.587	0.062	NR	NR	0.609	73.653
2000	15.350	9.499	2.558	0.110	0.713	0.800	0.750	64.102
2001	16.780	9.686	0.581	0.139	0.587	0.694	0.630	67.794
2002	16.157	8.138	0.602	0.145	0.657	0.767	0.701	57.007
2003	13.910	6.535	0.293	0.159	0.603	0.708	0.643	46.870
2004	13.458	5.588	0.267	0.222	0.684	0.793	0.723	40.177
2005	13.284	5.410	0.063	0.212	0.647	0.758	0.685	37.946
2006	13.243	5.225	0.036	0.239	0.627	0.747	0.668	35.973
2007	12.876	4.744	0.038	0.254	0.618	0.745	0.661	33.100
2008	11.690	3.911	0.036	0.252	0.566	0.692	0.611	27.641
2009	9.544	3.333	0.012	0.227	0.464	0.576	0.503	24.397
trend 1990-2009, %	-62.2	-81.2	-99.6	1411.4	-34.9	-27.9	-34.7	-80.0

Table 3.16. Emissions of heavy metals from road transport in 1990-2009, (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	73.785	0.008	NE	NE	0.133	3.341	0.065	0.009	1.478
1991	66.237	0.007	NE	NE	0.117	2.961	0.059	0.008	1.330
1992	31.167	0.004	NE	NE	0.061	1.530	0.030	0.004	0.672
1993	33.265	0.004	NE	NE	0.067	1.691	0.033	0.005	0.746
1994	42.559	0.005	NE	NE	0.084	2.119	0.042	0.006	0.953
1995	23.616	0.005	NE	NE	0.079	2.015	0.041	0.006	0.919
1996	20.174	0.005	NE	NE	0.083	2.105	0.042	0.006	0.961
1997	7.744	0.006	NE	NE	0.089	2.265	0.046	0.006	1.033
1998	4.195	0.005	NE	NE	0.080	2.026	0.041	0.006	0.911
1999	5.613	0.006	NE	NE	0.084	2.127	0.043	0.006	0.970
2000	3.749	0.006	NE	NE	0.085	2.153	0.043	0.006	0.977
2001	4.477	0.007	NE	NE	0.104	2.637	0.053	0.007	1.204
2002	4.136	0.007	NE	NE	0.108	2.722	0.054	0.008	1.247
2003	1.645	0.007	NE	NE	0.103	2.618	0.053	0.007	1.207
2004	1.601	0.007	NE	NE	0.108	2.719	0.054	0.008	1.254
2005	1.638	0.007	NE	NE	0.111	2.815	0.057	0.008	1.308
2006	1.140	0.008	NE	NE	0.119	3.028	0.061	0.009	1.409
2007	1.198	0.008	NE	NE	0.127	3.207	0.065	0.009	1.494
2008	1.190	0.008	NE	NE	0.125	3.172	0.064	0.009	1.462
2009	1.079	0.007	NE	NE	0.112	2.831	0.057	0.008	1.311
trend 1990-2009, %	-98.5	-11.5			-15.8	-15.2	-12.2	-11.0	-11.3

Table 3.17. Total emissions of POPs from road transport in 1990-2009

	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	Mg	Mg	Mg	Mg	kg	kg	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
trend 1990-2009, %	-24.9	31.3	-20.9	-15.8	-15.2	-11.4			

3.3.2.2 Methodological issues

1) Fuel combustion

Emission calculations from road transport are based on Tier 3 method, where exhaust emissions are calculated using a combination of reliable technical and detailed activity data. Tier 3 is implemented in COPERT 4 program (Computer Programme to calculate Emissions from Road Transport, Copert 4 version 8.0) which is used for the calculations and distributed by the European Environment Agency. Total emissions are calculated with 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 (passenger car, light duty vehicles etc.), 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 3.21) and number of vehicles (Table 3.22), which is supplied by Estonian Road Administration *(former Estonian Motor Vehicle Registration Centre)*. This improved statistics is available from 2001 and data for the years 1990-2000 is extrapolated. Meteorological data is obtained from Meteorological and Hydrological Institute and fuel consumption data from Statistics Estonia.

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

Emissions from different type of vehicles are heavily dependent on the engine operation conditions. Driving situations impose different engine operation 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 engine is at its normal operating temperature,
E_{COLD} – emissions during transient thermal 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 kilometers 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 3.23) by

emission factors (Table 3.18). The emission factors are based on the sulphur, carbon and heavy metal contents of the fuels.

- **SO_2** emissions are estimated by assuming that all sulphur in the fuel is transformed completely 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 3.18. Sulphur content of fuel (by weight)

Fuel	1990-2000	2001-2002	2003	2004	2005	2006	2007-2008	2009
Gasoline	0.1%	0.05%	0.015%	0.013%	0.005%	0.001%	0.0008%	0.0008%
Diesel	0.5%	0.05%	0.035%	0.030%	0.005%	0.004%	0.004%	0.001%

- **Pb** emissions are estimated by assuming that 75 % of lead contained in gasoline is emitted into 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 3.19. Lead content in gasoline

Fuel	1990	2003	2006
Leaded gasoline	0.15 g/l	-	-
Unleaded gasoline	0.013 g/l	0.005 g/l	0.003 g/l

- Emissions of **other heavy metals** are estimated by assuming 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 3.20. Heavy metals content in fuel (mg/kg)

Fuel	Cd	Cu	Cr	Ni	Se	Zn
Gasoline/ Diesel	0.01	1.7	0.05	0.07	0.01	1

Table 3.21. Average annual mileage in 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	2,620.0	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	6,865.0	965.6	991.6	29.8	8,852.0
2009	6,546.7	727.4	816.9	26.6	8,117.6

Table 3.22. Number of vehicles in 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
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	424.0	38.5	27.0	6.0	495.5
2009	424.0	36.9	26.9	6.7	494.5

Table 3.23. Fuel consumption in road transport sector (Gg)

	Gasoline	Diesel
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	347.93
2006	303.29	378.60
2007	317.96	405.32
2008	315.91	391.45
2009	287.86	348.34

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 directly as a result of the wear of tyre, brake 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 (NFR codes 1.A.3.b.i to iv).

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

Road abrasion sector is not included in COPERT model and therefore these emissions are calculated separately using Tier 1 default emission factors from EMEP/CORINAIR Emission Inventory Guidebook 2009.

3) Gasoline evaporation

This sector includes NMVOC evaporative fuel-related emissions from gasoline vehicles which is not deriving 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 to be negligible.

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

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

Uncertainty analysis for road transport sector.

Calculation of TSP emissions from Automobile tyre and brake wear sector.

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

3.3.3.1 Source category description

Emissions are split into different aircraft activities, 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)*

**Cruise emissions are reported as memo item and are not included in the national totals.*

Aviation sector has very minor share into total emissions. The total contribution of aircraft LTO emissions to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were *0.5%, 0.2%* and *0.5%* respectively in transport sector in 2009. Other pollutants have even smaller share.

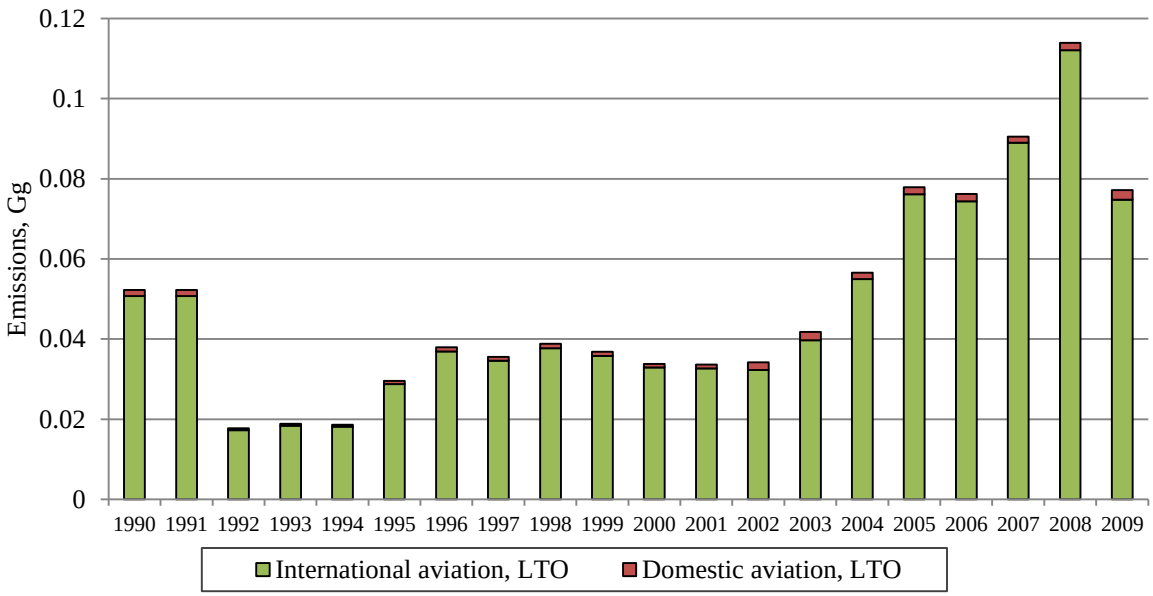

Figure 3.20. NO_x emissions from LTO-cycle

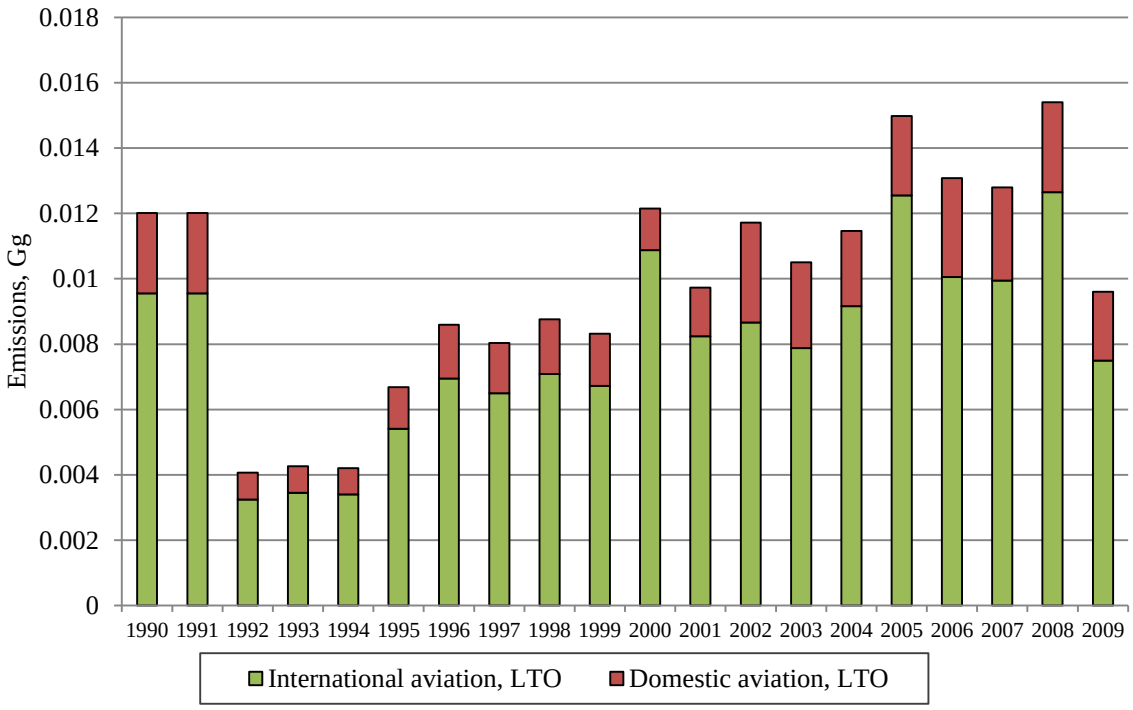

Figure 3.21. NMVOC emissions from LTO-cycle

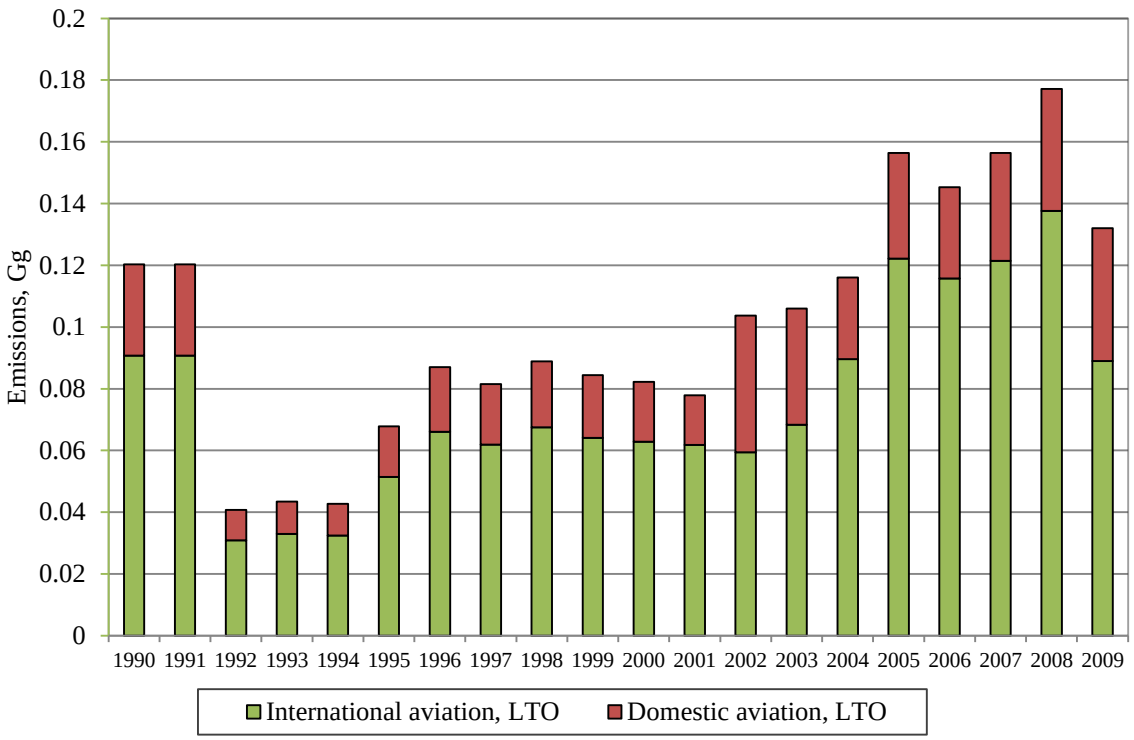

Figure 3.22. CO emissions from LTO-cycle

Table 3.24. Emissions from LTO-cycle in domestic aviation in 1990-2009 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.002	0.002	0.0003	NA	NR	NR	0.00002	0.030
1991	0.002	0.002	0.0003	NA	NR	NR	0.00002	0.030
1992	0.001	0.001	0.0001	NA	NR	NR	0.00001	0.010
1993	0.001	0.001	0.0001	NA	NR	NR	0.00000	0.010
1994	0.001	0.001	0.0001	NA	NR	NR	0.00000	0.010
1995	0.001	0.001	0.0001	NA	NR	NR	0.00001	0.016
1996	0.001	0.002	0.0002	NA	NR	NR	0.00001	0.021
1997	0.001	0.002	0.0002	NA	NR	NR	0.00001	0.020
1998	0.001	0.002	0.0002	NA	NR	NR	0.00001	0.021
1999	0.001	0.002	0.0002	NA	NR	NR	0.00001	0.020
2000	0.001	0.001	0.0001	NA	0.00001	0.00001	0.00001	0.019
2001	0.001	0.001	0.0002	NA	0.00001	0.00001	0.00001	0.016
2002	0.002	0.003	0.0003	NA	0.00002	0.00002	0.00002	0.044
2003	0.002	0.002	0.0003	NA	0.00002	0.00002	0.00002	0.038
2004	0.002	0.002	0.0003	NA	0.00001	0.00001	0.00001	0.027
2005	0.002	0.002	0.0003	NA	0.00001	0.00001	0.00001	0.034
2006	0.002	0.003	0.0003	NA	0.00002	0.00002	0.00002	0.030
2007	0.002	0.003	0.0003	NA	0.00001	0.00001	0.00001	0.035
2008	0.002	0.003	0.0003	NA	0.00001	0.00001	0.00001	0.040
2009	0.002	0.002	0.0004	NA	0.00001	0.00001	0.00001	0.043
trend 1990-2009, %	51.9	-13.8	41.1		-34.2	-34.2	-34.2	45.1

Table 3.25. Emissions from LTO-cycle in international aviation in 1990-2009 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.051	0.010	0.005	NA	NR	NR	0.0004	0.091
1991	0.051	0.010	0.005	NA	NR	NR	0.0004	0.091
1992	0.017	0.003	0.002	NA	NR	NR	0.0001	0.031
1993	0.018	0.003	0.002	NA	NR	NR	0.0001	0.033
1994	0.018	0.003	0.002	NA	NR	NR	0.0001	0.032
1995	0.029	0.005	0.003	NA	NR	NR	0.0002	0.051
1996	0.037	0.007	0.004	NA	NR	NR	0.0003	0.066
1997	0.035	0.006	0.000	NA	NR	NR	0.0003	0.062
1998	0.038	0.007	0.004	NA	NR	NR	0.0003	0.067
1999	0.036	0.007	0.004	NA	NR	NR	0.0003	0.064
2000	0.033	0.011	0.004	NA	0.0003	0.0003	0.0003	0.063
2001	0.033	0.008	0.003	NA	0.0003	0.0003	0.0003	0.062
2002	0.032	0.009	0.003	NA	0.0002	0.0002	0.0003	0.059
2003	0.040	0.008	0.004	NA	0.0003	0.0003	0.0003	0.068
2004	0.055	0.009	0.005	NA	0.0004	0.0004	0.0004	0.090
2005	0.076	0.013	0.007	NA	0.0006	0.0006	0.0006	0.122
2006	0.074	0.010	0.007	NA	0.0006	0.0006	0.0006	0.116
2007	0.089	0.010	0.009	NA	0.0008	0.0008	0.0008	0.121
2008	0.112	0.013	0.010	NA	0.0009	0.0009	0.0009	0.138
2009	0.075	0.008	0.007	NA	0.0006	0.0006	0.0006	0.089
trend 1990-2009, %	47.5	-21.2	36.5		57.8	57.8	57.8	-1.9

Table 3.26. Emissions from domestic aviation in 1990-2009 (Cruise), Gg

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	0.016	0.00015	0.0015	NA	NR	NR	0.00030	0.0030
1991	0.016	0.00015	0.0015	NA	NR	NR	0.00030	0.0030
1992	0.005	0.00005	0.0005	NA	NR	NR	0.00010	0.0010
1993	0.008	0.00008	0.0008	NA	NR	NR	0.00016	0.0016
1994	0.007	0.00007	0.0007	NA	NR	NR	0.00013	0.0013
1995	0.008	0.00008	0.0008	NA	NR	NR	0.00015	0.0015
1996	0.006	0.00006	0.0006	NA	NR	NR	0.00012	0.0012
1997	0.007	0.00006	0.0006	NA	NR	NR	0.00013	0.0013
1998	0.006	0.00006	0.0006	NA	NR	NR	0.00012	0.0012
1999	0.007	0.00007	0.0007	NA	NR	NR	0.00003	0.0003
2000	0.007	0.00006	0.0006	NA	0.00013	0.00013	0.00013	0.0013
2001	0.006	0.00006	0.0006	NA	0.00012	0.00012	0.00012	0.0012
2002	0.005	0.00005	0.0005	NA	0.00010	0.00010	0.00010	0.0010
2003	0.004	0.00004	0.0004	NA	0.00008	0.00008	0.00008	0.0008
2004	0.004	0.00004	0.0004	NA	0.00009	0.00009	0.00009	0.0009
2005	0.002	0.00002	0.0002	NA	0.00005	0.00005	0.00005	0.0005
2006	0.001	0.00001	0.0001	NA	0.00002	0.00002	0.00002	0.0002
2007	0.001	0.00001	0.0001	NA	0.00002	0.00002	0.00002	0.0002
2008	0.003	0.00003	0.0003	NA	0.00006	0.00006	0.00006	0.0006
2009	0.002	0.00002	0.0002	NA	0.00003	0.00003	0.00003	0.0003
trend 1990-2009, %	-89.7	-89.7	-89.7		-89.7	-89.7	-89.7	-89.7

Table 3.27. Emissions from international aviation in 1990-2009 (Cruise), Gg

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	0.369	0.014	0.029	NA	NR	NR	0.006	0.032
1991	0.369	0.014	0.029	NA	NR	NR	0.006	0.032
1992	0.123	0.005	0.010	NA	NR	NR	0.002	0.011
1993	0.194	0.008	0.015	NA	NR	NR	0.003	0.017
1994	0.158	0.006	0.012	NA	NR	NR	0.002	0.014
1995	0.180	0.007	0.014	NA	NR	NR	0.003	0.015
1996	0.145	0.006	0.011	NA	NR	NR	0.002	0.012
1997	0.227	0.009	0.002	NA	NR	NR	0.004	0.020
1998	0.141	0.005	0.011	NA	NR	NR	0.002	0.012
1999	0.223	0.009	0.017	NA	NR	NR	0.003	0.019
2000	0.217	0.008	0.017	NA	0.003	0.003	0.003	0.019
2001	0.152	0.006	0.012	NA	0.002	0.002	0.002	0.013
2002	0.182	0.007	0.014	NA	0.003	0.003	0.003	0.016
2003	0.172	0.007	0.013	NA	0.003	0.003	0.003	0.015
2004	0.290	0.011	0.023	NA	0.005	0.005	0.005	0.025
2005	0.499	0.019	0.040	NA	0.008	0.008	0.008	0.043
2006	0.300	0.012	0.023	NA	0.005	0.005	0.005	0.026
2007	0.509	0.020	0.040	NA	0.008	0.008	0.008	0.044
2008	0.209	0.008	0.016	NA	0.003	0.003	0.003	0.018
2009	0.316	0.012	0.025	NA	0.005	0.005	0.005	0.027
trend 1990-2009, %	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5

3.3.3.2 Methodological issues

Emissions calculations from 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 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 by the corresponding number of LTOs. In order to calculate the domestic and international LTO emissions, the number of LTOs for each aircraft type is multiplied with the respective emissions per LTO.

The cruise energy use is estimated as the difference between the total fuel use from aviation fuel sale statistics (Table 3.30, Figures 3.25, 3.26) and the total calculated LTO fuel use. Fuel-based cruise emission factors are taken from EMEP/EEA guidebook as a single set for an average aircraft (Table 3.29). At last, when given the fuel related cruise emission factors the total domestic and international energy use and emissions can be calculated. All the calculations are made by using 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 from and to 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 is supplied by 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 by two (Figure 3.24).

The methodology needs information of the number of LTO's grouped by representative aircraft types (Table 3.28). This kind of detailed knowledge is hard to obtain (individual aircraft with their specific engines) and therefore data is aggregated level for practical reasons (Figure 3.23). Assumptions are made if there exist missing data 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 based on the *EMEP/EEA* methodology and other referred sources in guidebook (IPCC, FOCA, ICAO engine database etc.).

A complete emission calculation (LTO and cruise emissions for domestic and international flights) has been carried out by EEIC for 1992-2009. There has been done extrapolation for 1990 and 1991.

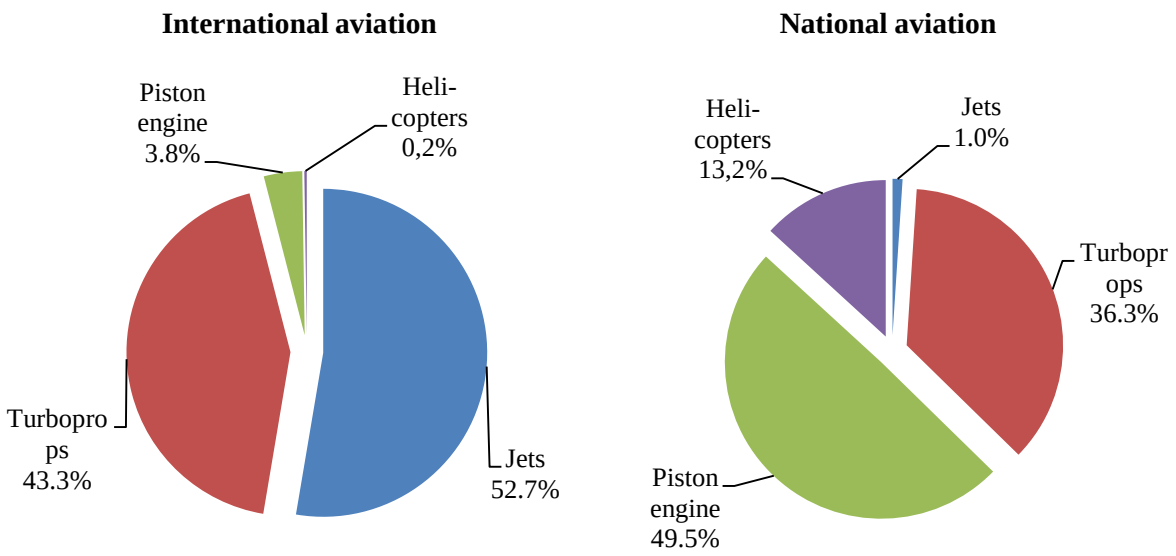

Figure 3.23. The share of different aircraft types in domestic and international civil aviation in 2009

Table 3.28. Emission factors for LTO-cycle (kg/LTO)

	NO_x	NMVOC	SO_2	$PM_{2,5}$	CO	Fuel consumption
Turbofans (Jets)*						
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**						
turboprop, <1000sph/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, >2000sph/engine	1.82	0.26	0.2	0	2.33	200
Piston engine***						
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****						
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
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
UH1	0.36	0.20	0.02	0.01	0.27	41.8

***Turbofans (Jet engine) –** *The original data source for the Large Commercial Aircraft group LTO emissions factors is the EMEP/EEA guidebook (EMEP/EEA air pollutant emission inventory guidebook 2009), the ICAO Engine Exhaust Emissions Data Bank (http://www.dera.gov.uk) and IPCC Guidelines (2006 IPCC Guidelines for National Greenhouse Gas Inventories).*

***Turboprops (Turbojet engine, driving a propeller) -** *This group is represented by three typical aircraft size based on engine shaft horsepower (2006 IPCC Guidelines for National Greenhouse Gas Inventories).*

****Piston engine aircraft** – *This group is represented by four typical aircraft size based on engine horsepower by "Aircraft Piston Engine Emissions Summary Report" (Federal Office of Civil Aviation FOCA) in Estonia's report.*

*****Helicopters** – *Emission factor of helicopters used are taken from "Guidance on the Determination of Helicopter Emissions" (Federal Office of Civil Aviation FOCA).*

Table 3.29. Emission factors for 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 3.30. Fuel consumption in aviation sector (Gg)

	Domestic LTO	Domestic cruise	International LTO	International cruise	Total
1990	0.280	1.520	5.358	28.842	36.000
1991	0.280	1.520	5.358	28.842	36.000
1992	0.094	0.506	1.821	9.579	12.000
1993	0.095	0.805	1.943	15.157	18.000
1994	0.094	0.656	1.917	12.333	15.000
1995	0.148	0.752	3.041	14.059	18.000
1996	0.192	0.608	3.902	11.298	16.000
1997	0.179	0.647	3.657	17.750	22.233
1998	0.196	0.618	3.987	10.987	15.788
1999	0.186	0.647	3.784	17.418	22.035
2000	0.156	0.635	3.634	16.944	21.369
2001	0.174	0.604	3.591	11.842	16.211
2002	0.324	0.478	3.487	14.246	18.535
2003	0.341	0.407	4.145	13.475	18.368
2004	0.273	0.436	5.641	22.650	29.000
2005	0.311	0.236	7.570	38.985	47.102
2006	0.316	0.088	7.526	23.433	31.363
2007	0.300	0.117	9.026	39.731	49.174
2008	0.351	0.278	10.757	16.342	27.728
2009	0.395	0.156	7.362	24.673	32.586

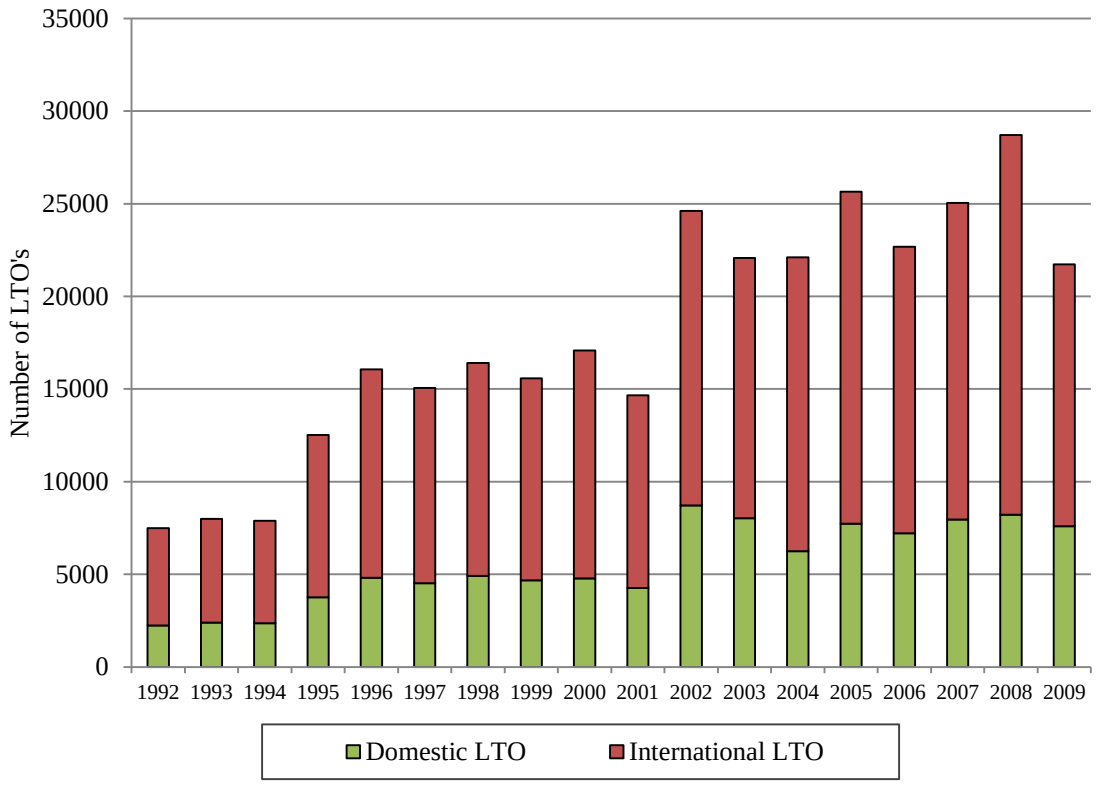

Figure 3.24. Number of LTO-cycles

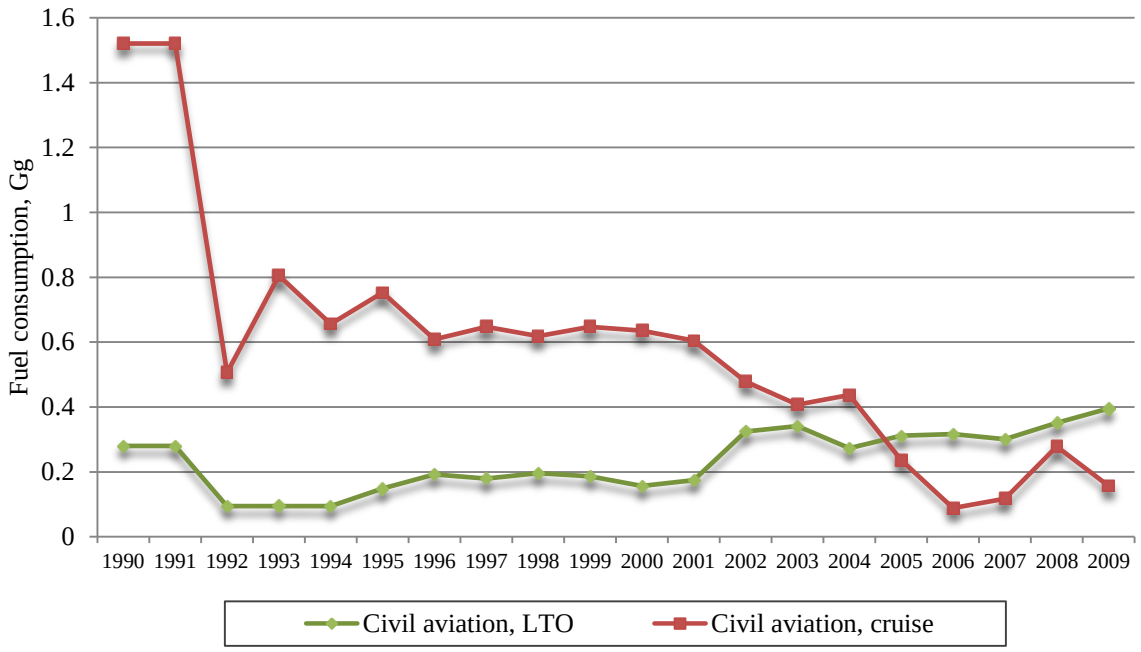

Figure 3.25. Fuel consumption in domestic aviation

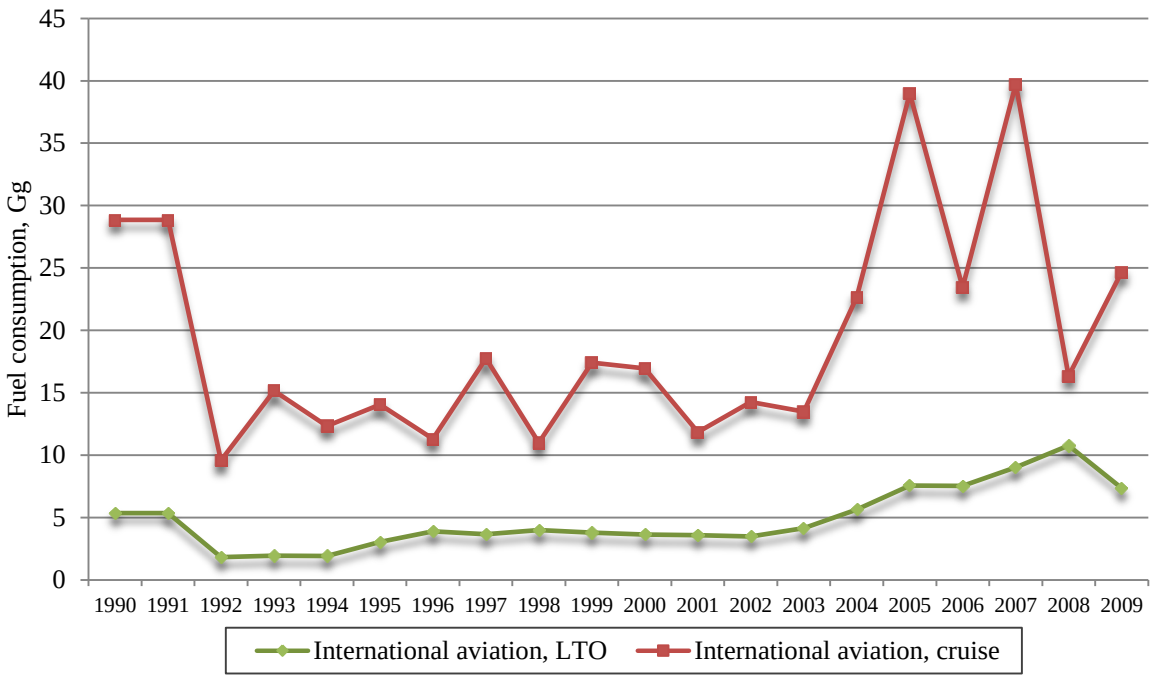

Figure 3.26. Fuel consumption in international aviation

3.3.3.3 Source-specific QA/QC and verification

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

3.3.3.4 Source-specific planned improvements

Uncertainty analysis for aviation sector.

3.3.4 Railways (1.A.3.c)

3.3.4.1 Source category description

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

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 12.3%, 3.6% and 1.3% respectively in transport sector in 2009.

The emissions of NO_x, NMVOC and CO have decreased compared to 1990 by 24.6%, 27.5% and 37.9% respectively and the trend of all the emissions is given in Tables 3.31-33.

Deviations of time series can be explained by changing statistical fuel consumption in railway sector (Figure 3.27).

Recalculations

All the SO_2 emissions are recalculated for period 1990-2008. Recalculations concern mainly using corrected sulphur contents in fuel. An overview of updated data is given in Chapter 10.

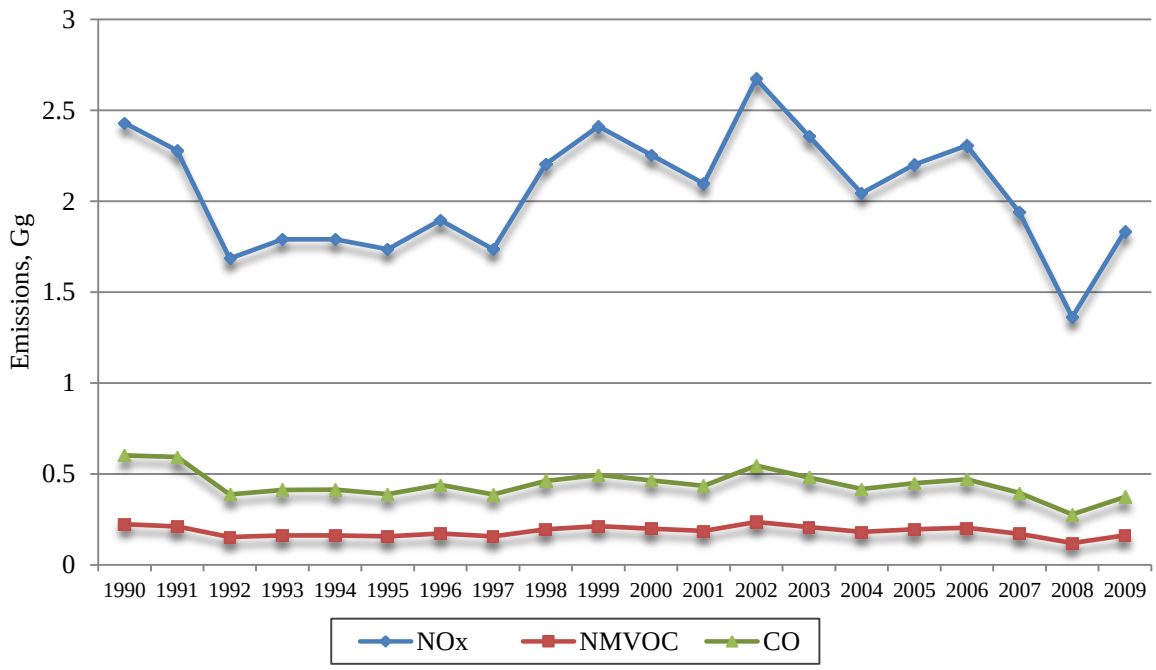

Figure 3.27. NO_x, NMVOC and CO emissions from railways sector

Table 3.31. Emissions from railway transport in 1990-2009 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	2.431	0.224	0.567	0.0003	NR	NR	0.085	0.603
1991	2.278	0.213	0.559	0.0003	NR	NR	0.083	0.593
1992	1.685	0.153	0.364	0.0002	NR	NR	0.055	0.388
1993	1.791	0.163	0.388	0.0002	NR	NR	0.058	0.413
1994	1.791	0.163	0.390	0.0002	NR	NR	0.059	0.415
1995	1.736	0.157	0.365	0.0002	NR	NR	0.055	0.389
1996	1.897	0.173	0.413	0.0003	NR	NR	0.062	0.440
1997	1.736	0.157	0.363	0.0002	NR	NR	0.055	0.388
1998	2.203	0.197	0.433	0.0003	NR	NR	0.066	0.462
1999	2.411	0.214	0.463	0.0003	NR	NR	0.070	0.495
2000	2.254	0.200	0.429	0.0003	0.060	0.063	0.066	0.466
2001	2.097	0.187	0.056	0.0003	0.056	0.059	0.062	0.435
2002	2.673	0.237	0.199	0.0004	0.070	0.074	0.078	0.547
2003	2.358	0.209	0.170	0.0003	0.062	0.065	0.068	0.482
2004	2.044	0.181	0.153	0.0003	0.053	0.056	0.059	0.417
2005	2.201	0.195	0.168	0.0003	0.058	0.060	0.064	0.449
2006	2.306	0.205	0.168	0.0003	0.060	0.063	0.067	0.471

2007	1.939	0.172	0.121	0.0003	0.051	0.053	0.056	0.396
2008	1.362	0.121	0.050	0.0002	0.036	0.037	0.040	0.278
2009	1.834	0.163	0.050	0.0002	0.048	0.050	0.053	0.375
trend 1990-2009, %	-24.6	-27.5	-91.1	-23.9	-19.5	-19.5	-37.2	-37.9

Table 3.32. Emissions of heavy metals from railway transport 1990-2009 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	0.016	0.0007	0.0009	0.0005	0.004	0.080	0.005	0.0007	0.070
1991	0.019	0.0007	0.0011	0.0006	0.004	0.076	0.005	0.0007	0.072
1992	0.007	0.0004	0.0004	0.0002	0.002	0.055	0.003	0.0004	0.042
1993	0.007	0.0004	0.0004	0.0002	0.002	0.059	0.003	0.0004	0.045
1994	0.007	0.0004	0.0004	0.0002	0.002	0.059	0.003	0.0004	0.045
1995	0.005	0.0004	0.0003	0.0002	0.002	0.057	0.003	0.0004	0.041
1996	0.008	0.0005	0.0005	0.0002	0.003	0.062	0.003	0.0005	0.048
1997	0.005	0.0004	0.0003	0.0001	0.002	0.057	0.003	0.0004	0.040
1998	0.002	0.0004	0.0001	0.0001	0.002	0.072	0.003	0.0004	0.045
1999	0.000	0.0005	0.0000	0.0000	0.002	0.078	0.003	0.0005	0.047
2000	0.001	0.0004	0.0000	0.0000	0.002	0.073	0.003	0.0004	0.044
2001	0.001	0.0004	0.0001	0.0000	0.002	0.068	0.003	0.0004	0.042
2002	0.000	0.0005	0.0000	0.0000	0.003	0.087	0.004	0.0005	0.051
2003	0.000	0.0005	0.0000	0.0000	0.002	0.077	0.003	0.0005	0.045
2004	0.000	0.0004	0.0000	0.0000	0.002	0.066	0.003	0.0004	0.039
2005	0.000	0.0004	0.0000	0.0000	0.002	0.071	0.003	0.0004	0.042
2006	0.000	0.0004	0.0000	0.0000	0.002	0.075	0.003	0.0004	0.044
2007	0.000	0.0004	0.0000	0.0000	0.002	0.063	0.003	0.0004	0.037
2008	0.000	0.0003	0.0000	0.0000	0.001	0.044	0.002	0.0003	0.026
2009	0.000	0.0004	0.0000	0.0000	0.002	0.060	0.002	0.0004	0.035
trend 1990-2009, %	-100.0	-48.1	-100	-100	-55.2	-25.9	-48.6	-48.1	-49.9

Table 3.33. Emissions of POPs from railway transport in 1990-2009

	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	Mg	Mg	Mg	Mg	kg	kg	kg
1990	0.024	0.007	0.009	0.004	0.003	0.023	0.000	NA	NA
1991	0.029	0.008	0.011	0.005	0.003	0.026	0.000	NA	NA
1992	0.010	0.003	0.004	0.002	0.001	0.011	0.000	NA	NA
1993	0.011	0.003	0.005	0.002	0.001	0.012	0.000	NA	NA
1994	0.011	0.004	0.005	0.002	0.001	0.012	0.000	NA	NA
1995	0.008	0.003	0.004	0.002	0.001	0.010	0.000	NA	NA
1996	0.012	0.004	0.005	0.003	0.001	0.013	0.000	NA	NA
1997	0.008	0.003	0.004	0.002	0.001	0.009	0.000	NA	NA
1998	0.003	0.002	0.003	0.002	0.001	0.007	0.000	NA	NA
1999	0.001	0.002	0.002	0.002	0.000	0.006	0.000	NA	NA
2000	0.001	0.002	0.003	0.002	0.000	0.006	0.000	NA	NA
2001	0.002	0.002	0.002	0.002	0.000	0.006	0.000	NA	NA

2002	0.000	0.002	0.003	0.002	0.000	0.006	0.000	NA	NA
2003	0.000	0.001	0.002	0.002	0.000	0.006	0.000	NA	NA
2004	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	NA
2005	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	NA
2006	0.000	0.001	0.002	0.002	0.000	0.005	0.000	NA	NA
2007	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	NA
2008	0.000	0.001	0.001	0.001	0.000	0.003	0.000	NA	NA
2009	0.000	0.001	0.002	0.001	0.000	0.004	0.000	NA	NA
trend 1990-2009, %	-100.0	-84.5	-81.2	-72.7	-89.2	-81.4	-100		

3.3.4.2 Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions of railway transport sector are calculated by multiplying the statistical fuel consumption (Table 3.38) by respective emission factors. Default emission factors for main pollutants and heavy metals are taken from "*EMEP/EEA air pollutant emission inventory guidebook 2009*" and are presented in Tables 3.34-36.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.38) by emission factors (Table 3.37). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely 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 3.34. Emission factors for railway transport

Fuel	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
	kg/t	kg/t	kg/t	kg/t	kg/t	kg/t	kg/t	kg/t
Light fuel oil/ Diesel	52.4	4.65	equation	0.007	1.37	1.44	1.52	10.7
	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ
Coal	173	88.8	900	-	108	117	124	931

Table 3.35. Emission factors for heavy metals

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

Table 3.36. Emission factors for POPs

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

Table 3.37. Sulphur content of fuel (by weight)

Fuel	1990-1999	2000	2001-2002	2003	2004	2005	2006-2008	2009
Light fuel oil	0.5%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%	0.2%
Diesel	0.5%	0.5%	0.05%	0.035%	0.030%	0.005%	0.004%	0.001%

Table 3.38. Fuel consumption in railway sector (Gg)

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

3.3.4.3 Source-specific QA/QC and verification

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

3.3.4.4 Source-specific planned improvements

Uncertainty analysis for railway sector.

Railway sector emission recalculations based on Tier 2 methodology. The improvements to be carried out in the inventory methodology will depend on how detailed information is possible to get 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 small emission source in transport sector. The share of navigation transport into total transport emissions in 2009 were: NO_x – 2.0 %, NMVOC – 1.3%, CO – 0.5%. Detailed emission data is provided in tables 3.39-41.

Deviations of time series can be explained by changing statistical fuel consumption in national navigation sector (Figure 3.28).

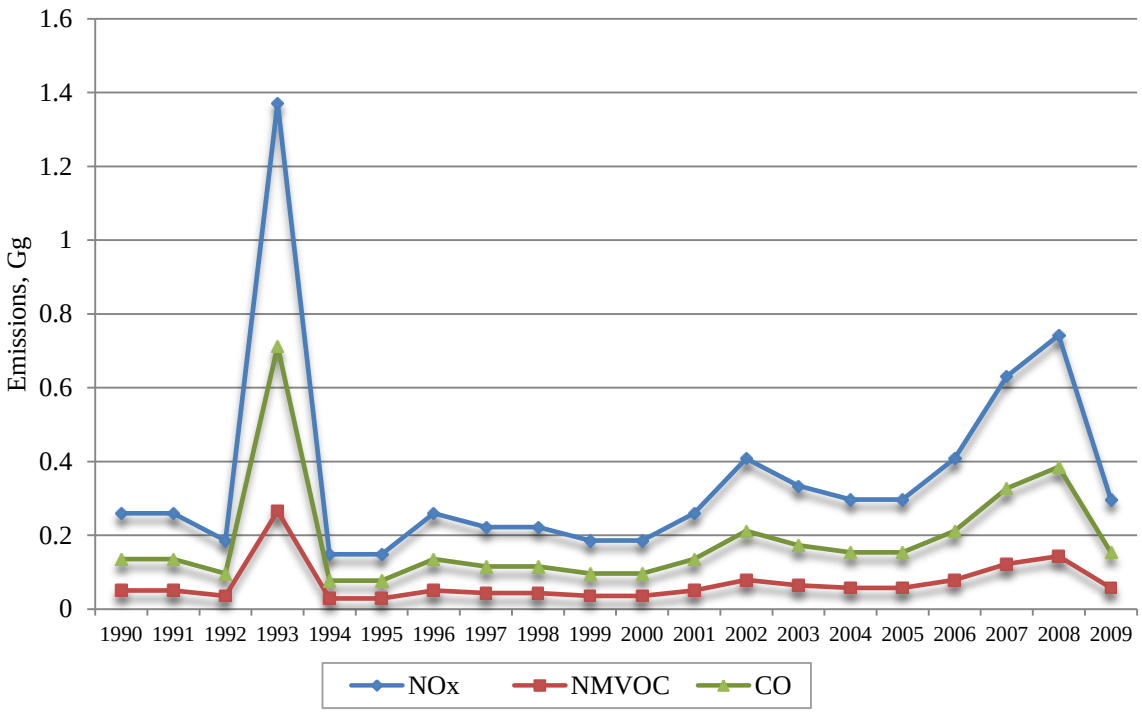

Figure 3.28. NO_x, NMVOC and CO emissions from national navigation sector

Table 3.39. Emissions from national navigation (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	0.260	0.050	0.070	0.00005	NR	NR	0.031	0.135
1991	0.260	0.050	0.070	0.00005	NR	NR	0.031	0.135
1992	0.185	0.036	0.050	0.00004	NR	NR	0.022	0.096
1993	1.372	0.266	0.370	0.00026	NR	NR	0.164	0.712
1994	0.148	0.029	0.040	0.00003	NR	NR	0.018	0.077

1995	0.148	0.029	0.040	0.00003	NR	NR	0.018	0.077
1996	0.260	0.050	0.070	0.00005	NR	NR	0.031	0.135
1997	0.223	0.043	0.060	0.00004	NR	NR	0.027	0.115
1998	0.223	0.043	0.060	0.00004	NR	NR	0.027	0.115
1999	0.185	0.036	0.050	0.00004	NR	NR	0.022	0.096
2000	0.185	0.036	0.020	0.00004	0.022	0.022	0.022	0.096
2001	0.260	0.050	0.028	0.00005	0.031	0.031	0.031	0.135
2002	0.408	0.079	0.044	0.00008	0.049	0.049	0.049	0.212
2003	0.334	0.065	0.036	0.00006	0.040	0.040	0.040	0.173
2004	0.297	0.057	0.032	0.00006	0.035	0.035	0.035	0.154
2005	0.297	0.057	0.032	0.00006	0.035	0.035	0.035	0.154
2006	0.408	0.079	0.044	0.00008	0.049	0.049	0.049	0.212
2007	0.630	0.122	0.068	0.00012	0.075	0.075	0.075	0.327
2008	0.742	0.144	0.080	0.00014	0.088	0.088	0.088	0.385
2009	0.297	0.057	0.032	0.00006	0.035	0.035	0.035	0.154
trend 1990-2009, %	14.3	14.3	-54.3	14.3	60.0	60.0	14.3	14.3

Table 3.40. Emissions of heavy metals from national navigation (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	NA	0.0001	NA	NA	0.0004	0.012	0.0005	0.0001	0.007
1991	NA	0.0001	NA	NA	0.0004	0.012	0.0005	0.0001	0.007
1992	NA	0.0001	NA	NA	0.0003	0.009	0.0004	0.0001	0.005
1993	NA	0.0004	NA	NA	0.0019	0.063	0.0026	0.0004	0.037
1994	NA	0.0000	NA	NA	0.0002	0.007	0.0003	0.0000	0.004
1995	NA	0.0000	NA	NA	0.0002	0.007	0.0003	0.0000	0.004
1996	NA	0.0001	NA	NA	0.0004	0.012	0.0005	0.0001	0.007
1997	NA	0.0001	NA	NA	0.0003	0.010	0.0004	0.0001	0.006
1998	NA	0.0001	NA	NA	0.0003	0.010	0.0004	0.0001	0.006
1999	NA	0.0001	NA	NA	0.0003	0.009	0.0004	0.0001	0.005
2000	NA	0.0001	NA	NA	0.0003	0.009	0.0004	0.0001	0.005
2001	NA	0.0001	NA	NA	0.0004	0.012	0.0005	0.0001	0.007
2002	NA	0.0001	NA	NA	0.0006	0.019	0.0008	0.0001	0.011
2003	NA	0.0001	NA	NA	0.0005	0.015	0.0006	0.0001	0.009
2004	NA	0.0001	NA	NA	0.0004	0.014	0.0006	0.0001	0.008
2005	NA	0.0001	NA	NA	0.0004	0.014	0.0006	0.0001	0.008
2006	NA	0.0001	NA	NA	0.0006	0.019	0.0008	0.0001	0.011
2007	NA	0.0002	NA	NA	0.0009	0.029	0.0012	0.0002	0.017
2008	NA	0.0002	NA	NA	0.0010	0.034	0.0014	0.0002	0.020
2009	NA	0.0001	NA	NA	0.0004	0.014	0.0006	0.0001	0.008
trend 1990-2009, %		14.3			14.3	14.3	14.3	14.3	14.3

Table 3.41. 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	Mg	Mg	Mg	Mg	kg	kg	kg
1990	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
1991	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
1992	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
1993	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1994	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
1995	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
1996	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
1997	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
1998	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
1999	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
2000	NA	0.000	0.000	NA	NA	0.000	NA	NA	NA
2001	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
2002	NA	0.000	0.001	NA	NA	0.001	NA	NA	NA
2003	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
2004	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
2005	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
2006	NA	0.000	0.001	NA	NA	0.001	NA	NA	NA
2007	NA	0.001	0.001	NA	NA	0.001	NA	NA	NA
2008	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2009	NA	0.000	0.000	NA	NA	0.001	NA	NA	NA
trend 1990-2009, %		14.3	14.3			14.3			

3.3.5.2 Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions of national navigation sector are calculated by multiplying the statistical fuel consumption (Table 3.45) by respective emission factors. Default emission factors for main pollutants are taken from "*EMEP/EEA air pollutant emission inventory guidebook 2009"* and are presented in Tables 3.42-43.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.45) by emission factors (Table 3.44). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely 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 3.42. 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 3.43. Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t	g/t	g/t	g/t	g/t	g/t	mg/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 3.44. Sulphur content of fuel (by weight)

	1990-1999	2000-2009
Light fuel oil/ Diesel	0.5%	0.2%

Table 3.45. Fuel consumption in 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

3.3.5.3 Source-specific QA/QC and verification

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

3.3.5.4 Source-specific planned improvements

Uncertainty analysis for national navigation sector.

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

3.3.6 Commercial/Institutional mobile (1.A.4.a.ii)

3.3.6.1 Source category description

Commercial and institutional land-based mobile machinery contribute small share to total emissions of transport sector. Military sector is also included under this sector.

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 1.9%, 4.7% and 1.9% respectively in transport sector in 2009. The trend of all the emissions is given in Tables 3.46-48.

Deviations of time series can be explained by changing statistical fuel consumption in commercial/institutional sector (Figure 3.29).

Recalculations

All the emissions are recalculated for period 1990-2008 because of corrected statistical fuel consumption which includes military sector. An overview of updated data is given in Chapter 10.

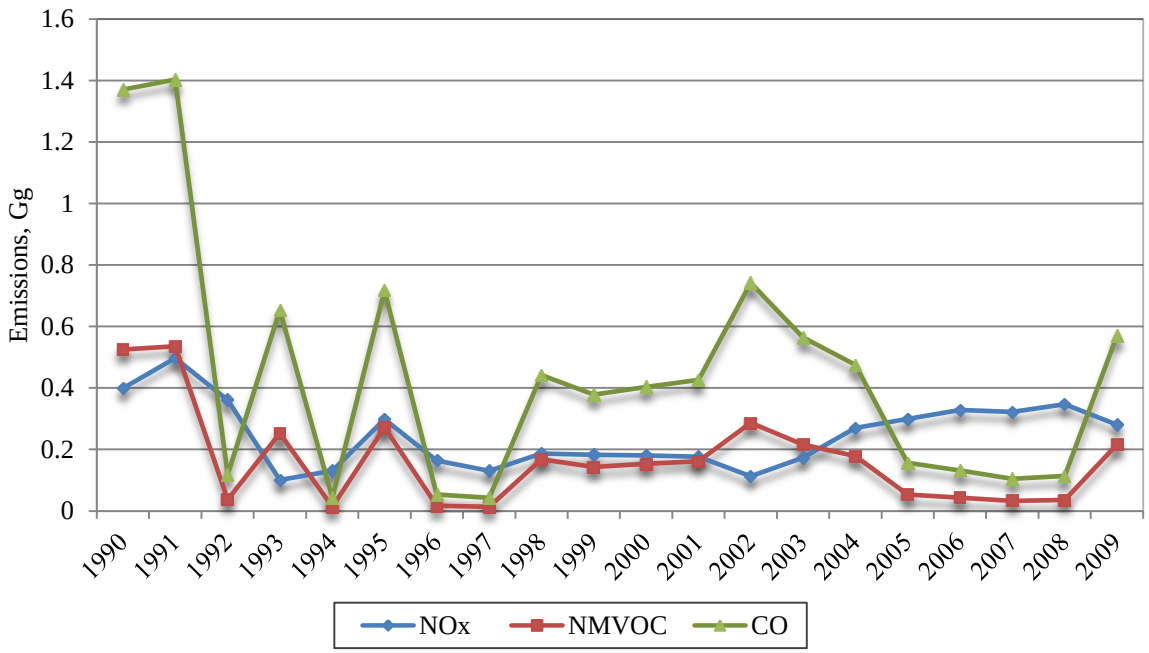

Figure 3.29. NO_x, NMVOC and CO emissions from commercial/institutional sector

Table 3.46. Emissions from commercial/institutional sector (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	0.399	0.525	0.124	0.0001	NR	NR	0.033	1.370
1991	0.497	0.535	0.154	0.0001	NR	NR	0.039	1.402
1992	0.361	0.037	0.110	0.0001	NR	NR	0.023	0.118
1993	0.101	0.252	0.032	0.0000	NR	NR	0.010	0.653
1994	0.131	0.014	0.040	0.0000	NR	NR	0.008	0.043
1995	0.298	0.273	0.092	0.0001	NR	NR	0.023	0.717
1996	0.164	0.017	0.050	0.0000	NR	NR	0.010	0.054
1997	0.131	0.014	0.040	0.0000	NR	NR	0.008	0.043
1998	0.187	0.168	0.058	0.0000	NR	NR	0.014	0.442
1999	0.183	0.143	0.057	0.0000	NR	NR	0.013	0.378
2000	0.181	0.153	0.056	0.0000	0.014	0.014	0.014	0.404
2001	0.177	0.162	0.006	0.0000	0.013	0.013	0.013	0.426
2002	0.113	0.287	0.004	0.0000	0.011	0.011	0.011	0.742
2003	0.173	0.216	0.004	0.0000	0.014	0.014	0.014	0.565
2004	0.270	0.179	0.005	0.0001	0.019	0.019	0.019	0.475
2005	0.299	0.054	0.001	0.0001	0.019	0.019	0.019	0.156
2006	0.328	0.043	0.001	0.0001	0.021	0.021	0.021	0.132
2007	0.322	0.033	0.001	0.0001	0.020	0.020	0.020	0.105
2008	0.347	0.036	0.001	0.0001	0.022	0.022	0.022	0.114
2009	0.280	0.216	0.000	0.0001	0.021	0.021	0.021	0.570
trend 1990-2009, %	-29.7	-58.9	-99.9	-31.2	52.6	52.6	-36.7	-58.4

Table 3.47. Heavy metals from commercial/institutional sector (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	0.300	0.0001	NA	NA	0.001	0.024	0.001	0.0001	0.014
1991	0.300	0.0002	NA	NA	0.001	0.029	0.001	0.0002	0.017
1992	0.000	0.0001	NA	NA	0.001	0.019	0.001	0.0001	0.011
1993	0.150	0.0000	NA	NA	0.000	0.007	0.000	0.0000	0.004
1994	0.000	0.0000	NA	NA	0.000	0.007	0.000	0.0000	0.004
1995	0.150	0.0001	NA	NA	0.001	0.017	0.001	0.0001	0.010
1996	0.000	0.0001	NA	NA	0.000	0.009	0.000	0.0001	0.005
1997	0.000	0.0000	NA	NA	0.000	0.007	0.000	0.0000	0.004
1998	0.092	0.0001	NA	NA	0.000	0.011	0.000	0.0001	0.006
1999	0.077	0.0001	NA	NA	0.000	0.010	0.000	0.0001	0.006
2000	0.007	0.0001	NA	NA	0.000	0.010	0.000	0.0001	0.006
2001	0.008	0.0001	NA	NA	0.000	0.010	0.000	0.0001	0.006
2002	0.015	0.0000	NA	NA	0.000	0.008	0.000	0.0000	0.004
2003	0.011	0.0001	NA	NA	0.000	0.010	0.000	0.0001	0.006
2004	0.003	0.0001	NA	NA	0.000	0.015	0.001	0.0001	0.009
2005	0.000	0.0001	NA	NA	0.000	0.016	0.001	0.0001	0.009

2006	0.000	0.0001	NA	NA	0.001	0.017	0.001	0.0001	0.010
2007	0.000	0.0001	NA	NA	0.000	0.017	0.001	0.0001	0.010
2008	0.000	0.0001	NA	NA	0.001	0.018	0.001	0.0001	0.011
2009	0.004	0.0001	NA	NA	0.000	0.016	0.001	0.0001	0.009
trend 1990-2009, %	-98.7	-33.9			-33.9	-33.9	-33.9	-33.9	-33.9

Table 3.48. POPs from commercial/institutional sector

	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	Mg	Mg	Mg	Mg	kg	kg	kg
1990	NA	0.0004	0.0007	NA	NA	0.0011	NA	NA	NA
1991	NA	0.0005	0.0008	NA	NA	0.0014	NA	NA	NA
1992	NA	0.0003	0.0006	NA	NA	0.0009	NA	NA	NA
1993	NA	0.0001	0.0002	NA	NA	0.0003	NA	NA	NA
1994	NA	0.0001	0.0002	NA	NA	0.0003	NA	NA	NA
1995	NA	0.0003	0.0005	NA	NA	0.0008	NA	NA	NA
1996	NA	0.0002	0.0003	NA	NA	0.0004	NA	NA	NA
1997	NA	0.0001	0.0002	NA	NA	0.0003	NA	NA	NA
1998	NA	0.0002	0.0003	NA	NA	0.0005	NA	NA	NA
1999	NA	0.0002	0.0003	NA	NA	0.0005	NA	NA	NA
2000	NA	0.0002	0.0003	NA	NA	0.0005	NA	NA	NA
2001	NA	0.0002	0.0003	NA	NA	0.0005	NA	NA	NA
2002	NA	0.0001	0.0002	NA	NA	0.0004	NA	NA	NA
2003	NA	0.0002	0.0003	NA	NA	0.0005	NA	NA	NA
2004	NA	0.0003	0.0004	NA	NA	0.0007	NA	NA	NA
2005	NA	0.0003	0.0005	NA	NA	0.0007	NA	NA	NA
2006	NA	0.0003	0.0005	NA	NA	0.0008	NA	NA	NA
2007	NA	0.0003	0.0005	NA	NA	0.0008	NA	NA	NA
2008	NA	0.0003	0.0005	NA	NA	0.0008	NA	NA	NA
2009	NA	0.0003	0.0005	NA	NA	0.0007	NA	NA	NA
trend 1990-2009, %		-35.1	-33.1			-33.9			

3.3.6.2 Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions of commercial and institutional sector are calculated by multiplying the statistical fuel consumption (Table 3.51) by respective emission factors. Default emission factors for main pollutants are taken from *"EMEP/EEA air pollutant emission inventory guidebook 2009"*.

Emissions of SO_2 and Pb are dependent on fuel consumption and fuel type. SO_2 and Pb emissions are calculated by multiplying statistical fuel use (Table 3.51) by emission factors (Table 3.18, 3.19). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely into SO_2. Equation:

$$E_{SO2} = 2 \text{ x } k \text{ x } FC$$

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

$$E_{Pb} = 0.75 \text{ x } k \text{ x } FC$$

Table 3.49. Emission factors for commercial and institutional sector (kg/t)

	NO_x	NMVOC	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
Diesel	32.792	3.385	0.008	2.086	2.086	2.086	10.722
Gasoline	2.765	242.197	0.003	3.762	3.762	3.762	620.793

Table 3.50. Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t	g/t	g/t	g/t	g/t	g/t	mg/t	mg/t
Diesel	0.01	0.05	1.7	0.07	0.01	1	0.04	0.04
Gasoline	0.01	0.05	1.7	0.07	0.01	1	0.03	0.05

Table 3.51. Fuel consumption in commercial and institutional sector (Gg)

	Gasoline	Diesel
1990	12	2
1991	15	2
1992	11	0
1993	3	1
1994	4	0
1995	9	1
1996	5	0
1997	4	0
1998	5.65	0.61
1999	5.54	0.51
2000	5.47	0.56
2001	5.36	0.59
2002	3.34	1.14
2003	5.22	0.82
2004	8.18	0.62
2005	9.11	0.09
2006	9.99	0.04
2007	9.81	0.00
2008	10.59	0.00
2009	8.49	0.77

3.3.6.3 Source-specific QA/QC and verification

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

3.3.6.4 Source-specific planned improvements

Uncertainty analysis for commercial/institutional sector.

3.3.7 Household and gardening mobile (1.A.4.b.ii)

3.3.7.1 Source category description

Household and gardening sector includes various machinery which has small influence to total emissions in transport sector.

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 0.3%, 11.3% and 9.5% respectively in transport sector in 2009. The trend of all the emissions is given in Tables 3.52-54.

Deviations of time series can be explained by changing statistical fuel consumption in household and gardening sector (Figure 3.30).

Recalculations

All the SO_2 and Pb emissions are recalculated for period 1990-2008. An overview of updated data is given in Chapter 10.

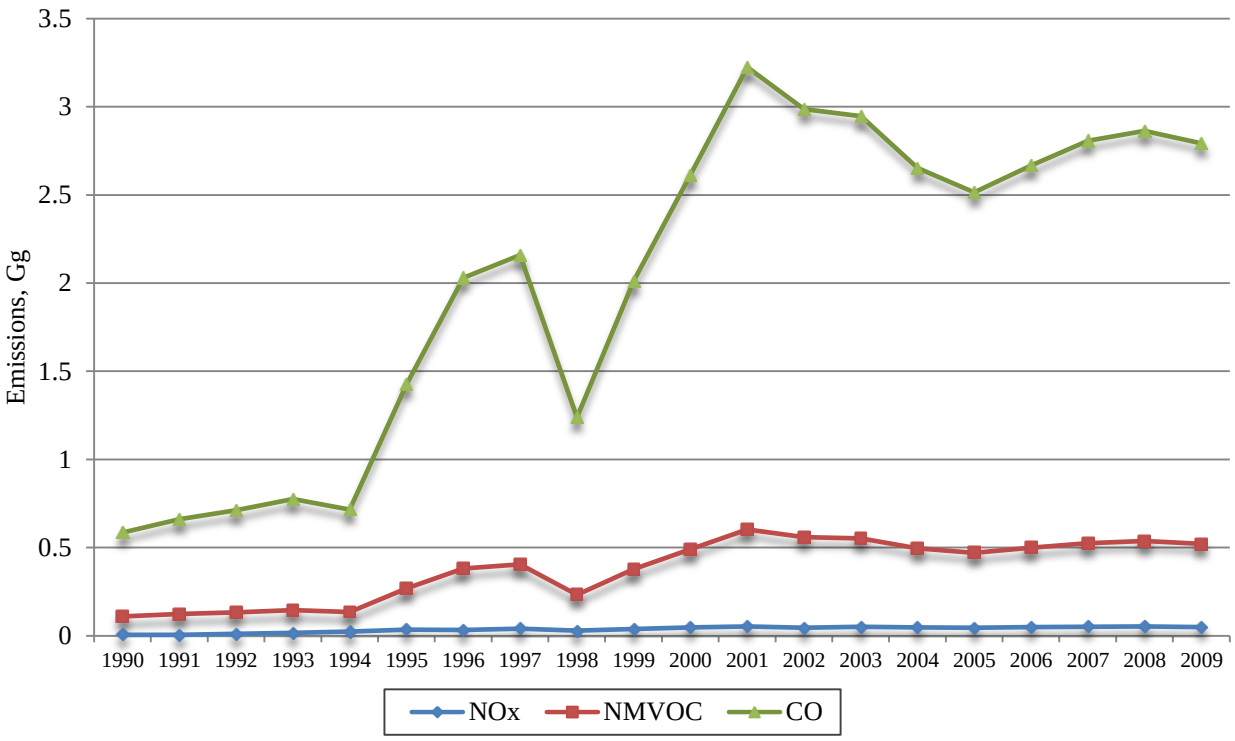

Figure 3.30. NO_x, NMVOC and CO emissions from household and gardening sector

Table 3.52. Emissions from household and gardening sector

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	0.006	0.109	0.0022	0.00000	NR	NR	0.002	0.585
1991	0.005	0.123	0.0019	0.00000	NR	NR	0.002	0.661
1992	0.010	0.133	0.0034	0.00000	NR	NR	0.002	0.711
1993	0.015	0.145	0.0052	0.00001	NR	NR	0.003	0.775
1994	0.023	0.134	0.0075	0.00001	NR	NR	0.003	0.715
1995	0.035	0.268	0.0116	0.00001	NR	NR	0.006	1.427
1996	0.032	0.380	0.0112	0.00001	NR	NR	0.007	2.030
1997	0.040	0.404	0.0137	0.00002	NR	NR	0.008	2.157
1998	0.028	0.232	0.0094	0.00001	NR	NR	0.005	1.237
1999	0.038	0.377	0.0130	0.00002	NR	NR	0.007	2.011
2000	0.047	0.489	0.0163	0.00002	0.009	0.009	0.009	2.611
2001	0.052	0.603	0.0055	0.00002	0.011	0.011	0.011	3.223
2002	0.045	0.558	0.0050	0.00002	0.010	0.010	0.010	2.985
2003	0.050	0.551	0.0019	0.00002	0.010	0.010	0.010	2.945
2004	0.046	0.496	0.0015	0.00002	0.009	0.009	0.009	2.652
2005	0.045	0.470	0.0004	0.00002	0.009	0.009	0.009	2.513
2006	0.048	0.499	0.0001	0.00002	0.009	0.009	0.009	2.667
2007	0.051	0.525	0.0001	0.00002	0.010	0.010	0.010	2.806
2008	0.052	0.536	0.0001	0.00002	0.010	0.010	0.010	2.862
2009	0.049	0.520	0.0001	0.00002	0.010	0.010	0.010	2.792
trend 1990-2009, %	739.7	375.5	375.5	529.9	5.6	5.6	-99.99	377.4

Table 3.53. Emissions of heavy metals from household and gardening sector (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	0.126	0.00001	NA	NA	0.0000	0.002	0.0001	0.00001	0.001
1991	0.143	0.00001	NA	NA	0.0000	0.002	0.0001	0.00001	0.001
1992	0.153	0.00001	NA	NA	0.0001	0.002	0.0001	0.00001	0.001
1993	0.167	0.00001	NA	NA	0.0001	0.002	0.0001	0.00001	0.001
1994	0.153	0.00002	NA	NA	0.0001	0.003	0.0001	0.00002	0.002
1995	0.306	0.00003	NA	NA	0.0001	0.005	0.0002	0.00003	0.003
1996	0.437	0.00003	NA	NA	0.0002	0.006	0.0002	0.00003	0.003
1997	0.464	0.00004	NA	NA	0.0002	0.007	0.0003	0.00004	0.004
1998	0.266	0.00002	NA	NA	0.0001	0.004	0.0002	0.00002	0.002
1999	0.432	0.00004	NA	NA	0.0002	0.006	0.0003	0.00004	0.004
2000	0.049	0.00005	NA	NA	0.0002	0.008	0.0003	0.00005	0.005
2001	0.060	0.00006	NA	NA	0.0003	0.009	0.0004	0.00006	0.006
2002	0.056	0.00005	NA	NA	0.0003	0.009	0.0004	0.00005	0.005
2003	0.055	0.00005	NA	NA	0.0003	0.009	0.0004	0.00005	0.005
2004	0.019	0.00005	NA	NA	0.0002	0.008	0.0003	0.00005	0.005
2005	0.018	0.00004	NA	NA	0.0002	0.008	0.0003	0.00004	0.004

2006	0.019	0.00005	NA	NA	0.0002	0.008	0.0003	0.00005	0.005
2007	0.020	0.00005	NA	NA	0.0002	0.008	0.0003	0.00005	0.005
2008	0.021	0.00005	NA	NA	0.0003	0.009	0.0004	0.00005	0.005
2009	0.020	0.00004	NA	NA	0.0002	0.007	0.0003	0.00004	0.004
trend 1990-2009, %	-84.0	349.5			349.5	349.5	349.5	349.5	349.5

Table 3.54. Emissions of POPs from household and gardening sector

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCBs
	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
1990	NA	0.00004	0.00004	NA	NA	0.0001	NA	NA	NA
1991	NA	0.00004	0.00004	NA	NA	0.0001	NA	NA	NA
1992	NA	0.00005	0.00005	NA	NA	0.0001	NA	NA	NA
1993	NA	0.00005	0.00006	NA	NA	0.0001	NA	NA	NA
1994	NA	0.00006	0.00007	NA	NA	0.0001	NA	NA	NA
1995	NA	0.00010	0.00012	NA	NA	0.0002	NA	NA	NA
1996	NA	0.00013	0.00014	NA	NA	0.0003	NA	NA	NA
1997	NA	0.00015	0.00016	NA	NA	0.0003	NA	NA	NA
1998	NA	0.00009	0.00010	NA	NA	0.0002	NA	NA	NA
1999	NA	0.00014	0.00015	NA	NA	0.0003	NA	NA	NA
2000	NA	0.00018	0.00019	NA	NA	0.0004	NA	NA	NA
2001	NA	0.00021	0.00023	NA	NA	0.0004	NA	NA	NA
2002	NA	0.00019	0.00021	NA	NA	0.0004	NA	NA	NA
2003	NA	0.00020	0.00021	NA	NA	0.0004	NA	NA	NA
2004	NA	0.00018	0.00019	NA	NA	0.0004	NA	NA	NA
2005	NA	0.00017	0.00019	NA	NA	0.0004	NA	NA	NA
2006	NA	0.00018	0.00020	NA	NA	0.0004	NA	NA	NA
2007	NA	0.00019	0.00021	NA	NA	0.0004	NA	NA	NA
2008	NA	0.00019	0.00021	NA	NA	0.0004	NA	NA	NA
2009	NA	0.00016	0.00016	NA	NA	0.0003	NA	NA	NA
trend 1990-2009, %		355.9	343.3			349.5			

3.3.7.2 Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions of households sector are calculated by multiplying the statistical fuel consumption (Table 3.57) by respective emission factors. Default emission factors for main pollutants are taken from *EMEP/EEA air pollutant emission inventory guidebook 2009* and are presented in Table 3.55-56.

Emissions of SO_2 and Pb are dependent on fuel consumption and fuel type. SO_2 and Pb emissions are calculated by multiplying statistical fuel use (Table 3.57) by emission factors (Table 3.18, 3.19). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely into SO_2.

Equation:

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

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

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

The fuel consumption from household and gardening sector is calculated by following principle: 1% of statistical final consumption in households is actually consumed in household and gardening sector for period 1990-1994, 1.5% for period 1995-1999 and 2% for period 2000-2008.

Therefore fuel consumption is continuously increasing and this leads to increase of emissions.

Table 3.55. Emission factors for households sector (kg/t)

	NO_x	NMVOC	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
Diesel	32.792	3.385	0.008	2.086	2.086	2.086	10.722
Gasoline: two-stroke	7.117	17.602	0.004	0.157	0.157	0.157	770.368
Gasoline: four-stroke	2.765	242.197	0.003	3.762	3.762	3.762	620.793

Table 3.56. Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t	g/t	g/t	g/t	g/t	g/t	mg/t	mg/t
Diesel	0.01	0.05	1.7	0.07	0.01	1	0.04	0.04
Gasoline	0.01	0.05	1.7	0.07	0.01	1	0.03	0.05

Table 3.57. Fuel consumption in household and gardening sector (Gg)

	Gasoline	Diesel
1990	0.84	0.05
1991	0.95	0.00
1992	1.02	0.14
1993	1.11	0.30
1994	1.02	0.55
1995	2.04	0.75
1996	2.91	0.54
1997	3.09	0.75
1998	1.77	0.59
1999	2.88	0.72
2000	3.74	0.88
2001	4.62	0.88
2002	4.28	0.72
2003	4.22	0.90
2004	3.80	0.84
2005	3.60	0.82
2006	3.82	0.90
2007	4.02	0.94
2008	4.10	0.96
2009	4.00	0.88

3.3.7.3 Source-specific QA/QC and verification

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

3.3.7.4 Source-specific planned improvements

Uncertainty analysis for household and gardening sector.

3.3.8 Agriculture/Forestry/Fishing: Off-road vehicles and other machinery (1.A.4.c.ii)

3.3.8.1 Source category description

Agricultural sector includes off-road vehicles and other machinery used in agriculture/forestry (agricultural tractors, harvesters, combines etc.). The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 13.7%, 4.3% and 2.2% respectively in transport sector in 2009.

The emissions of NO_x, NMVOC and CO have decreased approximately 53% compared to 1990. Detailed emission data is provided in Tables 3.58-60.

Deviations of time series can be explained by changing statistical fuel consumption in agricultural sector (Figure 3.31).

Recalculations

All the emissions are recalculated for period 1990-2008. Recalculations concern mainly using new emission factors for railway sector. An overview of updated data is given in Chapter 10.

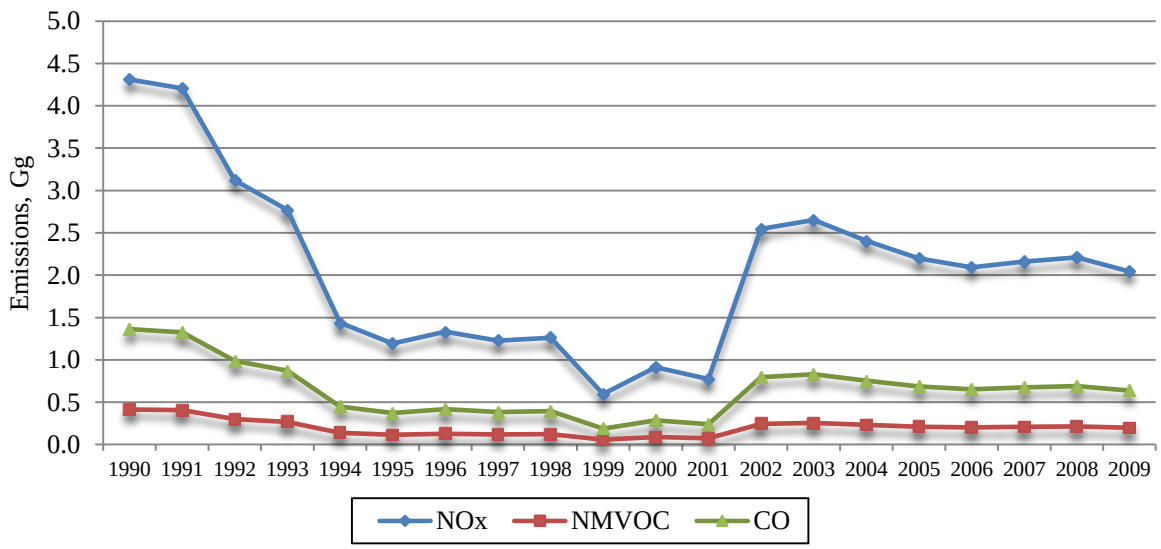

Figure 3.31. NO_x, NMVOC and CO emissions from agricultural sector.

Table 3.58. Emissions from agricultural sector (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	4.310	0.414	1.278	0.001	NR	NR	0.214	1.364
1991	4.205	0.404	1.232	0.001	NR	NR	0.209	1.325
1992	3.119	0.300	0.924	0.001	NR	NR	0.155	0.987
1993	2.768	0.266	0.804	0.001	NR	NR	0.137	0.870
1994	1.437	0.138	0.412	0.000	NR	NR	0.071	0.449
1995	1.191	0.114	0.342	0.000	NR	NR	0.059	0.373
1996	1.332	0.128	0.384	0.000	NR	NR	0.066	0.417
1997	1.227	0.118	0.354	0.000	NR	NR	0.061	0.384
1998	1.262	0.121	0.364	0.000	NR	NR	0.063	0.395
1999	0.596	0.057	0.172	0.000	NR	NR	0.030	0.187
2000	0.911	0.088	0.190	0.000	0.045	0.045	0.045	0.285
2001	0.771	0.074	0.062	0.000	0.038	0.038	0.038	0.241
2002	2.545	0.244	0.204	0.001	0.126	0.126	0.126	0.795
2003	2.649	0.255	0.155	0.001	0.131	0.131	0.131	0.829
2004	2.405	0.231	0.122	0.001	0.119	0.119	0.119	0.753
2005	2.196	0.211	0.091	0.001	0.109	0.109	0.109	0.686
2006	2.093	0.201	0.070	0.001	0.104	0.104	0.104	0.653
2007	2.159	0.207	0.066	0.001	0.107	0.107	0.107	0.675
2008	2.210	0.212	0.072	0.001	0.110	0.110	0.110	0.690
2009	2.044	0.196	0.022	0.001	0.101	0.101	0.101	0.638
trend 1990-2009, %	-52.6	-52.6	-98.3	-52.6	124.3	124.3	-52.6	-53.2

Table 3.59. Emissions of heavy metals from agricultural sector (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	3.600	0.001	NA	NA	0.006	0.209	0.009	0.001	0.123
1991	2.400	0.001	NA	NA	0.006	0.204	0.008	0.001	0.120
1992	2.550	0.001	NA	NA	0.004	0.151	0.006	0.001	0.089
1993	1.050	0.001	NA	NA	0.004	0.134	0.006	0.001	0.079
1994	0.150	0.000	NA	NA	0.002	0.070	0.003	0.000	0.041
1995	0.150	0.000	NA	NA	0.002	0.058	0.002	0.000	0.034
1996	0.300	0.000	NA	NA	0.002	0.065	0.003	0.000	0.038
1997	0.300	0.000	NA	NA	0.002	0.060	0.002	0.000	0.035
1998	0.300	0.000	NA	NA	0.002	0.061	0.003	0.000	0.036
1999	0.150	0.000	NA	NA	0.001	0.029	0.001	0.000	0.017
2000	0.013	0.000	NA	NA	0.001	0.044	0.002	0.000	0.026
2001	0.013	0.000	NA	NA	0.001	0.037	0.002	0.000	0.022
2002	0.013	0.001	NA	NA	0.004	0.123	0.005	0.001	0.073
2003	0.026	0.001	NA	NA	0.004	0.129	0.005	0.001	0.076
2004	0.015	0.001	NA	NA	0.003	0.117	0.005	0.001	0.069

2005	0.000	0.001	NA	NA	0.003	0.107	0.004	0.001	0.063
2006	0.000	0.001	NA	NA	0.003	0.102	0.004	0.001	0.060
2007	0.005	0.001	NA	NA	0.003	0.105	0.004	0.001	0.062
2008	0.000	0.001	NA	NA	0.003	0.107	0.004	0.001	0.063
2009	0.000	0.001	NA	NA	0.003	0.099	0.004	0.001	0.058
trend 1990-2009, %	-100.0	-52.6			-52.6	-52.6	-52.6	-52.6	-52.6

Table 3.60. Emissions POPs from agricultural sector

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCBs
	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
1990	NA	0.004	0.006	NA	NA	0.010	NA	NA	NA
1991	NA	0.004	0.006	NA	NA	0.010	NA	NA	NA
1992	NA	0.003	0.004	NA	NA	0.007	NA	NA	NA
1993	NA	0.002	0.004	NA	NA	0.006	NA	NA	NA
1994	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1995	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1996	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1997	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1998	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1999	NA	0.001	0.001	NA	NA	0.001	NA	NA	NA
2000	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2001	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2002	NA	0.002	0.004	NA	NA	0.006	NA	NA	NA
2003	NA	0.002	0.004	NA	NA	0.006	NA	NA	NA
2004	NA	0.002	0.003	NA	NA	0.005	NA	NA	NA
2005	NA	0.002	0.003	NA	NA	0.005	NA	NA	NA
2006	NA	0.002	0.003	NA	NA	0.005	NA	NA	NA
2007	NA	0.002	0.003	NA	NA	0.005	NA	NA	NA
2008	NA	0.002	0.003	NA	NA	0.005	NA	NA	NA
2009	NA	0.002	0.003	NA	NA	0.005	NA	NA	NA
trend 1990-2009, %		-52.6	-52.6			-52.6			

All the emission calculations are based on the Tier 1 method. Emissions of agricultural sector are calculated by multiplying the statistical fuel consumption (Table 3.63) by respective emission factors. Default emission factors for main pollutants are taken from "*EMEP/EEA air pollutant emission inventory guidebook 2009"* and are presented in Table 3.61-62.

Emissions of SO_2 and Pb are dependent on fuel consumption and fuel type. SO_2 and Pb emissions are calculated by multiplying statistical fuel use (Table 3.63) by emission factors (Table 3.18, 3.19, 3.37). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely into SO_2.

Equation:

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

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

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

Table 3.61. Emission factors for agricultural machinery (kg/t)

	NO_x	NMVOC	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
Diesel oil/ Light fuel oil	35.043	3.366	0.008	1.738	1.738	1.738	10.939
Gasoline	7.117	17.602	0.004	0.157	0.157	0.157	770.37

Table 3.62. Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t	g/t	g/t	g/t	g/t	g/t	mg/t	mg/t
Diesel oil/ Light fuel oil	0.01	0.05	1.7	0.07	0.01	1	0.03	0.05
Gasoline	0.01	0.05	1.7	0.07	0.01	1	0.04	0.04

Table 3.63. Fuel consumption in agricultural sector (Gg)

	Gasoline	Diesel	Light fuel oil
1990	24	9	114
1991	16	8	112
1992	17	7	82
1993	7	6	73
1994	1	4	37
1995	1	3	31
1996	2	4	34
1997	2	3	32
1998	2	5	31
1999	1	4	13
2000	1	12	14
2001	1	13	9
2002	1	43.62	29
2003	2	30.61	45
2004	3	23.64	45
2005	0	21.67	41
2006	0	16.73	43
2007	1	15.62	46
2008	0	17.07	46
2009	0	5.32	53

3.3.8.2 Source-specific QA/QC and verification

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

3.3.8.3 Source-specific planned improvements

Uncertainty analysis for agricultural sector.

Separate 1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery and 1.A.4.c.iii Agriculture/Forestry/Fishing: National fishing, which is aggregated into one sector in 2011 submission. The improvements to be carried out in the inventory methodology will depend on how detailed information is possible to get from Statistics Estonia.

3.3.9 Mobile Combustion in manufacturing industries and construction Industrial machinery (1.A.2.f.ii)

3.3.9.1 Source category description

Industrial machinery sector includes mobile combustion in manufacturing industries and construction land-based mobile machinery. The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 5.5%, 1.8% and 0.9% respectively in transport sector in 2009.

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have decreased compared to 1990 approximately by 85%. Detailed emission data is provided in Tables 3.64-66.

Deviations of time series can be explained by changing statistical fuel consumption in industrial sector (Figure 3.32).

Recalculations

All the emissions are recalculated for period 1990-2008. Recalculations concern mainly using new emission factors for industrial machinery sector. An overview of updated data is given in Chapter 10.

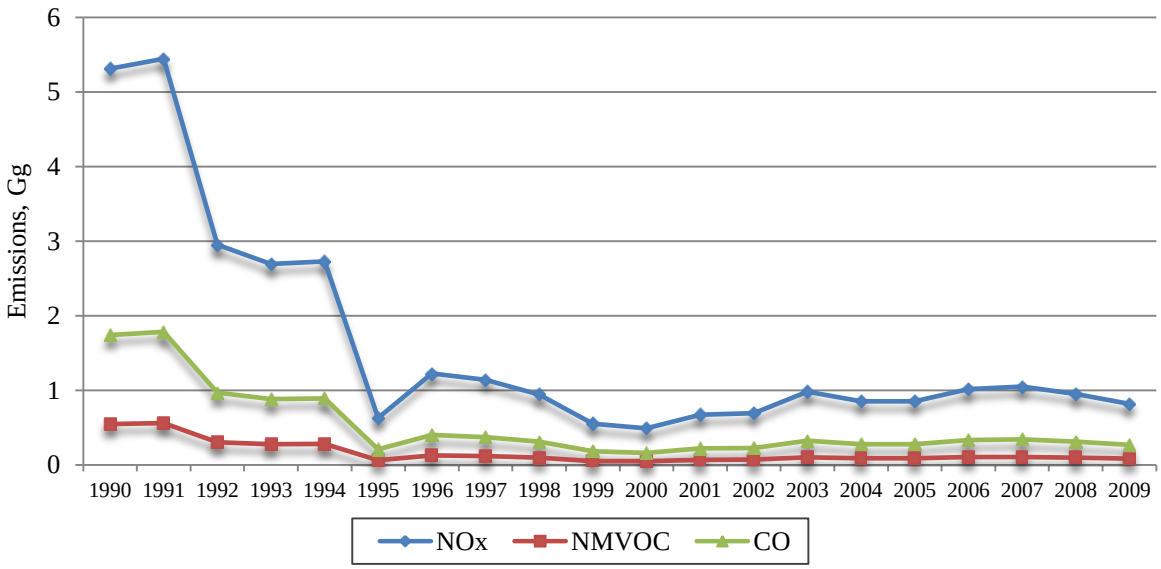

Figure 3.32. NO_x, NMVOC and CO emissions from industrial sector

Table 3.64. Emissions from industrial machinery sector (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	5.312	0.548	1.632	0.0013	NR	NR	0.338	1.742
1991	5.444	0.562	1.668	0.0013	NR	NR	0.346	1.783
1992	2.951	0.305	0.906	0.0007	NR	NR	0.188	0.967
1993	2.692	0.278	0.827	0.0007	NR	NR	0.171	0.883
1994	2.728	0.282	0.834	0.0007	NR	NR	0.174	0.893
1995	0.631	0.065	0.195	0.0002	NR	NR	0.040	0.207
1996	1.225	0.126	0.376	0.0003	NR	NR	0.078	0.401
1997	1.142	0.118	0.350	0.0003	NR	NR	0.073	0.374
1998	0.945	0.098	0.292	0.0002	NR	NR	0.060	0.310
1999	0.554	0.057	0.171	0.0001	NR	NR	0.035	0.182
2000	0.491	0.051	0.128	0.0001	0.031	0.031	0.031	0.161
2001	0.673	0.069	0.055	0.0002	0.043	0.043	0.043	0.220
2002	0.696	0.072	0.047	0.0002	0.044	0.044	0.044	0.228
2003	0.982	0.101	0.032	0.0002	0.062	0.062	0.062	0.324
2004	0.853	0.088	0.016	0.0002	0.054	0.054	0.054	0.280
2005	0.853	0.088	0.003	0.0002	0.054	0.054	0.054	0.280
2006	1.017	0.105	0.003	0.0002	0.065	0.065	0.065	0.333
2007	1.049	0.108	0.003	0.0003	0.067	0.067	0.067	0.344
2008	0.951	0.098	0.002	0.0002	0.060	0.060	0.060	0.311
2009	0.820	0.085	0.001	0.0002	0.052	0.052	0.052	0.269
trend 1990-2009, %	-84.6	-84.6	-99.97	-84.6	67.0	67.0	-84.6	-84.6

Table 3.65. Emissions of heavy metals from industrial machinery sector (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	0.900	0.002	NA	NA	0.008	0.275	0.011	0.002	0.162
1991	0.600	0.002	NA	NA	0.008	0.282	0.012	0.002	0.166
1992	0.450	0.001	NA	NA	0.005	0.153	0.006	0.001	0.090
1993	0.450	0.001	NA	NA	0.004	0.140	0.006	0.001	0.082
1994	0.150	0.001	NA	NA	0.004	0.141	0.006	0.001	0.083
1995	0.150	0.000	NA	NA	0.001	0.033	0.001	0.000	0.019
1996	0.150	0.000	NA	NA	0.002	0.064	0.003	0.000	0.037
1997	0.150	0.000	NA	NA	0.002	0.059	0.002	0.000	0.035
1998	0.300	0.000	NA	NA	0.001	0.049	0.002	0.000	0.029
1999	0.150	0.000	NA	NA	0.001	0.029	0.001	0.000	0.017
2000	0.013	0.000	NA	NA	0.001	0.025	0.001	0.000	0.015
2001	0.000	0.000	NA	NA	0.001	0.035	0.001	0.000	0.021
2002	0.013	0.000	NA	NA	0.001	0.036	0.001	0.000	0.021
2003	0.052	0.000	NA	NA	0.001	0.051	0.002	0.000	0.030
2004	0.005	0.000	NA	NA	0.001	0.044	0.002	0.000	0.026
2005	0.005	0.000	NA	NA	0.001	0.044	0.002	0.000	0.026

2006	0.005	0.000	NA	NA	0.002	0.053	0.002	0.000	0.031
2007	0.005	0.000	NA	NA	0.002	0.054	0.002	0.000	0.032
2008	0.000	0.000	NA	NA	0.001	0.049	0.002	0.000	0.029
2009	0.005	0.000	NA	NA	0.001	0.043	0.002	0.000	0.025
trend 1990-2009, %	-99.4	-84.6			-84.6	-84.6	-84.6	-84.6	-84.6

Table 3.66. Emissions of POPs from industrial machinery sector

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCBs
	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
1990	NA	0.005	0.008	NA	NA	0.013	NA	NA	NA
1991	NA	0.005	0.008	NA	NA	0.013	NA	NA	NA
1992	NA	0.003	0.005	NA	NA	0.007	NA	NA	NA
1993	NA	0.002	0.004	NA	NA	0.007	NA	NA	NA
1994	NA	0.002	0.004	NA	NA	0.007	NA	NA	NA
1995	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
1996	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1997	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
1998	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
1999	NA	0.001	0.001	NA	NA	0.001	NA	NA	NA
2000	NA	0.000	0.001	NA	NA	0.001	NA	NA	NA
2001	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2002	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2003	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2004	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2005	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2006	NA	0.001	0.002	NA	NA	0.002	NA	NA	NA
2007	NA	0.001	0.002	NA	NA	0.003	NA	NA	NA
2008	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
2009	NA	0.001	0.001	NA	NA	0.002	NA	NA	NA
trend 1990-2009, %		-84.6	-84.6			-84.6			

3.3.9.2 Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions of industrial machinery are calculated by multiplying the statistical fuel consumption (Table 3.69) by respective emission factors. Default emission factors for main pollutants are taken from "EMEP/EEA air pollutant emission inventory guidebook 2009" and are presented in Table 3.67-68.

Emissions of SO_2 and Pb are dependent on fuel consumption and fuel type. SO_2 and Pb emissions are calculated by multiplying statistical fuel use (Table 3.69) by emission factors (Table 3.18, 3.19, 3.37). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely into SO_2.

Equation:

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

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

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

Table 3.67. Emission factors for industrial machinery sector (kg/t)

	NO_x	NMVOC	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
Diesel	32.792	3.385	0.008	2.086	2.086	2.086	10.722
Gasoline	7.117	17.602	0.004	0.157	0.157	0.157	770.37

Table 3.68. Emission factors for heavy metals and PAHs

	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f
	g/t	g/t	g/t	g/t	g/t	g/t	mg/t	mg/t
Diesel oil/ Light fuel oil	0.01	0.05	1.7	0.07	0.01	1	0.03	0.05
Gasoline	0.01	0.05	1.7	0.07	0.01	1	0.04	0.04

Table 3.69. Fuel consumption in industrial machinery sector (Gg)

	Gasoline	Diesel	Light fuel oil
1990	6	162	0
1991	4	166	0
1992	3	90	0
1993	3	82	0.10
1994	1	83	0.18
1995	1	19	0.26
1996	1	37	0.35
1997	1	34	0.84
1998	2	26	2.81
1999	1	13	3.88
2000	1	11	3.97
2001	0	9	11.52
2002	1	13	8.23
2003	4	27	2.96
2004	1	26	0
2005	1	26	0
2006	1	31	0
2007	1	32	0
2008	0	29	0
2009	1	25	0

3.3.9.3 Source-specific QA/QC and verification

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

3.3.9.4 Source-specific planned improvements

Uncertainty analysis for industrial sector.

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

3.3.10.1 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 item and are not included in the national totals.

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have increased approximately 29% compared to 1990. Detailed emission data is provided in Tables 3.70-72.

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

Recalculations

All the emissions are recalculated for period 1990-2008. Recalculations concern mainly using new emission factors for industrial machinery sector. An overview of updated data is given in Chapter 10.

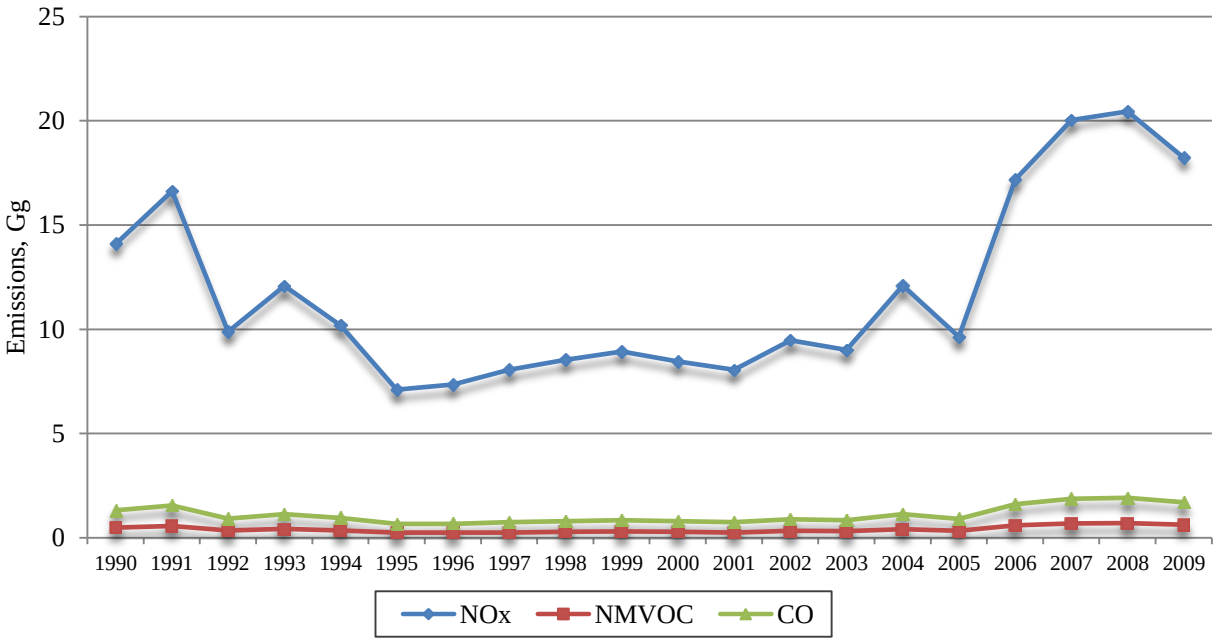

Figure 3.33. NO_x, NMVOC and CO emissions from international navigation sector

Table 3.70. Emissions from 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	NA	NR	NR	0.977	1.317
1991	16.627	0.570	9.888	NA	NR	NR	1.147	1.554
1992	9.878	0.342	4.858	NA	NR	NR	0.573	0.925
1993	12.075	0.420	5.094	NA	NR	NR	0.610	1.132
1994	10.179	0.355	4.150	NA	NR	NR	0.499	0.955
1995	7.105	0.247	3.100	NA	NR	NR	0.370	0.666
1996	7.347	0.255	3.482	NA	NR	NR	0.412	0.688
1997	8.064	0.279	4.144	NA	NR	NR	0.487	0.755
1998	8.540	0.295	4.512	NA	NR	NR	0.529	0.799
1999	8.931	0.309	4.474	NA	NR	NR	0.527	0.836
2000	8.452	0.293	3.678	NA	0.423	0.466	0.466	0.792
2001	8.053	0.280	3.258	NA	0.382	0.421	0.421	0.755
2002	9.477	0.329	4.030	NA	0.466	0.514	0.514	0.888
2003	9.005	0.312	3.956	NA	0.454	0.500	0.500	0.844
2004	12.093	0.418	5.762	NA	0.647	0.714	0.714	1.132
2005	9.639	0.334	4.338	NA	0.494	0.545	0.545	0.903
2006	17.172	0.590	5.340	NA	1.026	1.134	1.134	1.606
2007	20.038	0.686	6.784	NA	1.287	1.423	1.423	1.872
2008	20.443	0.699	7.220	NA	1.361	1.506	1.506	1.909
2009	18.227	0.623	6.510	NA	1.225	1.356	1.356	1.702
trend 1990-2009, %	29.3	28.8	-22.7		189.7	190.9	38.8	29.2

Table 3.71. Emissions of heavy metals from international maritime navigation sector (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	0.050	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
trend 1990-2009, %	32.5	35.3	24.0	41.5	41.3	32.7	41.9	35.6	29.2

Table 3.72. Emissions of POPs from international maritime navigation

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCBs
	g I-Teq	Mg	Mg	Mg	Mg	Mg	kg	kg	kg
1990	0.074	NE	NE	NE	NE	NE	0.023	NA	0.087
1991	0.087	NE	NE	NE	NE	NE	0.027	NA	0.102
1992	0.044	NE	NE	NE	NE	NE	0.015	NA	0.048
1993	0.047	NE	NE	NE	NE	NE	0.017	NA	0.049
1994	0.039	NE	NE	NE	NE	NE	0.014	NA	0.039
1995	0.029	NE	NE	NE	NE	NE	0.010	NA	0.030
1996	0.032	NE	NE	NE	NE	NE	0.011	NA	0.034
1997	0.037	NE	NE	NE	NE	NE	0.012	NA	0.042
1998	0.041	NE	NE	NE	NE	NE	0.013	NA	0.046
1999	0.041	NE	NE	NE	NE	NE	0.014	NA	0.045
2000	0.036	NE	NE	NE	NE	NE	0.012	NA	0.039
2001	0.033	NE	NE	NE	NE	NE	0.012	NA	0.034
2002	0.040	NE	NE	NE	NE	NE	0.014	NA	0.042
2003	0.039	NE	NE	NE	NE	NE	0.013	NA	0.042
2004	0.055	NE	NE	NE	NE	NE	0.018	NA	0.061
2005	0.042	NE	NE	NE	NE	NE	0.014	NA	0.046
2006	0.087	NE	NE	NE	NE	NE	0.028	NA	0.100
2007	0.108	NE	NE	NE	NE	NE	0.034	NA	0.128
2008	0.114	NE	NE	NE	NE	NE	0.035	NA	0.136
2009	0.103	NE	NE	NE	NE	NE	0.031	NA	0.123
trend 1990-2009, %	38.3						34.3		41.4

3.3.10.2 Methodological issues

All the emission calculations are based on the Tier 1 method. Emissions of international maritime navigation machinery are calculated by multiplying the statistical fuel consumption (Table 3.76) by respective emission factors. Default emission factors for main pollutants and heavy metals are taken from "EMEP/EEA air pollutant emission inventory guidebook 2009" and are presented in Tables 3.73-74.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 and Pb emissions are calculated by multiplying statistical fuel use (Table 3.76) by emission factors (Table 3.75). SO_2 emissions are estimated by assuming that all sulphur in the fuel is transformed completely into SO_2.

Equation:

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

Table 3.73. Emission factors for 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 3.74. Emission factors for heavy metals and PAHs

	Pb	Cd	Cu	Cr	As	Hg	Ni	Se	Zn	PCDD/F	HCB	PCB's
	g/t	g/t	g/t	g/t	g/t	g/t	g/t	g/t	g/t	TEQµg /t	mg/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	0.57
Marine diesel oil	0.13	0.01	0.88	0.05	0.04	0.03	1	0.1	1.2	0.13	0.08	0.038

Table 3.75. 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 3.76. Fuel consumption in 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

3.3.10.3 Source-specific QA/QC and verification

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

3.3.10.4 Source-specific planned improvements

Uncertainty analysis for international navigation sector.

International maritime navigation recalculations based on detailed activity data. The improvements to be carried out in the inventory methodology will depend on how detailed information is possible to get from ports and Estonian Maritime Administration.

3.4 Fugitive emissions (NFR 1.B)

3.4.4 Overview of the sector

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

Table 3.77. 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
	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 incinetration. Only two point sources data.	NO_x, SO_x, NMVOC, TSP, CO

Emissions of NMVOC from distribution of oil products and natural gas were recalculated this year submission. The reasons of the recalculation given in Chapter 10

NMVOC emission from this sector is contribute in total country emission about 5% and has decrease by 32% comparing with 1990 (Figure 3.34 and Table 3.78). Emissions of other pollutants are very small comparing with other sectors emission.

Figure 3.34

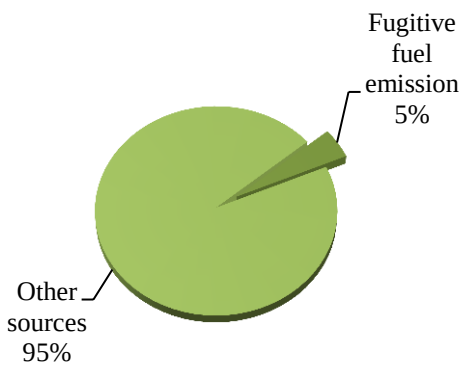

Figure 3.35

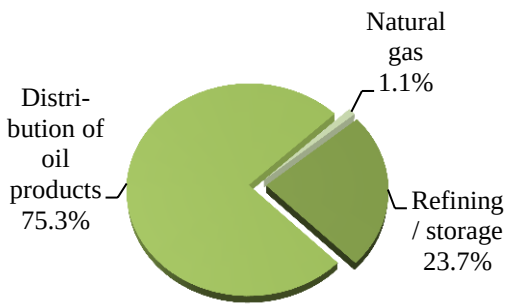

Figure 3.34. NMVOC emission distribution in 2009

Figure 3.35. NMVOC emission distribution inside if fuel fugitive emission sector in 2009

The Figure 3.35 on previous page shows that distribution of oil products is a main source of NMVOC emissions in fuel fugitive emissions sector (75.3%).

Table 3.78. Fugitive emission in 1990-2009

Year	Emissions, 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	2.38	NR	NR	NR				
1999	2.74	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
1990-2009. %	-31.9	518.1	215.3	142.9	256.2	-16.0	790.7	160.1

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 obtain 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

Emissions from this source category have historically contributed significantly to the 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 to 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 their 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[1]. That means only the smallest service stations are considered as diffuse sources. Emissions from oil terminals are based on the facilities data. 21 terminals presented reports on emissions in 2009. In the table below are presented NMVOC emission from gasoline distribution and terminals.

Table 3.79. NMVOC emissions from liquid fuel distribution

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gasoline distribution	2.055	1.82	0.896	0.924	1.124	0.971	1.1	1.199	1.159	1.1
Terminals	0.323	0.323	0.323	0.323	0.418	0.625	0.771	1.483	1.184	1.594
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Gasoline distribution	1.108	1.122	0.856	0.657	0.628	0.467	0.482	0.514	0.508	0.467
Terminals	3.157	4.012	3.645	3.695	3.91	3.199	2.626	1.2	0.629	0.799

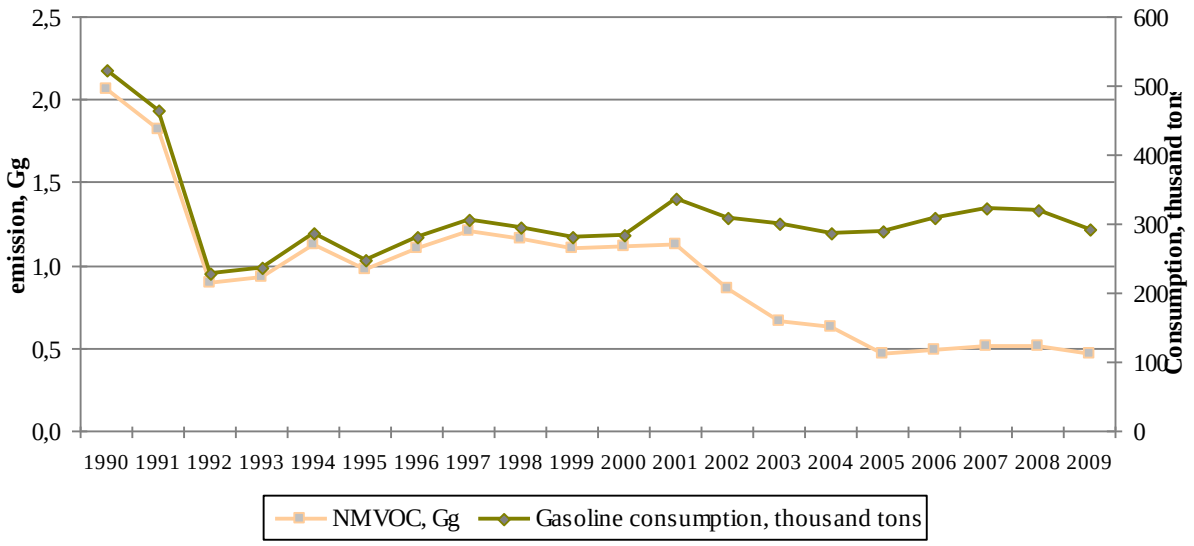

Figure 3.36. NMVOC emission and gasoline distribution

European Directive 94/63/EC has mandated vapour collection and recovery for discharge of tank trucks into storage at service stations (Stage 1.B). In Estonia the regulation on implementation 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 following:

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

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

Most probably the majority of the not-permitted gasoline stations are having turnover from 100 to 2000 m^3. From 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 1990-2004.

Beginning from 2005 emission estimates is used facilities data (about 94% from total gasoline distribution in 2009). Facilities are obligate to use the national method of NMVOC emission calculation Naftasaaduste laadimisel välisõhku eralduvate lenduvate orgaaniliste ühendite heitkoguste määramismeetodid - Elektrooniline Riigi Teataja

For 2005-2009 activity data relating to point sources is available and activity data for emission calculations from diffuse sources is calculated as following:

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

Emission factors for the 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 years 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 years 2005-2009 the Tier 2 technology specific emission factors for Service Stations from EMEP 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 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:

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

The Abatement efficiencies ($\eta_{abatement}$) for source category 1.B.2.a.v Distribution of oil products, Service stations, Storage tank filling from EMEP 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 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[2].

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

Table 3.80. Annual average RVP of gasoline 95 in Estonia in 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.

$$TVP = 74{,}6 \times 10^{(0{,}000007047 \times 74{,}6+0{,}0132)*5+(0{,}0002311 \times 74{,}6-0{,}5236)} = 27{,}2\ kPa$$

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 3.81. 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	37	-	27,2	1006

[2] www.emhi.ee

	controls in operation				
	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 3.82. Consumption of motor gasoline by counties in 1990-2009 (thousand tons)

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

3.4.2.3 Sources-specific QA/QC and verification

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

3.4.2.4 Sources-specific planned improvements

None

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 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.

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 goes through ten counties: Ida-Viru, Lääne-Viru, Harju, Rapla, Jõgeva, Tartu, Põlva, Võru, Viljandi and Pärnu. All counties have gas consumers.

The construction of the natural gas pipeline to the towns of Pärnu and Sindi was completed in 2006. The natural gas pipelines also reached the customers in the County town of Rapla and the town of Püssi.[3]

Table 3.83. NMVOC emission from gas distribution

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NMVOC emissions, Gg	0.096	0.096	0.056	0.028	0.041	0.036	0.04	0.039	0.037	0.036
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
NMVOC emissions, Gg	0.031	0.033	0.028	0.032	0.036	0.028	0.028	0.028	0.027	0.018

[3] Eesti Gaas. Annual Report 2006

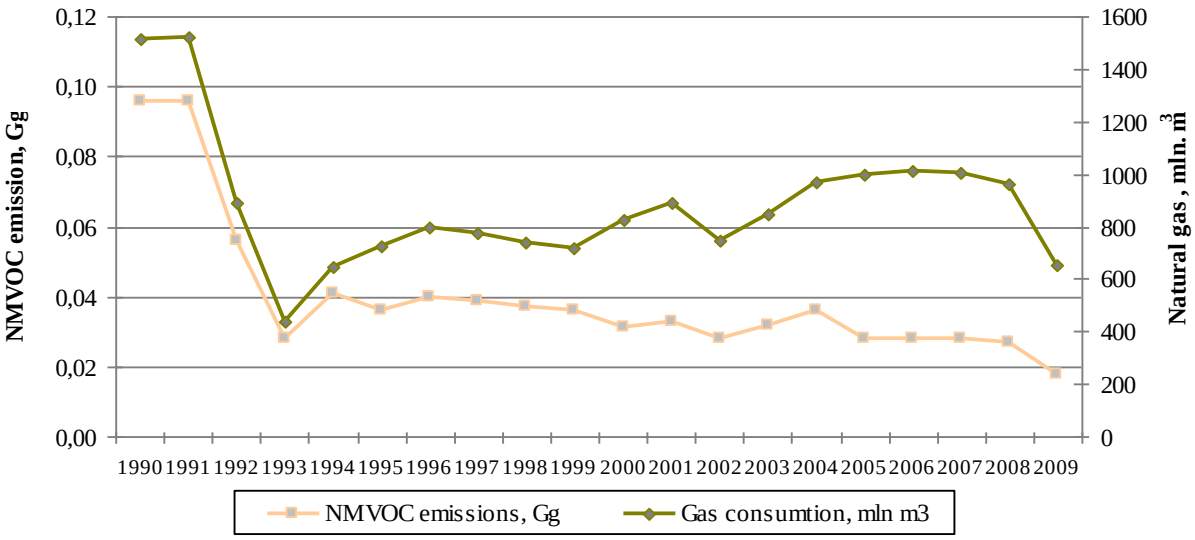

Figure 3.38. NMVOC emission from natural gas distribution

3.4.3.2 Methodological issues

Emission factors

EMEP/EEA air pollutant emission inventory guidebook (2009) does not provide calculations methodology for NMVOC calculations from gas distribution. Therefore IPPC Guidelines for National Greenhouse 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 3.84. 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 3.84. Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations

Category	Sub-category	Emission source	IPCC Code	In developed countries		In 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

Until 2004, the Estonian economy 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 3.85. 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	2005-2008	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 is available from Statistics Estonia.

Table 3.86. Gas consumption

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gas consumtion, mln m^3	1516	1521	890	441	646	723	799	778	738	719
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Gas consumtion, mln m^3	826	887	743	847	966	997	1009	1003	961	653

3.4.3.3 Sources-specific QA/QC and verification

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

3.4.3.4 Sources-specific planned improvements

- 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 paper, wood and chemical industries as well as production of mineral products and food. Compared to the 1990 industry has undergone major changes. Industrial sectors share of total emissions is no longer as significant as it used to be. This is mainly due to decrease of production volume; also some enterprises finished their business (phosphor fertilizers, benzene and toluene).

Until the economic crisis last year the volume of industrial production in Estonia rose again.

Last year production fell 20% in most sectors compared to the year 2008 (Economic survey of Estonia 2009, Ministry of Economic Affairs and Communication, Ministry of Finance. Tallinn 2010).

The Estonian inventory of air pollutants from industrial processes includes presently emissions from chemical-, pulp-, paper-, metal- and mineral products industry 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}, $PM_{2,5}$
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}$5, CO, Cr ,Ni ,Zn
	2.C.3	Aluminum 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}$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 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. electricial 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 sotorage and handling of peat, bulk and etc. Data reported by operators.	NO_X, NMVOC, NH_3, SO_X, TSP, PM_{10}, $PM_{2,5}$, CO,

Emissions data from manufacturing industry are based on the facilities data (Tier 3 method) and only NMVOC emission from food industry and from road paving with asphalt are calculated as diffuse sources on the basis of statistical data and 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 2009 was: TSP – 5.2%, NMVOC –2.4%, PM_{10} – 2.6%. The shares of other pollutants are not so significant. The emissions of NMVOC, NH_3 and NO_x have decreased comparing with 1990 by 94.2%, 84.2% and 69.7% respectively. The trend of the NMVOC and PM emissions of these categories is given in Figure 4.1. The emissions from industrial sector are presented in Table 4.2.

Table 4.2. Pollutants emission from industrial sector in 1990-2009

Year	NO_x	NMVOC	SO_x	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb
	Gg								Mg
1990	0.190	15.335	0.000	0.530	NR	NR	0.940	0.340	0.000
1991	0.100	13.894	0.000	0.460	NR	NR	0.100	0.300	0.000
1992	0.090	9.600	0.000	0.440	NR	NR	0.470	0.300	0.000
1993	0.050	4.405	0.000	0.120	NR	NR	0.150	0.010	0.000
1994	0.190	3.513	0.000	0.220	NR	NR	0.610	0.040	0.000
1995	0.070	4.377	0.000	0.240	NR	NR	0.490	0.000	0.000
1996	0.150	3.191	0.000	0.160	NR	NR	0.280	0.000	0.000
1997	0.150	3.142	0.000	0.120	NR	NR	0.140	0.010	0.000
1998	0.140	2.400	0.000	0.100	NR	NR	0.080	0.020	0.000
1999	0.190	1.457	0.000	0.140	NR	NR	0.180	0.000	0.000
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	0.000
2004	0.360	1.846	0.130	0.120	0.240	0.800	2.279	0.360	0.000
2005	0.180	1.573	0.130	0.200	0.219	0.727	2.053	0.340	0.000
2006	0.270	1.323	0.120	0.150	0.170	0.825	2.199	0.380	0.001
2007	0.250	1.072	0.020	0.131	0.222	0.771	2.211	0.440	0.001
2008	0.298	0.959	0.022	0.175	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
trend 1990-2009, %	-69.699	-94.256		-84.2	70.44	59.0544	33.337	-20.093	

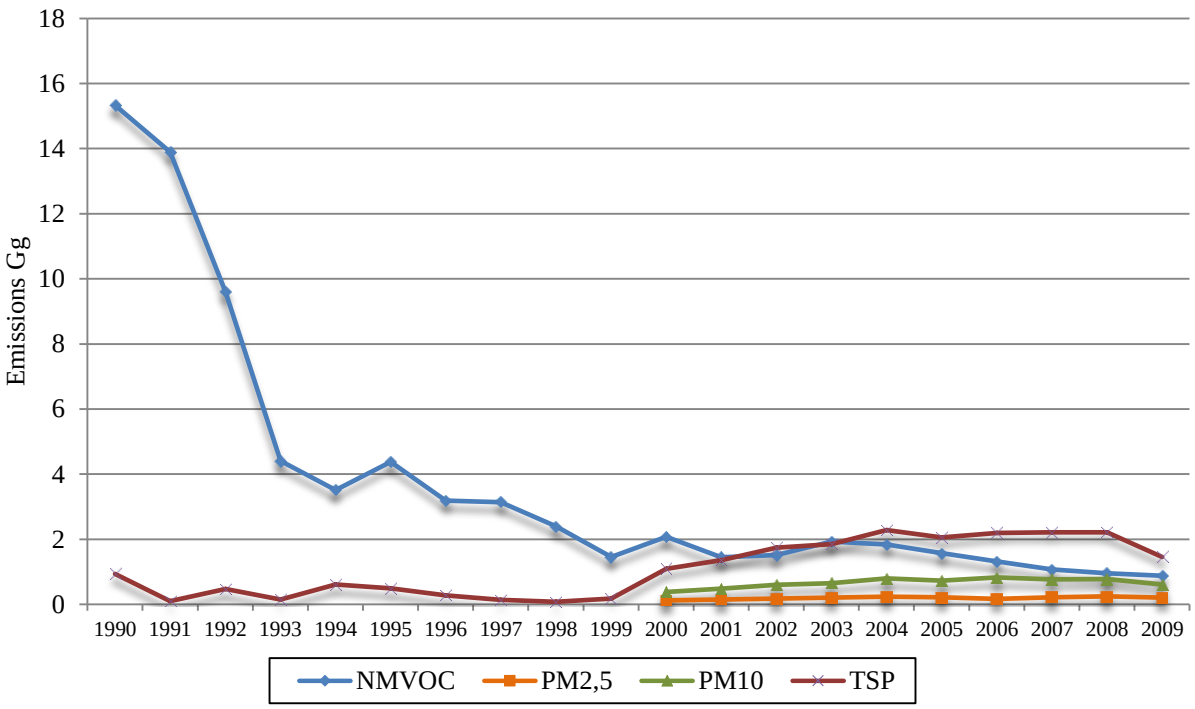

Figure 4.1. NMVOC and PM emissions from industry sector in 1990-2009 (Gg)

The NMVOC emissions in period 1990-2008 were recalculated for food and drink activities. Main reasons for that is renewed Guidebook with new emission factors (EMEP/EEA air pollutant emission inventory guidebook – 2009). An overview of updated data is given in Chapter 10.

At this year submission additionally were calculated NMVOC emissions from road paving with asphalt (2.A.6) in period 1990-2009 and PM_{10} and $PM_{2.5}$ emissions from constructions and demolition (2.A.7.b) in period 2000-2009.

The 2009 emissions from wood and furniture industry were allocated from NFR 2.A.7.d and 2.G and to include in NFR 2.D.3 Wood processing.

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 one enterprise that produces cement is Kunda Nordic Tsement AS. Cement is produced by 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 ºC 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 emission of CO_2, SO_x, NO_x and dust. During the years 1993-2000 cement manufacturing in Kunda was thoroughly renovated. The main goal was to eliminate dust pollution from clinker kilns and cement mills. They were provided with filters required for exhaust cleaning. In 1999 the company closed the local electricity and heat production plant operating on natural gas. (Sustainability report 2007. Kunda Nordic Tsement AS, 2007).

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

Quarrying and mining of minerals in Estonia includes limestone and dolomite extraction and crushed stone production.

The emissions from mineral product industry are presented in Table 4.3.

Table 4.3. Pollutants emission from mineral products in 1990-2009 (Gg)

Year	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.000	0.027			NR	NR	0.000	0.000
1991	0.000	0.023			NR	NR	0.000	0.000
1992	0.000	0.003	0.000	0.000	NR	NR	0.000	0.000
1993	0.000	0.006	0.000	0.000	NR	NR	0.000	0.000
1994	0.000	0.006	0.000	0.000	NR	NR	0.000	0.000
1995	0.000	0.008	0.000	0.000	NR	NR	0.000	0.000
1996	0.000	0.008	0.000	0.000	NR	NR	0.000	0.000
1997	0.000	0.007	0.000	0.000	NR	NR	0.000	0.000
1998	0.000	0.008	0.000	0.000	NR	NR	0.000	0.000

1999	0.000	0.011	0.000	0.000	NR	NR	0.000	0.000
2000	0.000	0.581	0.000	0.010	0.073	0.253	0.725	0.040
2001	0.010	0.019	0.010	0.010	0.113	0.361	1.072	0.040
2002	0.000	0.058	0.000	0.010	0.124	0.412	1.213	0.000
2003	0.000	0.104	0.000	0.010	0.151	0.499	1.439	0.010
2004	0.010	0.070	0.000	0.000	0.160	0.560	1.609	0.010
2005	0.010	0.099	0.000	0.000	0.159	0.517	1.473	0.020
2006	0.010	0.104	0.000	0.000	0.100	0.615	1.599	0.030
2007	0.010	0.024	0.000	0.000	0.022	0.161	0.381	0.000
2008	0.000	0.024	0.002	0.000	0.025	0.158	0.357	0.003
2009	0.007	0.016	0.001	NA	0.067	0.263	0.707	0.006

4.2.2 Methodological issues

As it was mentioned above (overview of the industrial sector) the emissions data are based on the facilities data (Tier 3 method). The operator submits data on the facility as a whole, and also separately on sources of emissions by SNAP codes. Basically all emissions from mineral industry are included in the combustion activity – NFR 1.A.2.f.i, excluding fugitive emission from the excavate and storage and handling activities. At last years the mineral product enterprises are not key sources of pollution, because very large efforts were made for reduction of pollutants emission. Emission of a dust from Kunda Nordic Tsement during 1990-2009 was reduced to 99.7%. If in 1990 the emission was 82.61 Gg (29.5% of total emission) then in 2009 – only 0.05 Gg (0.17% of total emission).

Data about heavy metals emission the enterprise presents since 2004 on the basis of measurements, therefore emissions for 1990-2003 have been calculated on the basis of a national emission factors and clinker production data Tselluloosi ja tsemendi tootmisel välisõhku eralduvate saasteainete heitkoguste määramismeetodid – Elektrooniline Riigi Teataja.

The Dioxins emission from mineral industry (cement, lime and brick) has been calculated on the base of productions and UNEP "Standardized Toolkit for Identification of Dioxin and Furan Releases" emission factors. For the cement production Toolkit EF was used from 1990 to 1996 and since 1997 on 2007 calculations were carried out on the basis results of project "Dioxin in Candidate Countries" in which frameworks the measurements of dioxins from technological equipment have been spent. Now Kunda Nordic is obliged to spend measurements twice a year and report dioxin emission. It is necessary to notice that the measured dioxin emission much less than the emission calculated on the basis of the emission factor. Dioxin emission also is reported under NFR 1.

Table 4.4. Clinker production and heavy metals emission factors

Year	Clinker, thousand tones	Heavy metals EF, g/t of clinker					
		Pb	Cd	Hg	Cu	Ni	Zn
1990	790	78.125	4.060	0.088	2.687	0.313	18.000
1991	773	78.125	4.060	0.088	2.687	0.313	18.000
1992	517	78.125	4.060	0.088	2.687	0.313	18.000
1993	378	78.125	4.060	0.088	2.687	0.313	18.000

1994	540	78.125	4.060	0.088	2.687	0.313	18.000
1995	571	43.750	2.275	0.049	1.505	0.175	10.080
1996	590	12.500	0.650	0.014	0.430	0.050	2.880
1997	651	0.780	0.040	0.004	0.030	0.003	0.180
1998	659	0.780	0.040	0.004	0.030	0.003	0.180
1999	590	0.780	0.040	0.004	0.030	0.003	0.180
2000	620	0.780	0.040	0.004	0.030	0.003	0.180
2001	629	0.780	0.040	0.004	0.030	0.003	0.180
2002	590	0.780	0.040	0.004	0.030	0.003	0.180
2003	560	0.780	0.040	0.004	0.030	0.003	0.180
2004	623						
2005	636						
2006	705						
2007	1043						
2008	1040						
2009	775						

Table 4.5. Dioxin emission factor for the cement industry

Year	Cement			Lime			Bricks and tiles		
	production, tones	EF, µg I-TEQ/t	emission, g	production, tones	EF, µg I-TEQ/t	emission, g	production, tones	EF, µg I-TEQ/t	emission, g
1990	938,000	0.06	0.563	185,000	0.07	0.013	541,401	0.2	0.108
1991	905,000	0.06	0.543	207,000	0.07	0.014	592,206	0.2	
1992	483,000	0.06	0.290	92,000	0.07	0.006	350,444	0.2	0.071
1993	354,000	0.06	0.212	21,000	0.07	0.001	139,217	0.2	
1994	402,500	0.06	0.242	18,000	0.07	0.001	128,283	0.2	0.026
1995	417,600	0.06	0.251	16,800	0.07	0.001	81,343	0.2	
1996	387,700	0.06	0.233	17,400	0.07	0.001	68,009	0.2	0.014
1997	422,500	0.07	0.030	19,500	0.07	0.001	62,674	0.2	
1998	321,300	0.07	0.022	32,100	0.07	0.002	54,674	0.2	0.011
1999	357,700	0.07	0.025	23,300	0.07	0.002	46,139	0.2	
2000	329,100	0.07	0.023	21,200	0.07	0.001	45,072	0.2	0.009
2001	404,600	0.07	0.028	20,000	0.07	0,001	54,140	0.2	
2002	465,900	0.07	0.033	21,200	0.07	0.001	61,608	0.2	0.012
2003	506,300	0.07	0.035	32,000	0.07	0.002	63,741	0.2	0.013
2004	506,300	0.07	0,035	32,000	0.07	0.002	63,741	0.2	0.003
2005	NA	0.07	NE	37,200	0.07	0.002		0.2	NE
2006	848,900	0.07	0.059	39,700	0.07	0.003	82,667	0.2	0.016
2007	936,200	0.07	0.065	43,500	0.07	0.003	143,485	0.2	0.029
2008	806,100	0.07	0.056	59,400	0.07	0.004	113,081	0.2	0.023
2009	326,000	0.07	0.023	30,200	0.07	0.004	38,938	0.2	0.007

Emission calculations from road paving with asphalt (2.A.6) and constructions and demolition (2.A.7.b) sectors based on Tier 1 method from 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. 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 emissions 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 new guidebook, but results of these calculations were assessing sector share to high. Therefore, in this year submission they are not taken in account.

Activity data

Information regarding asphalt production and laying is available from Estonian Asphalt Pavement Association (www.asfaldiliit.ee) for the years 1990-2009 (Table 4.7). According to the Asphalt Pavement Association all production companies but not all asphalt laying companies are members of the association. Values for the asphalt produced are 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 1990 – 2009 (tones)

Year	Produced Asphalt Mixtures, t
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

Information regarding constructions is available from Statistics Estonian (www.stat.ee) for the years 2000-2009 (Table 4.8). The historical data (1990-1999) for TSP calculation are not available. There is also no statistical information about demolition of buildings, so only data about construction were used.

Table 4.8. Activity data for PM emission calculations from construction sector in 2000-2009 (m^2 floor area)

Year	Dwelling	Non-residental 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	743,899.4
2006	391,999.5	896,644.2
2007	566,674.9	920,778.8
2008	458,415.2	1,004,572
2009	304,982.2	797,777

4.3 Chemical industry (NFR 2.B)

4.3.1 Sources category description

The Estonian chemical industry has been linked to oil shale industry but other chemical industry branches are also being developed (Economic survey of Estonia 2008). More than half of chemical industry is located in Ida-Virumaa county, 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 for the foams, benzoic acid, sodium benzoate and other products manufacturing. Emissions from the paint and varnishes production are located under Solvent use chapter.

Production of chemical industry degreased in 2009 by 25% due to economic crisis. Estonia's only producer of fertiliser Nitrofert AS stopped production in February.

The share of NMVOC emission from chemical industry in total country emission was in 1990 about 19%, and in 2009 is 2% (Figure 4.2). The main reason of that – is decrease in manufacture of chemical production at the shale oil enterprises. The emissions from chemical industry sector are presented in Table 4.9.

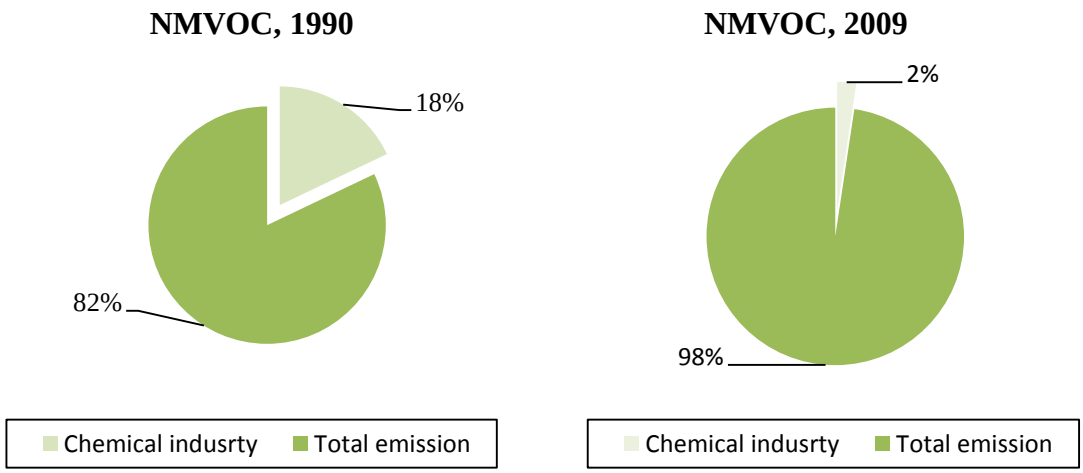

Figure 4.2. Distribution of NMVOC emissions by activities in 1990 and 2009

Table 4.9. Emission from Chemical industry (Gg)

Year	NO_x	NMVOC	SO_x	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO
1990	0.190	13.300	0.000	0.370	NR	NR	0.940	0.340
1991	0.100	12.330	0.000	0.300	NR	NR	0.100	0.300
1992	0.090	8.500	0.000	0.280	NR	NR	0.470	0.300
1993	0.050	3.500	0.000	0.080	NR	NR	0.150	0.010
1994	0.190	2.670	0.000	0.140	NR	NR	0.610	0.040
1995	0.070	3.530	0.000	0.140	NR	NR	0.490	0.000
1996	0.150	2.460	0.000	0.070	NR	NR	0.280	0.000
1997	0.150	2.390	0.000	0.060	NR	NR	0.140	0.010
1998	0.140	1.650	0.000	0.060	NR	NR	0.080	0.020
1999	0.190	0.790	0.000	0.090	NR	NR	0.180	0.000
2000	0.190	0.840	0.000	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	0.000	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	0.000	0.130	0.030	0.100	0.310	0.290
2006	0.230	0.410	0.000	0.060	0.030	0.090	0.280	0.330
2007	0.200	0.120	0.000	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	0.000	0.012	0.009	0.027	0.083	0.364
trend 1990-2009, %	-86.947	-99.487		-96.733	-54.380	-54.380	-91.176	6.987

4.3.2 Methodological issues

All largest facilities and also the facilities which emissions exceed thresholds established by the decision of the Minister of the Environment are obliged to deliver annually reports on emissions. Hus, all data about the emissions presented to this section, is based on the data of the enterprises (Tier 3 method). Emissions data are based on measurements or calculation methods. For some enterprises, for example oil shale chemistry, part of emissions are includes into energy sector (SNAP 010406 and 010407 – coke oven furnaces and coal gasification or liquefaction).

The production in Estonian chemical industry is given in Table 4.10.

Table 4.10. Main chemicals and fuel production

Year	Production, kt				
	Ammonia	Fuel oils	Bensene	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
2001	183	281.7	6.5	1.5	27
2002	47	301.8	0	0	30
2003	98	317.6	0	0	30
2004	202	340	0	0	35.6
2005	213	367.4	0	0	38.7
2006	211	389.2	0	0	40
2007	202	436.6	0	0	39.7
2008	209	444.8	0	0	34.6
2009	..	489.3	0	0	21.4

4.4 Metal Production (NFR 2.C)

4.4.1 Sources category description

Metal industry is consentrated in Tallinn and its surroundings (more than half the workplaces) and Ida-Viru County. Larger companies are 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 needs), AS Hanza Tarkon, AS Favor, OÜ BLRT Masinaehitus, Metalliset Eesti AS (metalworking), Metaprint AS (a metallic container production) and AS Demidov Industries (aluminum alloy).

The emissions from metal industry are presented in Table 4.11.

Table 4.11. Emission from Metal production sector (Gg)

Year	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.000	0.000	0.160	NR	NR	0.000	0.000
1991	0.000	0.000	0.160	NR	NR	0.000	0.000
1992	0.000	0.000	0.160	NR	NR	0.000	0.000
1993	0.000	0.000	0.040	NR	NR	0.000	0.000
1994	0.000	0.000	0.080	NR	NR	0.000	0.000
1995	0.000	0.000	0.100	NR	NR	0.000	0.000
1996	0.000	0.000	0.090	NR	NR	0.000	0.000
1997	0.000	0.000	0.060	NR	NR	0.000	0.000
1998	0.000	0.000	0.040	NR	NR	0.000	0.000
1999	0.000	0.000	0.050	NR	NR	0.000	0.000
2000	0.000	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

4.4.2 Methodological issues

All largest facilities and also the facilities which emissions exceed thresholds established by the decision of the Minister of the Environment are obliged to deliver annually reports on emissions. Hus, all data about the emissions presented to this section, is 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 pollutants emission from pulp and paper, food and drink and wood, furniture.

Pulp and paper industry is an industry with a long tradition, established in Estonia already in the 17th century. In the years 2002-2008 the output of paper industry grew by two times. 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, which has brought Nordic sack kraft qualities into a leading and preferred quality position globally. Horizons manufacture only unbleached varieties. Estonian Cell AS, aspen pulp factory in Kunda (launched in 2006) is the largest pulp producer.

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

Food industry is also the biggest industry in Estonia by production volume. During the 2002-2008 the output of food industry has increased by almost a half. Now the economic crisis is also affected this sector. The emissions from this sector are presented in Table 4.12.

Table 4.12. Pollutants emission from pulp, paper and food industries (Gg)

Year	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	0.000
2004	0.020	0.788	0.120	0.020	0.070	0.230	0.000
2005	0.000	0.744	0.130	0.020	0.070	0.220	0.020
2006	0.000	0.799	0.120	0.030	0.090	0.290	0.000
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

4.5.2 Methodological issues

Emissions data from these branches of industry are based on the facilities data (Tier 3 method) and only NMVOC emission from 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 drink 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 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 produces mainly vodka whose production 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 occur primarily from the cooking of meat, fish and poultry, releasing mainly fats and oils and their degradation products.

Table 4.13. NMVOC emission factors for 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 alcolol
Crude spirits	0.4	kg/hl alcolol
Distilled spirits	0.4	kg/hl alcolol

Activity data

Information regarding food and drink production is available from Statistics Estonia (www.stat.ee) for the years 1990-2009 (Table 4.14-15).

Table 4.14. Activity data for Food and Drink industries (thousand tones)

Year	Bread and pastry	Flour confectionery	Meat total (slaughter weight)	Fish total	Solid cooking fats	Margarine	Concentrated feeding stuffs
1990	151	14.9	182.5			6.6	851.8
1991	149.4	10.4	151.8			5.6	631.6
1992	138.6	5	107.9	132.0		0	303.5
1993	111.7	4.2	83.7	133.0		0.6	200.7
1994	109.3	5.5	69.4	120.8		0.1	184.6
1995	99.7	5	67.7	132.0	3.6	0.1	162.8
1996	93.9	5.6	58.6	108.7	4.8	0.1	97.6
1997	86.8	5.2	53.4	123.9	7		131.3
1998	81.6	4.3	60	119.3	7.2		151.7
1999	77.3	4.6	61.1	111.9	3.5		131.8
2000	76.5	4.4	53.3	113.4	0.8		133.3
2001	76.3	6	57.3	103.4	0.9		150.2
2002	77.2	7.4	68.3	101.0	0.9		167.1
2003	72.4	7.9	67.5	79.4	1		199.5
2004	72.8	9	71.3	84.5	1.6		207.3
2005	72.4	.	67.1	99.3	1.2		177
2006	74.4	9.4	69.4	90.6	.	..	208.9
2007	78.8	9.7	70.5	98.5	.	..	214.2
2008	77.6	8.9	74.6	101.7	.	..	229.5
2009	75.1	7.1	76	98.2			203.1

Table 4.15. Activity data for Drink industries (thousand hl)

Year	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
1990	37	769	82	147
1991	50.9	675.5	83.4	160.5
1992	20.5	425.7	70.7	120.9
1993	13	419.3	94.1	168.4
1994	12.8	476.9	76.1	123
1995	14	499.6	91	176
1996	22	459	79	96
1997	21.5	543	77	109
1998	31	744	59	102
1999	24	957	32	66
2000	32.6	950.1	20.4	86.4
2001	30.4	1015.2	24.1	115.2
2002	34.3	1044.1	33.1	142.4
2003	34.5	1040.2	38.3	173.1
2004	60.7	1202.8	40	187.9
2005	88.8	1342.5	37.1	167.9
2006	77.5	1431.1	61.6	183.1
2007	53.5	1411.6	39.3	216
2008	38.8	1281.8	15.5	202.8
2009	40.4	1245		189

4.6 Source-specific QA/QC and verification

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

Data from operator have been checked by local department of an environment 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 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. Use of solvents and products containing solvents result in emissions of non-methane volatile organic compounds (NMVOC) when emitted to the atmosphere. In addition to solvents, this sector also includes emissions of particles from product use.

In 2009-2010 Estonian Environment Information Centre outsourced an expert opinion of 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 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 2009

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, NH_3, 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.	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, Pb, Cu
	2 Dry cleaning	Includes emissions from dry cleaning.	NMVOC
3.C	**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, NO_x, NH_3, SO_x, TSP, CO, Cr, Zn
3.D	**Other product use**		
	1 Printing	Emissions from solvents in printing houses.	NMVOC, TSP

	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, SO_x, NH_3, TSP, Pb

5.1.2 Quantitative overview of NMVOCs

Solvent and Other Product Use sector is the largest pollution source of NMVOC emissions in Estonia after the non-industrial combustion in 2009 and it covers over 16% from the total NMVOC emissions. The largest share is for decorative coating application of 26% and the other are respectivly domestic solven use 23%, degreasing 17%, industrial coating application 11%, other product use 14%, chemical products 5%, printing 4% and dry cleaning 0.4% (Figure 5.1).

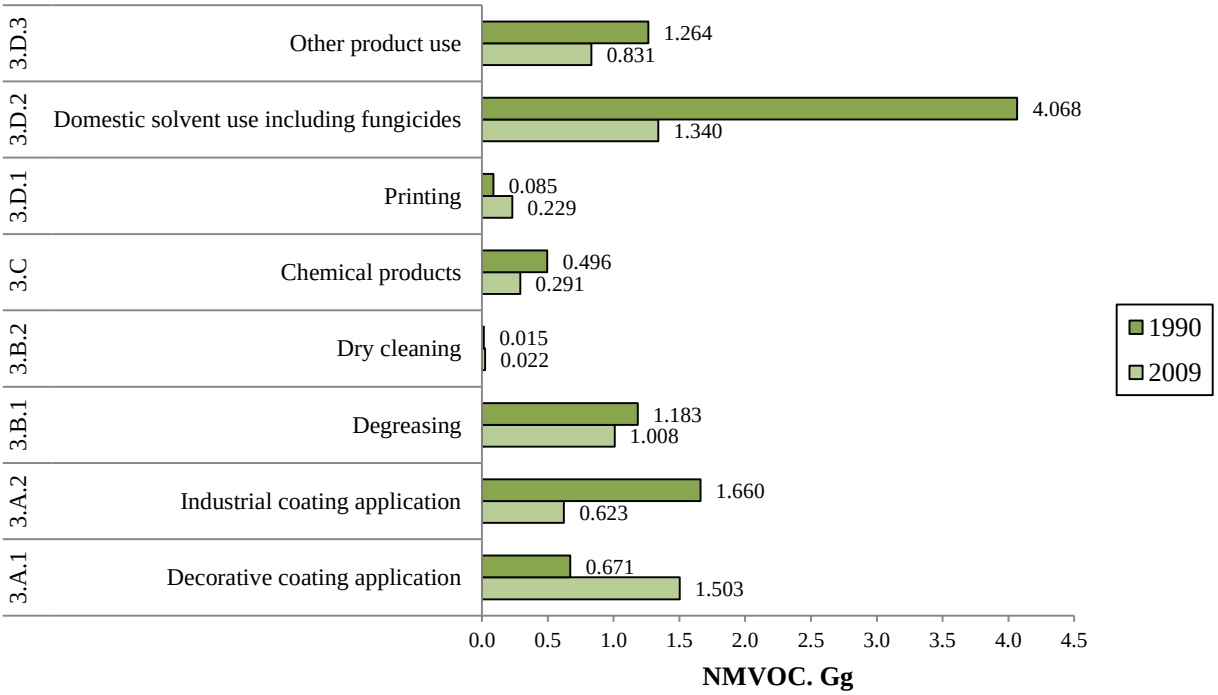

Figure 5.1. NMVOC emissions by sectors in 1990 and 2009

There is a decrease in trends in NMVOC emissions from Solvent and Other Product Use in later years. Since the 1990 in NFR 3 sector NMVOC emissions have decreased by 38%. 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 decreasing of NMVOC emissions have occurred in later years are paint application (3.A.1) and other product use (3.D.3). The fluctuation of NMVOC emissions in the period 1990-2009 has occurred mostly due to the welfare of the economic state of the country. Decrease in emissions between 1991 and 1993 is due to the economic crisis what was conditioned by the fall of the Soviet Union and the independece of the Estonian Republic. Between 1993 and 1998 the economic growth induced the growing usage of NMVOC containing paints in decorative and industrial coating application. At the end of 1998 the world was struck by the economic crisis, which affected the construction sector and as a consequence the usage of decorative coatings also. From 2001 the economy turned again into growth until in 2008 the

world suffered the worst economic depression ever seen. Because of that compaired with the year 2007 the NMVOC emissions fell 59% by the year 2009 (Figure 2). In 2004 and 2005 Estonia adopted into its legislation directives 1999/13/EC and 2004/42/EC, but it seems that the economic growth at that moment didn't affected the NMVOC emissions much and they grew steadily until the economic depression. One reason why the possible legislation's positive effect doesn't show on the graph is because the emissions from the point sources represent only about 20% of the total NMVOC emissions.

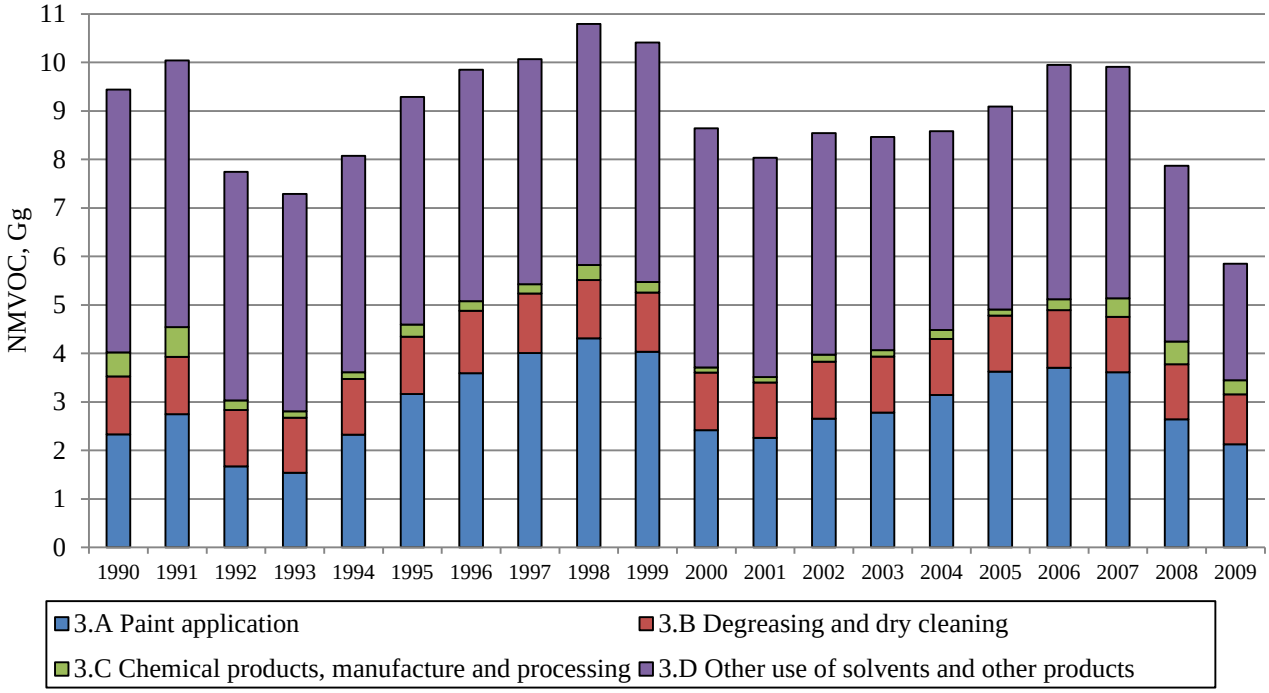

Figure 5.2. NMVOC emissions from Solvent and Other Product Use sector in 1990-2009

Table 5.2. NMVOC emissions in 1990-2008 reported under NFR 3 (Gg)

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

[1] Included in 3.A.1

Sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
3.A.1	1.913	1.811	2.037	2.220	2.522	2.891	2.952	2.842	1.691	1.503
3.A.2	0.505	0.447	0.617	0.558	0.623	0.733	0.753	0.768	0.951	0.623
3.A.3	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
3.B.1	1.139	1.097	1.118	1.096	1.093	1.093	1.122	1.090	1.084	1.008
3.B.2	0.050	0.047	0.056	0.064	0.064	0.062	0.065	0.054	0.051	0.022
3.C	0.107	0.113	0.151	0.127	0.184	0.125	0.226	0.384	0.468	0.291
3.D.1	0.263	0.306	0.334	0.412	0.583	0.774	0.669	0.401	0.674	0.229
3.D.2	3.554	3.103	2.654	2.224	1.783	1.348	1.345	1.342	1.341	1.340
3.D.3	1.111	1.113	1.574	1.763	1.728	2.065	2.818	3.025	1.611	0.831

[1] Included in 3.A.1

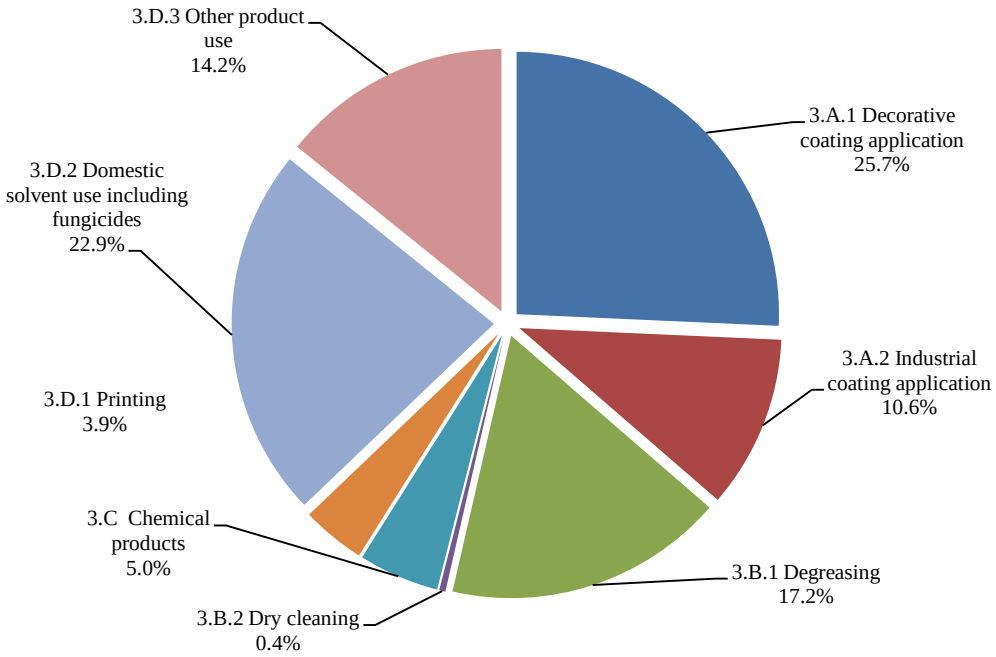

Figure 5.3. The share of NMVOC emissions in 2009 by NFR 3 subcategory codes

5.1.3 Methods

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

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 make up about 9% of the 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 to 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 to air; however, no emission factors are available.

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

In 2009 NMVOC emissions from this sector have been decreased by 8.8% in relation with the year 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 expected not 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 and any other non-industrial coatings which are not covered by any of the other SNAP codes described in “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 shop.

It is estimated that this sector is not very important and emission is estimated together 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 countries in the model has been derived from dividing total NMVOC emissions by total paint use. Data for 2000 has been used in order to estimate an average emission factor describing the situation; however care should be taken when applying this emission factor. Because of the EU directive 2004/42/EC, which came into force on January 1st 2007, it is no longer allowed 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 old literature 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 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. Equation 1 is applied.

$$E_{pollutant} = AR_{production} \text{ x } EF_{pollutant}$$

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, averaged emission factor is calculated taking into account the proportion of solvent borne and water borne paints used.

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 33 g/kg of paints.

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

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

(56% x 350 g/kg + 46% x 33 g/kg)/100% = 211 g/kg of paint

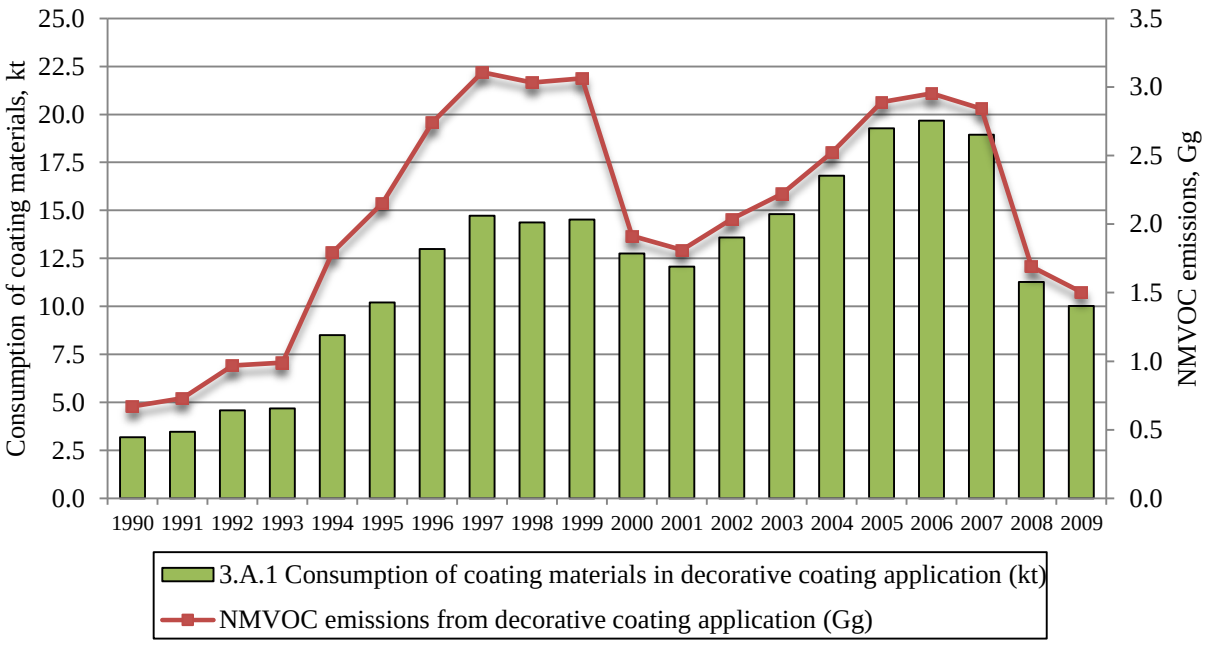

Figure 5.4. Consumption of coating materials and NMVOC emissions from decorative coating application

5.2.2.2 Industrial coating application (3.A.2)

For the years 2000-2008 EMEP Guidebook 2009 Tier 1 emission factor 400 g/kg paint applied is used for calculations. Equation 1 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 1990-1995 Corinair (2000) emission factor is used for calculations.

Different emission factors are proposed for vehicle refinishing (in range 280-700 g/kg of paint, no abatement included). Emission factor 600 g/kg of paint is chosen as 3 different factors are similar to this value.

NMVOC emission from point sources with the activity data are reported by operators and collected into OSIS database by SNAP codes.

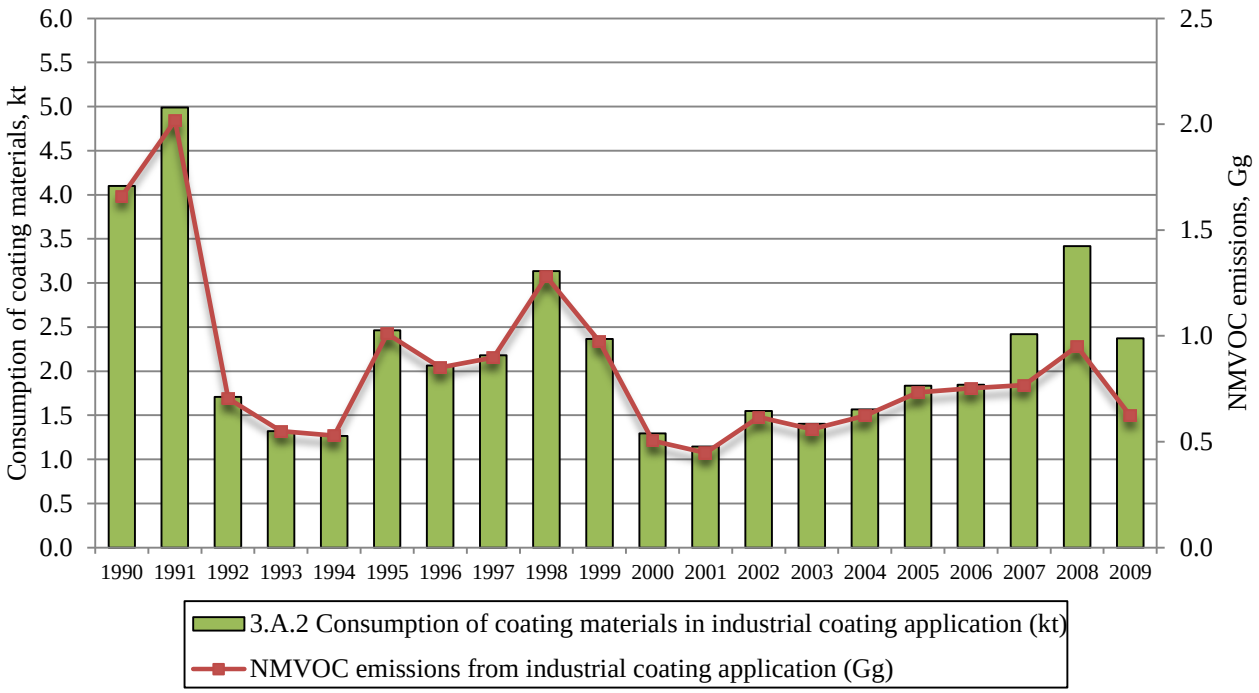

Figure 5.5. Consumption of coating materials and NMVOC emissions from industrial coating application

5.2.2.3 Activity data

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

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 industrial production of chemicals and chemical products in that period.

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 asked 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. The total amount of paint used for car repairing in Estonia is estimated to have risen from 100 tons in 1990 up to 184 tons in 2009. As this is a rough estimate, the 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. Hence, 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 3A1 and 3A2. Therefore all reported emission from point sources is estimated to be from industrial coating applications (3A2).

Data regarding paint use in point sources is available in the OSIS database for the years 2006-2008.

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

For dividing paint between these groups, paint production companies and construction stores were contacted.

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

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

1. Sales division by companies and private customers depends on the marketing policy of the store,
2. A change in the division between 1995 and 2009 also depends on the marketing policy,
3. In the years 2004-2007 an increase of paint use is mainly caused by the rapid increase of the developments and construction; the elevated 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 2008-2009 it is estimated that up to 60% of paint went to professional painters and the remaining 40% to private customers;
- Consumption of private consumers in 2005-2007 is assumed to be equal to consumption in 2000 and the remaining part is estimated to be used by professional painters and construction companies. 2004 is a transitional year between 2003 and 2005.

Table 5.4. NMVOC emissions and consumption of coating materials from paint application by SNAP codes in 1990-2009 (NFR 3.A.1)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060103	NMVOC emissions from paint application: construction and buildings (except 060107)	Gg	0.403	0.438	0.581	0.594	1.076	1.292	1.644	1.865	1.819	1.838
	Consumption of coating materials	kt	1.908	2.076	2.752	2.814	5.101	6.122	7.790	8.838	8.620	8.710
060104	NMVOC emissions from paint application: domestic use (except 060107)	Gg	0.268	0.292	0.387	0.396	0.718	0.861	1.096	1.243	1.213	1.225
	Consumption of coating materials	kt	1.272	1.384	1.835	1.876	3.401	4.081	5.194	5.892	5.747	5.807

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060103	NMVOC emissions from paint application: construction and buildings (except 060107)	Gg	1.148	1.086	1.222	1.332	1.682	2.126	2.187	2.077	1.015	0.902
	Consumption of coating materials	kt	7.654	7.243	8.149	8.881	11.209	14.169	14.583	13.846	6.764	6.012
060104	NMVOC emissions from paint application: domestic use (except 060107)	Gg	0.765	0.724	0.815	0.888	0.840	0.765	0.765	0.765	0.676	0.601
	Consumption of coating materials	kt	5.103	4.828	5.433	5.920	5.600	5.100	5.100	5.100	4.509	4.008

Table 5.5. NMVOC emissions and consumption of coating materials from paint application by SNAP codes in 1990-2009 (NFR 3.A.2)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060100	NMVOC emissions from paint application	Gg	1.575	1.955	0.639	0.428	0.430	0.795	0.626	0.610	0.976	0.689
	Consumption of coating materials	kt	3.938	4.887	1.598	1.071	1.076	1.989	1.565	1.526	2.440	1.721
060101	NMVOC emissions from paint application: manufacture of automobiles	Gg										
	Consumption of coating materials	kt										
060102	NMVOC emissions from paint application: car repairing	Gg	0.060	0.063	0.065	0.068	0.071	0.073	0.076	0.079	0.081	0.084
	Consumption of coating materials	kt	0.100	0.104	0.109	0.113	0.118	0.122	0.126	0.131	0.135	0.140
060106	NMVOC emissions from paint application: boat building	Gg										
	Consumption of coating materials	kt										
060107	NMVOC emissions from paint application: wood	Gg				0.054	0.027	0.047	0.037	0.097	0.110	0.088

	Consumption of coating materials	kt				0.135	0.067	0.119	0.093	0.243	0.276	0.220
060108	NMVOC emissions from other industrial paint application	Gg	0.025				0.001	0.094	0.112	0.112	0.114	0.114
	Consumption of coating materials	kt	0.063				0.004	0.236	0.280	0.280	0.284	0.284

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060101	NMVOC emissions from paint application: manufacture of automobiles	Gg						0.002	0.003	0.002		
	Consumption of coating materials	kt						0.004	0.006	0.002		
060102	NMVOC emissions from paint application: car repairing	Gg	0.058	0.059	0.061	0.063	0.065	0.066	0.070	0.072	0.074	0.076
	Consumption of coating materials	kt	0.178	0.175	0.161	0.164	0.170	0.169	0.173	0.179	0.184	0.188
060106	NMVOC emissions from paint application: boat building	Gg	0.117	0.116	0.080	0.082	0.137	0.131	0.171	0.357	0.336	0.160
	Consumption of coating materials	kt	0.292	0.290	0.201	0.206	0.342	0.329	0.472	1.108	1.008	0.477
060107	NMVOC emissions from paint application: wood	Gg	0.119	0.218	0.244	0.184	0.209	0.184	0.245	0.193	0.368	0.301
	Consumption of coating materials	kt	0.298	0.544	0.611	0.461	0.523	0.459	0.424	0.479	1.176	1.351
060108	NMVOC emissions from other industrial paint application	Gg	0.211	0.054	0.231	0.229	0.212	0.350	0.264	0.144	0.173	0.086
	Consumption of coating materials	kt	0.528	0.136	0.577	0.572	0.531	0.874	0.770	0.654	1.050	0.357

5.2.3 Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. Calculated emissions and emission data from 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 OSIS database by operators is firstly checked by the specialists from The Environmental Board and then by the specialists in Estonian Environment Information Centre.

5.2.4 Source-specific planned improvements

There are planned some corrections and recalculations of the NMVOC emissions for the years 1990-1999.

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 metal-working industries are the major users of solvent degreasing. Solvent degreasing is also used in industries as printing and production of chemicals, plastics, rubber, textiles, glass, paper, and electric power. Also repair stations for transportation vehicles use solvent cleaning part of the time.

The contribution of metal degreasing to the 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, using not more than 1 or 2 tons of solvent per year (depending on the risk profile of the solvent) are still allowed to use open top tanks. Closed tanks offer much better opportunities for the recycling of solvents.

In 2009 NMVOC emissions from the NFR 3.B sector have been decreased by 14% in relation with 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 routes 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 the 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 statistics, 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 EMEP Guidebook 2009) are considered for emission calculations,
2) cold cleaning – emission from the rest of vapour cleaning is estimated by different emission factor by inhabitant.

5.3.2.1.1 Emission factor for vapour cleaning

Tier 1 emission factor 460 g/kg cleaning products is used for calculations. Equation 1 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

Emission factor used for cold cleaning is 0.7 kg/kg, which is an expert estimate by VTT Technical Research Centre of Finland .

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 used also for dry cleaning, this is not included as 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 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 2008.

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.

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 2008, activity data regarding solvent use for degreasing in point sources is collected into OSIS database.

For the years 2006-2008 activity data for calculations is calculated as following:

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. Emission from point sources is subtracted from the total calculated VOC emission.

Table 5.6. NMVOC emissions and consumption of solvents from degreasing by SNAP codes in 1990-2009 (NFR 3.B.1)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060200	NMVOC emissions from degreasing **(vapour cleaning)**	Gg	0.0840	0.0715	0.0608	0.0666	0.1025	0.1434	0.2605	0.2389	0.2026	0.2072
	Consumption of solvents	kt	0.1826	0.1553	0.1321	0.1448	0.2228	0.3118	0.5663	0.5194	0.4404	0.4505
060200	NMVOC emissions from degreasing **(cold cleaning)**	Gg	1.0994	1.0974	1.0884	1.0579	1.0339	1.0137	0.9976	0.9842	0.9752	0.9655
	The population of Estonia	mln. inhab.	1.5706	1.5677	1.5549	1.5113	1.4770	1.4481	1.4252	1.4060	1.3931	1.3792
060201	NMVOC emissions from metal degreasing	Gg										
	Consumption of solvents	kt										
060203	NMVOC emissions from electronic components manufacturing	Gg										
	Consumption of solvents	kt										
060204	NMVOC emissions from other industrial cleaning	Gg										
	Consumption of solvents	kt										

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060200	NMVOC emissions from degreasing **(vapour cleaning)**	Gg	0.1779	0.1371	0.1598	0.1419	0.1410	0.1463	0.1596	0.1323	0.0993	0.0457
	Consumption of solvents	kt	0.3868	0.2981	0.3473	0.3084	0.3064	0.3180	0.3469	0.2876	0.2159	0.0993
060200	NMVOC emissions from degreasing **(cold cleaning)**	Gg	0.9604	0.9569	0.9529	0.9492	0.9457	0.9433	0.9413	0.9397	0.9387	0.9383
	The population of Estonia	mln. inhab.	1.3721	1.3670	1.3612	1.3560	1.3511	1.3475	1.3447	1.3424	1.3409	1.3404
060201	NMVOC emissions from metal degreasing	Gg		0.0007	0.0026	0.0025	0.0031	0.0003	0.0015	0.0048	0.0005	0.0059
	Consumption of solvents	kt		0.0015	0.0057	0.0053	0.0068	0.0007	0.0028	0.0059	0.0006	0.0067
060203	NMVOC emissions from electronic components manufacturing	Gg	0.0006	0.0017	0.0025	0.0022	0.0028	0.0029	0.0183	0.0090	0.0132	0.0053
	Consumption of solvents	kt	0.0013	0.0037	0.0054	0.0047	0.0060	0.0062	0.0387	0.0202	0.0266	0.0084
060204	NMVOC emissions from other industrial cleaning	Gg		0.0006	0.0005	0.0006	0.0001	0.0005	0.0013	0.0043	0.0320	0.0124
	Consumption of solvents	kt		0.0013	0.0010	0.0012	0.0001	0.0011	0.0019	0.0055	0.0382	0.0184

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 an 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 to the atmosphere (Passant, 1993; UBA, 1989). Also, a significant amount of the solvent goes back to the producers and to the recyclers together 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 mainly closed-circuit equipment are used for dry cleaning,
- closed-circuit equipment were the main practice already in the 90s,
- 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 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 tons)	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, the solvent consumption is taken as a basis for NMVOC calculations.

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 an 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 the import and export data. 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 industrial production of chemicals and chemical products in that period.

According to OSIS, no production of tetrachloroethylene/perchloroethylene is reported for the years 2006-2009.

According to OSIS part of PER emissions are reported as emissions from point sources. This is also subtracted to get the amount of PER emissions from diffuse sources.

5.3.2.2.3 Results

Perchloroethylene might be also 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 estimated to be used for dry cleaning purpose.

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

Table 5.8. NMVOC emissions and consumption of solvents from dry cleaning by SNAP codes in 1990-2009 (NFR 3.B.2)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060202	NMVOC emissions from dry cleaning	Gg	0.015	0.012	0.011	0.012	0.018	0.025	0.030	0.005	0.024	0.050
	Consumption of solvents	kt	0.036	0.031	0.026	0.029	0.044	0.062	0.076	0.012	0.060	0.124

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060202	NMVOC emissions from dry cleaning	Gg	0.051	0.047	0.056	0.064	0.064	0.062	0.065	0.054	0.051	0.022
	Consumption of solvents	kt	0.126	0.117	0.131	0.152	0.153	0.149	0.158	0.131	0.124	0.052

5.3.3 Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. Calculated emissions and emission data from 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 OSIS database by operators is firstly checked by the specialists from The Environmental Board and then by the specialists in Estonian Environment Information Centre.

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 the emissions from the use of chemical products. This includes many activities like paints, inks, glues and adhesives manufacturing, polyurethane and polystyrene foam processing, tyre production, fat, edible and non-edible oil extraction etc. However many of these activities are considered insignificant. For example total NMVOC emissions from these activities contributed to the national total NMVOC emissions in 2009 just 0.8% and to the whole NRF 3 sector only 5%.

In 2009 NMVOC emissions from the NFR 3.C sector have been decreased by 41.4% in relation with 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 the emission estimates for the years 2006-2009 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 the moment for the years 1990-2005 only total NMVOC emissions are known without any activity data. Also for some activities the activity data is unknown for the period 2006-2009.

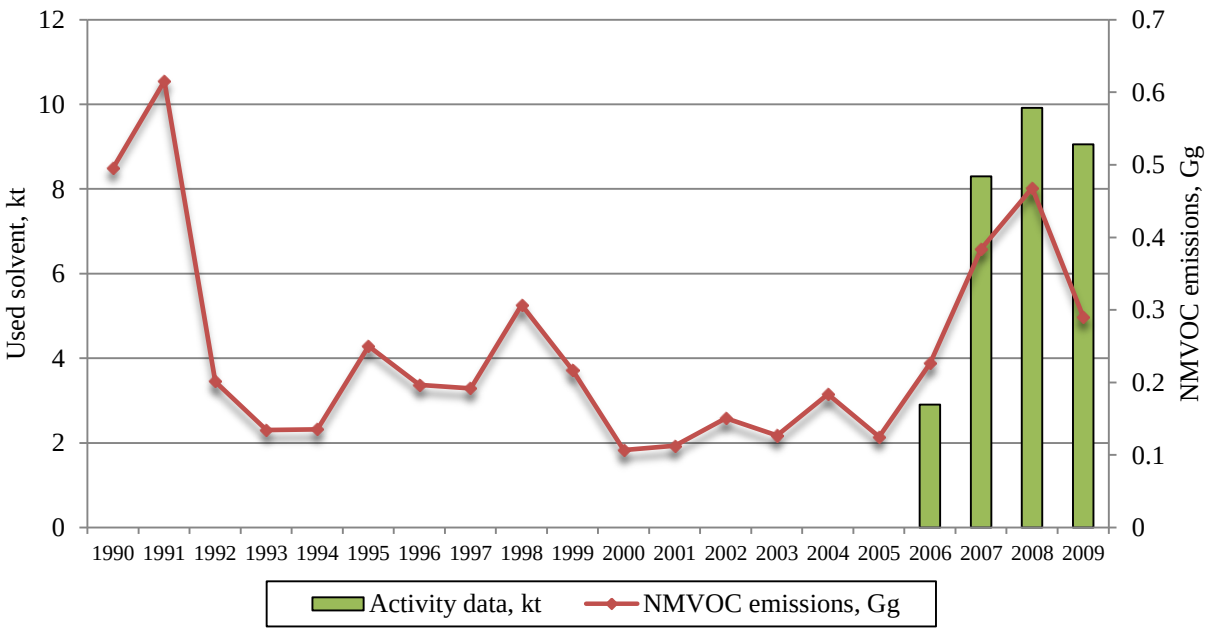

Figure 5.6. Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing

Table 5.9. NMVOC emissions and consumption of solvents from chemical products manufacturing or processing by SNAP codes in 1990-2009 (NFR 3.C)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060300	NMVOC emissions from chemical products manufacturing or processing	Gg	0.496	0.615	0.201	0.135	0.135	0.250	0.197	0.192	0.307	0.217
	Consumption of solvents	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060300	NMVOC emissions from chemical products manufacturing or processing	Gg	0.107	0.113	0.151	0.127	0.184	0.125				
	Consumption of solvents	kt	NA	NA	NA	NA	NA	NA				
060303	NMVOC emissions from polyurethane processing	Gg							0.2E-03	0.1E-03	5.8E-03	8.6E-03
	Consumption of solvents	kt							NA	1.2E-03	1.2E-03	3.6E-03
060304	NMVOC emissions from polystyrene foam processing	Gg							0.078	0.122	0.108	0.042
	Consumption of solvents	kt							0.136	0.089	2.165	1.680
060305	NMVOC emissions from rubber processing	Gg							0.033	0.019	0.008	0.006
	Consumption of solvents	kt							0.021	0.326	0.014	0.021
060307	NMVOC emissions from paints manufacturing	Gg							0.015	0.010	0.007	0.007
	Consumption of solvents	kt							2.157	7.285	6.988	6.126
060308	NMVOC emissions from inks manufacturing	Gg								0.001	0.001	0.3E-03
	Consumption of solvents	kt								0.041	0.053	0.026
060309	NMVOC emissions from glues manufacturing	Gg							0.002	0.002	0.001	0.5E-03
	Consumption of solvents	kt							0.088	NA	NA	0.6E-03
060312	NMVOC emissions from textile finishing	Gg							1.31E-03	4.0E-06	5.0E-06	2.0E-06
	Consumption of solvents	kt							NA	NA	NA	NA
060313	NMVOC emissions from leather tanning	Gg							0.04E-03	0.04E-03	0.04E-03	0.16E-03
	Consumption of solvents	kt							1.36E-03	1.46E-03	2.71E-03	7.52E-03
060314	NMVOC emissions from other processes	Gg							0.097	0.232	0.338	0.226
	Consumption of solvents	kt							0.500	0.555	0.690	1.187

5.4.3 Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. Emission data from 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 OSIS database by operators is firstly checked by the specialists from The Environmental Board and then by the specialists in Estonian Environment Information Centre.

5.4.4 Source-specific planned improvements

As some activities are not included in this inventory, then there is a need to conduct a research if the emissions from these activities are important at all for this inventory. Also there is a need to review the NMVOC emissions for the years 1990-2005 and study the possibility to obtain the activity data for these emissions.

5.5 Other (NFR 3D)

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) like application of glues and adhesives, preservation of wood, underseal treatment and conservation of vehicles, 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 involves 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 threshold 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, especially smaller facilities will close down. The total capacity exceeds local market needs and any increase is connected with export.

It is expected that the near future will bring an end to growth. In 2008 and 2009 some printing facilities have stopped their activity and decreasing demands will continue to reduce production outputs and the number of employees.

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 lost mainly 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 drying of leftover seeds before resale as animal feed.

If the oil content of the seed is high, for example 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 which 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 which 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 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. In the UK, this is usually done only on cars destined for export. Removal of the coating is usually done only 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 do only the driver's door, 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 the 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 a number of years already.

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 their car against rust and stone chip damage they had to pay to have their 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 having 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 2009 NMVOC emissions from the NFR 3.D sector have been decreased by 55.7% in relation with the year 1990.

5.5.2 Methodological issues

5.5.2.1 Printing Industry (3.D.1)

Tier 1 emission factors are used for calculations. Equation 1 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[4] can be concluded that for press and edition/publication the following techniques are applied (with relevant emission factors):

- 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 is not available for the years 1990-1995, therefore these amounts were calculated by the change of percentage of the current prices in industrial production of chemicals and chemical products in that period.

Information regarding ink production is not available.

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

5.5.2.1.2 Results

A number of printing facilities is permitted.

Between 2006 and 2009, activity data regarding ink use in point sources is collected in the OSIS database.

For the years 2006 to 2009 activity data for calculations is calculated as following:

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 consumption of solvents from printing industry by SNAP code in 1990-2009 (NFR 3.D.1)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060403	NMVOC emissions from printing industry	Gg	0.085	0.071	0.058	0.062	0.097	0.136	0.132	0.190	0.209	0.250
	Consumption of inks and solvents	kt	0.171	0.142	0.117	0.124	0.194	0.271	0.264	0.379	0.418	0.500

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060403	NMVOC emissions from printing industry	Gg	0.263	0.306	0.334	0.412	0.583	0.774	0.669	0.401	0.674	0.229
	Consumption of inks and solvents	kt	0.525	0.611	0.668	0.823	1.165	1.547	1.674	1.942	2.170	1.708

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. Equation 1 is applied.

$$E_{pollutant} = AR_{production} \text{ x } EF_{pollutant}$$

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 2,590 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 1990-2009 (NFR 3.D.2)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060408	NMVOC emissions from domestic solvent use (other than paint application)	Gg	4.068	4.060	4.027	3.914	3.825	3.751	3.691	3.642	3.608	3.572
	The population of Estonia	mln. inhab.	1.571	1.568	1.555	1.511	1.477	1.448	1.425	1.406	1.393	1.379

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060408	NMVOC emissions from domestic solvent use (other than paint application)	Gg	3.554	3.103	2.654	2.224	1.783	1.348	1.345	1.342	1.341	1.340
	The population of Estonia	mln. inhab.	1.372	1.367	1.361	1.356	1.351	1.348	1.345	1.342	1.341	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 activites have been conducted in Estonia and if yes, then how big the manufacturing capacities were.

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

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

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

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

At Werol Industries they use mechanical hot pressing for the 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 pressed out only mechanically. The production was started 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 been occurred in the process are from natural origin and are reported by operators who are environmental permit obligor.

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 2006-2009. At the moment there is no information available regarding adhesives production between 1990 and 1999.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2009, activity data regarding adhesives use in point sources is collected in the OSIS database (SNAP 060405).

For the years 2006-2009 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 by using waterborne preservatives. Before it was banned in 2004 CCA was used. CCA is a waterborne preservative. Some creosote and shale oil was used historically. Nowadays creosote is believed not to be in use and therefore wood treated with creosote is imported.

In 2005, all 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 following: (only waterborne preservatives were used)

- Hansacom Ltd. – 33,000 m^3
- Kestvuspuit plc – 30,000 m^3
- Imprest plc – 15,000 m^3
- Kehra Wood Industries Ltd. – 8,000 m^3
- Natural plc – 5,000 m^3.

Solvent borne preservatives are used by some companies producing 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 tons in year. This is the threshold for 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 asked from 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 a treatment with bituminous materials was wide spread but there is no statistics available. Nowadays treatment with bituminous coating is negligible and if needed, treatment is done by special polymers.

So, NMVOC emissions from this activity are calculated for the years 1990 to 2004 and since 2005 emissions from treatment of vehicles is considered negligible.

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 then a reduction coefficient for emission factor is applied.

Table 5.12. Motorisation rate - cars per 1,000 inhabitants[5]

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

Taking into account that since 2005 NMVOC emissions from vehicles treatment are considered negligible, then the emission factors for the years 2001-2004 are not calculated using the previous method and is reduced 10% per year from the year 2000.

5.5.2.3.6 Vehicles dewaxing (SNAP 060409)

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 during the last five years no dewaxing operations have been carried out. If needed, paint protection is provided by using (polyethylene) film. Waxing is only used in very rare cases, for example 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. Relevant data is very difficult to get. Most of the dewaxing operations of imported cars are conducted in a treatment centre that is located port Hanko in Finland.

According to the gathered information NMVOC emissions from this source is considered approximately zero and historical emissions are considered negligible.

[5] EUROSTAT - http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsdpc340&plugin=0

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 2000-2009 are gathered from OSIS and CollectER databases, reported by operators.

5.5.2.3.9 Use of tobacco (SNAP 060602)

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 and because of that the production amounts for the years 1990-1994 are considered equal with the consumption.

Table 5.13. NMVOC emissions from chemical products manufacturing or processing and the activity data by SNAP codes in 1990-2009 (NFR 3.D.3)

SNAP code	SNAP name	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
060400	Other use of solvents and related activities	Gg	0.817	1.014	0.332	0.224	0.223	0.412	0.325	0.316	0.506	0.357
	Consumption of solvents	kt	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
060404	Fat, edible and non edible oil extraction	Gg										
	Consumption of solvents	kt										
060405	Application of glues and adhesives	Gg	0.324	0.215	0.155	0.127	0.155	0.218	0.438	0.296	0.448	0.556
	Consumption of glues and adhesives	kt	0.415	0.275	0.198	0.163	0.199	0.279	0.562	0.379	0.574	0.712
060406	Preservation of wood	Gg										
	Consumption of solvents	kt										
060407	Underseal treatment and conservation of vehicles	Gg	0.124	0.136	0.141	0.154	0.161	0.180	0.187	0.195	0.201	0.199
	The population of Estonia	mln. inhab.	1.571	1.568	1.555	1.511	1.477	1.448	1.425	1.406	1.393	1.379
060412	Other (preservation of seeds,...)	Gg										
	Consumption of solvents	kt										
060602	Use of tobacco	Gg	17E-06	14E-06	7E-06	11E-06	9E-06	9E-06	8E-06	13E-06	8E-06	8E-06
	Consumption of tobacco	kt	3.494	3.001	1.493	2.207	1.919	1.784	1.686	2.667	1.576	1.756

SNAP code	SNAP name	Unit	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
060404	Fat, edible and non edible oil extraction	Gg			0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	Consumption of solvents	kt			NA	NA	NA	NA	NA	NA	NA	NA
060405	Application of glues and adhesives	Gg	0.907	0.928	1.385	1.601	1.609	2.060	2.781	2.998	1.582	0.803
	Consumption of glues and adhesives	kt	1.162	1.189	1.776	2.052	2.063	2.641	5.775	8.118	4.375	3.119
060406	Preservation of wood	Gg	0.5E-03	1.9E-03	0.14E-03			0.01E-03	9.3E-03	16.6E-03	7.4E-03	13.8E-03
	Consumption of solvents	kt	NA	NA	NA			NA	0.078	0.071	0.017	0.026
060407	Underseal treatment and conservation of vehicles	Gg	0.196	0.176	0.157	0.136	0.116					
	The population of Estonia	mln. inhab.	1.372	1.367	1.361	1.356	1.351					
060412	Other (preservation of seeds,...)	Gg	0.008	0.008	0.030	0.025	0.001	0.003	0.025	0.008	0.020	0.012
	Consumption of solvents	kt	NA	NA	NA	NA	NA	NA	0.204	0.255	0.364	0.052
060602	Use of tobacco	Gg	8E-06	8E-06	9E-06	9E-06	9E-06	10E-06	10E-06	14E-06	6E-06	10E-06
	Consumption of tobacco	kt	1.630	1.628	1.928	1.958	1.948	2.088	2.044	2.958	1.286	1.987

5.5.3 Source-specific QA/QC and verification

Normal statistical quality checking related to assessment of magnitude and trends has been carried out. Calculated emissions and emission data from 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 OSIS database by operators is firstly checked by the specialists from The Environmental Board and then by the specialists in Estonian Environment Information Centre.

5.5.4 Source-specific planned improvements

As some activities are not included in this inventory, then there is a need to conduct a research if the emissions from these activities are important at all for this inventory. Also there is a need to review the NMVOC emissions for the years 1990-1999 and study the possibility to obtain the 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 includes presently emissions from animal husbandry and application of fertilizers as listed in Table 6.1.

In the previous submission in 2010 NMVOC emissions from agriculture were included for first time to the inventory.

The NH_3 and TSP emissions in period 1990-2008 and PM_{10}, $PM_{2.5}$ emissions in period 2000-2008 were recalculated for all activities. Main reasons for that were renewed Guidebook with new emission factors (EMEP/EEA air pollutant emission inventory guidebook – 2009). An overview of updated data is given in Chapter 10.

Table 6.1. Reporting activities for agriculture sector

NFR	Source	Description	Emissions reported
4.B.1.a	Cattle dairy	Includes emissions from dairy cows	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	NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$
4.B.3	Sheep	Includes emissions from sheep and goats	NMVOC, NH3
4.B.4	Goats	Emissions from this sector are allocated to 4.B.4	IE
4.B.6	Horses	Includes emissions from horses	NMVOC, NH_3, PM_{10}, $PM_{2,5}$
4.B.8	Swine	Includes emissions from fattening pigs and sows	NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$
4.B.9.a	Laying hens	Includes emissions from laying hens	NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$
4.B.9.b	Broilers	Includes emissions from broilers	NMVOC, NH_3, TSP, PM_{10}, $PM_{2,5}$
4.B.9.d	Other poultry	Includes emission from cocks, ducks, geese and turkeys	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	NMVOC, NH_3, PM_{10}, $PM_{2,5}$

The share of agriculture sources into total emissions in 2009 was: NH_3 – 95.4%, NMVOC – 9.98%, PM_{10} – 3.9%. The share of other pollutants was not so significant. The emissions of NH_3, NMVOC and TSP have decreased compared to 1990 by 61%, 66% and 67.8% respectively and the trend of the emissions of these categories is given in Figure 6.1. The emissions from agricultural sector are presented in Table 6.2.

Decrease of air pollution is mainly caused of rapid economic changes in the 1990s.

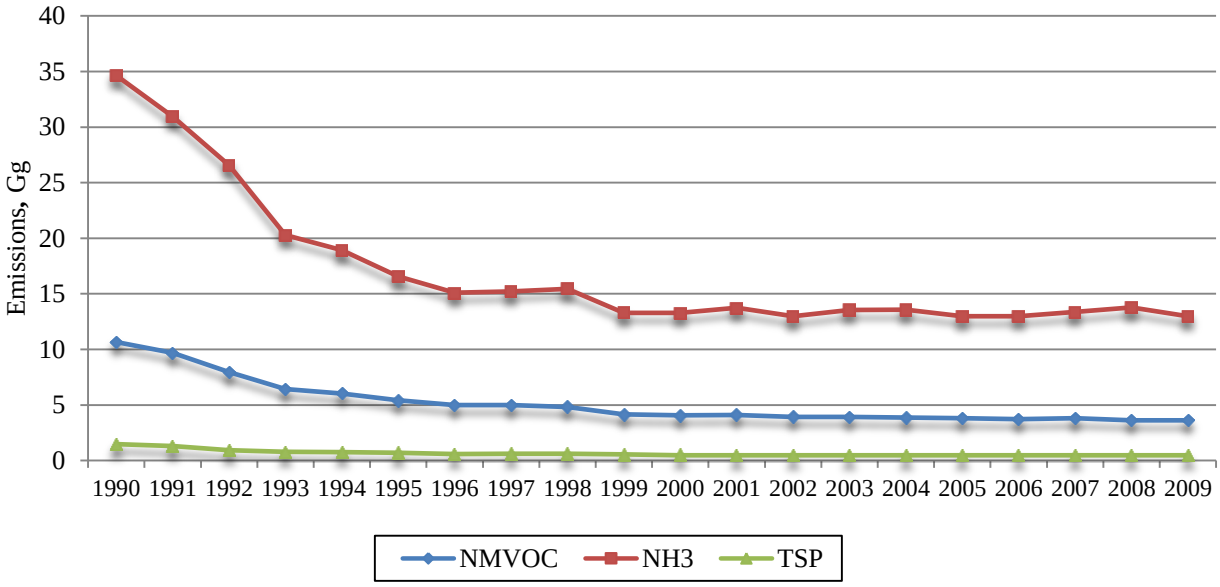

Figure 6.1. NH_3, NMVOC and TSP emissions from agriculture sector in 1990-2009 (Gg)

Table 6.2. Total emissions from agriculture sector in 1990-2009 (Gg)

Year	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP
1990	10.661	24.000	NR	NR	1.486
1991	9.676	21.271	NR	NR	1.299
1992	7.953	18.621	NR	NR	0.942
1993	6.421	13.867	NR	NR	0.788
1994	6.041	12.878	NR	NR	0.768
1995	5.411	11.146	NR	NR	0.707
1996	4.999	10.098	NR	NR	0.599
1997	4.998	10.227	NR	NR	0.624
1998	4.825	10.630	NR	NR	0.622
1999	4.150	9.146	NR	NR	0.547
2000	4.064	9.212	0.101	0.968	0.537
2001	4.114	9.628	0.096	0.825	0.525
2002	3.939	9.048	0.096	0.870	0.523
2003	3.923	9.629	0.095	0.850	0.501
2004	3.861	9.699	0.096	0.885	0.515
2005	3.800	9.185	0.101	1.071	0.485
2006	3.740	9.269	0.102	1.105	0.477
2007	3.812	9.548	0.106	1.210	0.486

2008	3.638	10.130	0.096	0.987	0.486
2009	3.621	9.365	0.092	0.912	0.478
trend 1990-2009, %	-66.040	-60.978	-67.813	-8.548	-5.772

The largest part of NH_3 emissions comes from manure management – 75% and 25% from use of synthetic fertilizers (Figure 6.2). The main polluter of PM_{10} is agricultural crop operations – 74% (Figure 6.3).

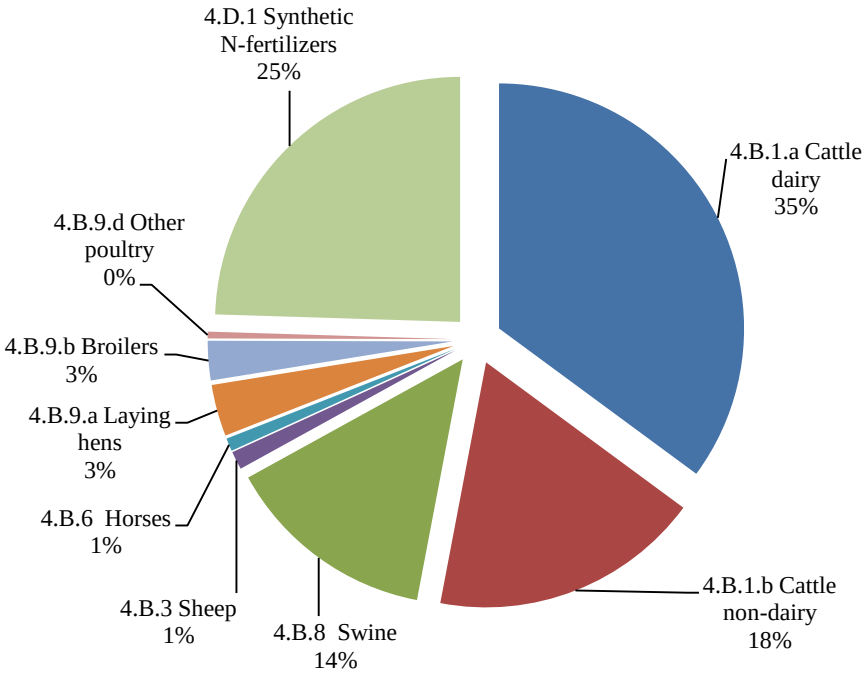

Figure 6.2. NH_3 emission distributions by agriculture sector activities in 2009

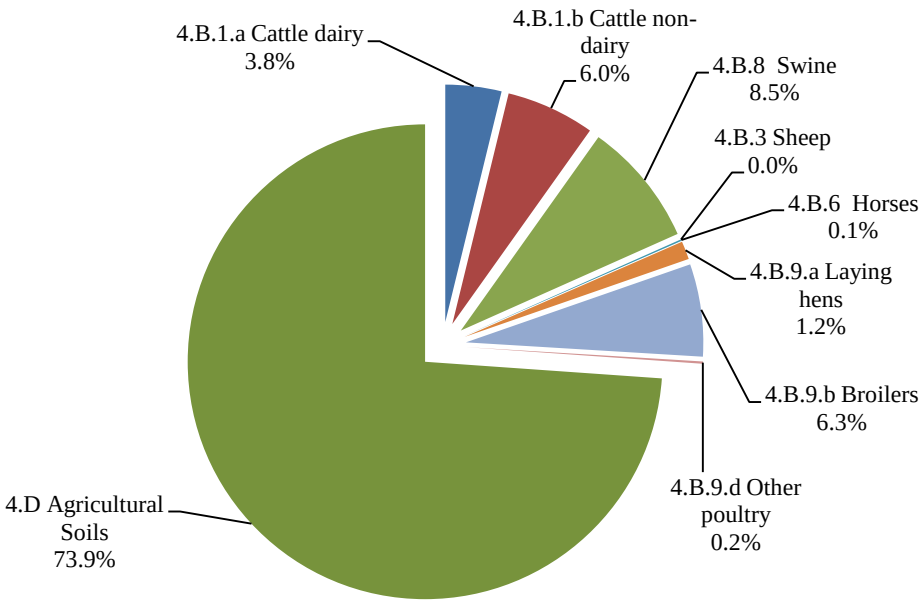

Figure 6.3. PM_{10} emissions from livestock and agricultural soils in 2009

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 into total emissions in 2009 was 71.8%. Sector covers management of manure from domestic livestock. Estonia reports emissions from manure management of cattle, swine, horses, goats, sheep and poultry.

In addition to NH_3, NMVOC, TSP, PM_{10} and $PM_{2,5}$ are generated from manure management.

All the emission time series are presented in Tables 6.3-6.6.

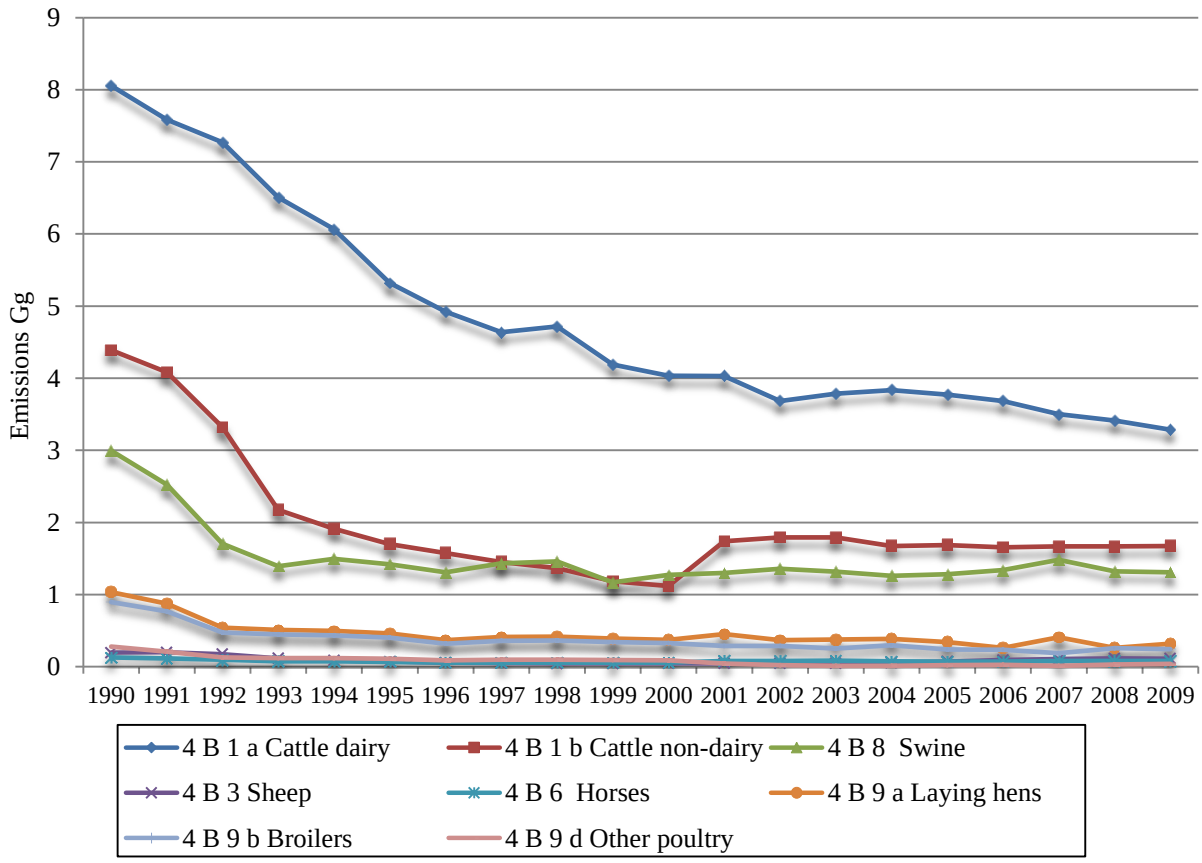

Figure 6.4. NH_3 emissions from manure management

During 1990-2009, emission of NH3 has been decreased 79.9% (Figure 6.4). Diminishing of air pollution is mainly caused of rapid economic changes in agriculture in the 1990s.

Table 6.3. Total emissions of NH_3 from manure management in 1990-2009 (Gg)

Year	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.8 Swine	4.B.3 Sheep	4.B.6 Horses	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	8.056	4.389	2.995	0.196	0.127	1.035	0.899	0.279
1991	7.585	4.085	2.528	0.200	0.115	0.877	0.768	0.210
1992	7.273	3.323	1.707	0.174	0.098	0.541	0.474	0.130
1993	6.506	2.176	1.395	0.117	0.077	0.511	0.447	0.123
1994	6.067	1.915	1.498	0.086	0.074	0.496	0.434	0.119
1995	5.321	1.702	1.422	0.070	0.068	0.461	0.404	0.111
1996	4.925	1.577	1.309	0.055	0.062	0.368	0.322	0.088
1997	4.638	1.453	1.432	0.050	0.062	0.412	0.361	0.099
1998	4.720	1.370	1.462	0.043	0.058	0.418	0.365	0.100
1999	4.192	1.186	1.171	0.043	0.058	0.390	0.341	0.094
2000	4.037	1.121	1.273	0.045	0.062	0.375	0.328	0.090
2001	4.032	1.740	1.300	0.045	0.081	0.452	0.288	0.043
2002	3.685	1.795	1.360	0.047	0.078	0.367	0.287	0.025
2003	3.785	1.793	1.320	0.048	0.086	0.376	0.252	0.015
2004	3.838	1.674	1.262	0.057	0.075	0.388	0.298	0.020
2005	3.775	1.688	1.282	0.073	0.071	0.344	0.241	0.023
2006	3.686	1.656	1.339	0.092	0.073	0.262	0.234	0.028
2007	3.502	1.669	1.485	0.107	0.078	0.407	0.188	0.013
2008	3.414	1.669	1.322	0.115	0.078	0.264	0.258	0.032
2009	3.288	1.675	1.311	0.113	0.080	0.319	0.243	0.042
trend 1990-2009, %	-59.189	-61.832	-56.245	-42.489	-37.209	-69.179	-72.989	-85.078

Table 6.4. Total emissions of NMVOC from manure management in 1990-2009 (Gg)

Year	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.8 Swine	4.B.3 Sheep	4.B.6 Horses	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	3.818	3.531	1.937	0.028	0.028	0.647	0.409	0.265
1991	3.594	3.286	1.642	0.029	0.029	0.548	0.349	0.199
1992	3.446	2.673	1.107	0.025	0.025	0.338	0.215	0.123
1993	3.083	1.750	0.916	0.017	0.017	0.319	0.203	0.116
1994	2.875	1.540	0.981	0.012	0.012	0.310	0.197	0.113
1995	2.521	1.369	0.924	0.010	0.010	0.288	0.183	0.105
1996	2.334	1.268	0.921	0.008	0.008	0.230	0.146	0.084
1997	2.281	1.168	1.019	0.007	0.007	0.258	0.164	0.094
1998	2.157	1.102	1.032	0.006	0.006	0.261	0.166	0.095
1999	1.882	0.954	0.814	0.006	0.006	0.244	0.155	0.089
2000	1.782	0.901	0.899	0.006	0.006	0.234	0.149	0.085
2001	1.749	0.976	0.921	0.006	0.006	0.283	0.131	0.041
2002	1.572	1.023	0.946	0.007	0.007	0.229	0.131	0.023

2003	1.588	1.039	0.919	0.007	0.007	0.235	0.115	0.014
2004	1.584	0.986	0.877	0.008	0.008	0.242	0.135	0.019
2005	1.534	1.012	0.887	0.010	0.010	0.215	0.109	0.022
2006	1.474	1.009	0.933	0.013	0.013	0.164	0.106	0.027
2007	1.401	1.018	1.011	0.015	0.015	0.255	0.086	0.012
2008	1.365	1.018	0.909	0.016	0.016	0.165	0.117	0.030
2009	1.315	1.021	0.903	0.016	0.016	0.199	0.110	0.040
trend 1990-2009, %	-65.550	-71.075	-53.387	-42.489	-42.489	-69.179	-72.989	-85.078

Table 6.5. Total emissions of PM_{10} from manure management in 2000-2009 (Gg)

Year	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.8 Swine	4.B.6 Horses	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
2000	0.047	0.049	0.072	0.001	0.013	0.078	0.003
2001	0.046	0.053	0.073	0.001	0.016	0.068	0.001
2002	0.042	0.055	0.079	0.001	0.013	0.068	0.001
2003	0.042	0.056	0.077	0.001	0.013	0.060	0.000
2004	0.042	0.053	0.073	0.001	0.014	0.070	0.001
2005	0.041	0.054	0.075	0.001	0.012	0.057	0.001
2006	0.039	0.054	0.078	0.001	0.009	0.055	0.001
2007	0.037	0.055	0.089	0.001	0.014	0.045	0.000
2008	0.036	0.055	0.078	0.001	0.009	0.061	0.001
2009	0.035	0.055	0.077	0.001	0.011	0.057	0.001
trend 2000-2009, %	-26.183	13.300	7.637	28.571	-14.869	-25.981	-53.622

Table 6.6. Total emissions of $PM_{2.5}$ from manure management in 2000-2009 (Gg)

Year	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.8 Swine	4.B.6 Horses	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
2000	0.030	0.019	0.011	0.001	0.002	0.010	0.000
2001	0.030	0.021	0.012	0.001	0.002	0.009	0.000
2002	0.027	0.022	0.013	0.001	0.002	0.009	0.000
2003	0.027	0.022	0.012	0.001	0.002	0.008	0.000
2004	0.027	0.021	0.012	0.001	0.002	0.009	0.000
2005	0.026	0.022	0.012	0.001	0.001	0.008	0.000
2006	0.025	0.022	0.012	0.001	0.001	0.007	0.000
2007	0.024	0.022	0.014	0.001	0.002	0.006	0.000
2008	0.023	0.022	0.012	0.001	0.001	0.008	0.000
2009	0.022	0.022	0.012	0.001	0.001	0.008	0.000
trend 2000-2009, %	-26.183	13.300	7.820	28.571	-14.869	-25.981	-53.622

6.2.2 Methodological issues

Emission calculations from manure management based on Tier 1 method from renewed Guidebook.

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:

$$E = AR_{\text{Population Size}} \times EF,$$

where,
$AR_{\text{Population Size}}$ = 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 animal category (Table 6.8). According to the new guidebook there are different emission factor for solid and slurry manure type (Table 6.7). 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, Tõuloomakasvatus, 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 renewed Guidebook, so calculated TSP emission factors were used proportion between PM_{10} and TSP in old Guidebook (new PM_{10} EF*100% / the proportion of an old PM_{10} EF of old TSP EF).

Table 6.7. NH_3, NMVOC and PM emission factors for manure management

NFR	NH_3, slurry	NH_3, solid	NMVOC	$PM_{2,5}$	PM_{10}	TSP
	kg/capita					
Cattle dairy	39.3	28.7	13.6	0.23	0.36	0.799
Cattle non-dairy	13.4	9.2	7.4	0.16	0.24	0.533
Sheep and goats		1.4	0.2			
Horses		14.8		0.12	0.18	
Fattening pigs	6.7		3.9	0.08	0.5	1.111
Sows	15.8		13.3	0.09	0.58	1.288
Laying hens		0.48	0.3	0.002	0.017	0.038
Broilers		0.22	0.1	0.007	0.052	0.115
Other poultry		0.95	0.9	0.004	0.032	0.068

Activity data

Information regarding number of livestock in agriculture is available from Statistics Estonian (www.stat.ee) for the years 1990-2009.

Table 6.8. Number of livestock (1,000 head)

Year	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Layng hens	Broilers	Other poultry
1990	280.7	477.1	139.8	8.6	336.0	47.1	2,157	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	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
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
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	780.912	1,490.8	94.656
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	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	848.618	856.7	13.496
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

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 into total NH_3 emissions in 2009 was 0.26%, so this sector does not contribute to the total NH_3 emission. In addition to NH_3, NMVOC, PM_{10} and $PM_{2.5}$ are generated from this sector.

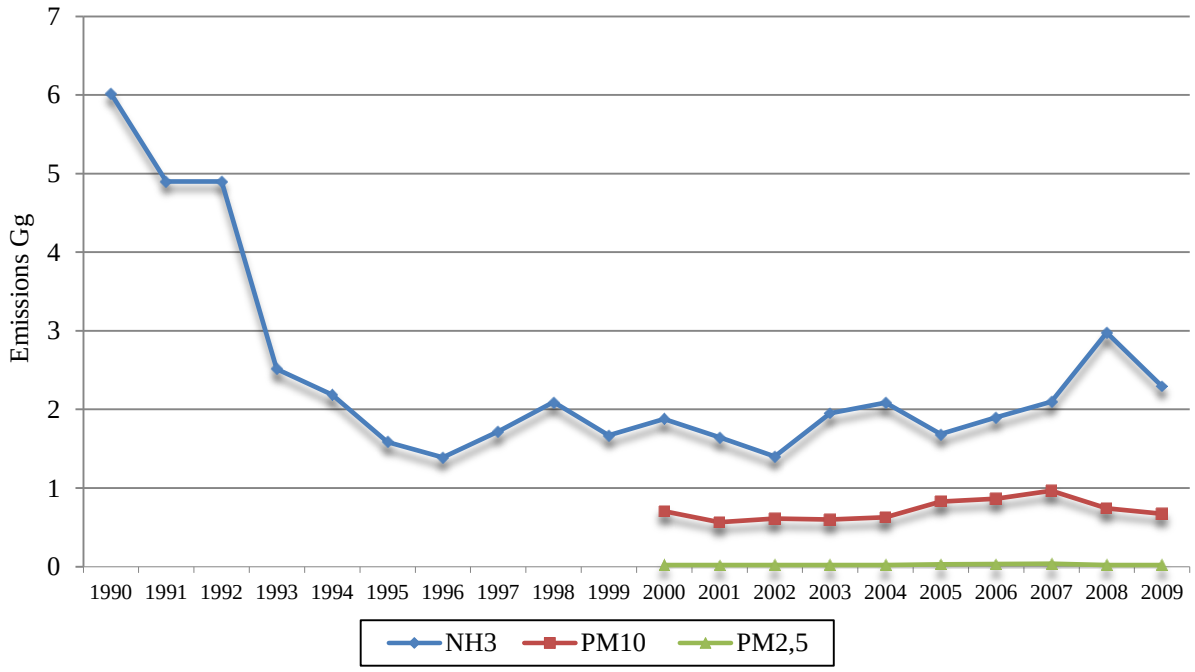

Figure 6.5. NH_3, PM_{10} and $PM_{2,5}$ emissions from agricultural soils

During 1990-2009, emission of NH_3 has been decreased 61.9% (Figure 6.5) mainly for changes in Estonian agriculture. All the emission time series are presented in Table 6.9.

Table 6.9. Total emissions from agricultural soils in 1990-2009 (Gg)

Year	NH_3	NMVOC	PM_{10}	$PM_{2,5}$
1990	6.023	4.27E-07	NR	NR
1991	4.902	3.48E-07	NR	NR
1992	4.902	5.48E-07	NR	NR
1993	2.516	3.19E-07	NR	NR
1994	2.190	2.99E-07	NR	NR
1995	1.588	2.09E-07	NR	NR
1996	1.391	1.79E-07	NR	NR
1997	1.720	1.94E-07	NR	NR
1998	2.094	2.14E-07	NR	NR
1999	1.671	1.83E-07	NR	NR
2000	1.881	1.85E-07	0.706	0.027
2001	1.647	1.6E-07	0.567	0.022

2002	1.403	1.51E-07	0.612	0.024
2003	1.953	1.75E-07	0.601	0.023
2004	2.086	2.04E-07	0.631	0.024
2005	1.687	1.74E-07	0.830	0.032
2006	1.899	1.81E-07	0.867	0.033
2007	2.098	2.19E-07	0.968	0.037
2008	2.978	2.71E-07	0.745	0.029
2009	2.296	2.23E-07	0.674	0.026
trend 1990-2009, %	-61.886	-47.672	-4.527	-4.527

6.3.2 Methodological issues

Emission calculations from agricultural soils based on Tier 1 method from renewed Guidebook. Tier 1 method uses readily available statistical data (Table 6.10) and default emission factors (Table 6.11).

Table 6.10. NH_3, NMVOC and PM emission factors agricultural soils

Pollutant	Unit	Value
NH3	kg kg-1 fertilizer-N applied	0.084
NMVOC	kg kg-1 fertilizer-N applied	5.96E-09
$PM_{2,5}$	g/ha	0.06
PM_{10}	g/ha	1.56

Activity Data

Information regarding synthetic N-fertilizers use and area covered by crop is available from Statistics Estonian (www.stat.ee) for the years 1990-2009.

Table 6.11. Synthetic N-fertilizers use and area covered by crop in 1990-2009

Year	Synthetic N-fertilizers, ton	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
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

6.4 Source-specific QA/QC and verification

Common statistical quality checking related to 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 emission estimating which based on the detail 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

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, TSP, CO,
6.B	Waste-water handling	Includes emissions 9 waste water treatment plants. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, CO
6.C.a	Clinical waste incineration	Only one operator is reported data about hospital waste inceneration. Only point sources data.	PCDD/PCDF (expert estimated, not reported by operator), NO_x, SO_x, NMVOC, NH_3, TSP, CO, HM emissions located in NFR 6.c.b
6.C.b	Industrial waste incineration	Includes emission from flaring in chemical industry, sluge and waste oil incineration. Data from 5 operators.	NO_x, SO_x, NMVOC, NH_3, TSP, CO, Cu, PCDD/PCD
6.C.d	Cremation	Includes data from 2 operators	NO_x, SO_x, NMVOC, NH_3, TSP, CO
6.D	Other	Includes data from 2 point sources, one from them of compost production	NO_x, SO_x, NMVOC, NH_3, TSP, CO

8.1.2 Methodological issues

Emissions from the all NFR of waste sector are based on the facilities data. In addition to the facility data emissions of PCDD/PCDF from clinical and industrial waste incineration are calculated. In this calculation were used data from the Waste data management system.

Emissions are calculated by operators on the basis of measurements or the combined method (measurements plus calculations) is used.

For calculation of dioxin emissions from clinical and industrial waste incineration were used UNEP Standardized Toolkit emission factors:

Clinical waste incineration	525 µg/Mg of waste
Industrial waste incineration	350 µg/Mg of waste

Activity data

Activity data for hospital waste incineration are obtained from the national Waste management system, which are located in Estonian Environmental Information Centre. Data are available only from 1996. For emission estimation for the period 1990-1999 were used calculated emission factor per capita – 0.4309 µg/capita (on the basis of dioxin emission and population in 1996).

Table 8.2. Amount of incinerated hospital waste

	Dioxine EF, µg TEQ/t	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Hospital waste, uncontrolled combustion	40,000	10.66	15.61	13.92	7.26	8.14	5.46	13.60	13.19	12.35	13.00	0.90	0.80	0.00	0.00
Hospital waste, controlled combustion, good APC	525	0.14	0.64	2.10	3.50	8.87	7.18	1.51	7.31	6.30	9.70	1.89	9.79	48.88	141.86

8.1.3 Sources-specific planned improvements

- To calculate emission from landfills and waste water treatment by using data from the Waste management system.
- To calculate HCP and PCB emissions from waste incineration.
- To improve QA/QC procedure.

9. OTHER AND NATURAL EMISSIONS (7.A, 7.B, 11.A, 11.B, 11.C)

9.1 Overview of the sector

The emissions are not included in the present inventory

The NMVOC emission from forests is estimated and will be included to the next year submission.

10. RECALCULATIONS AND IMPROVEMENTS

10.1 Recalculations

The latest recalculations to emission inventory were done for the time period from 1990 to 2008. The reason on recalculations is specified in the Summary part.

Main objective of recalculation is to improve the emissions inventory and the quality of reports.

Following changes in comparison with the last year's report have been carried out.

10.1.1 Energy sector (NFR 1)

10.1.1.1 Transport sector

Overviews of recalculations are given below by each subsector. The comparison between 2010 and 2011 submissions are made by using exact calculation numbers.

It should be noted that all the emissions data were rounded to three decimal places after zero in 2010 submission. But in 2011 year's submission all the emissions are given as they were initially calculated.

Therefore, there might be some differences in calculating the change comparing the 2010 and 2011 submission by using submissions data or exact calculated data.

1.A.3.b Road transport

All the emissions are recalculated for period 1990-2008.

Explanations for improvements and recalculations in road transport sector:

- New COPERT version 8.0 (COPERT 4 v8.0. Report NO.: 10.RE.0037.V1, Thessaloniki, November 1, 2010).
- Change in activity data (correction of average annual mileage; vehicle numbers in 1991-1994, 1996-1999)
- Small correction in statistical fuel consumption (included the share of military's sectors fuel consumption which is consumed for on road transport)
- Correction of sulphur and lead content in fuels. Mistakes were made in 2010 submission which is corrected in 2011 submission. This correction has led to major changes in SO_2 and Pb emissions.
- New heavy metals (Pb, Cd, Cr, Cu, Ni, Se, Zn) emissions for Automobile tyre and brake wear sector (updated this sector in new COPERT).

The difference in road transport emissions between 2010 and 2011 year submissions are presented in Table 10.1.

Table 10.1. The difference in road transport emissions between in 2010 and 2011 submission

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb	Cd	Cr	Cu	Ni	Se	Zn	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs
1990	-7.4	-0.4	847	-25.0	NR	NR	-37.4	-24.9	1,058	4.1	269	175	27.8	13.2	107.0	-6.3	11.3	27.2	57.2	5.3	26.1
1991	-6.5	5.2	842	-40.8	NR	NR	-35.3	-15.0	1,113	7.1	267	167	30.0	36.2	103.7	0.1	4.1	19.1	27.7	10.6	16.8
1992	-6.9	1.6	877	-53.5	NR	NR	-33.5	-23.9	1,183	26.0	281	175	28.9	37.1	104.9	-8.9	-12.9	20.7	53.8	7.3	19.4
1993	-6.9	1.1	899	-44.5	NR	NR	-29.8	-18.2	1,259	4.9	273	171	32.1	52.9	103.3	-7.5	0.2	13.6	34.6	-4.2	18.3
1994	-4.7	2.6	900	-22.4	NR	NR	-30.5	-18.7	1,333	7.2	250	165	26.8	17.0	102.4	1.9	0.7	5.7	8.1	6.2	5.7
1995	-3.9	8.2	948	1.5	NR	NR	-30.3	-10.1	890	4.9	231	155	24.6	16.3	97.1	2.6	-3.1	2.2	6.8	-0.2	6.1
1996	1.1	7.8	2,461	-44.4	NR	NR	-34.0	-10.3	794	-9.3	232	158	28.3	18.8	99.3	14.2	-4.4	3.3	6.0	3.0	2.8
1997	0.7	17.3	2,628	-58.0	NR	NR	-30.2	3.2	268	-16.0	244	155	30.6	28.2	96.9	16.4	-42.0	24.1	-20.0	62.9	1.8
1998	-9.6	-7.0	2,637	-69.7	NR	NR	-39.8	-14.6	156	-25.4	208	123	12.8	13.4	70.1	-1.8	-43.8	34.0	-7.9	31.6	1.2
1999	3.8	26.5	2,461	-66.2	NR	NR	-27.7	18.5	370	-21.1	250	154	30.1	20.4	95.9	29.0	-37.2	33.0	-14.5	47.8	6.8
2000	5.9	30.1	1,232	-50.0	26.1	13.4	-7.5	9.9	353	-21.1	240	157	30.3	20.5	96.6	41.5	-8.0	12.7	9.3	11.7	8.1
2001	1.2	22.1	146	-46.0	-9.5	-15.8	-33.8	3.5	353	-15.7	237	158	28.1	22.9	98.4	52.0	-0.7	10.9	3.5	1.7	4.8
2002	0.2	20.6	134	-44.1	-9.4	-15.1	-32.4	2.1	355	-22.4	236	157	29.5	27.4	98.2	71.6	9.4	5.7	11.7	3.9	4.4
2003	-1.6	12.4	16.8	-43.8	-11.0	-16.6	-34.0	-3.1	89	-15.4	223	154	28.3	23.5	97.5	97.5	10.5	0.5	6.2	0.6	3.7
2004	-3.6	12.8	0.3	-21.3	-8.5	-14.1	-31.3	-1.2	91	-12.5	236	156	29.7	27.9	98.5	132.1	2.8	5.9	1.7	6.5	4.2
2005	-2.9	12.2	26.5	-21.4	-11.9	-17.0	-34.6	-1.6	90	-33.4	217	147	29.3	14.7	92.6	140.0	10.5	-0.3	3.4	-1.8	2.2
2006	-1.4	10.9	0.9	-20.7	-13.8	-19.0	-37.3	-4.2	24.2	-34.2	223	147	27.7	23.6	92.5	162.7	6.0	0.0	2.5	-4.7	0.7
2007	-2.0	10.0	-3.8	-20.9	-14.8	-20.1	-39.0	-3.3	24.4	-35.6	224	146	24.9	31.1	92.6	199.4	1.4	-1.4	0.0	1.8	2.5
2008	0.9	7.8	-1.7	-19.6	-14.4	-19.8	-39.6	-2.6	24.4	-36.9	230	151	30.1	28.2	94.4	274.5	-2.3	3.8	8.4	-2.8	2.4

1.A.3.c Railways

All the SO_2 emissions are recalculated for period 1990-2008.

Explanation for recalculations in railways sector:

- Correction of sulphur content in fuels. Mistakes were made in 2010 submission which is corrected in 2011 submission. This correction has led to major changes in SO_2 emissions.

The difference in railways emissions between 2010 and 2011 year submissions are presented in Table 10.2.

Table 10.2. The difference in railways emissions between in 2010 and 2011 submission

SO_2			
	Old, Gg	Recal, Gg	%
1990	0.144	0.567	294.1
1991	0.163	0.559	242.6
1992	0.070	0.364	422.4
1993	0.075	0.388	417.6
1994	0.077	0.390	407.8
1995	0.062	0.365	493.7
1996	0.082	0.413	404.4
1997	0.060	0.363	508.5
1998	0.046	0.433	836.4
1999	0.040	0.463	1,071.4
2000	0.024	0.429	1,681.7
2001	0.032	0.056	74.8
2002	0.198	0.199	0.7
2003	0.169	0.170	0.6
2004	0.152	0.153	0.2
2005	0.168	0.168	0
2006	0.168	0.168	0
2007	0.121	0.121	-0.1
2008	0.050	0.050	0

1.A.4.a.ii Commercial/Institutional: Mobile

All the emissions are recalculated for period 1990-2008.

Explanations for improvements and recalculations in commercial/institutional sector:

- Correction in statistical fuel consumption (excluded the share of military's sectors fuel consumption which is consumed for on-road transport)
- Correction of sulphur and lead content in fuels. Mistakes were made in 2010 submission which is corrected in 2011 submission. This correction has led to major changes in SO_2 and Pb emissions.

The difference in commercial and institutional emissions between 2010 and 2011 year submissions are presented in Table 10.3.

Table 10.3. The difference in commercial and institutional emissions between in 2010 and 2011 submission

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f	Total PAHs
1990	0	0	1,108.6	0	NR	NR	0	0	1,056.1	0	0	0	0	0	0	0	0	0
1991	0	0	1,116.4	0	NR	NR	0	0	1,056.1	0	0	0	0	0	0	0	0	0
1992	0	0	1,150.0	0	NR	NR	0	0		0	0	0	0	0	0	0	0	0
1993	0	0	1,072.2	0	NR	NR	0	0	1,056.1	0	0	0	0	0	0	0	0	0
1994	0	0	1,150.0	0	NR	NR	0	0		0	0	0	0.0	0	0	0	0	0
1995	-2.0	52.6	1,114.6	-0.7	NR	NR	4.7	50.4	1,798.3	1.8	1.8	1.8	1.8	1.8	1.8	3.0	1.0	1.8
1996	-7.0	-88.2	1,027.0	-9.5	NR	NR	-20.2	-85.8	-100	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5	-17.0	-13.0	-14.5
1997	-9.0	-88.7	1,002.2	-11.5	NR	NR	-22.1	-86.4	-100	-16.5	-16.5	-16.5	-16.5	-16.5	-16.5	-18.9	-15.0	-16.5
1998	-11.8	-52.9	943.0	-14.4	NR	NR	-23.6	-52.3	413.1	-19.0	-19.0	-19.0	-19.0	-19.0	-19.0	-21.0	-17.6	-19.0
1999	-15.1	-62.5	898.5	-18.2	NR	NR	-29.2	-61.9	299.2	-23.7	-23.7	-23.7	-23.7	-23.7	-23.7	-26.2	-22.1	-23.7
2000	-17.0	-58.8	1,015.6	-19.7	-29.1	-29.1	-29.1	-58.2	-0.5	-24.4	-24.4	-24.4	-24.4	-24.4	-24.4	-26.5	-23.0	-24.4
2001	-19.9	-55.4	17.5	-22.0	-29.9	-29.9	-29.9	-54.9	9.0	-25.9	-25.9	-25.9	-25.9	-25.9	-25.9	-27.7	-24.8	-25.9
2002	-27.9	-16.5	22.2	-27.0	-24.0	-24.0	-24.0	-16.7	116.9	-25.5	-25.5	-25.5	-25.5	-25.5	-25.5	-24.8	-25.9	-25.5
2003	-23.2	-29.5	-23.6	-23.6	-24.8	-24.8	-24.8	-29.4	80.7	-24.2	-24.2	-24.2	-24.2	-24.2	-24.2	-24.4	-24.0	-24.2
2004	-17.0	-44.6	-29.9	-18.0	-22.3	-22.3	-22.3	-43.9	-47.8	-20.0	-20.0	-20.0	-20.0	-20.0	-20.0	-21.0	-19.4	-20.0
2005	-16.5	-37.2	-17.1	-16.7	-17.6	-17.6	-17.6	-35.3	-53.0	-17.1	-17.1	-17.1	-17.1	-17.1	-17.1	-17.3	-16.9	-17.1
2006	-16.9	-50.1	-33.6	-17.2	-18.6	-18.6	-18.6	-46.8	-79.2	-17.8	-17.8	-17.8	-17.8	-17.8	-17.8	-18.2	-17.7	-17.8
2007	-19.6	-55.1	-35.8	-19.9	-21.1	-21.1	-21.1	-51.0	-100	-20.4	-20.4	-20.4	-20.4	-20.4	-20.4	-20.7	-20.3	-20.4
2008	-21.1	-53.5	-36.9	-21.3	-22.4	-22.4	-22.4	-49.5	-100	-21.8	-21.8	-21.8	-21.8	-21.8	-21.8	-22.0	-21.6	-21.8

1.A.4.b.ii Residential: Household and gardening (mobile)

All the SO_2 and Pb emissions are recalculated for period 1990-2008.

Explanation for recalculations in household and gardening sector:

- Correction of sulphur and lead content in fuels. Mistakes were made in 2010 submission which is corrected in 2011 submission. This correction has led to major changes in SO_2 and Pb emissions.

The difference in household and gardening emissions between 2010 and 2011 year submissions are presented in Table 3.78.

Table 10.4. The difference in household and gardening emissions between in 2010 and 2011 submission

	SO_2			**Pb**		
	Old, Gg	Recal, Gg	%	Old, Mg	Recal, Mg	%
1990	0.0003	0.0028	34,353	0.00001	0.126	1,155,969
1991	0.0003	0.0019	39,263	0.00001	0.143	1,155,969
1992	0.0004	0.0034	29,541	0.00001	0.153	1,155,969
1993	0.0006	0.0052	23,849	0.00001	0.167	1,155,969
1994	0.0008	0.0075	17,201	0.00001	0.153	1,155,969
1995	0.0013	0.0116	20,913	0.00003	0.306	1,155,969
1996	0.0014	0.0112	27,181	0.00004	0.437	1,155,969
1997	0.0016	0.0137	24,838	0.00004	0.464	1,155,969
1998	0.0011	0.0094	21,942	0.00002	0.266	1,155,969
1999	0.0015	0.0130	24,569	0.00004	0.432	1,155,969
2000	0.0017	0.0163	28,024	0.00002	0.049	258,109
2001	0.0020	0.0055	30,026	0.00002	0.060	258,109
2002	0.0018	0.0050	31,131	0.00002	0.056	258,109
2003	0.0019	0.0019	28,973	0.00002	0.055	258,109
2004	0.0017	0.0015	28,630	0.00002	0.019	99,900
2005	0.0004	0.0004	106,328	0.00002	0.018	99,900
2006	0.0002	0.0001	299,938	0.00002	0.019	99,900
2007	0.0002	0.0001	301,149	0.00002	0.020	99,900
2008	0.0002	0.0001	300,932	0.00002	0.021	99,900

1.A.4.c.ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery

All the emissions are recalculated for period 1990-2008.

Explanations for improvements and recalculations in agricultural sector:

- New emission factors in new "EMEP/EEA air pollutant emission inventory guidebook 2009"
- New gasoline emission factors. In 2010 submission gasoline 2-stroke bulk emission factors were used. This mistake is corrected and gasoline 4-stroke bulk emission factors are used in 2011 submission.
- Correction of sulphur and lead content in fuels. Mistakes were made in 2010 submission which is corrected in 2011 submission. This correction has led to major changes in SO_2 and Pb emissions.

The difference in agricultural machinery emissions between 2010 and 2011 year submissions are presented in Table 10.5.

Table 10.5. The difference in agricultural machinery emissions between in 2010 and 2011 submission

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f	Total PAHs
1990	-1.5	-93.3	575.8	-6.8	NR	NR	-29.7	-91.6	1,056.1	-16.3	-16.3	-16.3	-16.3	-16.3	-16.3	-20.6	-13.5	-16.3
1991	-1.0	-90.6	604.5	-4.8	NR	NR	-22.4	-88.2	1,056.1	-11.8	-11.8	-11.8	-11.8	-11.8	-11.8	-15.1	-9.6	-11.8
1992	-1.5	-93.2	554.3	-6.7	NR	NR	-29.3	-91.4	1,056.1	-16.0	-16.0	-16.0	-16.0	-16.0	-16.0	-20.3	-13.2	-16.0
1993	-0.7	-86.4	566.1	-3.2	NR	NR	-16.1	-83.3	1,056.1	-8.1	-8.1	-8.1	-8.1	-8.1	-8.1	-10.6	-6.6	-8.1
1994	-0.2	-63.7	489.2	-0.9	NR	NR	-5.0	-58.0	1,056.1	-2.4	-2.4	-2.4	-2.4	-2.4	-2.4	-3.1	-1.9	-2.4
1995	-0.2	-67.9	520.4	-1.1	NR	NR	-6.0	-62.5	1,056.1	-2.9	-2.9	-2.9	-2.9	-2.9	-2.9	-3.8	-2.3	-2.9
1996	-0.4	-79.1	465.9	-1.9	NR	NR	-10.2	-74.8	1,056.1	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-6.6	-4.0	-5.0
1997	-0.4	-80.4	529.2	-2.1	NR	NR	-11.0	-76.3	1,056.1	-5.4	-5.4	-5.4	-5.4	-5.4	-5.4	-7.1	-4.4	-5.4
1998	-0.4	-80.0	382.4	-2.0	NR	NR	-10.7	-75.8	1,056.1	-5.3	-5.3	-5.3	-5.3	-5.3	-5.3	-6.9	-4.3	-5.3
1999	-0.5	-80.9	239.0	-2.2	NR	NR	-11.3	-76.9	1,056.1	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6	-7.3	-4.5	-5.5
2000	-0.3	-73.5	227.0	-1.4	-7.7	-7.7	-7.7	-68.5	158.2	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7	-4.9	-3.0	-3.7
2001	-0.4	-76.6	5.8	-1.7	-9.0	-9.0	-9.0	-72.0	158.2	-4.3	-4.3	-4.3	-4.3	-4.3	-4.3	-5.7	-3.5	-4.3
2002	-0.1	-49.8	4.8	-0.5	-2.9	-2.9	-2.9	-43.8	158.2	-1.4	-1.4	-1.4	-1.4	-1.4	-1.4	-1.8	-1.1	-1.4
2003	-0.2	-65.6	0	-1.0	-5.4	-5.4	-5.4	-59.9	158.2	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-3.4	-2.1	-2.6
2004	-0.3	-75.9	-3.6	-1.6	-8.6	-8.6	-8.6	-71.2	0	-4.2	-4.2	-4.2	-4.2	-4.2	-4.2	-5.5	-3.4	-4.2
2005	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0
2006	0	0	-1.2	0	0	0	0	0		0	0	0	0	0	0	0	0	0
2007	-0.1	-53.9	-1.4	-0.6	-3.4	-3.4	-3.4	-47.9	0	-1.6	-1.6	-1.6	-1.6	-4.2	-1.6	-2.1	-1.3	-1.6
2008	0	0	85.8	0	0	0	0	0		0	0	0	0	0	0	0	0	0

1.A.2.f.ii Mobile Combustion in manufacturing industries and construction

All the emissions are recalculated for period 1990-2008.

Explanations for improvements and recalculations in industrial sector:

- New emission factors in new “EMEP/EEA air pollutant emission inventory guidebook 2009”
- New gasoline emission factors. In 2010 submission gasoline 2-stroke bulk emission factors were used. This mistake is corrected and gasoline 4-stroke bulk emission factors are used in 2011 submission.
- Correction of sulphur and lead content in fuels. Mistakes were made in 2010 submission which is corrected in 2011 submission. This correction has led to major changes in SO_2 and Pb emissions.

The difference in industrial machinery emissions between 2010 and 2011 year submissions are presented in Table 10.6.

Table 10.6. The difference in industrial machinery emissions between in 2010 and 2011 submission

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb	Cd	Cr	Cu	Ni	Se	Zn	B(a)p	B(b)f	Total PAHs
1990	-0.3	-72.6	1,140.3	-1.4	NR	NR	-6.3	-68.1	1,056.1	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6	-4.7	-2.9	-3.6
1991	-0.2	-63.3	1,143.7	-0.9	NR	NR	-4.2	-58.2	1,056.1	-2.4	-2.4	-2.4	-2.4	-2.4	-2.4	-3.1	-1.9	-2.4
1992	-0.3	-70.5	1,141.3	-1.2	NR	NR	-5.7	-65.8	1,056.1	-3.2	-3.2	-3.2	-3.2	-3.2	-3.2	-4.3	-2.6	-3.2
1993	-0.3	-72.3	1,122.9	-1.4	NR	NR	-6.2	-67.8	1,056.1	-3.5	-3.5	-3.5	-3.5	-3.5	-3.5	-4.6	-2.8	-3.5
1994	-0.1	-46.2	1,116.0	-0.4	NR	NR	-2.1	-41.0	1,056.1	-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	-1.6	-1.0	-1.2
1995	-0.4	-78.8	976.1	-1.9	NR	NR	-8.6	-75.0	1,056.1	-4.9	-4.9	-4.9	-4.9	-4.9	-4.9	-6.5	-4.0	-4.9
1996	-0.2	-65.7	1,022.3	-1.0	NR	NR	-4.6	-60.7	1,056.1	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-3.4	-2.1	-2.6
1997	-0.2	-67.2	875.2	-1.1	NR	NR	-4.9	-62.4	1,056.1	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-3.7	-2.2	-2.8
1998	-0.6	-83.2	489.0	-2.5	NR	NR	-11.1	-80.0	1,056.1	-6.5	-6.5	-6.5	-6.5	-6.5	-6.5	-8.5	-5.3	-6.5
1999	-0.5	-80.9	244.8	-2.2	NR	NR	-9.7	-77.3	1,056.1	-5.6	-5.6	-5.6	-5.6	-5.6	-5.6	-7.3	-4.5	-5.6
2000	-0.6	-82.7	435.6	-2.4	-10.8	-10.8	-10.8	-79.4	158.2	-6.3	-6.3	-6.3	-6.3	-6.3	-6.3	-8.2	-5.1	-6.3
2001	0	0	5.2	0	0	0	0	0		0	0	0	0	0	0	0	0	0
2002	-0.4	-77.1	10.9	-1.7	-7.8	-7.8	-7.8	-73.1	158.2	-4.5	-4.5	-4.5	-4.5	-4.5	-4.5	-5.9	-3.6	-4.5
2003	-1.1	-90.5	0.0	-4.8	-19.4	-19.4	-19.4	-88.4	158.2	-11.8	-11.8	-11.8	-11.8	-11.8	-11.8	-15.1	-9.6	-11.8
2004	-0.3	-73.3	-14.3	-1.4	-6.5	-6.5	-6.5	-68.9	0	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7	-4.9	-3.0	-3.7
2005	-0.3	-73.3	0	-1.4	-6.5	-6.5	-6.5	-68.9	0	-3.7	-3.7	-3.7	-3.7	-3.7	-3.7	-4.9	-3.0	-3.7
2006	-0.3	-69.8	-19.9	-1.2	-5.5	-5.5	-5.5	-65.0	0	-3.1	-3.1	-3.1	-3.1	-3.1	-3.1	-4.1	-2.5	-3.1
2007	-0.3	-69.1	-20.0	-1.2	-5.3	-5.3	-5.3	-64.3	0	-3.0	-3.0	-3.0	-3.0	-3.0	-3.0	-4.0	-2.4	-3.0
2008	0	0	-20.0	0	0	0	0	0		0	0	0	0	0	0	0	0	0

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

All the emissions are recalculated for period 1990-2008.

Explanations for recalculations in international maritime sector:

- New emission factor in new "EMEP/EEA air pollutant emission inventory guidebook 2009".
- New emission factors for PCDD/PCDF, HCB and PCB in new "EMEP/EEA air pollutant emission inventory guidebook 2009". Therefore new pollutants emissions are included in international maritime navigation sector (In 2011 submission emissions for B(a)p, (B(b)f, B(k)f, I(1,2,3-cd)p and Total PAHs are not calculated because of these emission factors are not estimated in new Guidebook).

The difference in household and gardening emissions between 2010 and 2011 year submissions are presented in Table 10.7.

Table 10.7. The difference in international maritime emissions between in 2010 and 2011 submission

	NO_x	NMVOC	$PM_{2,5}$	PM_{10}	TSP	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	10.0	13.1	NR	NR	-6.2	-6.7	-31.5	-12.4	35.0	251.9	176.5	7.2	-47.7	43.0
1991	10.0	13.2	NR	NR	-6.2	-6.6	-31.4	-12.7	35.0	251.6	177.6	7.2	-47.7	43.3
1992	9.8	13.9	NR	NR	-4.0	-1.7	-28.4	-22.7	33.2	237.7	225.2	8.3	-48.0	57.4
1993	9.6	14.5	NR	NR	-1.9	2.3	-25.7	-27.6	31.4	224.5	273.3	9.4	-48.3	68.6
1994	9.6	14.6	NR	NR	-1.4	3.2	-25.1	-28.4	31.0	221.3	285.4	9.7	-48.3	71.0
1995	9.6	14.4	NR	NR	-2.4	1.4	-26.3	-26.7	31.9	227.6	261.9	9.1	-48.2	66.2
1996	9.7	14.1	NR	NR	-3.5	-0.7	-27.8	-24.1	32.8	234.7	235.9	8.5	-48.1	60.1
1997	9.8	13.8	NR	NR	-4.5	-2.8	-29.1	-20.9	33.7	241.1	213.2	8.0	-47.9	54.2
1998	9.8	13.7	NR	NR	-4.9	-3.5	-29.5	-19.6	33.9	243.2	205.9	7.9	-47.9	52.1
1999	9.8	13.9	NR	NR	-4.2	-2.2	-28.7	-22.0	33.4	239.1	220.1	8.2	-48.0	56.0
2000	9.7	14.1	-12.2	-3.3	-3.3	-0.2	-27.4	-24.7	32.6	233.1	241.6	8.7	-48.1	61.5
2001	9.6	14.3	-11.4	-2.4	-2.4	1.3	-26.4	-26.5	31.9	228.0	260.5	9.1	-48.2	65.9
2002	9.7	14.2	-12.0	-3.0	-3.0	0.3	-27.1	-25.3	32.4	231.5	247.5	8.8	-48.1	62.9
2003	9.7	14.1	-12.3	-3.4	-3.4	-0.4	-27.6	-24.4	32.7	233.8	239.3	8.6	-48.1	60.9
2004	9.8	13.9	-13.2	-4.2	-4.2	-2.2	-28.7	-21.9	33.4	239.2	219.9	8.2	-48.0	56.0
2005	9.7	14.0	-12.6	-3.6	-3.6	-1.0	-27.9	-23.7	32.9	235.4	233.4	8.5	-48.1	59.5
2006	9.9	13.4	-14.6	-5.7	-5.7	-5.4	-30.7	-15.8	34.6	248.3	188.5	7.5	-47.8	46.9
2007	10.0	13.0	-15.4	-6.5	-6.5	-7.4	-31.9	-10.4	35.2	253.6	170.8	7.1	-47.7	41.0
2008	10.1	12.8	-15.8	-6.9	-6.9	-8.4	-32.4	-6.9	35.5	256.1	162.6	6.9	-47.6	38.1

10.1.1.2 Fugitive fuel emissions

1.B.2.a.v Distribution of oil products.

NMVOC emission was recalculated for the period from 1990 to 2009. The main reason for change of data is emission factor improvement and activity data correction.

Table 10.8. The difference in emissions from distribution of oil products between 2010 and 2011 submissions

Year	NMVOC		
	2010	2011	%
1990	2.060	2.378	15.44
1991	1.820	2.143	17.75
1992	0.900	1.219	35.44
1993	1.240	1.247	0.56
1994	1.550	1.542	-0.52
1995	1.600	1.596	-0.25
1996	1.870	1.871	0.05
1997	2.680	2.682	0.07
1998	2.340	2.343	0.13
1999	2.690	2.694	0.15
2000	4.290	4.265	-0.58
2001	5.230	5.134	-1.84
2002	4.930	4.501	-8.70
2003	4.650	4.352	-6.41
2004	5.050	4.538	-10.14
2005	4.350	3.666	-15.72
2006	3.300	3.108	-5.82
2007	1.910	1.714	-10.26
2008	1.383	1.137	-17.81

1 B 2 b Natural gas

NMVOC emission was recalculated for the period from 1990 to 2009. The main reason for recalculation is emission factor improvement. The improvements in this sector were planned at last year submission.

Table 10.9. The difference in emissions from natural gas between 2010 and 2011 submissions

Year	NMVOC		
	2010	2011	%
1990	5.730	0.096	-98.32
1991	5.750	0.096	-98.33
1992	3.360	0.056	-98.33
1993	1.670	0.028	-98.32
1994	2.400	0.041	-98.29
1995	2.730	0.036	-98.68
1996	3.010	0.04	-98.67
1997	2.930	0.039	-98.67
1998	2.780	0.037	-98.67

1999	2.700	0.036	-98.67
2000	3.110	0.031	-99.00
2001	3.340	0.033	-99.01
2002	2.800	0.028	-99.00
2003	3.080	0.032	-98.96
2004	3.640	0.036	-99.01
2005	3.760	0.028	-99.26
2006	3.810	0.028	-99.27
2007	3.790	0.028	-99.26
2008	3.630	0.027	-99.26

10.1.2 Industrial Processes (NFR 2)

2.D.2 Food and drink

The NMVOC emissions in period 1990-2008 were recalculated. Main reason for that was renewed Guidebook with new emission factors and corrected statistical data. Calculations were based on Tier 2 method.

Year	NMVOC		
	Old, Gg	Recal, Gg	%
1990	1.780	1.788	0.5
1991	1.790	1.541	-13.9
1992	1.550	1.097	-29.2
1993	1.830	0.899	-50.9
1994	1.530	0.837	-45.3
1995	1.760	0.839	-52.3
1996	1.520	0.713	-53.1
1997	1.480	0.745	-49.6
1998	1.200	0.742	-38.2
1999	0.770	0.646	-16.1
2000	0.770	0.619	-19.7
2001	0.610	0.650	6.6
2002	0.700	0.715	2.1
2003	0.850	0.734	-13.6
2004	0.920	0.768	-16.5
2005	0.960	0.724	-24.6
2006	0.930	0.779	-16.3
2007	0.960	0.808	-15.8
2008	0.574	0.799	39.3

10.1.3 Solvent and Other Product Use (NFR 3)

NFR 3.A Paint application

Within NFR 3.A code recalculation of NMVOC emissions has been performed for year 2007 in NFR 3.A.1, due to the new NMVOC emissions calculation methodology, which was used to calculate the NMVOC emissions for the years 1990-2006, 2008 and 2009.

NFR 3.A.2 was updated for the whole time series with the NMVOC emissions from car repairing in diffuse sources. For the point sources there was made some corrections in the NMVOC emissions due to the change of emissions allocation for some activity. The corrections were made for the years 2000-2008.

Due to the updating and correcting of the data, the average growth of the NMVOC emissions for the years 1990-2008 is 336% in relation with the 2010 submission.

NFR 3.B Degreasing and dry cleaning

Additionally to the NMVOC emissions from the point sources, the emissions from the diffuse sources are included. In NFR 3.B.2 NMVOC emissions for the year 1990 were recalculated due to the new emissions calculation methodology.

Due to the updating and correcting the data, the average growth of the NMVOC emissions for the years 1990-2008 is 9095% in relation with the 2010 submission.

NFR 3.C Chemical products manufacturing and processing

No recalculations were made. For the years 1990-2003 and 2008 only precision corrections were made and for the years 2004-2007 NMVOC emissions miscalculations were corrected. Because of that the average growth of the NMVOC emissions for the years 1990-2008 is 5% in relation with the 2010 submission.

NFR 3.D Printing, domestic solvent use (other than paint application) and other product use

Recalculations were made for the NFR 3.D.2 due to the new methodology and emission factor. The average growth of the NMVOC emissions for the years 1990-2008 is -26.4% in relation with the 2010 submission.

Recalculated were also emissions for NFR 3.D1 and 3.D.3 for the years 2007 and 2008 because of the new methodology and emission factors. NMVOC emissions for the years 1990-2008 are included in the inventory first time.

Due to the updating and recalculating the data, the average growth of the NMVOC emissions for the NFR 3.D sector for the years 1990-2008 is 168.4% in relation with the 2010 submission.

Table 10.10. 2011 submission of NMVOC emissions and the difference in relation with the 2010 submission

Year	3.A			3.B			3.C			3.D		
	NMVOC, Gg		Difference (%)	NMVOC, Gg		Difference (%)	NMVOC, Gg		Difference (%)	NMVOC, Gg		Difference (%)
	2010	2011		2010	2011		2010	2011		2010	2011	
1990	1.600	2.331	45.7	0.030	1.198	3,893.2	0.500	0.496	-0.8	5.070	5.418	6.9
1991	1.950	2.748	40.9	0.040	1.181	2,853.2	0.620	0.615	-0.7	5.180	5.496	6.1
1992	0.640	1.672	161.3	0.010	1.160	11,497.4	0.200	0.201	0.6	4.390	4.713	7.4
1993	0.480	1.540	220.7	0.010	1.136	11,260.4	0.130	0.135	3.7	4.170	4.481	7.5
1994	0.460	2.323	405.0	0.010	1.154	11,441.0	0.140	0.135	-3.2	4.110	4.462	8.6
1995	0.940	3.163	236.5	0.010	1.182	11,719.1	0.250	0.250	0.2	4.130	4.696	13.7
1996	0.780	3.590	360.3	0.010	1.288	12,784.7	0.200	0.197	-1.5	4.040	4.772	18.1
1997	0.820	4.006	388.5	0.010	1.228	12,178.0	0.190	0.192	1.1	3.990	4.639	16.3
1998	1.200	4.312	259.3	0.020	1.202	5,908.3	0.310	0.307	-0.9	4.150	4.972	19.8
1999	0.890	4.037	353.6	0.010	1.222	12,122.5	0.220	0.217	-1.5	3.610	4.933	36.7
2000	0.460	2.418	425.7	0.000	1.190		0.100	0.107	7.0	3.680	4.927	33.9
2001	0.400	2.258	464.5	0.010	1.144	11,336.0	0.110	0.113	2.6	3.810	4.522	18.7
2002	0.560	2.654	373.9	0.010	1.174	11,639.1	0.150	0.151	0.6	3.810	4.562	19.7
2003	0.500	2.779	455.7	0.010	1.161	11,505.7	0.130	0.127	-2.2	3.780	4.398	16.3
2004	0.470	3.145	569.2	0.010	1.157	11,469.8	0.150	0.184	22.6	3.730	4.094	9.8
2005	0.540	3.624	571.1	0.000	1.156		0.090	0.125	39.2	3.810	4.186	9.9
2006	0.670	3.705	453.0	0.020	1.187	5,834.6	0.200	0.226	13.2	3.930	4.832	23.0
2007	0.710	3.610	408.5	0.024	1.144	4,666.9	0.330	0.384	16.5	3.870	4.768	23.2
2008	0.904	2.642	192.2	0.043	1.135	2,510.6	0.473	0.468	-1.0	3.657	3.626	-0.9
2009		2.126			1.030			0.291			2.400	
Trend 1990-2009 (%)		**-8.8**			**-14.0**			**-41.4**			**-55.7**	

10.1.4 Agriculture (NFR 4)

NFR 4 B Manure Management

The NH_3 and TSP emissions in period 1990-2008 and PM_{10}, $PM_{2.5}$ emissions in period 2000-2008 were recalculated for all activities. Main reason for that was renewed Guidebook with new emission factors. Calculations were based on Tier 1 method.

Table 10.11. Cattle dairy (4.B.1.a)

Year	NH_3	TSP	$PM_{2.5}$	PM_{10}
1990	0.7	-10.3	NR	NR
1991	0.7	-8.2	NR	NR
1992	0.7	-7.9	NR	NR
1993	0.7	-9.4	NR	NR
1994	0.8	-11.1	NR	NR
1995	0.8	-7.4	NR	NR
1996	0.7	-8.6	NR	NR
1997	-3.0	-10.6	NR	NR
1998	4.4	-9.5	NR	NR
1999	6.4	-7.8	NR	NR
2000	8.2	-9.7	151.1	-9.3
2001	9.9	-6.6	195.8	-7.4
2002	12.0	-7.6	165.9	-16.8
2003	13.7	-9.4	168.6	-10.5
2004	15.6	-6.9	168.0	-16.1
2005	17.6	-9.8	159.4	-9.8
2006	19.3	-13.4	149.3	-2.4
2007	13.3	-17.7	136.9	-7.3
2008	19.3	-9.7	160.0	-9.7

Table 10.12. Cattle non-dairy (4.B.1.b)

Year	NH_3	TSP	$PM_{2.5}$	PM_{10}
1990	-35.6	-39.5	NR	NR
1991	-35.7	-39.3	NR	NR
1992	-35.7	-39.9	NR	NR
1993	-35.6	-40.0	NR	NR
1994	-35.8	-38.4	NR	NR
1995	-35.8	-38.4	NR	NR
1996	-35.6	-39.1	NR	NR
1997	-35.7	-39.9	NR	NR
1998	-35.7	-39.0	NR	NR
1999	-35.6	-37.6	NR	NR
2000	-35.6	-39.9	77.2	-0.9
2001	-7.9	-41.4	111.0	5.1
2002	-9.3	-38.6	121.3	-8.1
2003	-10.8	-39.7	87.2	-0.1
2004	-12.3	-40.8	113.3	6.3
2005	-13.4	-39.3	118.7	-0.9
2006	-15.1	-39.4	118.2	8.7
2007	-19.7	-43.6	120.0	-8.7
2008	-15.1	-39.8	80.8	0.0

Table 10.13. Sheep (4.B.3)

Year	Old	Recal	%
1990	0.190	0.196	3.0
1991	0.190	0.200	5.2
1992	0.170	0.174	2.4
1993	0.110	0.117	6.0
1994	0.080	0.086	7.6
1995	0.070	0.070	-0.4
1996	0.050	0.055	9.8
1997	0.050	0.050	-0.3
1998	0.040	0.043	7.8
1999	0.040	0.043	8.1
2000	0.040	0.045	12.7
2001	0.040	0.045	13.4
2002	0.040	0.047	18.3
2003	0.040	0.048	20.1
2004	0.050	0.057	14.8
2005	0.070	0.073	4.8
2006	0.080	0.092	15.5
2007	0.110	0.107	-2.8
2008	0.110	0.115	4.5

Table 10.14. Horses (4.B.6)

Year	Old	Recal	%
1990	0.070	0.127	81.8
1991	0.060	0.115	92.4
1992	0.050	0.098	95.4
1993	0.040	0.077	92.4
1994	0.040	0.074	85.0
1995	0.040	0.068	70.2
1996	0.020	0.062	210.8
1997	0.030	0.062	107.2
1998	0.030	0.058	92.4
1999	0.030	0.058	92.4
2000	0.030	0.062	107.2
2001	0.040	0.081	103.5
2002	0.040	0.078	96.1
2003	0.050	0.086	71.7
2004	0.040	0.075	88.7
2005	0.040	0.071	77.6
2006	0.040	0.073	81.3
2007	0.050	0.078	56.9
2008	0.042	0.078	85.0

Table 10.15. Swine (4.B.8)

Year	NH_3	TSP	$PM_{2.5}$	PM_{10}
1990	2.6	-42.1	NR	NR
1991	2.4	-42.2	NR	NR
1992	2.2	-41.4	NR	NR
1993	2.6	-40.1	NR	NR
1994	1.9	-40.8	NR	NR
1995	2.3	-41.5	NR	NR
1996	0.7	-28.0	NR	NR
1997	0.2	-26.1	NR	NR
1998	0.8	-29.4	NR	NR
1999	0.9	-31.3	NR	NR
2000	0.3	-32.3	-52.5	-32.2
2001	-15.0	-39.9	-61.4	-39.2
2002	-21.8	-35.1	-58.3	-34.2
2003	-3.7	-54.5	-55.0	-37.2
2004	-5.1	-52.0	-61.2	-38.8
2005	-2.9	-53.7	-60.3	-37.4
2006	-0.1	-52.1	-59.0	-35.4
2007	-0.4	-46.3	-52.7	-31.2
2008	-5.6	-39.3	-56.6	-39.4

Table 10.16. Laying hens (4.B.9.a)

Year	NH_3	TSP	$PM_{2.5}$	PM_{10}
1990	29.4	-54.8	NR	NR
1991	29.0	-54.0	NR	NR
1992	28.9	-52.7	NR	NR
1993	31.0	-55.4	NR	NR
1994	30.5	-56.7	NR	NR
1995	28.1	-54.7	NR	NR
1996	31.5	-58.6	NR	NR
1997	28.8	-53.7	NR	NR
1998	30.5	-53.1	NR	NR
1999	30.0	-56.2	NR	NR
2000	-44.9	-80.9	-89.6	-80.8
2001	29.1	-55.6	-76.5	-60.0
2002	31.1	-54.2	-74.5	-55.2
2003	29.7	-54.5	-73.9	-54.1
2004	29.3	-49.2	-76.9	-54.2
2005	32.3	-54.9	-76.1	-59.4
2006	31.1	-48.4	-72.7	-53.6
2007	31.4	-54.2	-83.0	-51.9
2008	-17.5	-71.0	-84.7	-71.0

Table 10.17. Broilers (4.B.9.b)

Year	NH_3	TSP	$PM_{2.5}$	PM_{10}
1990	-21.2	38.7	NR	NR
1991	-21.7	38.9	NR	NR
1992	-21.0	38.1	NR	NR
1993	-21.6	38.0	NR	NR
1994	-21.1	42.3	NR	NR
1995	-20.9	41.2	NR	NR
1996	-21.4	40.9	NR	NR
1997	-21.6	45.6	NR	NR
1998	-20.6	36.9	NR	NR
1999	-20.7	37.7	NR	NR
2000	134.3	319.8	160.9	330.7
2001	-22.2	37.3	-16.8	36.0
2002	-22.4	39.6	-16.9	38.6
2003	-21.2	39.3	-19.8	38.6
2004	-21.6	42.1	-13.9	40.8
2005	-22.4	40.3	-23.5	42.2
2006	-22.1	36.3	-17.3	38.2
2007	-21.5	41.3	-40.0	48.5
2008	5.0	85.9	12.9	85.9

Table 10.18. Other poultry (4.B.9.d)

Year	NH_3	TSP	$PM_{2.5}$	PM_{10}
1990	3.5	-87.4	NR	NR
1991	5.2	-87.4	NR	NR
1992	-0.1	-88.3	NR	NR
1993	2.1	-87.4	NR	NR
1994	-0.9	-87.8	NR	NR
1995	0.6	-88.6	NR	NR
1996	-1.8	-87.3	NR	NR
1997	9.9	-88.1	NR	NR
1998	0.1	-88.0	NR	NR
1999	4.0	-86.5	NR	NR
2000	349.6	-35.2	-62.1	-9.3
2001	8.1	-84.4	-93.9	-9.3
2002	22.6	-87.4	-89.7	-9.3
2003	-26.4	-88.2	-93.8	-9.3
2004	1.6	-85.3	-91.4	-9.3
2005	16.4	-83.2	-90.2	-9.3
2006	-6.3	-89.9	-94.1	-9.3
2007	28.2	-90.8	-94.6	-9.3
2008	146.1	-70.5	-82.8	-9.3

4.D Agricultural Soils

The NH_3 emissions in period 1990-2008 and PM_{10} emissions in period 2000-2008 were recalculated for all activities. Main reason for that was renewed Guidebook with new emission factors. Calculations were based on Tier 1 method.

Table 10.19. Recalculated NH_3 and $PM_{2.5}$ emissions from agricultural soils

Year	**NH_3**, Gg			**$PM_{2.5}$**, Gg		
	Old	Recal	%	Old	Recal	%
1990	5.22	6.023	15.4	NR	NR	NR
1991	4.25	4.902	15.3	NR	NR	NR
1992	2.84	4.902	72.6	NR	NR	NR
1993	2.18	2.516	15.4	NR	NR	NR
1994	1.92	2.190	14.0	NR	NR	NR
1995	1.38	1.588	15.1	NR	NR	NR
1996	1.21	1.391	15.0	NR	NR	NR
1997	1.49	1.720	15.4	NR	NR	NR
1998	1.82	2.094	15.1	NR	NR	NR
1999	1.42	1.671	17.7	NR	NR	NR
2000	1.63	1.881	15.4	0.080	0.706	782.4
2001	1.43	1.647	15.2	0.060	0.567	845.1
2002	1.22	1.403	15.0	0.060	0.612	919.7
2003	1.69	1.953	15.6	0.052	0.601	1,054.9
2004	1.81	2.086	15.2	0.050	0.631	1,161.4
2005	1.46	1.687	15.5	0.060	0.830	1,284.0
2006	1.65	1.899	15.1	0.060	0.867	1,345.8
2007	1.82	2.098	15.3	0.060	0.968	1,513.2
2008	2.583	2.978	15.3	0.060	0.745	1,146.8

11. PROJECTION

On the frame of the draft „National program on reduction of pollutants emissions from the point and mobile sources by 2015“ are established emission projections for the NEC Directive substances and other pollutants by 2010 and 2015.

Table 11.1. National emissions ceilings for 2010 and emissions projections for 2010 and 2015

Pollutant	National emissions ceiling for 2010 (Gg)	Emission projection 2010 (Gg)	Emission projection 2015 (Gg)
SO_2	100	80.4	43.4
NO_x	60	38.6	36.2
NMVOC	49	40.7	41.7
NH_3	29	8.8	7.3
TSP	NA	25.5	23.3
PM_{10}	NA	17.3	16.5
$PM_{2,5}$	NA	14.8	14.6

Pollutant	National emissions ceiling for 2010 (Gg)	Emission projection 2010 (Gg)	Emission projection 2015 (Gg)
Pb, Mg	NA	39.1	34.6
Cd, Mg	NA	0.6	0.5
Hg, Mg	NA	0.6	0.5
Dioxin, g I-TEQ	NA	3.5	3.46
PAHs, Mg	NA	12.1	12.1

The program develops emission reduction measurements for a different sectors of pollution, which should be taken for achievement of the environmental objectives.

http://www.envir.ee/orb.aw/class=file/action=preview/id=375957/nec_final020107.pdf

Estonia will recalculate the emissions projections after implementing the industrial emissions directive 2010/75/EU into the state legislation, because of the directive states to the large combustion plants, which are the biggest air polluters in Estonia, more stringent emission limit values. (Ministry of the Environment)

ANNEX I

Table 1. Key sources categories for NO_x emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**10.314**	**35.56**
1 A 3 b iii Road transport:, Heavy duty vehicles	**4.947**	**52.61**
1 A 3 b i Road transport: Passenger cars	**3.924**	**66.14**
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	**2.044**	**73.19**
1 A 3 c Railways	**1.834**	**79.51**
1 A 4 b i Residential: Stationary plants	**1.554**	**84.87**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	1.333	89.46
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.820	92.29
1 A 3 b ii Road transport:Light duty vehicles	0.666	94.59
1 A 4 a i Commercial / institutional: Stationary	0.344	95.77
1 A 1 c Manufacture of solid fuels and other energy industries	0.319	96.87
1 A 3 d ii National navigation (Shipping)	0.297	97.90
1 A 4 a ii Commercial / institutional: Mobile	0.280	98.86
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.080	99.14
1 A 3 a i (i) International aviation (LTO)	0.075	99.40
1 A 4 b ii Residential: Household and gardening (mobile)	0.049	99.56
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.034	99.68
2 B 1 Ammonia production	0.025	99.77
2 D 1 Pulp and paper	0.017	99.83
6 C b Industrial waste incineration (d)	0.016	99.88
2 C 1 Iron and steel production	0.008	99.91
1 A 3 b iv Road transport: Mopeds & motorcycles	0.008	99.94
2 A 7 a Quarrying and mining of minerals other than coal	0.007	99.96
1 A 1 b Petroleum refining	0.004	99.97
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.003	99.98
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.002	99.99
1 B 2 a iv Refining / storage	0.001	99.99
1 B 2 c Venting and flaring	0.001	100.00
6 B Waste-water handling	0.000	100.00
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.000	100.00
2 C 5 e Other metal production	0.000	100.00
2 G Other production, consumption, storage, transportation or handling of bulk products	0.000	100.00
6 C d Cremation	0.000	100.00
2 D 2 Food and drink	0.000	100.00
2 C 3 Aluminum production	0.000	100.00
3 A 2 Industrial coating application	0.000	100.00

2 C 5 b Lead production	0.000	100.00
2 D 3 Wood processing	0.000	100.00
2 B 5 a Other chemical industry	0.000	100.00

Table 2. Key sources categories for NMVOC emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**17.116**	**47.17**
1 A 3 b i Road transport: Passenger cars	**2.456**	**53.94**
3 A 1 Decorative coating application	**1.503**	**58.09**
1 A 1 c Manufacture of solid fuels and other energy industries	**1.429**	**62.02**
3 D 2 Domestic solvent use including fungicides	**1.340**	**65.72**
4 B 1 a Cattle dairy	**1.315**	**69.34**
1 B 2 a v Distribution of oil products	**1.266**	**72.83**
4 B 1 b Cattle non-dairy	**1.021**	**75.65**
3 B 1 Degreasing	**1.008**	**78.42**
4 B 8 Swine	**0.903**	**80.91**
3 D 3 Other product use	0.831	83.20
2 D 2 Food and drink	0.747	85.26
3 A 2 Industrial coating application	0.623	86.97
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.605	88.64
1 A 4 b ii Residential: Household and gardening (mobile)	0.520	90.07
1 A 3 b v Road transport: Gasoline evaporation	0.464	91.35
1 A 1 a Public electricity and heat production	0.422	92.52
1 B 2 a iv Refining / storage	0.398	93.61
3 C Chemical products	0.291	94.41
1 A 3 b iii Road transport:, Heavy duty vehicles	0.263	95.14
3 D 1 Printing	0.229	95.77
1 A 4 a ii Commercial / institutional: Mobile	0.216	96.37
4 B 9 a Laying hens	0.199	96.92
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.196	97.46
1 A 3 c Railways	0.163	97.91
4 B 9 b Broilers	0.110	98.21
1 A 3 b ii Road transport:Light duty vehicles	0.109	98.51
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.085	98.74
1 A 3 d ii National navigation (Shipping)	0.057	98.90
2 B 5 b Storage, handling and transport of chemical products	0.046	99.03
1 A 3 b iv Road transport: Mopeds & motorcycles	0.041	99.14
4 B 9 d Other poultry	0.040	99.25
1 A 4 a i Commercial / institutional: Stationary	0.038	99.35
2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)	0.025	99.42
6 A Solid waste disposal on land	0.024	99.49
3 B 2 Dry cleaning	0.022	99.55
2 B 5 a Other chemical industry	0.022	99.61
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.018	99.66
1 B 2 b Natural gas	0.018	99.71
4 B 3 Sheep	0.016	99.75
4 B 6 Horses	0.016	99.80

2 A 6 Road paving with asphalt	0.016	99.84
2 D 1 Pulp and paper	0.012	99.87
6 C d Cremation	0.010	99.90
2 D 3 Wood processing	0.009	99.92
1 A 3 a i (i) International aviation (LTO)	0.008	99.94
6 B Waste-water handling	0.005	99.96
2 C 1 Iron and steel production	0.004	99.97
6 D Other waste(e)	0.004	99.98
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.002	99.99
1 B 2 c Venting and flaring	0.002	99.99
6 C b Industrial waste incineration (d)	0.001	99.99
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.001	100.00
2 B 1 Ammonia production	0.001	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.000	100.00
2 C 5 e Other metal production	0.000	100.00
2 F Consumption of POPs and heavy metals (e.g. electricial and scientific equipment)	0.000	100.00
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.000	100.00
2 C 3 Aluminum production	0.000	100.00
4 D 1 a Synthetic N-fertilizers	0.000	100.00

Table 3. Key sources categories for SO_x emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**48.527**	**88.53**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	4.817	97.32
1 A 1 c Manufacture of solid fuels and other energy industries	0.611	98.43
1 A 4 b i Residential: Stationary plants	0.402	99.17
1 A 4 a i Commercial / institutional: Stationary	0.219	99.57
1 A 3 c Railways	0.050	99.66
1 A 3 d ii National navigation (Shipping)	0.032	99.72
2 D 1 Pulp and paper	0.024	99.76
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.022	99.80
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.022	99.84
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.019	99.88
6 C b Industrial waste incineration (d)	0.017	99.91
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.014	99.93
1 B 2 a iv Refining / storage	0.011	99.95
1 A 3 a i (i) International aviation (LTO)	0.007	99.97
1 A 3 b i Road transport: Passenger cars	0.007	99.98
1 A 3 b iii Road transport:, Heavy duty vehicles	0.003	99.99
1 B 2 c Venting and flaring	0.001	99.99
1 A 3 b ii Road transport:Light duty vehicles	0.001	99.99
3 D 3 Other product use	0.001	99.99

2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)	0.001	99.99
2 A 7 a Quarrying and mining of minerals other than coal	0.001	100.00
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.001	100.00
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.000	100.00
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.000	100.00
2 B 1 Ammonia production	0.000	100.00
1 A 4 a ii Commercial / institutional: Mobile	0.000	100.00
6 B Waste-water handling	0.000	100.00
3 C Chemical products	0.000	100.00
1 A 4 b ii Residential: Household and gardening (mobile)	0.000	100.00
6 C d Cremation	0.000	100.00
2 C 1 Iron and steel production	0.000	100.00
2 D 3 Wood processing	0.000	100.00
2 B 5 a Other chemical industry	0.000	100.00
2 D 2 Food and drink	0.000	100.00
2 C 5 b Lead production	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0.000	100.00
2 B 5 b Storage, handling and transport of chemical products	0.000	100.00
6 D Other waste(e)	0.000	100.00

Table 4. Key sources categories for NH_3 emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
4 B 1 a Cattle dairy	**3.288**	**33.40**
4 D 1 a Synthetic N-fertilizers	**2.296**	**56.72**
4 B 1 b Cattle non-dairy	**1.675**	**73.74**
4 B 8 Swine	**1.311**	**87.05**
4 B 9 a Laying hens	**0.319**	**90.29**
4 B 9 b Broilers	0.243	92.76
1 A 3 b i Road transport: Passenger cars	0.219	94.99
4 B 3 Sheep	0.113	96.13
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.089	97.04
4 B 6 Horses	0.080	97.85
1 A 4 b i Residential: Stationary plants	0.069	98.55
2 C 5 b Lead production	0.066	99.23
4 B 9 d Other poultry	0.042	99.65
2 B 5 a Other chemical industry	0.008	99.74
1 A 3 b ii Road transport:Light duty vehicles	0.005	99.79
2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)	0.005	99.84
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.004	99.88

2 B 1 Ammonia production	0.003	99.91
1 A 3 b iii Road transport:, Heavy duty vehicles	0.002	99.92
6 C d Cremation	0.002	99.94
3 C Chemical products	0.001	99.95
6 B Waste-water handling	0.001	99.96
2 B 5 b Storage, handling and transport of chemical products	0.001	99.97
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.001	99.98
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.000	99.98
2 F Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	0.000	99.98
1 A 1 c Manufacture of solid fuels and other energy industries	0.000	99.99
1 A 3 c Railways	0.000	99.99
2 C 1 Iron and steel production	0.000	99.99
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.000	99.99
6 D Other waste(e)	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00
1 A 4 a ii Commercial / institutional: Mobile	0.000	100.00
2 C 5 e Other metal production	0.000	100.00
1 A 3 d ii National navigation (Shipping)	0.000	100.00
6 A Solid waste disposal on land	0.000	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0.000	100.00
3 D 3 Other product use	0.000	100.00
1 A 4 b ii Residential: Household and gardening (mobile)	0.000	100.00
3 A 2 Industrial coating application	0.000	100.00
1 A 1 a Public electricity and heat production	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.000	100.00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.000	100.00
1 A 4 a i Commercial / institutional: Stationary	0.000	100.00
1 B 2 c Venting and flaring	0.000	100.00

Table 5. Key sources categories for $PM_{2,5}$ emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**12.221**	**65.93**
1 A 1 a Public electricity and heat production	**2.892**	**81.52**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	1.584	90.07
1 A 4 a i Commercial / institutional: Stationary	0.332	91.86
1 A 1 c Manufacture of solid fuels and other energy industries	0.305	93.50
1 A 3 b i Road transport: Passenger cars	0.163	94.38
1 A 3 b iii Road transport:, Heavy duty vehicles	0.112	94.99
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.108	95.57
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.101	96.12

1 A 3 b vi Road transport: Automobile tyre and brake wear	0.085	96.58
1 A 3 b ii Road transport:Light duty vehicles	0.056	96.88
2 A 7 a Quarrying and mining of minerals other than coal	0.054	97.17
1 B 2 a iv Refining / storage	0.053	97.46
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.052	97.74
2 D 1 Pulp and paper	0.048	98.00
1 A 3 c Railways	0.048	98.26
1 A 3 b vii Road transport: Automobile road abrasion	0.047	98.51
1 A 3 d ii National navigation (Shipping)	0.035	98.70
4 D 1 a Synthetic N-fertilizers	0.026	98.84
2 D 2 Food and drink	0.026	98.98
2 D 3 Wood processing	0.024	99.11
4 B 1 a Cattle dairy	0.022	99.23
4 B 1 b Cattle non-dairy	0.022	99.35
1 A 4 a ii Commercial / institutional: Mobile	0.021	99.46
2 G Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)	0.019	99.56
2 C 1 Iron and steel production	0.016	99.64
4 B 8 Swine	0.012	99.71
1 A 4 b ii Residential: Household and gardening (mobile)	0.010	99.76
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.009	99.81
2 A 7 b Construction and demolition	0.009	99.86
2 B 5 a Other chemical industry	0.009	99.91
4 B 9 b Broilers	0.008	99.95
2 A 3 Limestone and dolomite use	0.003	99.96
4 B 9 a Laying hens	0.001	99.97
2 C 5 e Other metal production	0.001	99.97
2 A 1 Cement production	0.001	99.98
4 B 6 Horses	0.001	99.98
1 A 3 a i (i) International aviation (LTO)	0.001	99.99
2 C 3 Aluminum production	0.001	99.99
1 A 3 b iv Road transport: Mopeds & motorcycles	0.001	99.99
2 B 5 b Storage, handling and transport of chemical product	0.000	99.99
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.000	100.00
2 A 2 Lime production	0.000	100.00
4 B 9 d Other poultry	0.000	100.00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.000	100.00
2 A 7 d Other Mineral products	0.000	100.00
2 C 5 a Copper production	0.000	100.00
2 C 5 d Zinc production	0.000	100.00
2 C 5 b Lead production	0.000	100.00
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00

1 B 2 c Venting and flaring	0.000	100.00
2 B 1 Ammonia production	0.000	100.00
3 A 2 Industrial coating application	0.000	100.00
6 A Solid waste disposal on land	0.000	100.00
6 B Waste-water handling	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00
6 C d Cremation	0.000	100.00
6 D Other waste(e)	0.000	100.00

Table 6. Key sources categories for PM_{10} emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**12.221**	**52.58**
1 A 1 a Public electricity and heat production	**5.197**	**74.93**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**2.173**	**84.28**
4 D 1 a Synthetic N-fertilizers	0.674	87.18
1 A 1 c Manufacture of solid fuels and other energy industries	0.606	89.79
1 A 4 a i Commercial / institutional: Stationary	0.406	91.54
1 A 3 b i Road transport: Passenger cars	0.163	92.24
2 A 7 a Quarrying and mining of minerals other than coal	0.162	92.93
2 D 1 Pulp and paper	0.161	93.63
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.159	94.31
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.115	94.80
1 A 3 b iii Road transport:, Heavy duty vehicles	0.112	95.29
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.101	95.72
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.092	96.12
2 A 7 b Construction and demolition	0.090	96.50
1 A 3 b vii Road transport: Automobile road abrasion	0.086	96.87
4 B 8 Swine	0.077	97.21
2 D 3 Wood processing	0.072	97.52
1 B 2 a iv Refining / storage	0.065	97.80
4 B 9 b Broilers	0.057	98.04
1 A 3 b ii Road transport:Light duty vehicles	0.056	98.29
2 G Other production, consumption, storage, transportation or handling of bulk products	0.055	98.53
4 B 1 b Cattle non-dairy	0.055	98.76
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.052	98.99
1 A 3 c Railways	0.050	99.20
1 A 3 d ii National navigation (Shipping)	0.035	99.36
4 B 1 a Cattle dairy	0.035	99.51
2 B 5 a Other chemical industry	0.026	99.62
1 A 4 a ii Commercial / institutional: Mobile	0.021	99.71
2 C 1 Iron and steel production	0.020	99.79

4 B 9 a Laying hens	0.011	99.84
1 A 4 b ii Residential: Household and gardening (mobile)	0.010	99.88
2 A 3 Limestone and dolomite use	0.008	99.92
2 D 2 Food and drink	0.008	99.95
2 A 1 Cement production	0.002	99.96
4 B 9 d Other poultry	0.001	99.97
2 B 5 b Storage, handling and transport of chemical products	0.001	99.97
2 C 5 e Other metal production	0.001	99.98
4 B 6 Horses	0.001	99.98
2 A 2 Lime production	0.001	99.99
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.001	99.99
2 C 3 Aluminum production	0.001	99.99
1 A 3 a i (i) International aviation (LTO)	0.001	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0.001	100.00
2 A 7 d Other Mineral products	0.000	100.00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.000	100.00
2 C 5 a Copper production	0.000	100.00
2 C 5 d Zinc production	0.000	100.00
2 C 5 b Lead production	0.000	100.00
3 A 2 Industrial coating application	0.000	100.00
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 B 2 c Venting and flaring	0.000	100.00
2 B 1 Ammonia production	0.000	100.00
6 A Solid waste disposal on land	0.000	100.00
6 B Waste-water handling	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00
6 C d Cremation	0.000	100.00
6 D Other waste(e)	0.000	100.00

Table 7. Key sources categories for TSP emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**13.966**	**49.58**
1 A 1 a Public electricity and heat production	**6.544**	**72.81**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**3.070**	**83.72**
1 A 1 c Manufacture of solid fuels and other energy industries	0.845	86.72
1 A 4 a i Commercial / institutional: Stationary	0.612	88.89
2 A 7 a Quarrying and mining of minerals other than coal	0.494	90.64
2 D 1 Pulp and paper	0.223	91.43
2 D 3 Wood processing	0.219	92.21

1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.188	92.88
2 A 7 b Construction and demolition	0.179	93.51
4 B 8 Swine	0.172	94.12
1 A 3 b vii Road transport: Automobile road abrasion	0.171	94.73
2 G Other production, consumption, storage, transportation or handling of bulk products	0.169	95.33
1 A 3 b i Road transport: Passenger cars	0.163	95.91
4 B 9 b Broilers	0.127	96.36
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.122	96.79
1 A 3 b iii Road transport:, Heavy duty vehicles	0.112	97.19
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.101	97.55
2 B 5 a Other chemical industry	0.079	97.83
1 B 2 a iv Refining / storage	0.079	98.11
4 B 1 a Cattle dairy	0.077	98.39
4 B 1 b Cattle non-dairy	0.074	98.65
1 A 3 b ii Road transport:Light duty vehicles	0.056	98.85
1 A 3 c Railways	0.053	99.04
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.052	99.22
1 A 3 d ii National navigation (Shipping)	0.035	99.35
2 C 1 Iron and steel production	0.032	99.46
2 A 3 Limestone and dolomite use	0.025	99.55
4 B 9 a Laying hens	0.025	99.64
2 D 2 Food and drink	0.023	99.72
1 A 4 a ii Commercial / institutional: Mobile	0.021	99.80
1 A 4 b ii Residential: Household and gardening (mobile)	0.010	99.83
3 A 2 Industrial coating application	0.008	99.86
2 A 1 Cement production	0.007	99.88
3 D 3 Other product use	0.006	99.91
3 C Chemical products	0.005	99.92
2 B 5 b Storage, handling and transport of chemical products	0.004	99.94
4 B 9 d Other poultry	0.003	99.95
2 A 2 Lime production	0.002	99.95
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.002	99.96
3 D 1 Printing	0.002	99.97
2 C 5 e Other metal production	0.002	99.98
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.002	99.98
2 C 3 Aluminum production	0.001	99.99
2 A 7 d Other Mineral products	0.001	99.99
3 B 1 Degreasing	0.001	99.99
1 B 2 c Venting and flaring	0.001	99.99
1 A 3 a i (i) International aviation (LTO)	0.001	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0.001	100.00
6 C b Industrial waste incineration (d)	0.000	100.00
2 C 5 a Copper production	0.000	100.00

2 C 5 d Zinc production	0.000	100.00
6 C d Cremation	0.000	100.00
2 C 5 b Lead production	0.000	100.00
6 A Solid waste disposal on land	0.000	100.00
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
2 B 1 Ammonia production	0.000	100.00
6 B Waste-water handling	0.000	100.00
6 D Other waste(e)	0.000	100.00

Table 8. Key sources categories for CO emissions for 2009, level assessment

NFR code	2009 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**106.904**	**63.54**
1 A 3 b i Road transport: Passenger cars	**21.734**	**76.46**
1 A 1 c Manufacture of solid fuels and other energy industries	**19.552**	**88.08**
1 A 1 a Public electricity and heat production	5.400	91.29
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	5.172	94.36
1 A 4 b ii Residential: Household and gardening (mobile)	2.792	96.02
1 A 3 b iii Road transport:, Heavy duty vehicles	1.119	96.69
1 A 3 b ii Road transport:Light duty vehicles	1.059	97.32
1 A 4 a i Commercial / institutional: Stationary	0.939	97.88
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.638	98.25
1 A 4 a ii Commercial / institutional: Mobile	0.570	98.59
1 A 3 b iv Road transport: Mopeds & motorcycles	0.485	98.88
1 A 3 c Railways	0.375	99.10
2 B 5 a Other chemical industry	0.364	99.32
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.269	99.48
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.244	99.63
1 A 3 d ii National navigation (Shipping)	0.154	99.72
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.152	99.81
1 A 3 a i (i) International aviation (LTO)	0.089	99.86
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.064	99.90
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.043	99.92
2 D 1 Pulp and paper	0.026	99.94
6 A Solid waste disposal on land	0.024	99.95
1 B 2 a iv Refining / storage	0.015	99.96
2 G Other production, consumption, storage, transportation or handling of bulk products	0.015	99.97
6 C b Industrial waste incineration (d)	0.013	99.98
2 C 1 Iron and steel production	0.012	99.99
6 B Waste-water handling	0.006	99.99
2 A 7 a Quarrying and mining of minerals other than coal	0.006	99.99

1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.004	100.00
1 A 1 b Petroleum refining	0.003	100.00
3 C Chemical products	0.002	100.00
2 D 2 Food and drink	0.001	100.00
1 B 2 c Venting and flaring	0.001	100.00
2 C 5 e Other metal production	0.000	100.00
2 B 1 Ammonia production	0.000	100.00
6 C d Cremation	0.000	100.00
2 C 3 Aluminum production	0.000	100.00
3 A 2 Industrial coating application	0.000	100.00
6 D Other waste(e)	0.000	100.00

Table 9. Key sources categories for Pb emissions for 2009, level assessment

NFR code	2009 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**25.093**	**89.78**
1 A 3 b i Road transport: Passenger cars	0.827	92.74
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	0.749	95.42
1 A 4 b i Residential: Stationary plants	0.723	98.00
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.216	98.78
1 A 4 a i Commercial / institutional: Stationary	0.124	99.22
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.099	99.57
1 A 3 b ii Road transport:Light duty vehicles	0.037	99.71
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.024	99.79
1 A 1 c Manufacture of solid fuels and other energy industries	0.022	99.87
1 A 4 b ii Residential: Household and gardening (mobile)	0.020	99.94
2 C 5 b Lead production	0.005	99.96
1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)	0.005	99.98
1 A 4 a ii Commercial / institutional: Mobile	0.004	99.99
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.001	100.00
2 C 5 e Other metal production (Please specify the sources included/excluded in the notes column to the right)	0.000	100.00
3 B 1 Degreasing	0.000	100.00
3 D 3 Other product use	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 3 b iii Road transport:, Heavy duty vehicles	0.000	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0.000	100.00
1 A 3 c Railways	0.000	100.00
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.000	100.00
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.000	100.00
2 C 1 Iron and steel production	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00

Table 10. Key sources categories for Cd emissions for 2009, level assessment

NFR code	2009 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0.425**	**88.85**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	0.021	93.30
1 A 4 b i Residential: Stationary plants	0.018	97.05
1 A 3 b i Road transport: Passenger cars	0.004	97.90
1 A 4 a i Commercial / institutional: Stationary	0.004	98.74
1 A 3 b iii Road transport:, Heavy duty vehicles	0.002	99.09
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.001	99.30
1 A 1 c Manufacture of solid fuels and other energy industries	0.001	99.47
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.001	99.60
1 A 3 b ii Road transport:Light duty vehicles	0.001	99.71
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.001	99.83
1 A 3 c Railways	0.000	99.90
1 A 2 f ii Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)	0.000	99.95
1 A 4 a ii Commercial / institutional: Mobile	0.000	99.97
1 A 3 d ii National navigation (Shipping)	0.000	99.99
1 A 4 b ii Residential: Household and gardening (mobile)	0.000	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.000	100.00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.000	100.00
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.000	100.00
2 C 1 Iron and steel production	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00

Table 11. Key sources categories for Hg emissions for 2009, level assessment

NFR code	2009 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0.417**	**94.06**
1 A 4 b i Residential: Stationary plants	0.019	98.34
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	0.006	99.64
1 A 4 a i Commercial / institutional: Stationary	0.001	99.83
1 A 1 c Manufacture of solid fuels and other energy industries	0.001	99.99
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.000	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.000	100.00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-	0.000	100.00

ferrous metals		
1 A 3 c Railways	0.000	100.00
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.000	100.00
2 C 1 Iron and steel production	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00

Table 12. Key sources categories for PCB emissions for 2009, level assessment

NFR code	2009 (Kg)	Cumulative Total
1 A 1 a Public electricity and heat production	**35.599**	**82.41**
1 A 4 b i Residential: Stationary plants	6.680	97.87
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other (Please specify in your IIR)	0.645	99.36
1 A 4 a i Commercial / institutional: Stationary	0.172	99.76
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.041	99.86
1 A 1 c Manufacture of solid fuels and other energy industries	0.037	99.94
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.026	100.00
1 A 1 b Petroleum refining	0.000	100.00
6 C b Industrial waste incineration (d)	0.000	100.00

Table 13. Key sources categories for PCDD/PCDF emissions for 2009, level assessment

NFR code	2009 (g I-Teq)	Cumulative Total
1 A 1 a Public electricity and heat production	**2.167**	**44.54**
1 A 4 b i Residential: Stationary plants	**1.750**	**80.52**
6 C b Industrial waste incineration (d)	0.508	90.96
1 A 2 f i Stationary combustion in manufacturing industries and construction: Othe	0.169	94.44
1 A 3 b i Road transport: Passenger cars	0.138	97.27
6 C a Clinical wasteincineration (d)	0.074	98.80
1 A 4 a i Commercial / institutional: Stationary	0.024	99.29
1 A 1 c Manufacture of solid fuels and other energy industries	0.017	99.65
1 A 3 b iii Road transport:, Heavy duty vehicles	0.009	99.83
1 A 3 b ii Road transport:Light duty vehicles	0.005	99.92
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.002	99.96
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.001	99.98
1 A 3 b iv Road transport: Mopeds & motorcycles	0.001	100.00
1 A 1 b Petroleum refining	0.000	100.00
1 A 3 c Railways	0.000	100.00

Table 14. Key sources categories for PAHs emissions for 2009, level assessment

NFR code	2009 (Mg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**12.313**	**81.69**
1 A 1 a Public electricity and heat production	1.853	93.99
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.634	98.20
1 A 4 a i Commercial / institutional: Stationary	0.125	99.02
1 A 1 c Manufacture of solid fuels and other energy industries	0.067	99.47
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.024	99.63
1 A 3 b i Road transport: Passenger cars	0.022	99.78
1 A 3 b iii Road transport:, Heavy duty vehicles	0.011	99.85
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.005	99.89
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.005	99.92
1 A 3 b ii Road transport:Light duty vehicles	0.004	99.95
1 A 3 c Railways	0.004	99.97
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.002	99.99
1 A 4 a ii Commercial / institutional: Mobile	0.001	99.99
1 A 3 d ii National navigation (Shipping)	0.001	100.00
1 A 4 b ii Residential: Household and gardening (mobile)	0.000	100.00
1 A 3 b iv Road transport: Mopeds & motorcycles	0,000	100.00
1 A 1 b Petroleum refining	0,000	100.00
6 C b Industrial waste incineration (d)	0,000	100.00