Estonian Environment Information Centre

Estonian Informative Inventory Report
1990-2008

Tallinn 2010

Data sheet

Title: Estonian Informative Inventory Report 1990-2008

Date: March 2010-03-15

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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 sources 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 emissions invetories for years from 1990 to 2008. The inventories accounts antropogenic emisssions of main pollutants (SO_x, NO_x, NMVOC, NH_3 and CO), particulate matter (TSP, PM10, PM2,5), 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 regulate data collection and reporting. Method 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 2008 about 1600) 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, analysis, storage, 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 data of emission within the country. The emission data is update every year and results are reported yearly.

1.3 The process of inventory preparation

The process 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 analyse of inventory preparation have to be part of inventory preparation. The main activities of inventory preparation have given in figure 1. The involving databases are given in figure 3.

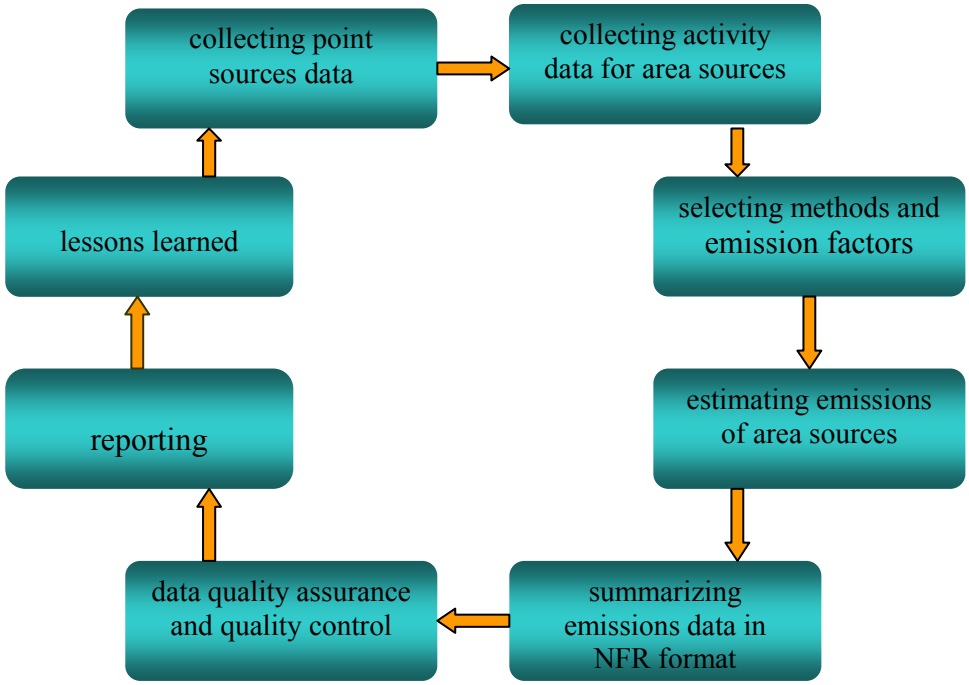


Figure 1 The main activities of inventory preparation

The national database contains data of point and diffuse sources of emissions. For the 1990-1999 the emission inventory is based on data for the large point sources and area sources. Since 2000 to 2004 for data (both – point and area) gathering the CollectER software was used. For gathering the information on point sources the Estonian Environment Information Centre in 2004 has been created a new web-interface air emissions data system for the point sources (OSIS), where operators of point sources fill directly their annual air pollution reports. If in 2000 in a database there was data on 600 enterprises, in 2008 - already on 1600.

The point sources information system contains data 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 are represented on each source of pollution and on the facility as a whole. The owner of point sources can input their calculated or measured annual emissions directly to the system or use OSIS calculation models, what 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 data supervises local department of an environment agrees the report; then last step of the checking in EEIC is carried out and data are ready for use at generating of various reports.

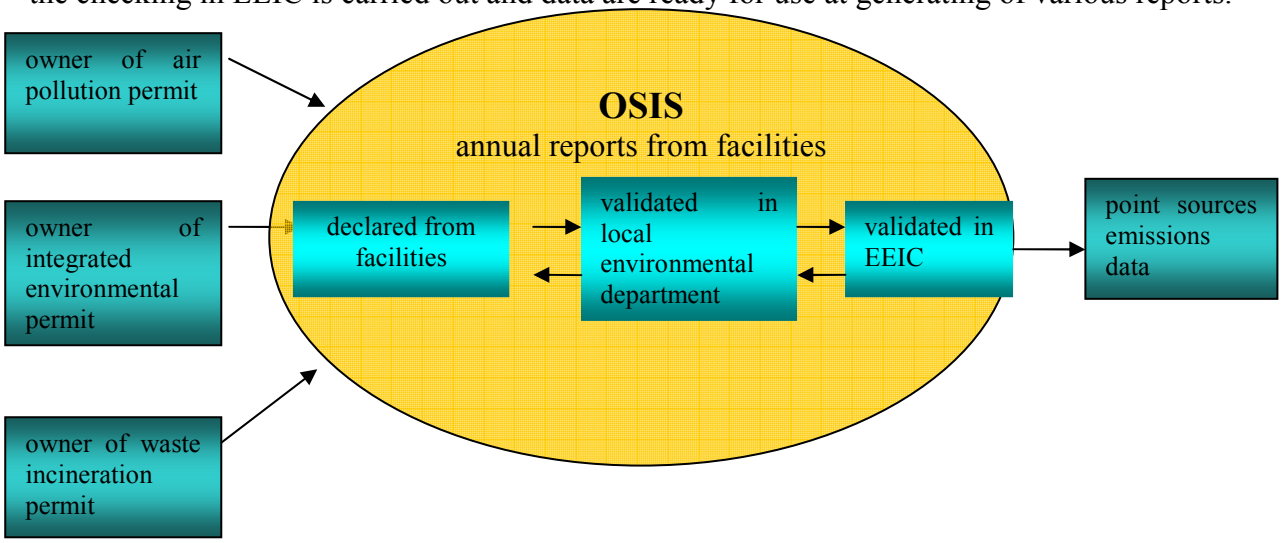
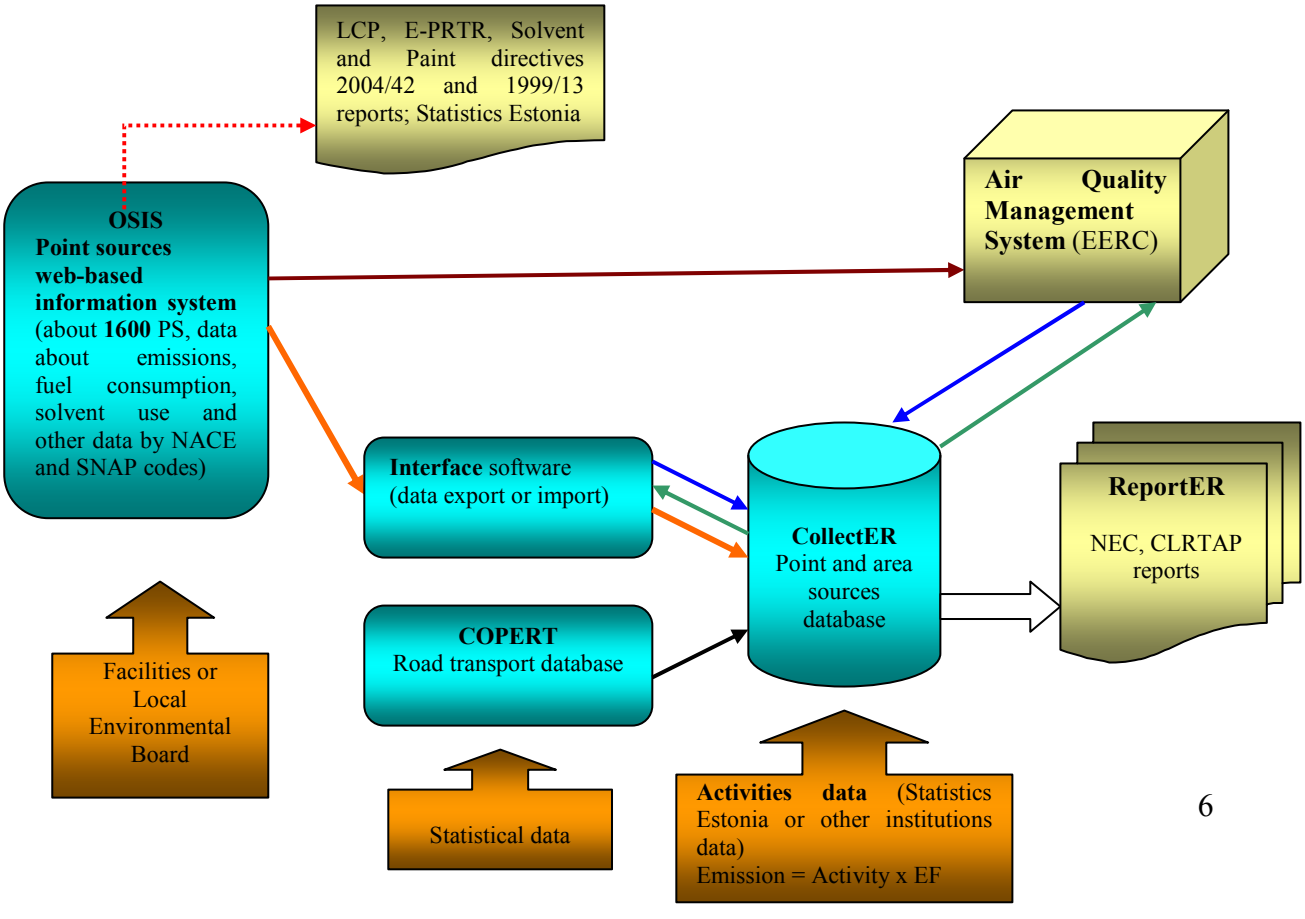


Figure 2. Validation of Estonian point sources data

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

For the calculation emission from road transport we are using COPERT IV tool methodology and emission factors. Total emissions are calculated with 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 received from the Estonian Motor Vehicle Registration Centre. For meteodata is responsible Meteorological and Hydrological Institute. Data about fuel consumption from Statistical Office of Estonia.

By means of the special export module data of point sources (emissions and burnt fuel) are transferred from OSIS into CollectER. National emission inventory data stored in the CollectER annual inventory databases are used for reporting with the ReportER III tool.



1.4 Key Categories

This chapter presents results of Estonian key sources analyses.

Key sources analysis is based on methods described in chapter 6 of the IPCC report "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" and in the EMEP/CORINAIR Guidebook, Third Edition, part B: methodology chapter Good Practice Guidance for the CLTRAP Emission Inventories.

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 95% 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 2008 the only level assessment was chosen. Key sources analysis and uncertainty assessment of sulphur dioxide, nitrogen oxides and ammonia emissions in

The results of the key source category analysis for main pollutants are presented in Annex in ascending NFR category order. The results of all pollutants (including main pollutants) which are reported under CLRTAP are in Table 1.

The energy (1 A 1 a) and road transport (1A3b i- 1A3biii) 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 bi) is also main sources of NMVOC (46,3%). Additionally, the domestic solvent use (3 D 2), natural gas distribution (1 B 2 b) and road transport (1A4b) are key sources too.

According to level assessment SO_2 emissions for 2008 from the energy sector (1A1a) and stationary combustion in manufacturing industries and construction (1A2fi) are responsible for 97,6 % of SO_2 emissions in 2008. 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 (4B1a-4B1b) and mineral fertilisers uses (4D1a) 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 transport sector (road transport mainly) is also big.

According to level assessment 60,9% of CO emissions comes from residential combustion plants (1 A 4 b i) . In addition to this road transport and oil-shale industry (1 A 1 c Manufacture of solid fuels and other energy industries) are also main polluters of CO. The combustion in residential sector is key source for heavy metals, PCB and dioxins.

Table 1 Results of key sources analysis

Pollutant	Key sources categories (sorted from high to low from left to right)													Total (%)
NO_x	1 A 1 a	1 A 3 b iii	1 A 3 b i	1 A 2 f i	1 A 4 c ii	1 A 4 b i	1 A 3 c	1 A 2 f ii	1 A 3 b ii	1 A 3 d ii	1 A 4 a ii			
	34,7%	18,5%	12,5%	6,7%	6,4%	4,4%	4,0%	2,8%	2,7%	2,2%	1,3%			96,1%
NMVOC	1 A 4 b i	1 B 2 b	3 D 2	1 A 3 b i	1 B 2 a v	1 A 1 c	1 A 2 f i	3 A 2	2 D 2	1 A 4 b ii	3 C	1 A 1 a	1 A 3 b iii	
	46,3%	10,3%	9,8%	7,6%	3,9%	3,7%	2,7%	2,6%	1,6%	1,5%	1,3%	1,3%	1,2%	93,8%
SO_x	1 A 1 a	1 A 2 f i												
	89,0%	8,7%												97,6%
NH_3	4 B 1 a	4 D 1 a	4 B 1 b	4 B 8	4 B 9 a	1 A 3 b i	4 B 9 b	2 B 5 a						
	28,0%	25,3%	19,3%	13,7%	3,1%	2,9%	2,4%	1,1%						96%
$PM_{2,5}$	1 A 4 b i	1 A 2 f i	1 A 1 a	1 A 4 a i	1 A 3 b i	1 A 1 c	1 A 3 b iii							
	58,2%	16,0%	15,9%	1,8%	1,1%	1,0%	1,0%							95,0%
PM_{10}	1 A 4 b i	1 A 1 a	1 A 2 f i	1 A 4 a i	1 A 1 c	2 G	1 A 3 b i	1 A 3 b iii	1 A 3 b vi	2 B 5 a	4 B 8			
	47,0%	24,7%	15,2%	1,8%	1,5%	1,4%	1,1%	0,9%	0,7%	0,7%	0,5%			95,5%
TSP	1 A 4 b i	1 A 1 a	1 A 2 f i	4 D 1 a	2 G	1 A 4 a i	1 A 1 c	2 B 5 a	4 B 8	1 A 3 b i	1 A 3 b vi	2 D 1	1 A 3 b iii	
	40,5%	24,1%	15,0%	3,4%	3,2%	2,1%	1,7%	1,6%	0,9%	0,8%	0,7%	0,7%	0,7%	95,4%
CO	1 A 4 b i	1 A 3 b i	1 A 1 c	1 A 2 f i	1 A 1 a	1 A 4 b ii	1 A 3 b iii							
	60,9%	14,3%	9,7%	5,6%	2,7%	1,7%	1,3%							96,2%
Pb	1 A 1 a	1 A 2 f i	1 A 3 b i											
	90,4%	3,3%	2,6%											96,3%
Cd	1 A 1 a	1 A 2 f i	1 A 4 b i											
	84,8%	9,2%	2,8%											96,8%
Hg	1 A 1 a	1 A 2 f i												
	90,6%	5,8%												96,5%
As	1 A 1 a													
	98,5%													98,5%
Cr	1 A 1 a	1 A 2 f i												
	92,4%	3,7%												96,1%
Cu	1 A 1 a	1 A 3 b i	1 A 3 b iii	1 A 4 b i	1 A 3 b ii	1 A 2 f i	1 A 4 c ii							
	53,1%	19,8%	8,9%	4,0%	3,5%	3,2%	2,7%							95,2%
Ni	1 A 1 a	1 A 2 f i	1 A 4 b i											
	88,0%	6,2%	2,4%											96,6%
Zn	1 A 1 a	1 A 4 b i	1 A 2 f i											

	89,2%	4,6%	3,6%											97,4%
DIOX	1 A 1 a	1 A 4 b i	1 A 2 f i	6 C b										
	44,5%	33,0%	11,8%	8,5%										97,8%
benzo(a) pyrene	1 A 4 b i	1 A 1 a	1 A 2 f i											
	83,8%	7,3%	7,2%											98,3%
benzo(b) fluoranthene	1 A 4 b i	1 A 1 a	1 A 2 f i											
	80,3%	8,8%	8,6%											97,8%
benzo(k) fluoranthene	1 A 4 b i	1 A 1 a	1 A 2 f i											
	86,0%	6,2%	6,1%											98,3%
Indeno(1,2,3-cd)pyrene	1 A 4 b i	1 A 1 a	1 A 2 f i											
	87,4%	5,7%	5,5%											98,6%
PAH total 1-4	1 A 4 b i	1 A 1 a												
	90,2%	7,8%												98,0%
HCB	1 A 4 b i	1 A 2 f i	1 A 1 a											
	68,2%	15,7%	14,3%											98,2%
PCB	1 A 1 a	1 A 4 b i												
	84,8%	12,6%												97,4%

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: 1990-2008
- PM_{10} and $PM_{2,5}$: 2000-2008
- All heavy metals: 1990-2008
- POPs: 1999-2008.

Table 2.1 Main pollutants emission in 1990-2008

Year	**Emissions**, Gg							
	NO_x	**NMVOC**	**SO_2**	**NH_3**	**CO**	**PM2,5**	**PM10**	**TSP**
1990	73,73	70,07	267,60	26,02	285,60	NR	NR	280,35
1991	67,96	64,65	245,54	23,23	259,69	NR	NR	280,04
1992	42,11	42,84	188,23	18,76	155,09	NR	NR	251,28
1993	38,96	33,59	152,44	14,78	142,07	NR	NR	198,87
1994	41,50	35,22	146,66	13,85	166,49	NR	NR	177,35
1995	38,85	44,06	112,90	12,13	205,07	NR	NR	136,75
1996	41,45	46,76	121,63	11,01	229,05	NR	NR	125,95
1997	40,23	47,38	112,64	11,23	228,41	NR	NR	102,57
1998	39,02	41,40	100,67	11,18	194,30	NR	NR	91,04
1999	35,41	37,76	94,39	9,63	180,64	NR	NR	89,46
2000	36,06	39,69	94,15	9,68	178,66	21,03	36,63	76,23
2001	39,20	39,75	90,20	9,82	187,34	22,20	36,93	74,47
2002	40,37	39,38	86,62	9,43	181,96	22,73	32,92	53,78
2003	40,96	40,70	100,18	9,58	179,72	20,87	29,56	49,84
2004	38,62	40,74	88,24	9,67	174,55	22,06	29,64	47,01
2005	36,12	37,07	76,25	9,26	159,07	19,89	26,19	38,53
2006	34,75	34,55	69,93	9,27	146,11	15,24	19,71	29,15
2007	37,89	36,08	87,97	9,84	165,16	20,33	28,21	37,31
2008	34,39	35,25	69,33	10,22	167,62	20,02	24,81	32,87
trend 1990-2008, %	-53,35	-49,69	-74,09	-60,73	-41,31	-4,76	-32,25	-88,28

Sulphur dioxide

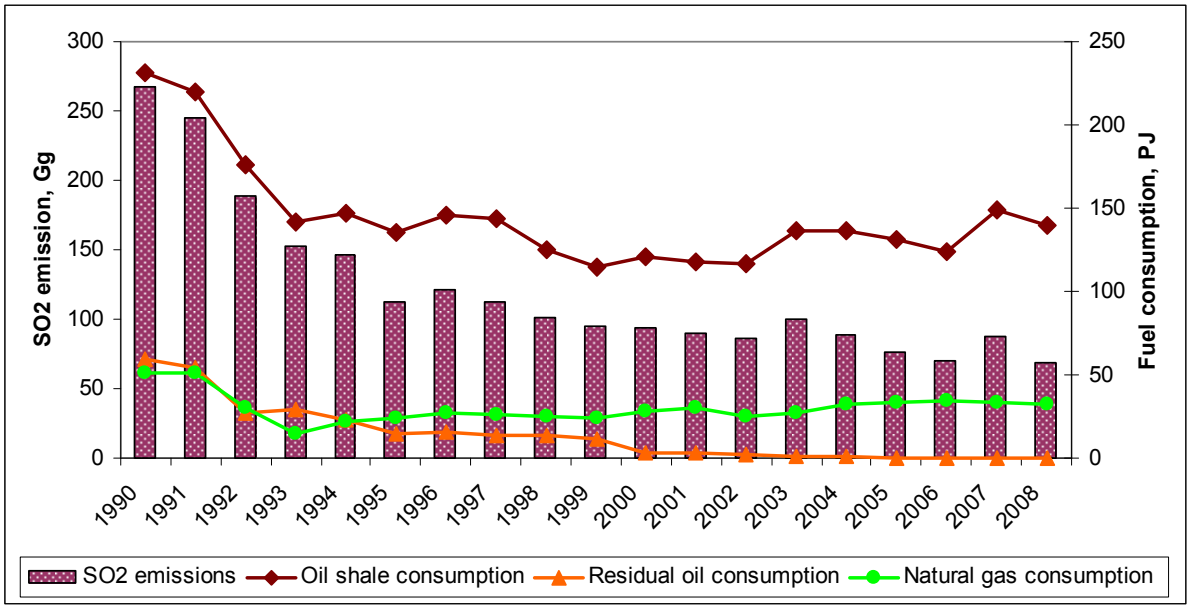


Figure 2.1 SO_2 emissions in 1990-2008

During the period 1990-2008, the emissions of sulphur dioxide has decreased by approximately 74%, conditioned by decline in energy production (oil shale consumption as main fuel in Estonia fell from 231 PJ in 1990 to 139 PJ in 2008) (Figure 2.1). The latter, in its turn, has been caused by the restructuring of the economy. Likewise, the export possibilities, regarding elektricity, has 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 sulfur 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 1A1a-c) is responsible for about 84% of total emissions. The share of SO_2 emissions from two larger oil shale Narva Power Plants (Eesti and Balti) is about 74% of total emissions. The main reason for the drop emissions beginning from the 2004 is the launch of two new circulating fluidized-bed (CFB) technology based boilers at the Narva PP. The new boilers have reduced SO_2 emissions to practically zero. Emissions have also been considerably reduced by shutting down the old blocks. (6)

Nitrogen oxides

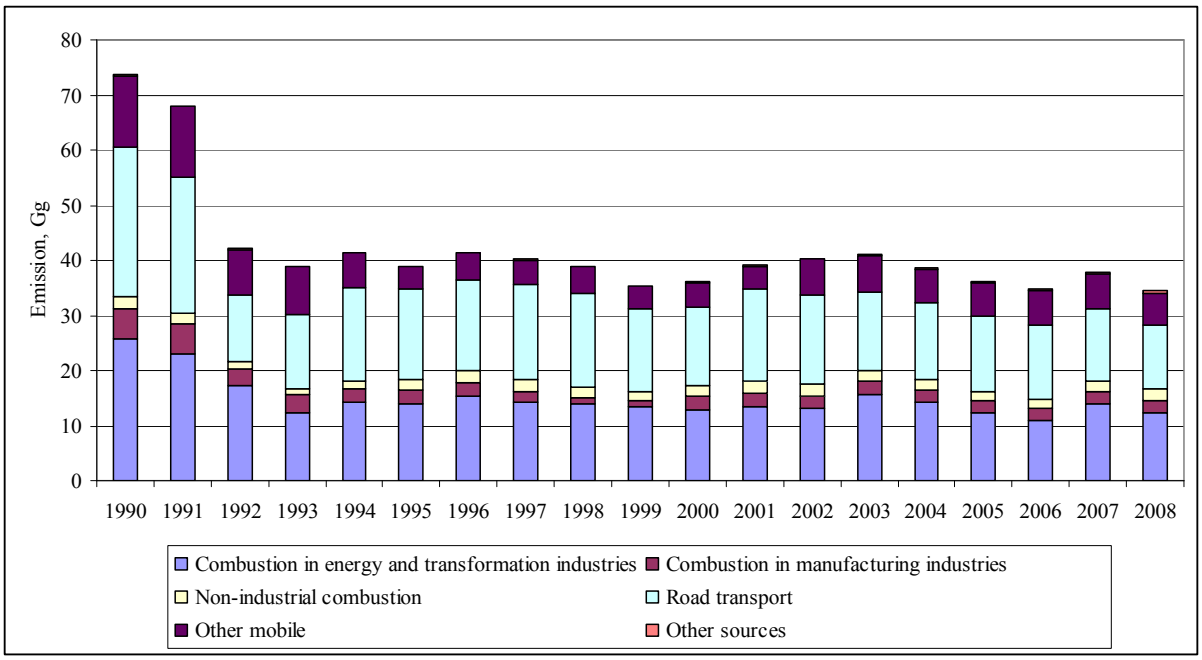


Figure 2.2 NO_x emissions in 1990-2008

Emissions of nitrogen oxides have decreased by 53% compared with 1990. The reduction is mainly due to fall of energy production and transport sector from 1990 to 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 of the NOx emissions reduction. The road transport sector and energy industry are main sources of nitrogen oxides emissions – 34% and 35% respectively. The share of other mobile sources is 17% in 2008 (Figure 2.3).

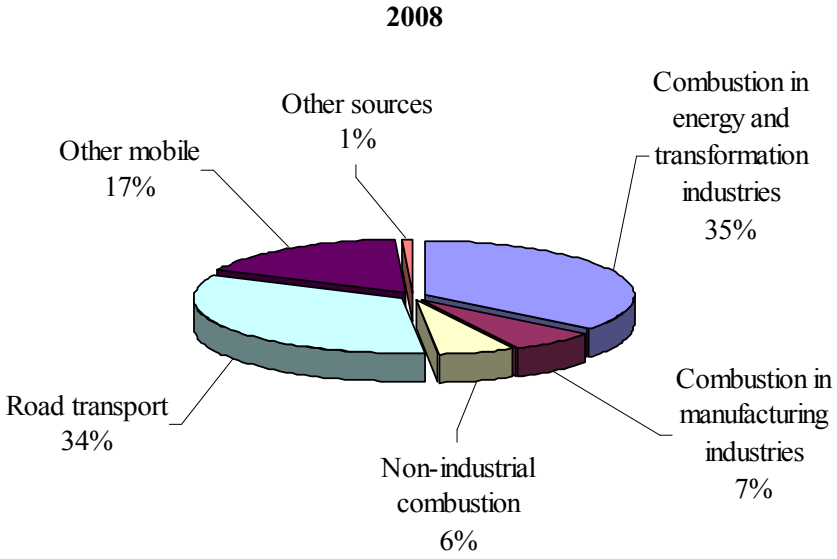


Figure 2.3 NOx emissions by sources of pollution in 2005

Non-methane volatile compounds

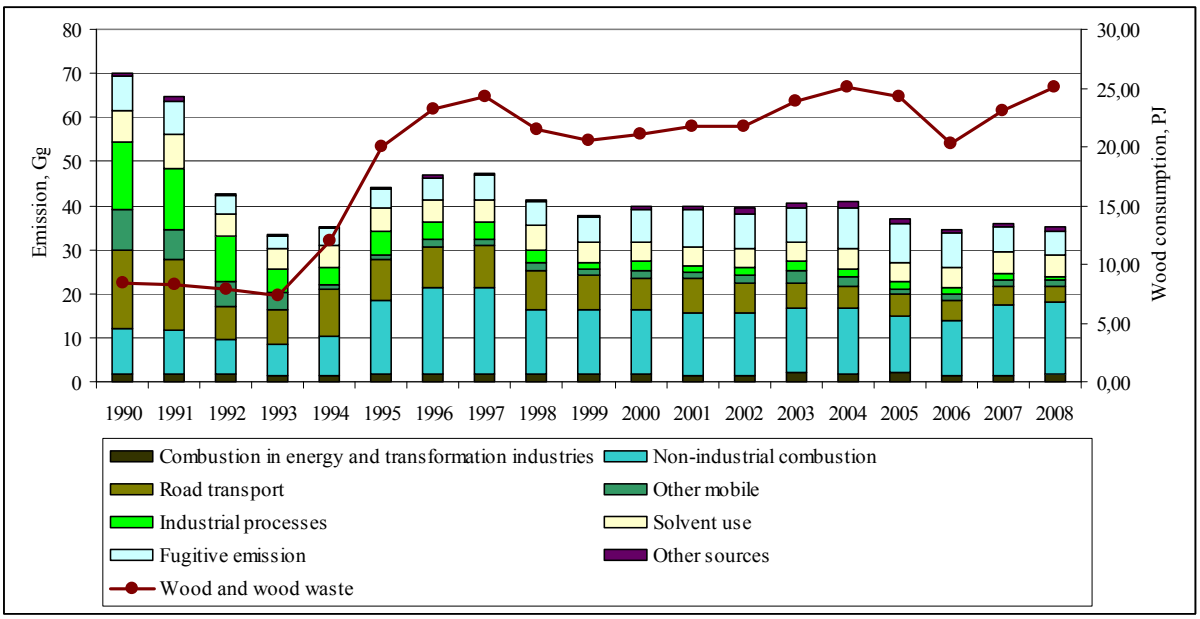


Figure 2.4 Emissions of non-methane volatile organic compounds in 1990-2008

The total non-methane volatile organic compounds emission have decreased by 50% from 1990 to 2008. If in 1990 the main polluters of NMVOC were road transport (26%) and industrial processes (22%), then in 2008 the dominate sources are non-industrial combustion (about 48%) and fugitive fuel emissions (15%) (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 comparining with gasoline. In the second, during with 1990 on 2008 manufacture of chemical products has fallen. Emissions from non-industrial fuel combustion (mainly in households) has grown from 1995, it is caused by an increase tendency of wood and wood waste combustion (the emission factor for these fuels much higher, then for combustion in other boilers). The grows of fugitive fuel emissions can be explaned by increasing of emissions from marine terminals.

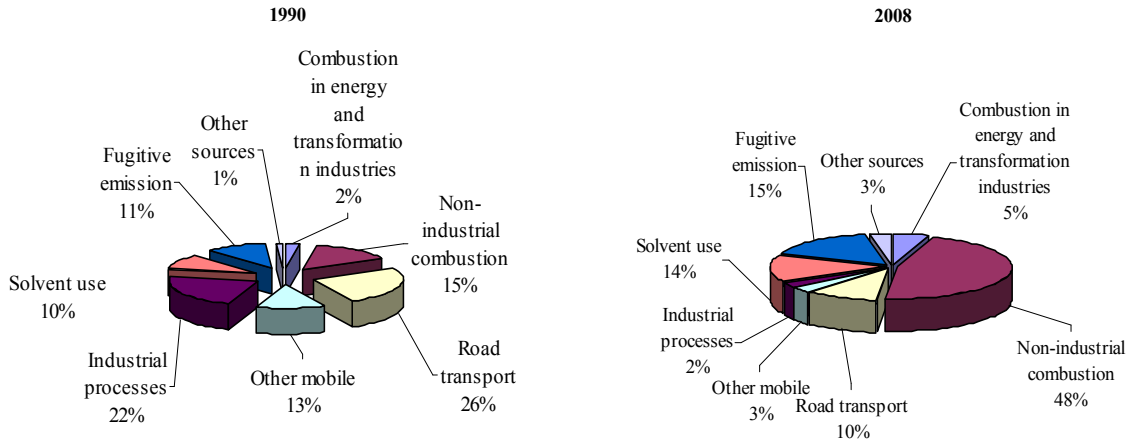


Figure 2.5 NMVOC emissions by sources of pollution in 1990 and 2008

Ammonia

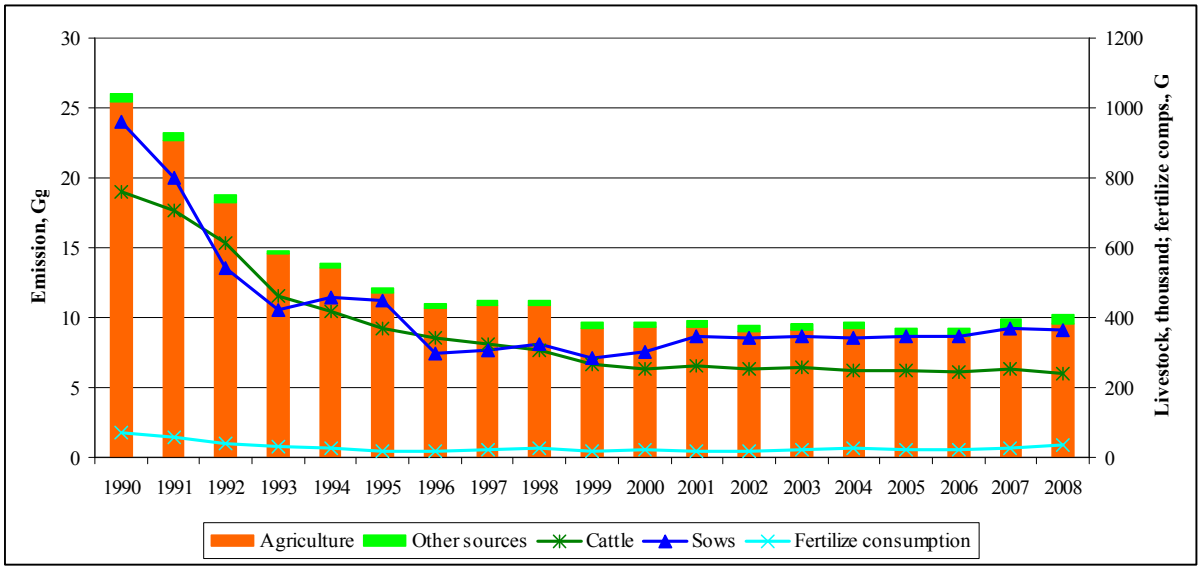


Figure 2.6 Emissions of ammonia in 1990-2008

Total NH_3 emission have decreased by 61% from 1990 to 2008 due to reduction in the number of animals and use of fertilisers (Figure 2.6). The livestock manure management and mineral fertilisers use are the main sources of pollution regarding ammonia (about 93%). The road transport gives 3% from total emission and have increased at the last years due to grows of catalyst cars.

Carbon monoxide

Between 1990-2008 the emissions of carbon monoxide decreased by 41%, 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 2008 the biggest polluters of CO were combustion in non-industrial sector (about 62%) and road transport (17%) (Figure 2.8).

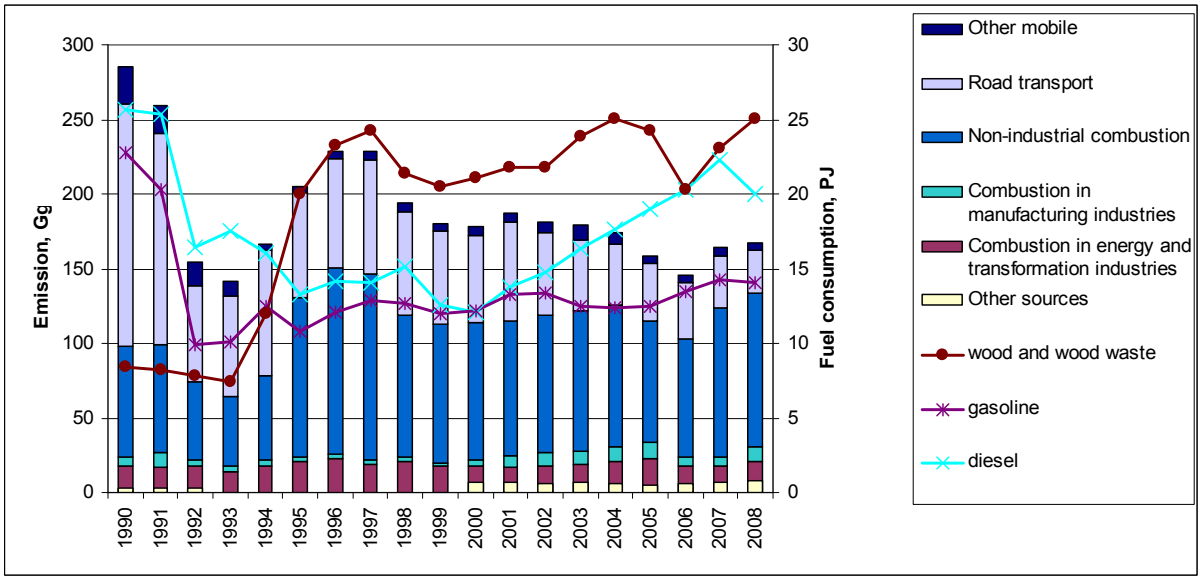


Figure 2.7 Emissions of carbon monoxide in 1990-2008

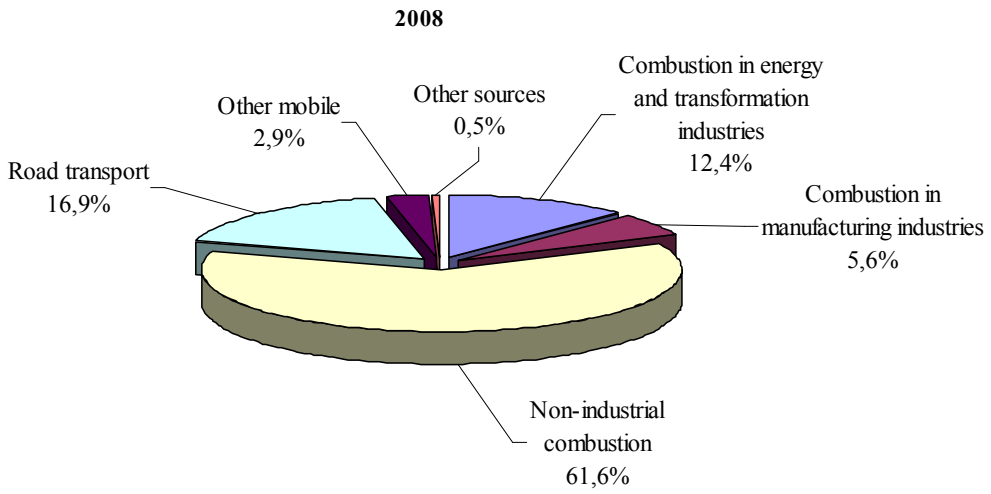


Figure 2.8 CO emissions by sources of pollution in 2008

Particulates

The emissions of TSP, PM2,5 and PM10 are shown in the figure 2.9
In 1990-2008 TSP emission have dropped significantly – by 88%. This is in due to the increase in efficiency of combustion devices and cleaning installations (especially in oil shale power plants and cement factory) as well as from the decrease in electricity production.

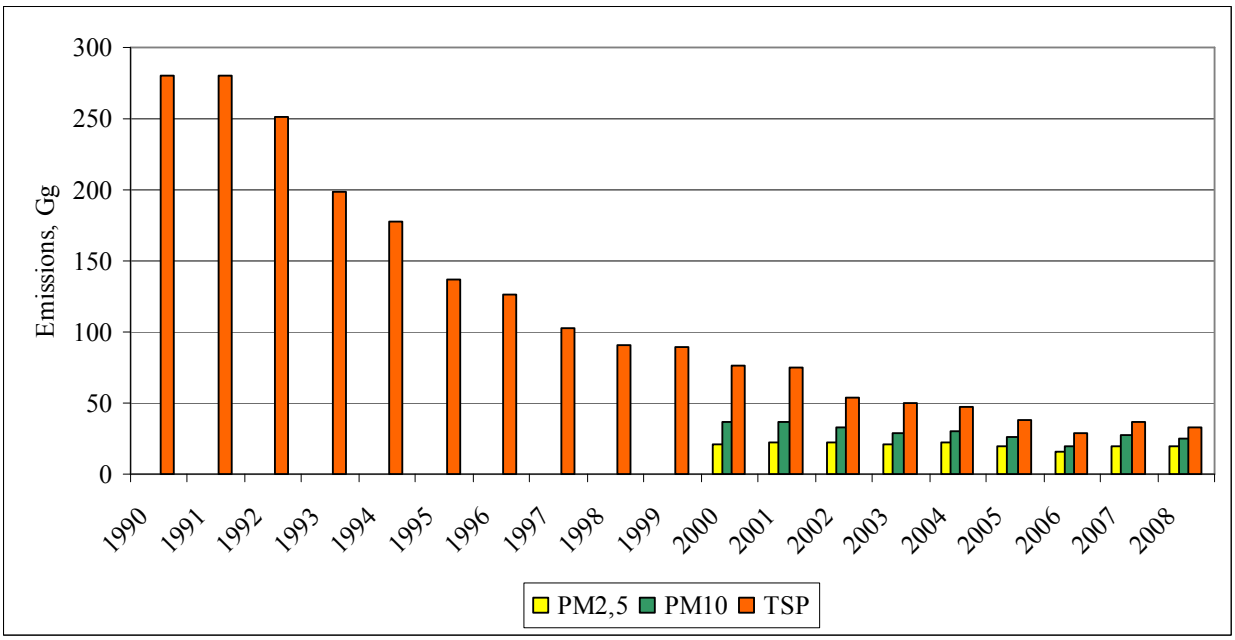


Figure 2.9 Particulates emission in 1990-2008

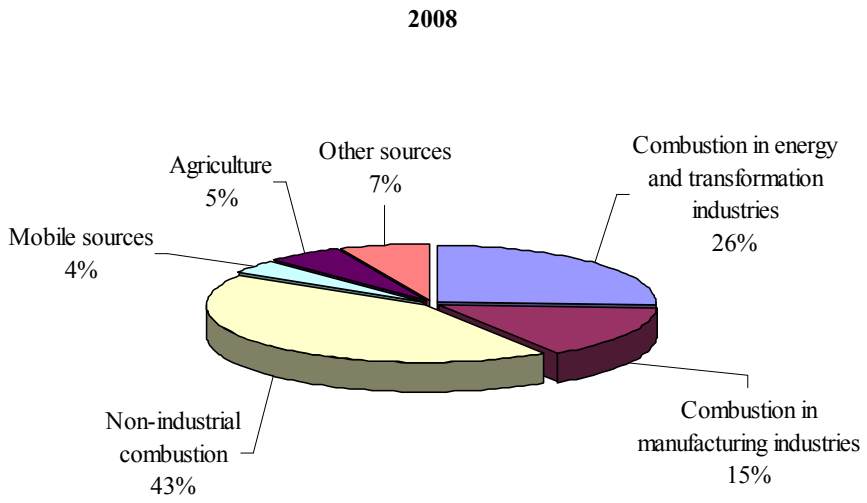


Figure 2.10

The primary sources of particulates emissions in 2008 is non-industrial combustion – 43% (combustion of wood and wood waste) and combustion in energy and transformation industries - 26% (Figure 2.10).

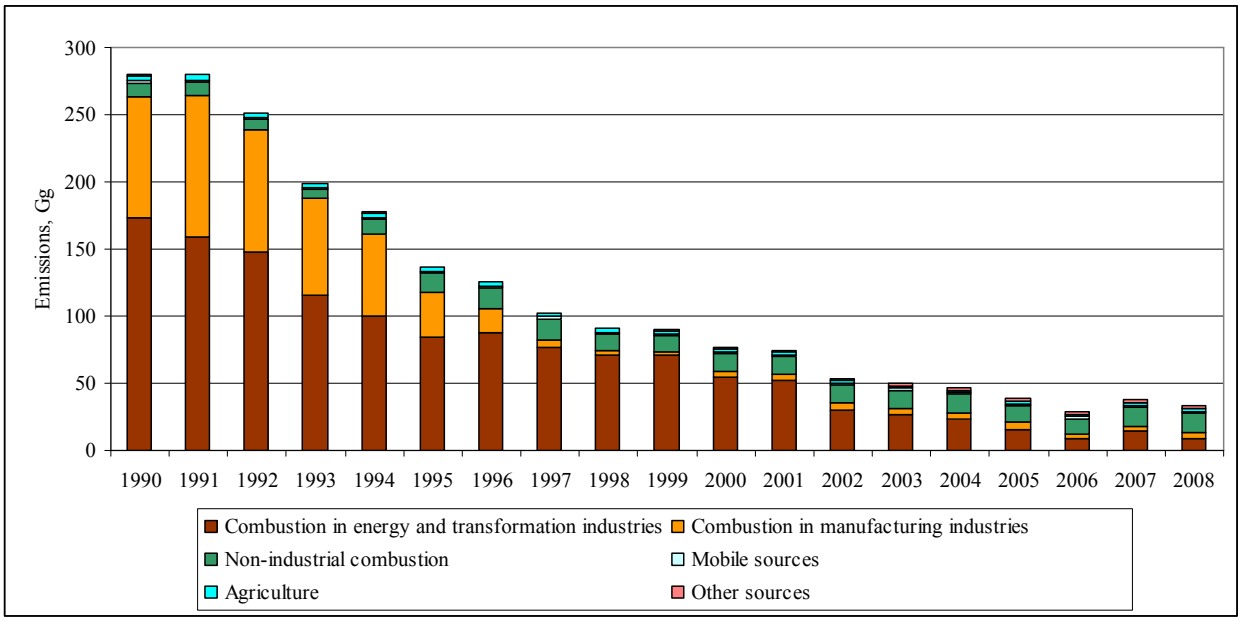


Figure 2.11 TSP emission by activities in 1990-2008

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 have decreased by 74% due to modernization of the cleaning equipment at Narva power plant an Kunda Nordic Tsement AS and to decreasing of energy production. The other reason, that the use of leaded petrol was discontinued in Estonia in 2000.

Tabel 2.2 Heavy metals emission in 1990-2008

Year	**Emissions**, Mg							
	Pb	**Cd**	**Hg**	**As**	**Cr**	**Cu**	**Ni**	**Zn**
1990	133,52	4,40	1,12	18,86	18,23	9,22	27,39	103,78
1991	124,19	4,20	1,02	16,45	15,89	8,62	25,95	95,05
1992	92,33	3,00	0,83	14,03	13,68	6,29	17,04	77,67
1993	69,95	2,22	0,64	10,84	10,34	5,01	14,36	60,02
1994	82,53	2,87	0,64	10,68	10,17	5,41	12,89	62,91
1995	63,07	1,96	0,60	10,07	9,62	4,62	10,52	57,60
1996	46,45	1,05	0,60	10,36	9,84	4,14	10,96	55,07
1997	38,75	1,07	0,60	10,20	9,55	4,08	9,84	54,59
1998	34,74	1,01	0,53	9,15	8,58	3,82	8,89	49,51
1999	32,71	0,95	0,50	8,71	8,18	3,54	7,67	47,28
2000	31,72	0,56	0,51	8,59	8,05	3,21	6,64	47,29
2001	31,34	0,55	0,50	8,39	7,91	3,36	6,52	43,27
2002	30,93	0,57	0,50	8,36	8,02	3,51	6,33	42,65
2003	36,22	0,63	0,58	10,11	9,47	3,75	6,81	51,22
2004	35,07	0,59	0,54	9,79	9,04	3,86	6,75	51,03
2005	33,76	0,58	0,52	9,22	8,78	3,87	6,52	47,43
2006	30,94	0,55	0,52	8,59	8,16	3,71	5,86	42,99
2007	39,53	0,68	0,65	11,08	10,39	4,35	6,82	54,54
2008	34,30	0,62	0,57	9,42	8,93	3,92	6,02	47,71
trend 1990-2008, %	-74,31	-85,99	-48,88	-50,08	-51	-57,49	-78,03	-54,03

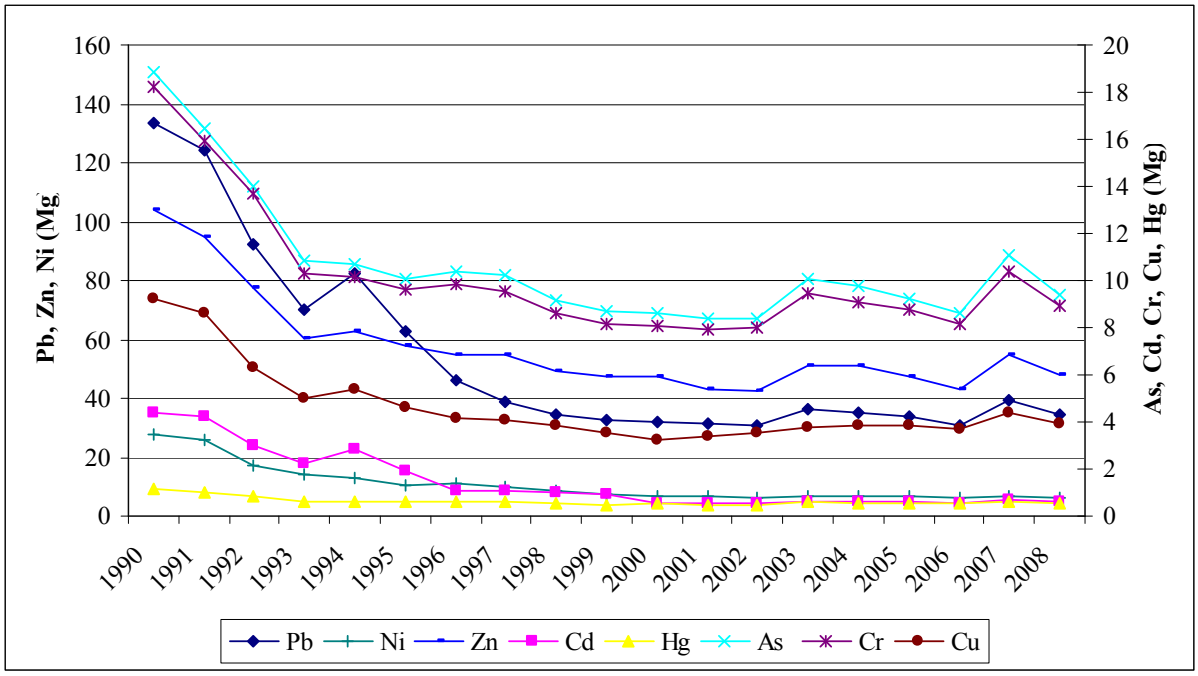


Figure 2.12 Heavy metals emissions in 1990-2008

Persistent organic pollutants

The emissions of POPs are shown in the table 2.3 and figure 2.13

Table 2.3 POPs emission in 1990-2008

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	5,68	3,64	4,29	2,21	2,05	12,19	0,06	90,27
1991	5,41	3,53	4,21	2,14	1,99	11,87	0,06	81,03
1992	4,30	2,55	2,91	1,54	1,48	8,47	0,05	67,25
1993	3,56	2,14	2,42	1,31	1,27	7,14	0,04	57,02
1994	3,83	2,57	2,84	1,57	1,58	8,56	0,07	53,44
1995	4,53	4,36	4,76	2,64	2,73	14,48	0,12	51,78
1996	4,91	5,04	5,56	3,08	3,18	16,86	0,14	54,46
1997	4,81	4,97	5,46	3,03	3,15	16,60	0,14	54,03
1998	3,81	4,00	4,44	2,43	2,51	13,38	0,13	48,33
1999	3,42	3,86	4,30	2,35	2,42	12,93	0,12	45,81
2000	3,36	3,76	4,16	2,27	2,37	12,56	0,13	44,80
2001	3,48	3,73	4,18	2,26	2,34	12,51	0,14	46,92
2002	3,69	3,81	4,26	2,31	2,40	12,78	0,13	46,50
2003	4,05	3,95	4,42	2,37	2,48	13,23	0,15	53,92
2004	3,72	4,15	4,67	2,48	2,57	13,87	0,16	52,39
2005	3,28	3,77	4,28	2,23	2,31	12,59	0,15	49,67
2006	2,67	3,76	3,87	2,06	2,03	11,73	0,12	45,84
2007	4,80	3,94	4,36	2,41	2,52	13,23	0,13	57,30
2008	5,06	4,21	4,63	2,54	2,68	14,05	0,15	50,87
trend 1990-2008, %	-10,95	13,51	7,34	12,76	23,41	13,22	59,07	-43,64

Dioxin and PCB emissions have decreased by about 11% and 44% respectively comparing with 1990. The main source of PCB emission – is oil shale combustion and directly depended from 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 inceniration.

At the same time emissions of PAH have increased and reason is that biomass consumption in energy sector is increased.

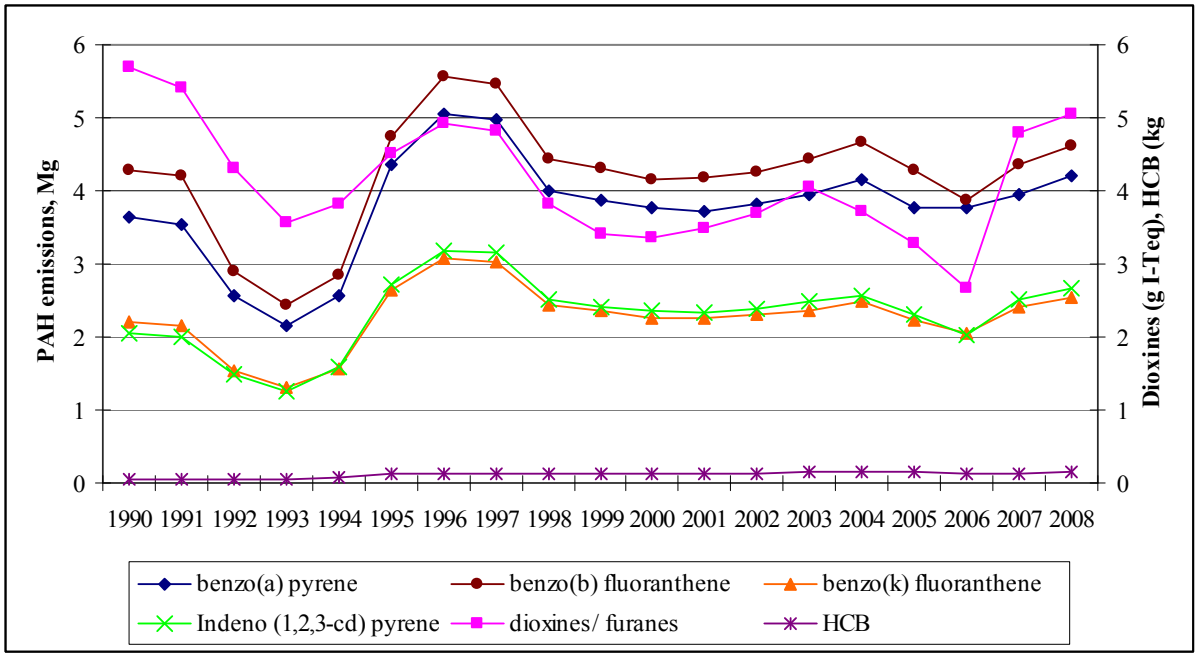


Figure 2.13 POPs emissions in 1990-2008.

3. Energy sector (NFR 1)

3.1 Overview of sector

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 2005, the share of domestic fuels – oil shale, wood and peat – accounted for about 74% of the primary energy supply. Imported fuels (natural gas, fuel oils, coal and motor fuels) made up 26%. Renewables formed about 11% of the primary energy supply in 2008, 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.

The efficiency of primary energy consumption (the ratio of the final energy consumption to the primary energy consumed) in Estonia is about 54% which is a relatively low indicator. This is mainly caused by the facts that there are no large hydro-electric stations and more than 90% of the elektric energy is produced in condensation power stations the efficiency of which is about 30%. Losses in a power or district heating network and the export of conversed energy (electricity, shale oil and oil shale coke, peat briquette, wood chips) also reduce the efficiency indicator of the energy sector. The national goal in this field is continuous rise of the efficiency of the energy sector and as efficient as possible use of energy.

Regading 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 circulationg 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 has decreased as a result of shutting down the older boilers: in the of 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 lanched. 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. Due to the successful operation and maintenance of new CFB units the elektricity generation by unit no. 8 in Eesti PP and by unit no. 11 in Balti PP accounted for 31% of all elektricity sold by Narva Elektrijaamad AS in the 2005/2006 financial year. (1)

Table 3.1 Pollutants emission from the energy sector

		1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Nox	Gg	73,54	67,86	42,02	38,91	41,31	38,78	41,30	40,08	38,88	35,22	35,86
NMVOC	Gg	47,57	42,74	27,55	23,47	26,30	33,44	37,74	38,50	32,87	31,46	32,90
SO2	Gg	267,60	245,54	188,23	152,44	146,66	112,90	121,63	112,64	100,67	94,39	94,11
NH3	Gg	0,06	0,06	0,05	0,05	0,07	0,10	0,15	0,20	0,21	0,24	0,28

PM2,5	Gg	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	20,84
PM10	Gg	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	35,90
TSP	Gg	275,18	276,00	247,38	195,52	173,56	133,16	122,76	99,52	88,04	86,46	73,01
CO	Gg	285,26	259,39	154,79	142,06	166,45	205,07	229,05	228,40	194,28	180,64	178,13
Pb	Mg	133,52	124,19	92,33	69,95	82,53	63,07	46,45	38,75	34,74	32,71	31,71
Cg	Mg	4,40	4,20	3,00	2,22	2,87	1,96	1,05	1,07	1,01	0,95	0,56
Hg	Mg	1,12	1,02	0,83	0,64	0,64	0,60	0,60	0,60	0,53	0,50	0,51
As	Mg	18,86	16,45	14,03	10,84	10,68	10,07	10,36	10,20	9,15	8,71	8,59
Cr	Mg	18,23	15,89	13,68	10,34	10,17	9,62	9,84	9,55	8,58	8,18	8,04
Cu	Mg	9,22	8,62	6,29	5,01	5,41	4,62	4,14	4,08	3,82	3,54	3,20
Ni	Mg	27,39	25,95	17,04	14,36	12,89	10,52	10,96	9,84	8,89	7,67	6,64
Zn	Mg	103,78	95,05	77,67	60,02	62,91	57,60	55,07	54,59	49,51	47,28	43,59
Dioxines	g I-Teq	5,21	4,94	3,84	3,11	3,39	4,10	4,48	4,19	3,25	3,13	2,96
PAH (4 total)	Mg	12,19	11,87	8,47	7,14	8,56	14,48	16,86	16,72	13,38	12,93	12,56
HCB	kg	0,06	0,06	0,05	0,04	0,07	0,12	0,14	0,14	0,13	0,12	0,13
PCB	kg	90,27	81,03	67,25	57,02	53,44	51,78	54,46	54,03	48,33	45,81	44,80

		2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**1990-2008, %**
Nox	Gg	38,86	40,24	40,80	38,26	35,94	34,48	37,64	34,09	-53,65
NMVOC	Gg	34,02	33,33	34,12	34,17	30,77	28,27	29,94	29,46	-38,08
SO2	Gg	90,12	86,46	100,02	88,06	76,10	69,81	87,94	69,30	-74,10
NH3	Gg	0,32	0,33	0,34	0,35	0,37	0,41	0,47	0,48	+87,17
PM2,5	Gg	21,98	22,48	20,61	21,76	19,62	15,01	20,05	19,72	-5,38
PM10	Gg	36,10	31,98	28,61	28,59	25,19	18,64	27,21	23,78	-33,75
TSP	Gg	71,24	50,31	46,37	43,20	34,78	25,37	33,41	29,08	-89,43
CO	Gg	186,82	181,67	179,41	174,19	158,71	145,73	164,72	167,13	-41,41
Pb	Mg	31,33	30,92	36,22	34,83	33,49	30,72	39,30	34,30	-74,31
Cg	Mg	0,55	0,57	0,63	0,59	0,58	0,55	0,68	0,62	-85,99
Hg	Mg	0,50	0,50	0,58	0,54	0,52	0,52	0,65	0,57	-48,88
As	Mg	8,39	8,36	10,11	9,79	9,22	8,59	11,08	9,42	-50,08
Cr	Mg	7,89	7,98	9,46	9,04	8,71	8,10	10,33	8,85	-51,42
Cu	Mg	3,36	3,49	3,74	3,86	3,85	3,69	4,34	3,92	-57,52
Ni	Mg	6,51	6,29	6,80	6,75	6,49	5,84	6,80	5,98	-78,17
Zn	Mg	43,21	42,51	51,10	51,03	47,41	42,98	54,53	47,70	-54,03
Dioxines	g I-Teq	3,12	3,07	3,57	3,06	3,07	2,62	4,50	4,60	-11,73
PAH (4 total)	Mg	12,51	12,78	13,23	13,87	12,59	11,73	13,23	13,04	+6,52
HCB	kg	0,14	0,13	0,15	0,16	0,15	0,12	0,13	0,15	+59,07
PCB	kg	46,92	46,50	53,92	52,39	49,67	45,84	57,30	50,87	-43,64

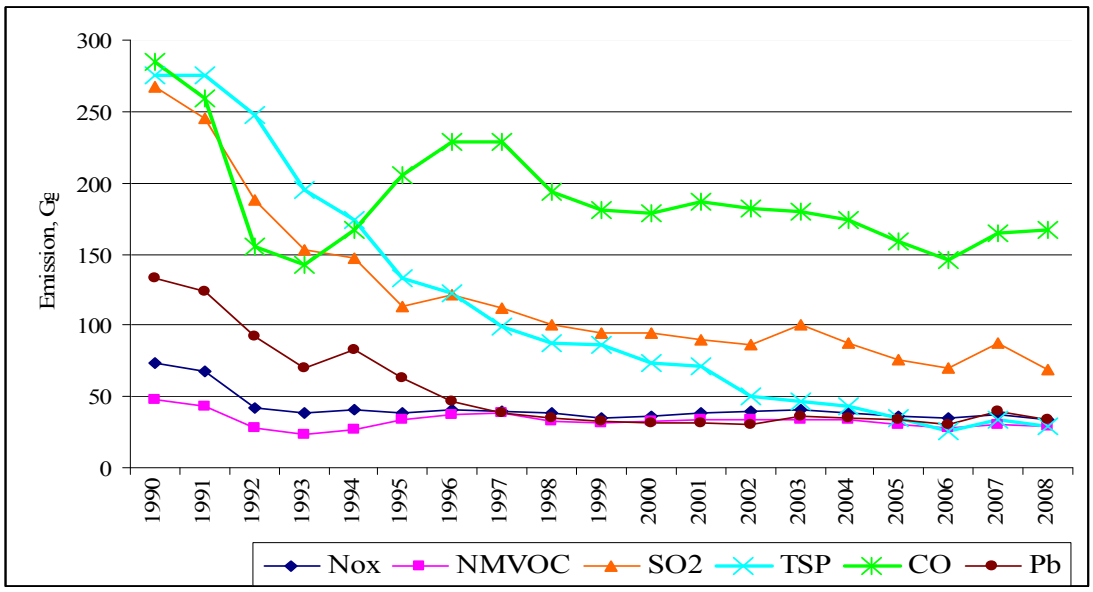


Figure 3.1 Pollutants emission from energy industry in 1990-2008

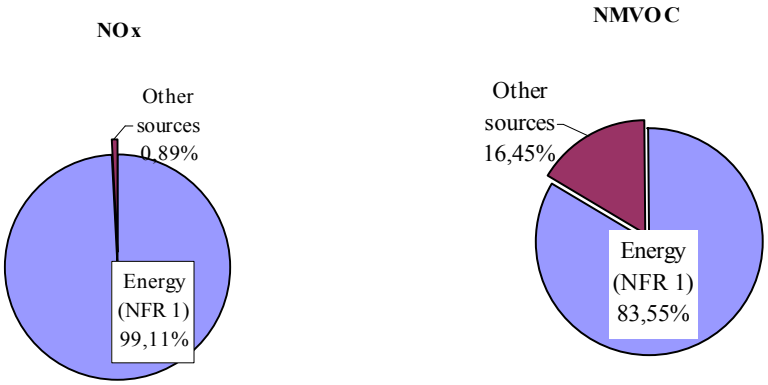


Figure 3.2 – 3.3 Share of NOx and NMVOC emission from energy sector in total emission

3.2 Stationary fuel combustion

3.2.1 Sources category description

This chapter includes follows activities:

1A1 - Combustion in energy and transformation industries
1 A 2 f i - Combustion in manufacturing industries
1 A 4 a i - Combustion in commercial/Institutional,
1 A 4 b i - Residential: Stationary plants
1 A 4 c i - Agriculture/Forestry/Fishing
1 A 5 a - Other stationary (including military)

The sector 1A2fi includes total data about emissions from all industrial boilers. As Estonia uses CollectER and ReportER for generation NFR report, it is impossible to divide emissions from boilers on industries (only one SNAP code 0301 for industrial combustion in boilers).

The sector 1A4 includes emissions from the boilers in commercial, institutional, residual, agricultural sectors.
Off-road vehicles and other machinery in manufacturing industries and agriculture are included in the chapter 3.3 "Transport"

Table 3.2 Pollutants emission from stationary fuel combustion in 1990-2008

		1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Nox	Gg	33,43	30,51	21,51	16,75	18,08	18,28	19,89	18,30	16,94	16,12	17,14
NMVOC	Gg	12,85	12,41	9,92	8,69	10,75	18,79	21,85	21,51	16,92	16,63	16,42
SO2	Gg	266,71	244,67	187,72	151,61	146,16	112,46	121,27	112,32	100,33	94,09	93,77
NH3	Gg	0,04	0,03	0,03	0,03	0,04	0,07	0,08	0,08	0,06	0,06	0,06
PM2,5	Gg	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	20,06
PM10	Gg	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	34,97
TSP	Gg	273,13	274,09	246,27	194,25	172,35	132,00	121,58	98,33	86,73	85,43	71,88
CO	Gg	98,26	98,52	73,93	63,99	78,31	130,35	150,26	146,13	118,71	113,19	113,67
Pb	Mg	126,73	118,44	89,64	67,36	79,53	60,65	44,15	36,60	33,03	31,47	30,86
Cd	Mg	4,39	4,19	2,99	2,21	2,86	1,95	1,04	1,06	1,00	0,94	0,56
Hg	Mg	1,12	1,02	0,83	0,64	0,64	0,60	0,60	0,60	0,53	0,50	0,51
As	Mg	18,86	16,45	14,03	10,84	10,68	10,07	10,36	10,20	9,15	8,71	8,59
Cr	Mg	18,17	15,84	13,65	10,31	10,14	9,59	9,81	9,52	8,55	8,15	8,01
Cu	Mg	7,35	6,87	5,31	3,96	4,32	3,65	3,10	2,99	2,69	2,54	2,18
Ni	Mg	27,31	25,88	17,00	14,31	12,84	10,48	10,92	9,80	8,85	7,63	6,60
Zn	Mg	102,66	93,99	77,08	59,39	62,26	57,02	54,45	53,94	48,85	46,69	42,99
Dioxines	g I-Teq	4,97	4,72	3,74	3,00	3,25	3,97	4,35	4,06	3,14	3,03	2,86
PAH (4 total)	Mg	12,11	11,79	8,43	7,08	8,51	14,44	16,81	16,68	13,34	12,89	12,52
HCB	kg	0,06	0,06	0,05	0,04	0,07	0,12	0,14	0,14	0,13	0,12	0,13
PCB	kg	90,25	81,01	67,24	57,01	53,43	51,77	54,45	54,02	48,33	45,81	44,80

		2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**1990-2008, %**
Nox	Gg	18,15	17,55	20,00	18,26	16,22	14,70	18,17	16,61	-50,31
NMVOC	Gg	15,89	16,70	17,60	17,56	15,88	14,64	18,04	19,18	+33
SO2	Gg	89,70	85,72	99,37	87,45	75,75	69,48	87,62	69,07	-74,10
NH3	Gg	0,06	0,07	0,06	0,06	0,05	0,05	0,06	0,07	+40,23
PM2,5	Gg	21,11	21,42	19,57	20,69	18,58	13,96	18,97	18,70	-6,77
PM10	Gg	35,05	30,72	27,39	27,34	23,95	17,36	25,91	22,54	-35,54
TSP	Gg	69,91	48,78	44,84	41,69	33,25	23,76	31,80	27,53	-89,92
CO	Gg	115,21	118,55	121,29	125,56	114,84	102,59	124,11	133,55	-35,91
Pb	Mg	30,33	29,99	35,31	33,96	32,62	29,80	38,33	33,34	+73,69
Cd	Mg	0,54	0,56	0,62	0,58	0,57	0,54	0,67	0,60	-86,27
Hg	Mg	0,50	0,50	0,58	0,54	0,52	0,52	0,65	0,57	-48,83
As	Mg	8,39	8,36	10,11	9,79	9,22	8,59	11,08	9,42	-50,08
Cr	Mg	7,86	7,94	9,42	9,00	8,67	8,05	10,28	8,81	-51,51
Cu	Mg	2,16	2,14	2,54	2,52	2,44	2,18	2,75	2,39	-67,52
Ni	Mg	6,46	6,24	6,75	6,70	6,44	5,78	6,74	5,92	-78,32

Zn	Mg	42,50	41,72	50,39	50,24	46,59	42,08	53,59	46,79	-54,42
Dioxines	g I-Teq	3,01	2,98	3,49	3,00	3,01	2,56	4,44	4,55	-8,37
PAH (4 total)	Mg	12,47	12,73	13,18	13,82	12,54	11,67	13,17	12,98	+6,72
HCB	kg	0,14	0,13	0,15	0,16	0,15	0,12	0,13	0,15	+59,07
PCB	kg	46,92	46,50	53,92	52,39	49,67	45,84	57,30	50,87	-43,63

3.2.2. Quantitative overview

Energy related activities (without transport) are the most significant contributors to SO_2 emissions – 99,6% in 2008. The share of mobile sources in total emission is very small – 0,32% (Figure 3.4). The oil shale Power Plants contributes to total SO_2 emissions about 77%. Estonian shale is high-ash shale (up to 46%), low net caloric value (8,4-9 MJ/kg) and sulphur content 1,4-1,8%.

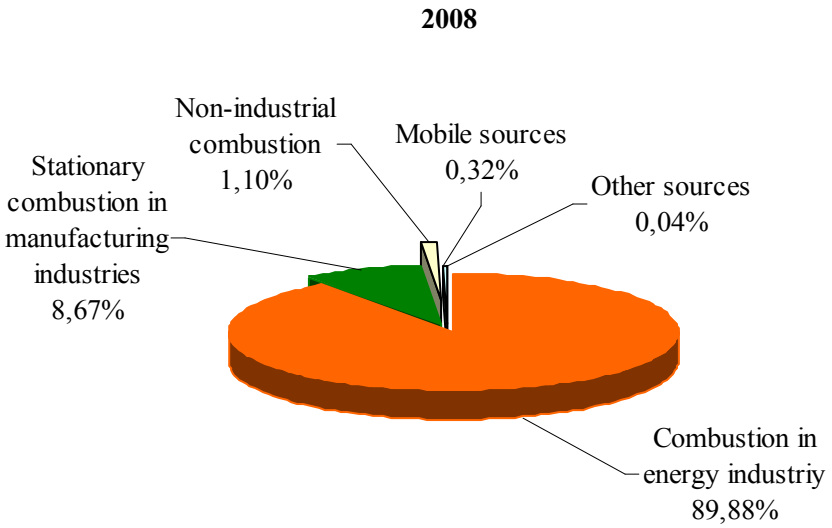


Figure 3.4 SO_2 emissions by sources of pollution in 2008

3.2.3. Methodological issues

Emissions data from the energy industries includes data from point sources (PS) reported by facilities and 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 contains summary data for the district heating and industrial boilers (SNAP 01 and SNAP 03). Fuel consumption by 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. All large combustion plant >100MW are obliged according to the national legislation 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 (Table 3.3-3.7).

Tabel 3.3 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		

Tabel 3.4 NOx 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 3.5 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 3.6 Carbone minoxide 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	
Oilshale oil	100				100	
Light fuel oil	100				100	
Gas	60				40	

Table 3.7 Heavy metals emission factors for boilers, mg/GJ

Fuel /purification equipement	**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 = $0,02 \times B \times S^r \times (1-\eta)$, were

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

Estonia at present has no national emission factors for PM10 and PM2,5. 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.
For the emissions calculating from residual sectors were used activity data from Energy Balance and Guidebook emission factor (Table 3.8).

Table 3.8. Pollutants emission factors for area energy sources

Pollutant	Coal	Wood, peat	Gaseous fuels	Liquid fuels	Units
SO2	900	10	0	138	g/GJ
NOx	130	80	60	70	g/GJ
NH3	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
PM10	400	700	1	5	g/GJ
PM2,5	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

3.3 Transport

3.3.1 Sources category description

Table 3.9 Chapter of transport sector includes following reporting categories:

NFR code	Description	Remarks
1 A 3 b Road transport	Transportation on roads by vehicles with combustion engines: passengers cars, light duty vehicles, heavy duty trucks, buses and motorcycles	Includes activities: gasoline evaporation, automobile tyre and brake wear and automobile road abrasion
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	Activities include all use of aircraft (jets, turboprop powered and piston engine aircraft, helicopters) consisting passengers and freight transport.	
1 A 3 a i (i) International aviation (LTO)	Activities include all use of aircraft (jets, turboprop powered and piston engine aircraft, helicopters) consisting passengers and freight transport.	
1 A 3 a ii (ii) Civil aviation (Domestic, Cruise)	Activities include all use of aircraft consisting passengers and freight transport.	
1 A 3 a i (ii) International aviation (Cruise)	Activities include all use of aircraft consisting passengers and freight transport.	
1 A 3 c Railways	Railway transport operated by steam and diesel locomotives	
1 A 3 d ii National navigation (Shipping)	Merchant ships, passenger ships, technical ships, pleasure and tour ships and other inland vessels.	
1 A 4 a ii Commercial/Institutional: Mobile	Commercial and institutional landbased mobile machinery	
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.	
1 A 4 c ii Agriculture/Forestry/Fishing: Off-raod vehicles and other machinery	Off-road vehicles and other machinery used in agriculture/forestry landmased mobile machinery (agricultural tractors, harvesters, combines etc.)	
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	Mobile combustion in manufacturing industries and construction landbased mobile machinery (e.g. rollers, asphalt pavers, excavators, cranes, tractors, other industrial machinery)	Includes 1 A 5 b Other, Mobile - Military sector
1 A 3 d i (i) International maritime navigation	Vessels of all flags that are engaged in international water-borne navigation.	

The share of mobile sources into total emission in 2008 were: NO_x – 50,8%, NMVOC – 13,7%, CO – 19,9%. The share of other pollutants are not so significant. The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have decreased comparing with 1990 by 56,5%, 82,1% and 75,3% respectively (Figure 3.5). The trend of the emissions of these categories is given in Figure 3.5, Tables 3.10 and 3.11.
All the emissions in period 1990-2008 are recalculated from transport sector. Main reasons for that are: research results from project made by Tallinn University of Technology

("Liikuvatest saasteallikate saasteainete heitkoguste arvutamine ja analüüs" uurimis- ja arendustegevuse leping nr: 7118/06.12.2007) and renewed Guidebook with new emission factors *(EMEP/EEA air pollutant emission inventory guidebook — 2009).* Recalculations led to a change in total emissions and detail overview is given in each transport subsector.

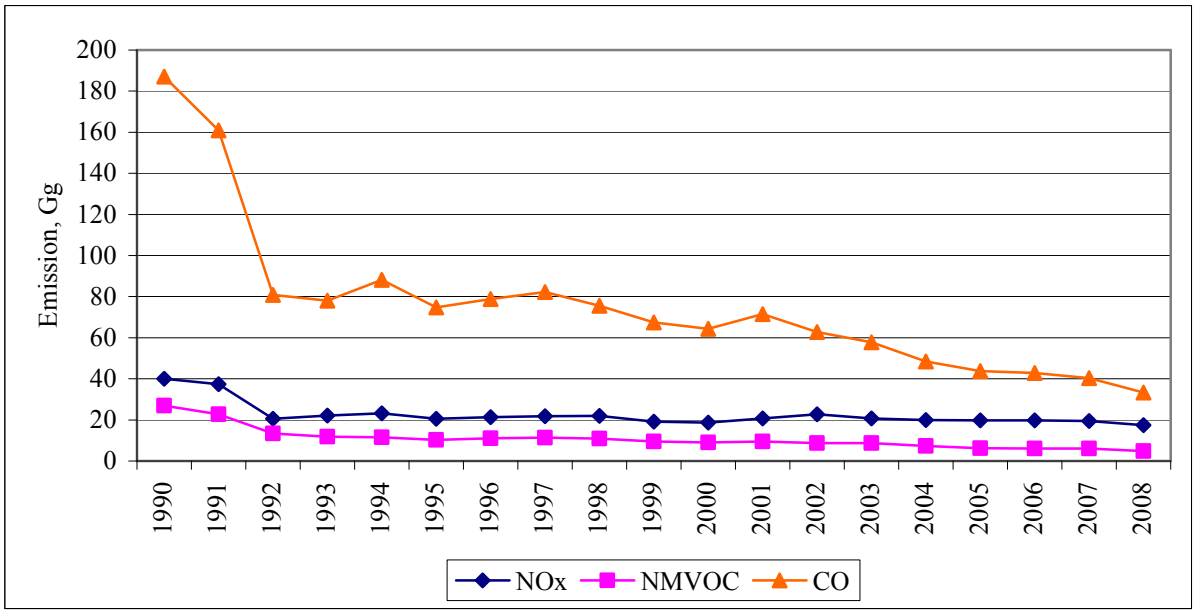


Figure 3.5 NO_x, NMVOC and CO emissions from transport sector.

Table 3.10 Total emissions from transport sector in 1990-2008 (Gg)

	NO_x		**NMVOC**		**SO_2**		**NH_3**		**$PM_{2,5}$**		**PM_{10}**		**TSP**		**CO**	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	40,020	40,108	26,570	26,932	6,110	0,890	0,020	0,022	0	1,655	0	1,877	4,090	2,048	214,570	187,004
1991	38,070	37,345	24,210	22,755	5,870	0,871	0,020	0,026	0	1,555	0	1,756	2,360	1,907	177,840	160,867
1992	21,210	20,512	11,990	13,366	3,390	0,507	0,010	0,016	0	0,938	0	1,114	1,470	1,114	101,740	80,857
1993	23,080	22,159	12,590	11,869	3,560	0,826	0,010	0,021	0	1,077	0	1,187	1,620	1,270	92,250	78,067
1994	24,600	23,228	13,830	11,604	4,720	0,497	0,020	0,029	0	0,969	0	1,106	1,470	1,210	90,440	88,140
1995	20,130	20,503	12,050	10,316	4,390	0,435	0,030	0,028	0	0,925	0	1,058	1,240	1,159	75,780	74,715
1996	21,350	21,413	12,880	11,014	3,510	0,362	0,040	0,068	0	0,938	0	1,077	1,300	1,182	83,090	78,786
1997	21,700	21,784	13,660	11,375	3,560	0,317	0,060	0,117	0	0,922	0	1,072	1,220	1,187	89,900	82,273
1998	21,770	21,942	11,550	10,834	2,210	0,343	0,080	0,152	0	0,980	0	1,160	1,240	1,310	80,110	75,567
1999	18,180	19,102	11,330	9,434	1,900	0,304	0,100	0,182	0	0,779	0	0,923	0,970	1,032	77,020	67,450
2000	17,350	18,710	9,930	9,046	1,930	0,337	0,130	0,221	0,950	0,768	1,093	0,911	1,826	1,020	70,000	64,256
2001	19,060	20,696	10,260	9,531	1,130	0,417	0,170	0,257	1,196	0,851	1,342	1,029	2,190	1,160	74,140	71,426
2002	22,190	22,683	9,970	8,781	1,610	0,745	0,210	0,260	1,530	1,048	1,726	1,230	2,670	1,367	70,880	62,850
2003	19,260	20,791	8,230	8,765	1,440	0,654	0,260	0,284	1,308	1,026	1,490	1,200	2,434	1,329	61,670	57,768
2004	18,380	19,998	6,900	7,308	1,420	0,610	0,310	0,283	1,270	1,058	1,460	1,237	2,450	1,370	49,080	48,366
2005	15,950	19,711	5,490	6,187	1,330	0,352	0,370	0,271	1,140	1,027	1,340	1,209	2,390	1,347	43,320	43,700
2006	15,820	19,769	5,750	6,141	1,380	0,330	0,370	0,301	1,130	1,044	1,330	1,243	2,420	1,390	45,520	42,889
2007	16,070	19,457	6,380	6,020	0,720	0,308	0,340	0,321	1,172	1,070	1,296	1,279	1,970	1,434	44,730	40,392
2008		17,458		4,832		0,220		0,314		0,994		1,197		1,349		33,302

**Old - inventory submissions 2009; Recal – Recalculated inventory submissions 2010*

Table 3.11 Total emissions of heavy metals from transport sector in 1990-2008 (Mg)

	Pb		Cd		Cr		Cu		Ni		Se		Zn	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	73,870	6,789	0,010	0,012	0,103	0,056	1,880	1,868	0,121	0,079	0	0,012	1,137	1,121
1991	13,170	5,749	0,008	0,011	0,111	0,053	1,730	1,746	0,128	0,073	0	0,010	1,066	1,056
1992	31,230	2,690	0,004	0,005	0,050	0,029	0,976	0,979	0,058	0,041	0	0,005	0,576	0,586
1993	33,530	2,591	0,004	0,006	0,043	0,030	1,046	1,045	0,062	0,043	0	0,005	0,633	0,625
1994	44,360	2,996	0,007	0,006	0,053	0,032	1,351	1,089	0,068	0,045	0	0,006	0,811	0,652
1995	23,630	2,420	0,000	0,005	0,045	0,029	0,954	0,970	0,054	0,040	0	0,005	0,564	0,579
1996	20,930	2,304	0,005	0,006	0,056	0,032	1,044	1,040	0,067	0,042	0	0,005	0,624	0,624
1997	7,810	2,152	0,005	0,007	0,026	0,032	1,071	1,093	0,059	0,044	0	0,005	0,642	0,653
1998	5,320	1,707	0,005	0,007	0,038	0,032	1,092	1,124	0,049	0,045	0	0,005	0,660	0,666
1999	5,410	1,240	0,005	0,007	0,035	0,028	0,985	1,004	0,046	0,039	0	0,005	0,594	0,595
2000	3,640	0,845	0,005	0,007	0,025	0,029	0,965	1,019	0,036	0,040	0	0,005	0,582	0,604
2001	4,010	1,001	0,010	0,008	0,041	0,035	1,155	1,200	0,051	0,048	0,010	0,006	0,661	0,714
2002	3,990	0,926	0	0,011	0,031	0,041	1,383	1,349	0,052	0,054	0	0,008	0,805	0,798
2003	3,965	0,907	0	0,008	0,001	0,036	0,862	1,203	0,001	0,048	0	0,007	0,133	0,712
2004	3,775	0,865	0,006	0,009	0,033	0,040	1,313	1,338	0,047	0,054	0	0,007	0,775	0,794
2005	3,787	0,867	0,006	0,012	0,035	0,042	1,343	1,404	0,050	0,055	0,006	0,008	0,801	0,824
2006	4,004	0,924	0,008	0,013	0,038	0,046	1,428	1,507	0,053	0,059	0,008	0,008	0,829	0,896
2007	1,610	0,974	0,010	0,014	0,031	0,048	1,520	1,587	0,061	0,063	0,010	0,008	0,902	0,943
2008		0,958		0,014		0,045		1,528		0,059		0,008		0,909

3.3.2 Road transport

Road transport is the most important emission source in transport sector (Figure 3.6). Road tranport contributes to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide 66,4%, 75,1% and 16,8% respectively in 2008. The lead emissions from road transport has decreased for about 85% since 1990 (Figure 3.11). Reduction of emissions is connected with prohibition, since 2000 years, uses of lead gasoline (Figure 3.12). The share of road tranport in total Pb emissions was in 2008 2,8%.

In figures below (Figures 3.7-3.11) is provided detail overview of NO_x, NMVOC, CO, SO_2 and Pb emission sources in road transport sector.

Road transport includes all transportation types of vehicles on road (passenger cars, light duty vehicles, heavy duty trucks, buses, motorcycles). The source category does not cover farm and firest tractors driving ocasionally on the roads because they are included in other sectors as off-raods (railways, agricultural and industial machinery etc.)

In last years the consumption of gasoline in road transport becomes quite stable and diesel consumption increases. If in 1990 the gasoline consumption was dominated, then beginning from 2002 we can see continuous grows of diesel consumption by road transport (Figure 3.13).

Therefore the emissions reductions were due to decreasing of gasoline consumption in period 1990-2008 by 36% and also increasing of amount new cars, which due to new technologies are designed to reduce both energy consumption and pollutant emissions.

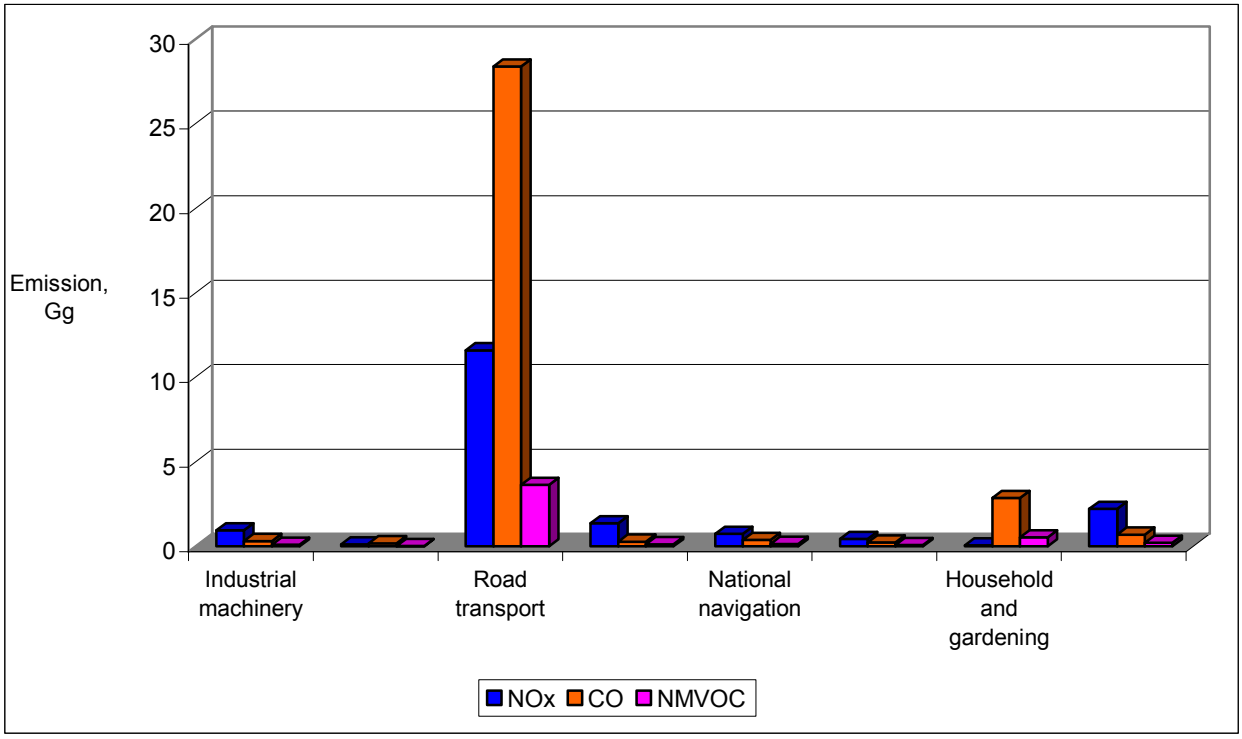


Figure 3.6 NO_x, NMVOC and CO emission share from transport sectors.

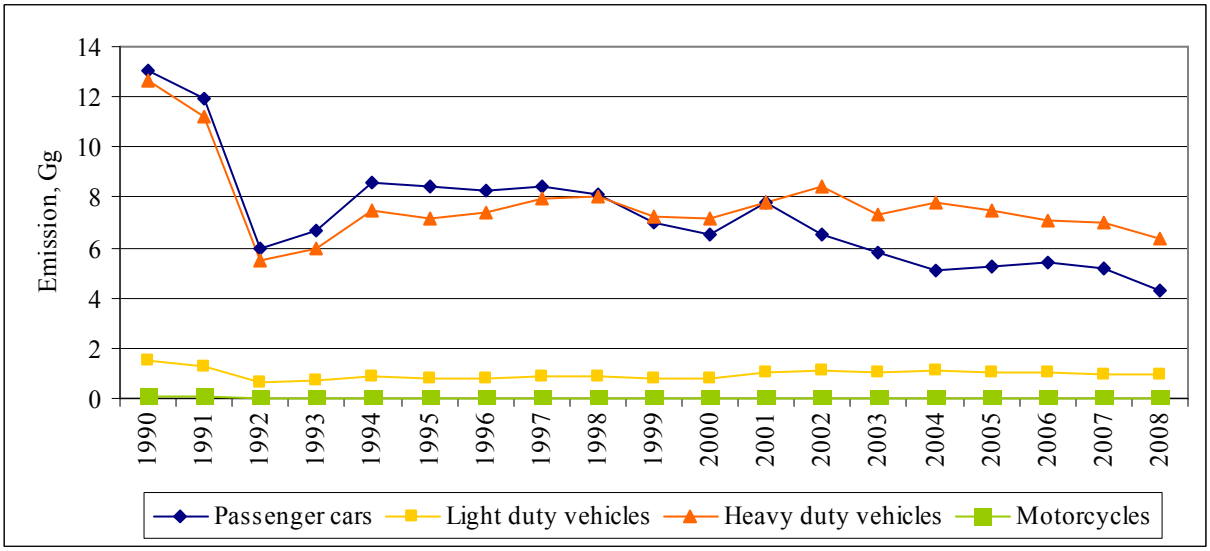


Figure 3.7 NO_x emissions from road transport

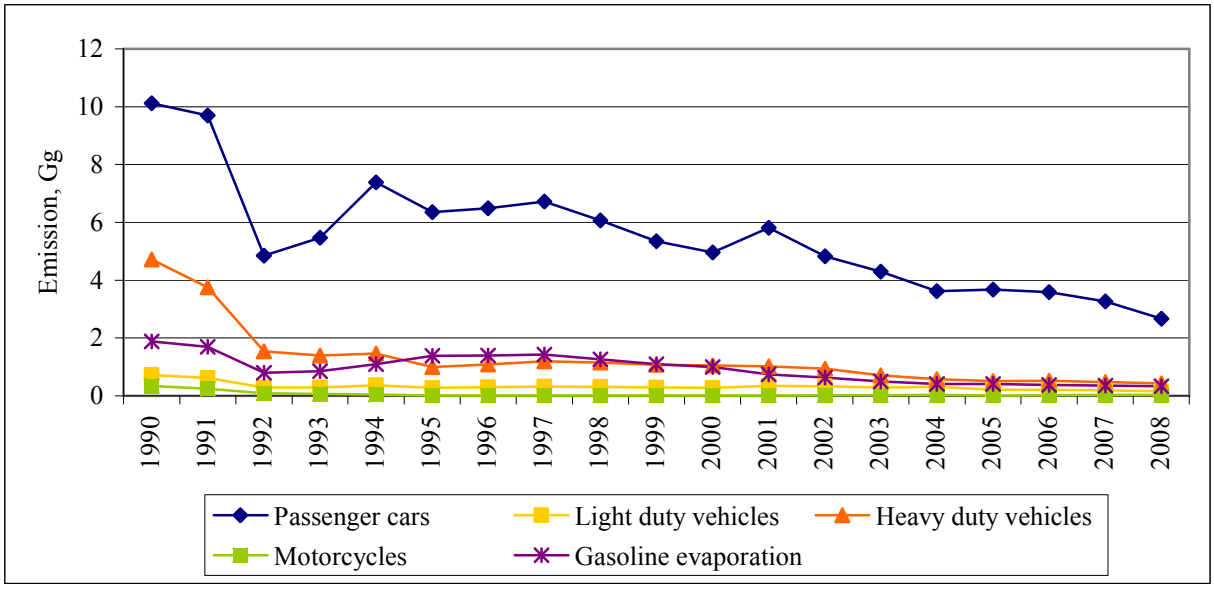


Figure 3.8 NMVOC emissions from road transport

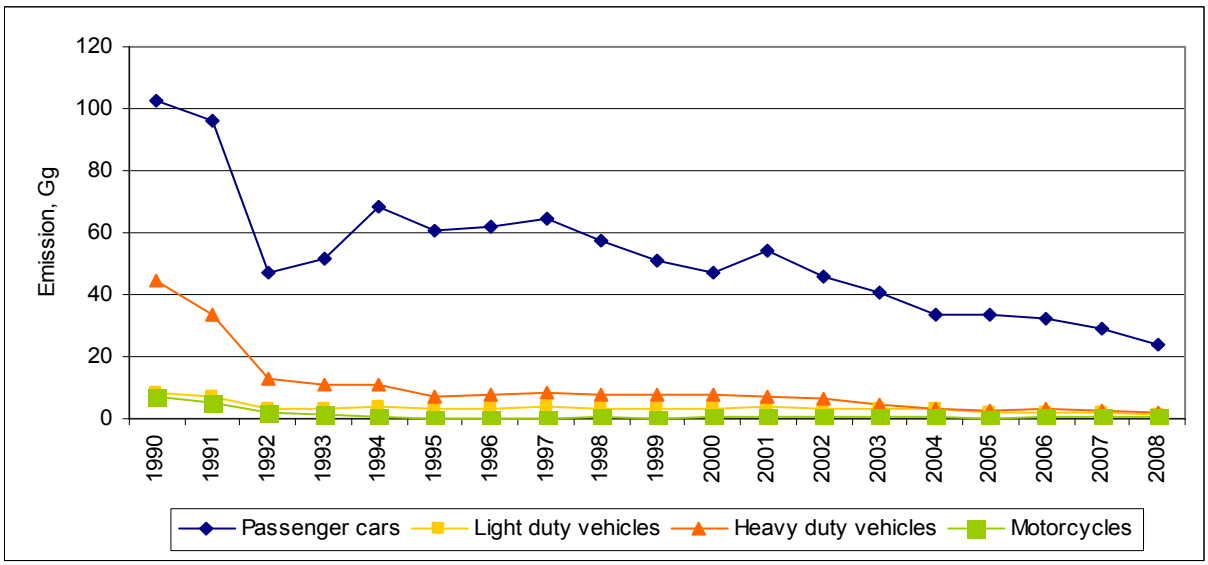


Figure 3.9 CO emissions from road transport

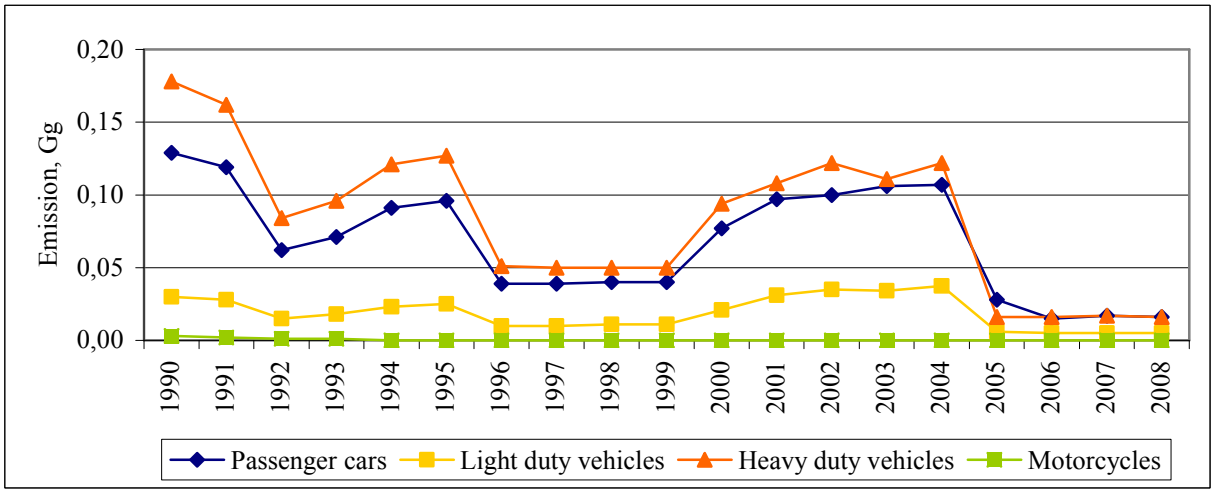


Figure 3.10 SO_2 emissions from road transport

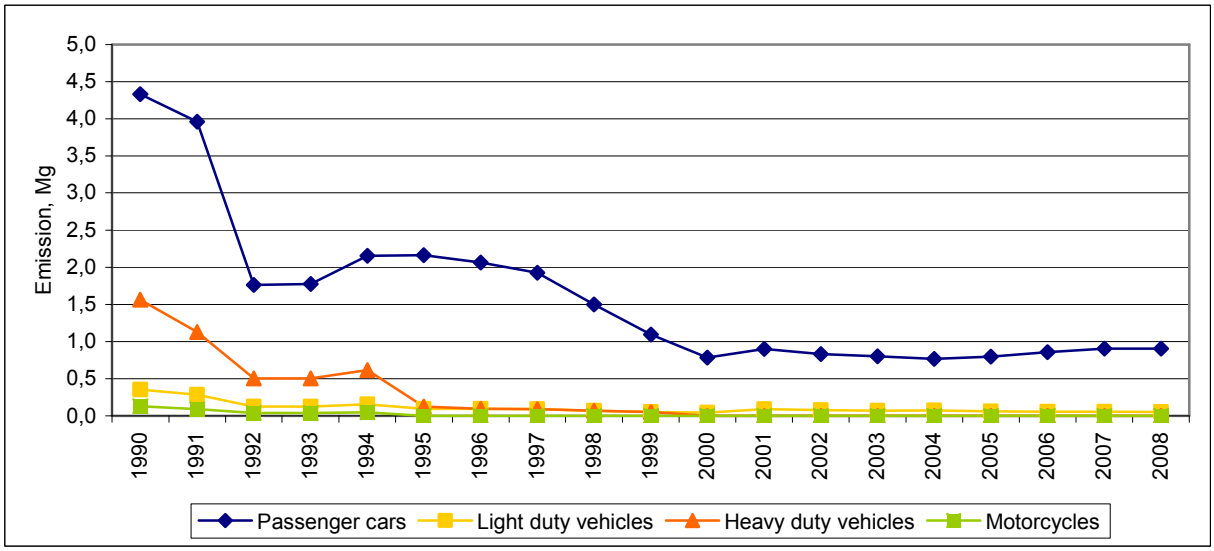


Figure 3.11 Pb emissions from road transport

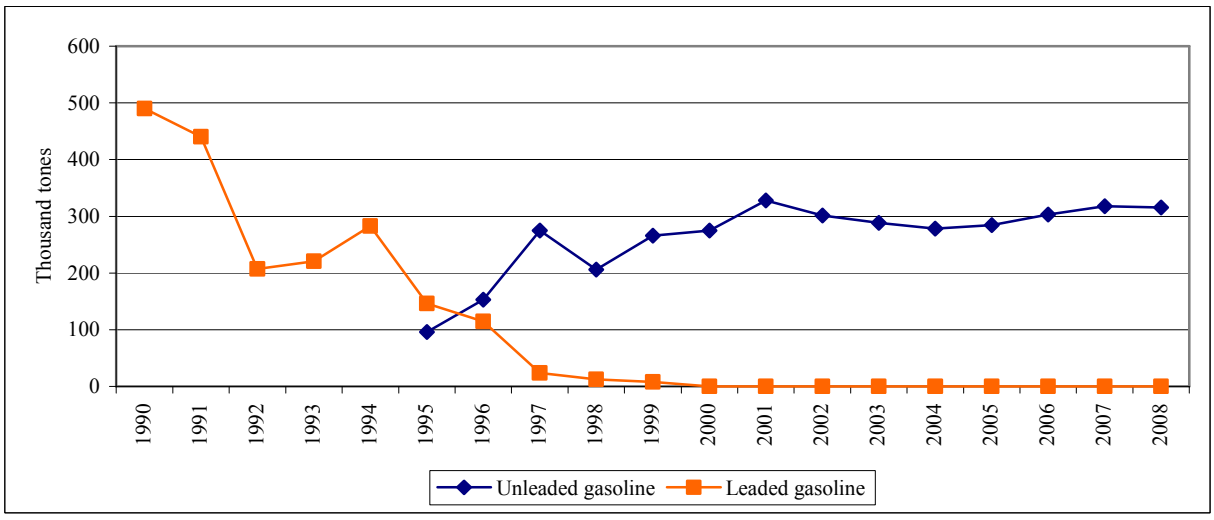


Figure 3.12 Gasoline consumption by road transport

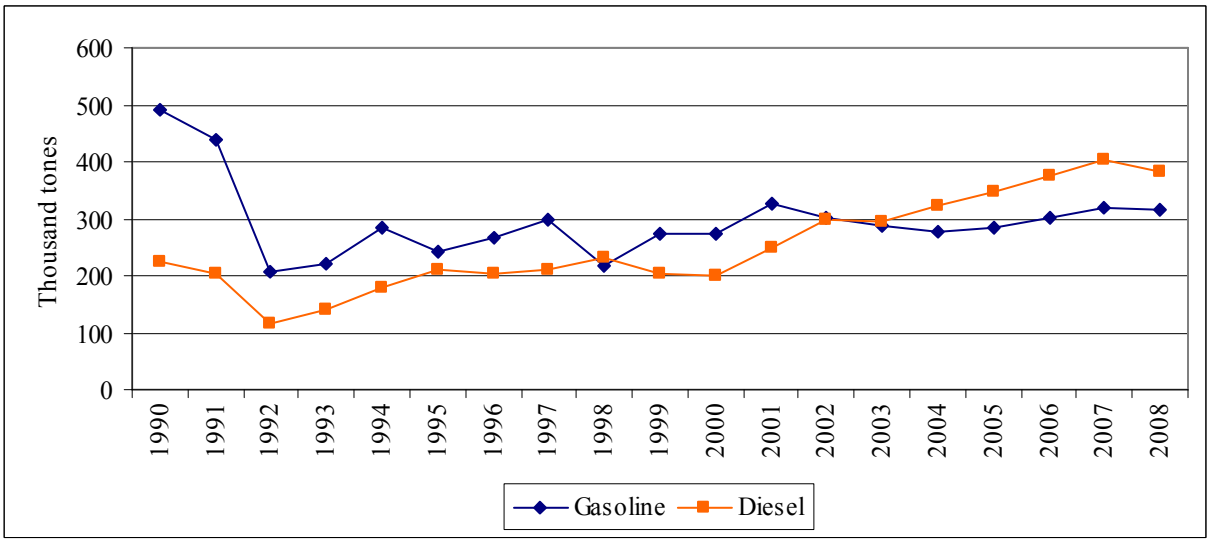


Figure 3.13 Gasoline and diesel consumption by road transport

Methodological issues

Emissions of road transport are calculated from detailed activity data based on Tier 3 method. Calculations are made by using the COPERT tool (Computer Programme to calculate Emissions from Road Transport, Copert 4 version 6.1), 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. Vehicles are divided into following classes:

Conventional - vehicles without catalytic conventers)

PRE ECE	up to 1971
ECE 15 00 & 01	1972 to 1977
ECE 15 02	1978 to 1980
ECE 15 03	1981 to 1985
ECE 15 04	1985 to 1992
EURO I	1992 to 1996
EURO II	1996 to 2000
EURO III	2000 to 2005
EURO IV	since 2006

Calculations demand annual mileage per vehicle (Table 3.15) and number of vehicles (Table 3.16), which is supplied by Estonian Road Administration *(ERA, former Estonian Motor Vehicle Registration Centre)*. This improved statistics are avaliable from 2001 and data for the years 1990-2000 is extrapolated. For meteorological data is responsible Meteorological and Hydrological Institute and for the fuel consumption 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

In the Tier 3 method, exhaust emissions are calculated using a combination of firm technical and activity data. This approach was entitled 'Detailed methodology' in the previous version of the Guidebook, and is implemented in Copert 4 programme.
Vehicle emissions are heavily dependent on the engine operation conditions. Different 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 :

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

where,

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

E_{HOT} – emissions during stabilised (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, NH3 and PM in these source categories are dependent on fuel type, emission reduction technology, vehicle type and vehicle use. These emissions are calculated on the basis of traffic performance (vehicle kilometres) and specific

emission factors for a variation of different vehicle classes and for three different road types (urban, rural, highway).

Emissions of SO_2 and heavy metals are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.17) with emission factors (Table 3.12). 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:

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

where:

E_{SO2} – emissions of SO_2

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

FC – fuel consumption

Table 3.12 Sulphur content of fuel (by weight)

	1990-1999	**2000-2004**	**2005**	**2006-2008**
Gasoline	0,0165%	0,013%	0,004%	0,001%
Diesel	0,04%	0,03%	0,004%	0,004%

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

$$\mathbf{E_{Pb} = 0{,}75 \times k \times FC}$$

where:

E_{Pb} – emissions of Pb

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

FC – fuel consumption

Table 3.13 Lead content in gasoline

	1990	**1995**	**Since 2000**
Leaded gasoline	0,013 g/l	0,013 g/l	-
Unleaded gasoline	-	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:

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

where:

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

FC – fuel consumption

Table 3.14 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 3.15 Road transport mileage in Estonia (million km/year)

	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	5601,3	658,0	1539,0	317,1	8115,4
1991	5376,0	609,9	1283,6	230,0	7499,6
1992	2724,9	302,6	625,9	82,6	3736,0
1993	3112,6	342,5	672,2	61,0	4188,4
1994	4197,4	462,4	777,6	43,4	5480,9
1995	3897,1	446,8	805,5	7,7	5157,2
1996	4201,7	484,8	803,7	10,0	5500,2
1997	4596,8	538,6	863,4	12,8	6011,6
1998	3440,2	422,1	934,5	10,5	4807,4
1999	4121,7	503,0	871,7	14,5	5511,0
2000	4064,7	506,4	881,3	15,9	5468,3
2001	5157,5	727,7	1008,6	16,2	6910,0
2002	5096,0	835,6	1060,7	17,3	7009,7
2003	5185,5	824,4	920,8	19,3	6950,1
2004	5225,6	922,7	961,7	32,8	7142,8
2005	5728,0	898,2	914,6	10,7	7551,6
2006	6440,5	950,5	917,9	19,2	8328,3
2007	6946,8	966,9	957,0	28,1	8898,8
2008	6863,4	946,8	939,9	29,8	8780,0

Table 3.16 Number of vehicles in Estonia, 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

Table 3.17 Fuel consumption by road transport (thousand tones)

	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	242,35	211,03
1996	267,57	202,13
1997	298,48	209,89
1998	217,85	231,07
1999	273,63	202,82
2000	274,82	199,59
2001	327,97	250,48
2002	301,37	298,62
2003	288,61	293,32
2004	278,01	323,34
2005	284,20	346,29
2006	302,99	376,09
2007	317,85	402,87
2008	315,77	381,63

Recalculations

All the emissions in period 1990-2008 are recalculated from transport sector. Main reasons for that are research results from project made by Tallinn University of Technology (TUT) *("Liikuvatest saasteallikate saasteainete heitkoguste arvutamine ja analüüs" uurimis- ja arendustegevuse leping nr: 7118/06.12.2007)* and improved new edition of COPERT programme.
Previously submitted estimates of road transport emissions were calculated by COPERT 3 version. The calculation methodology of COPERT is improved (detailed vehicle classes, updated emission factors etc.) and therefore new COPERT 4 is implemented to calculate emissions.
As a result of the project, new approach adopted to interpret raw activity data:

- All the raw mileage estimates consist cross-borded movements. Therefore the mileage have been corrected in some extent.
- The registry data (ERA) contains vehicles that are not actually in use (mostly many old cars in registry). Corrections have been made with vehicle numbers on the basis of additional information from Technical Inspection (TUT project, ERA).

- During resent years there has been a significant trend to import used cars to Estonia. Cars which are brought to Estonia firstly must be examined in Technical Inspection. ERA calculates annual mileage based on Technical Inspection data which are collected every year Therefore the mileage given is higher than actually driven in Estonia.
- Corrected statistical fuel consumtion (excluded military and household sectors share)
- Corrected SO_2 and Pb content in fuel (Table 3.12-3.13)

3.18 Emissions from road transport in 1990-2008, (Gg)

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	30,400	27,253	23,030	17,783	4,740	0,340	0,020	0,020	NR	0,848	NR	1,066	2,880	1,232	165,520	162,483
1991	28,720	24,548	21,600	16,012	4,500	0,311	0,020	0,024	NR	0,779	NR	0,975	1,150	1,122	146,880	142,447
1992	14,580	12,127	9,700	7,555	2,480	0,162	0,010	0,014	NR	0,424	NR	0,522	0,660	0,594	70,490	65,149
1993	14,680	13,372	10,840	8,073	2,410	0,186	0,010	0,019	NR	0,501	NR	0,608	0,620	0,688	76,350	67,518
1994	19,180	16,945	13,040	10,356	3,920	0,235	0,020	0,028	NR	0,635	NR	0,770	0,800	0,870	86,900	84,266
1995	16,140	16,422	11,380	9,013	3,810	0,248	0,030	0,028	NR	0,723	NR	0,853	0,730	0,951	71,790	70,458
1996	17,200	16,445	12,190	9,277	2,890	0,100	0,040	0,068	NR	0,675	NR	0,811	0,760	0,913	78,670	73,037
1997	17,850	17,228	12,980	9,682	3,000	0,099	0,060	0,117	NR	0,683	NR	0,830	0,730	0,942	84,880	76,598
1998	17,250	17,020	10,790	8,808	1,590	0,101	0,080	0,152	NR	0,733	NR	0,910	0,680	1,056	75,350	69,551
1999	14,740	15,061	10,810	7,818	1,430	0,101	0,100	0,182	NR	0,596	NR	0,736	0,550	0,842	74,210	62,163
2000	13,480	14,489	9,400	7,300	1,400	0,192	0,130	0,221	0,530	0,565	0,650	0,705	1,360	0,811	68,090	58,310
2001	14,810	16,584	9,420	7,934	0,580	0,236	0,170	0,257	0,750	0,649	0,880	0,824	1,710	0,952	70,930	65,530
2002	14,620	16,120	8,580	6,750	0,650	0,257	0,210	0,259	0,740	0,726	0,890	0,904	1,800	1,037	63,760	55,850
2003	12,990	14,133	6,980	5,813	0,640	0,251	0,260	0,283	0,655	0,678	0,803	0,849	1,712	0,975	54,880	48,389
2004	12,150	13,960	5,950	4,952	0,630	0,266	0,310	0,282	0,620	0,747	0,780	0,923	1,730	1,053	46,780	40,666
2005	10,970	13,681	4,690	4,823	0,690	0,050	0,370	0,270	0,630	0,734	0,800	0,914	1,830	1,048	41,310	38,550
2006	10,990	13,425	4,930	4,710	0,740	0,036	0,370	0,301	0,650	0,727	0,820	0,923	1,870	1,066	43,480	37,539
2007	10,930	13,132	5,490	4,313	0,060	0,039	0,340	0,321	0,652	0,725	0,756	0,932	1,400	1,084	42,560	34,233
2008		11,587		3,628		0,037		0,313		0,661		0,863		1,012		28,373

3.19 Emissions of heavy metals from road transport, (Mg)

	Pb		Cd		Cr		Cu		Ni		Se		Zn	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	73,790	6,372	0,010	0,008	0,043	0,036	1,480	1,214	0,061	0,051	0	0,008	0,867	0,714
1991	66,300	5,461	0,008	0,007	0,040	0,032	1,360	1,107	0,056	0,045	0	0,006	0,806	0,653
1992	31,200	2,429	0,004	0,003	0,020	0,016	0,706	0,556	0,028	0,023	0	0,003	0,416	0,328
1993	33,490	2,447	0,004	0,004	0,021	0,018	0,716	0,623	0,030	0,025	0	0,003	0,423	0,367
1994	44,320	2,969	0,007	0,005	0,033	0,024	1,141	0,799	0,047	0,033	0	0,005	0,671	0,471
1995	23,600	2,385	0,000	0,005	0,024	0,024	0,796	0,790	0,033	0,033	0	0,005	0,468	0,466
1996	20,890	2,257	0,005	0,006	0,025	0,025	0,875	0,817	0,036	0,033	0	0,005	0,513	0,482
1997	7,780	2,107	0,005	0,007	0,005	0,026	0,921	0,887	0,038	0,035	0	0,005	0,541	0,525
1998	5,310	1,637	0,005	0,007	0,027	0,026	0,916	0,908	0,038	0,036	0	0,005	0,545	0,536
1999	5,410	1,195	0,005	0,007	0,024	0,024	0,843	0,836	0,035	0,033	0	0,005	0,501	0,495
2000	3,640	0,828	0,005	0,007	0,024	0,025	0,835	0,839	0,035	0,033	0	0,005	0,490	0,497
2001	4,000	0,989	0,010	0,008	0,030	0,031	1,000	1,023	0,040	0,041	0,01	0,006	0,580	0,607
2002	3,990	0,909	0,000	0,009	0,030	0,032	1,100	1,061	0,040	0,042	0	0,006	0,650	0,629
2003	3,965	0,871	NA	0,008	NA	0,032	0,640	1,030	NA	0,041	NA	0,006	NA	0,611
2004	3,775	0,839	0,006	0,008	0,032	0,032	1,090	1,063	0,045	0,042	0	0,006	0,640	0,632
2005	3,787	0,861	0,006	0,011	0,034	0,035	1,175	1,139	0,049	0,044	0,006	0,007	0,691	0,679
2006	4,004	0,918	0,008	0,012	0,037	0,037	1,258	1,228	0,052	0,048	0,008	0,007	0,739	0,732
2007	1,610	0,963	0,010	0,013	0,030	0,039	1,340	1,304	0,060	0,052	0,010	0,007	0,790	0,776

2008	0,957	0,013	0,038	1,262	0,049	0,007	0,752

3.3.3 Aircraft

The total contribution of aircraft LTO emissions to national total NOx, NMVOC and CO emissions are considered to be about *0,3%, 0,05%* and *0,1%* in 2008. Other pollutants have even smaller share.

All the emissions in period 1990-2008 are recalculated from aviation sector. Recalculations based on the Tier 2 method *(EMEP/EEA air pollutant emission inventory guidebook — 2009)* on more detailed way than previously submitted emissions and this led to a change in total emissions.

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.*

Methodological issues

All flights from and to Estonias airports are separated into domestic and international flights. Separate emission estimates are made for domestic and international civil aircraft. Aviation estimates 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 data is supplied by airports. Estonian aircraft movements 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 comparing to previous submission data (Figure 3.15). The methodology needs information of the number of LTO's grouped by representative aircraft types (Table 3.20). 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 3.14). Assumptions is made if there excists 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 http://www.dera.gov.uk etc).
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 with 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 3.22, Figures 3.16, 3.17) 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 3.21). 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:

Total Emissions =LTO Emissions + Cruise Emissions

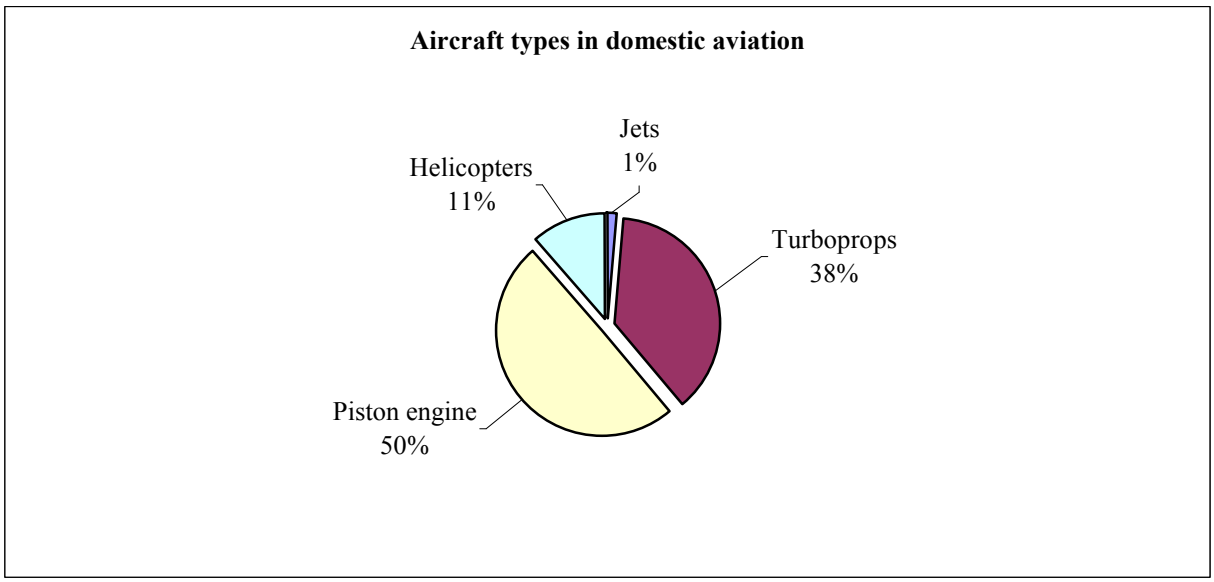
LTO Emissions = Number of LTOs * Emission Factor LTO

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

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

A complete emission calculation (LTO and cruise emissions for domestic and international flights) has been carried out by EEIC for 1992-2008. There has been done extrapolation for 1990 and 1991.

Figure 3.14 The share of different aircraft types in domestic and international civil aviation in 2008.



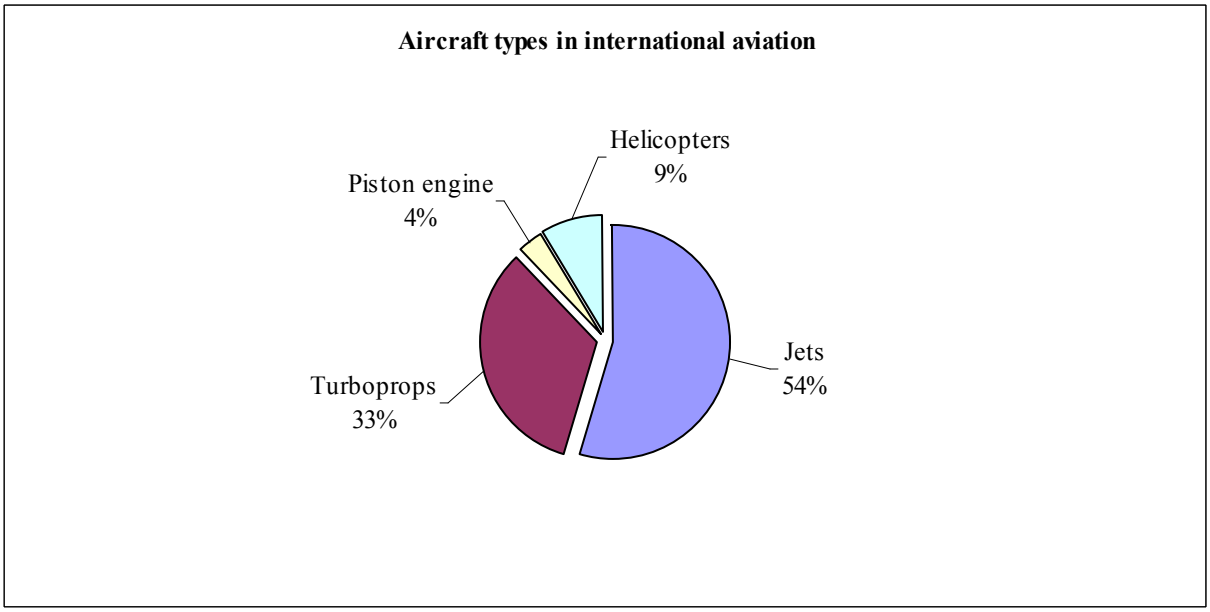


Table 3.20 Emission factors for LTO-cycle (kg/LTO)

	NO_x	NMVOC	SO_2	$PM_{2,5}$	CO	Fuel consumption
Turbofans (Jets)*						
Aribus 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/enigne	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	1,40
4 seat single engine (<180hp)	0,01	0,06	0,00	0	3,93	3,90
singe engine high perfomance (180-360hp)	0,02	0,16	0,00	0	7,33	7,50
twin engine high perfomance (2x235hp)	0,05	0,22	0,01	0	19,33	21,60
Helicopters****						
A109	0,13	0,89	0,02	0,01	1,31	32,80
A139	0,38	0,68	0,03	0,01	0,97	60,30
ALO3	0,11	0,28	0,01	0,00	0,40	21,40
AS32	0,65	0,49	0,04	0,02	0,68	77,40
AS35	0,18	0,22	0,01	0,01	0,32	27,50
AS50	0,15	0,24	0,01	0,01	0,35	25,20
AS55	0,15	0,82	0,02	0,01	1,20	34,80
H269	0,01	0,09	0,00	0,00	6,59	6,60
B412	0,64	0,49	0,04	0,02	0,69	77,00
B06	0,08	0,35	0,01	0,00	0,50	18,20
EC35	0,21	0,71	0,02	0,01	1,03	41,10
EN48	0,08	0,34	0,01	0,00	0,48	18,60
MI8	0,53	0,55	0,04	0,02	0,78	70,00
R22	0,01	0,09	0,00	0,00	6,21	6,20
R44	0,02	0,11	0,00	0,00	8,79	8,80
S76	0,29	0,59	0,02	0,01	0,85	48,20
UH1	0,36	0,20	0,02	0,01	0,27	41,80

**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 (www.eea.europa.eu/emep-eea-guidebook) 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 Estonias report.*

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

Table 3.21 Emission factors for cruise (kg/tonne).

	NO_x	CO	NMVOC	SO_2	$PM_{2,5}$
Domestic aviation, cruise	3150	2	0,1	1	0,2
International aviation, cruise	3150	1,1	0,5	1	0,2

Table 3.22 Fuel consumption from aviation sector (thousand tones)

	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

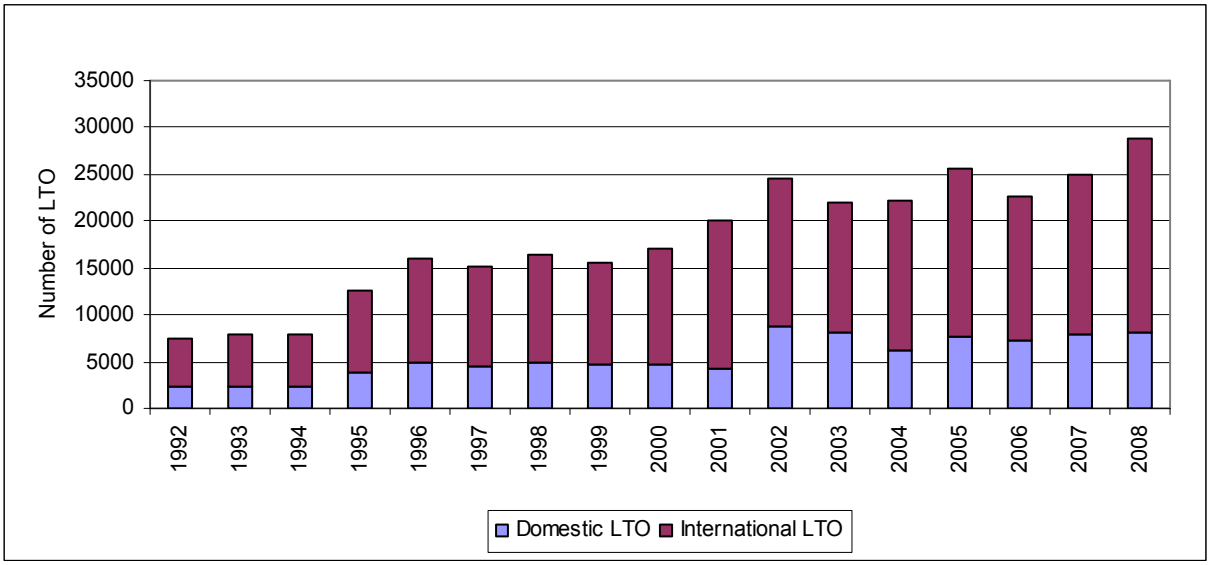


Figure 3.15 Number of LTO-cycles

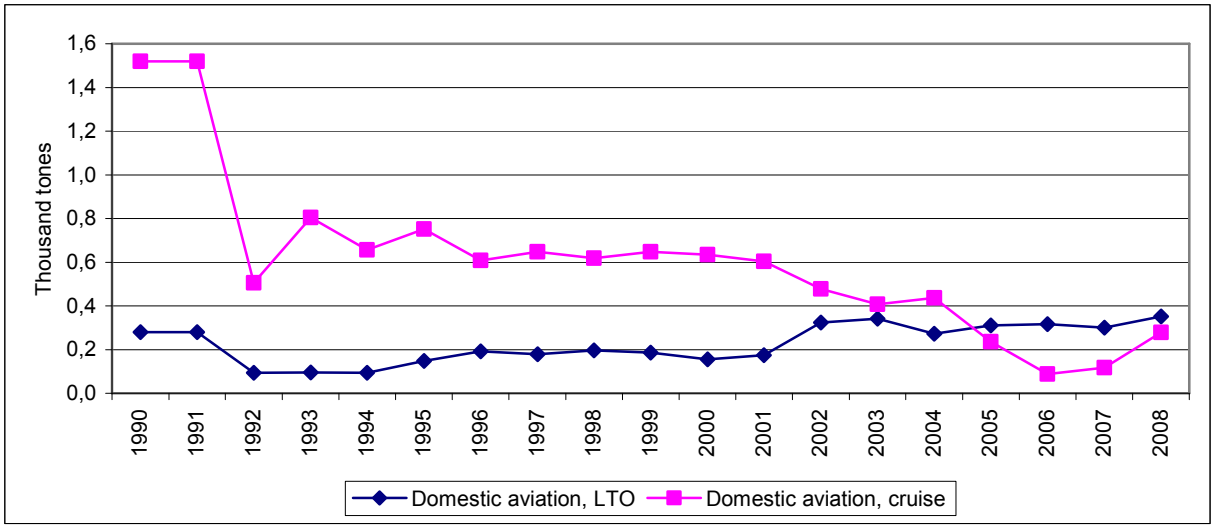


Figure 3.16 Fuel consumption in domestic aviation

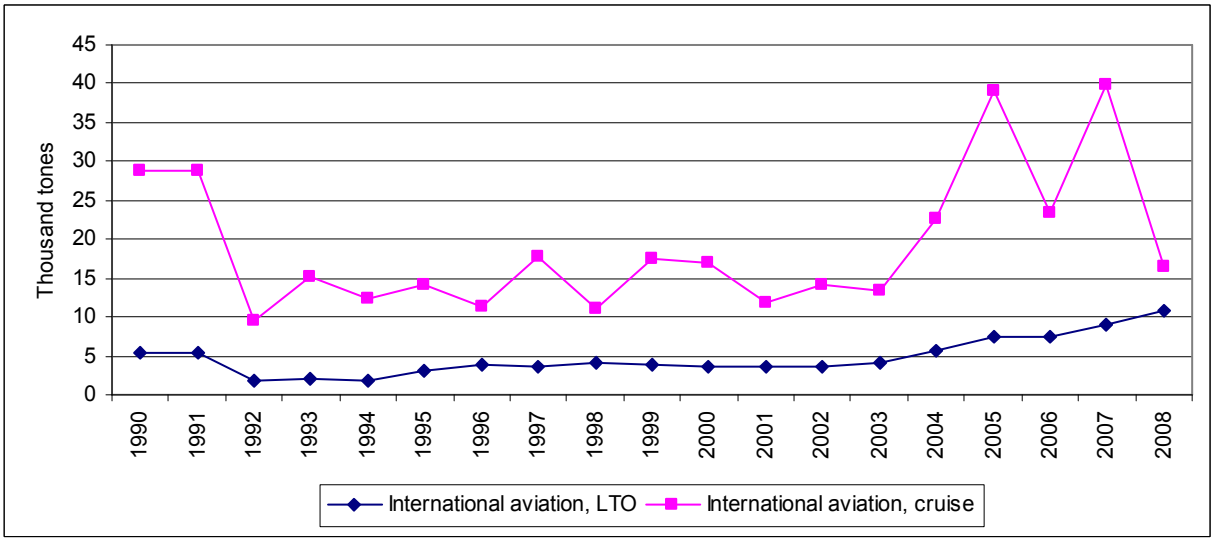


Figure 3.17 Fuel consumption in international aviation

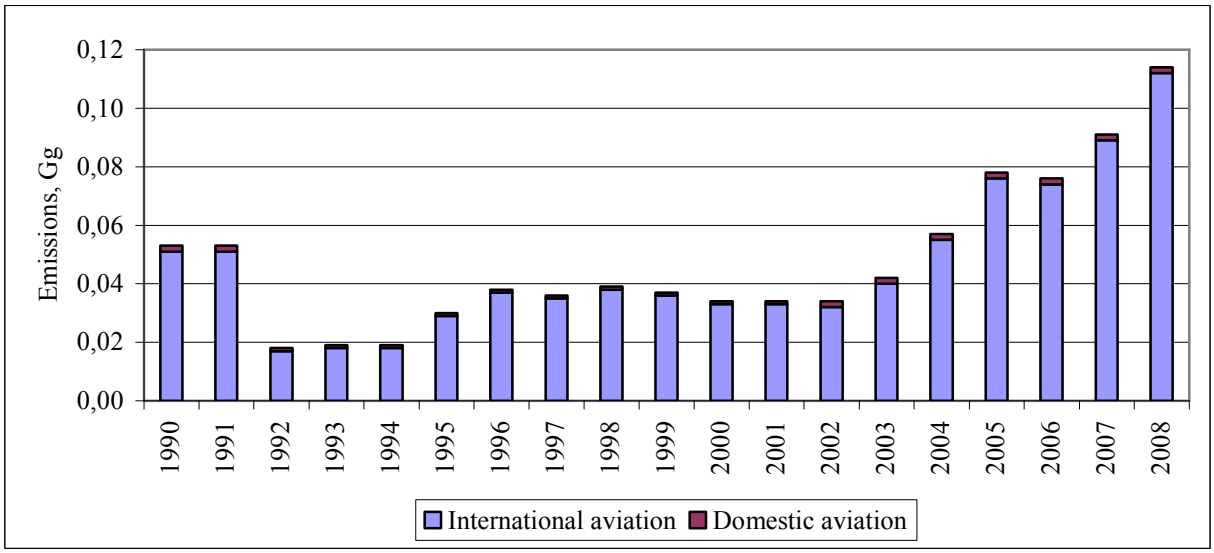


Figure 3.18 NO_x emissions from LTO-cycle

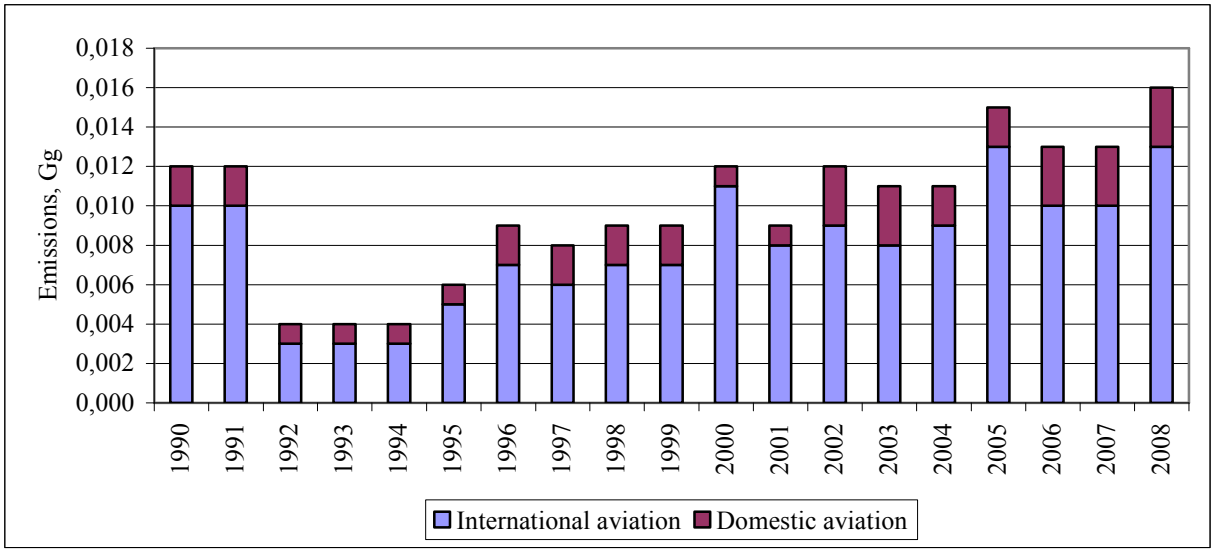


Figure 3.19 NMVOC emissions from LTO-cycle

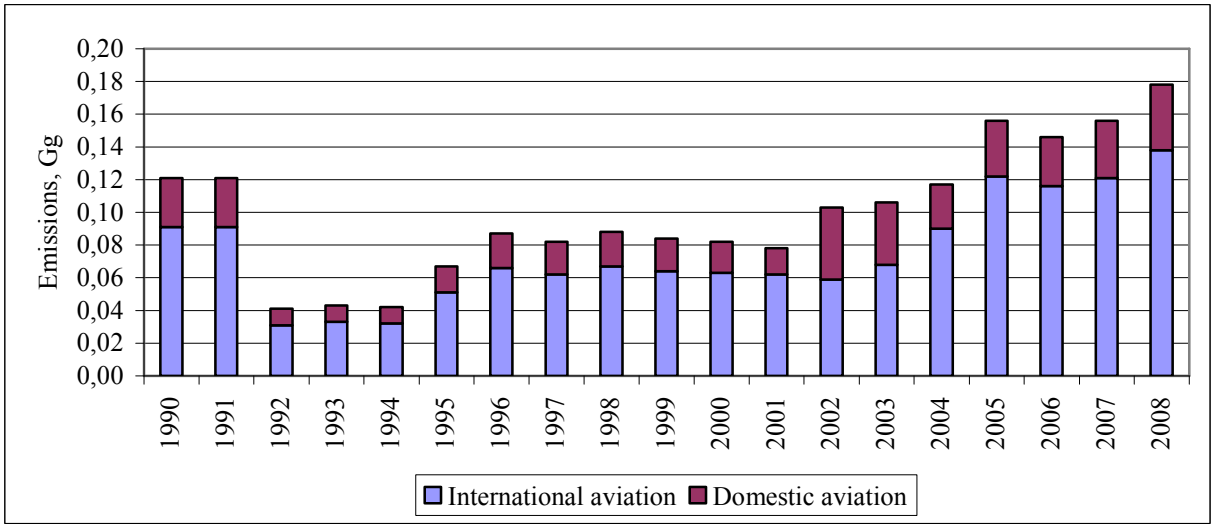


Figure 3.20 CO emissions from LTO-cycle

3.23 Emissions from LTO-cycle in domestic aviation (Gg)

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	NE	0,002	NE	0,002	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,030
1991	NE	0,002	NE	0,002	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,030
1992	NE	0,001	NE	0,001	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,010
1993	NE	0,001	NE	0,001	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,010
1994	NE	0,001	NE	0,001	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,010
1995	NE	0,001	NE	0,001	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,016
1996	NE	0,001	NE	0,002	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,021
1997	NE	0,001	NE	0,002	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,020
1998	NE	0,001	NE	0,002	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,021
1999	NE	0,001	NE	0,002	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,020
2000	NE	0,001	NE	0,001	NE	0	NE	NE	NE	0	NE	0	NE	0	NE	0,019
2001	0	0,001	0	0,001	0	0	0	NE	0	0	0	0	0	0	0,010	0,016
2002	0,010	0,002	0	0,003	0	0	0	NE	0	0	0	0	0	0	0,010	0,044
2003	0,010	0,002	0,010	0,003	0	0	0	NE	0,002	0	0,002	0	0,002	0	0,060	0,038
2004	0	0,002	0,010	0,002	0	0	0	NE	0	0	0	0	0	0	0,030	0,027
2005	0	0,002	0,010	0,002	0	0	0	NE	0	0	0	0	0	0	0,020	0,034
2006	0	0,002	0	0,003	0	0	NE	NE	0	0	0	0	0	0	0,030	0,030
2007	0	0,002	0	0,003	0	0	0	NE	0	0	0	0	0	0	0,010	0,035
2008		0,002		0,003		0		NE		0		0		0		0,040

3.24 Emissions from LTO-cycle in International aviation (Gg)

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	NE	0,051	NE	0,010	NE	0,005	NE	NE	NR	0	NR	0	NE	0	NE	0,091
1991	NE	0,051	NE	0,010	NE	0,005	NE	NE	NR	0	NR	0	NE	0	NE	0,091
1992	NE	0,017	NE	0,003	NE	0,002	NE	NE	NR	0	NR	0	NE	0	NE	0,031
1993	NE	0,018	NE	0,003	NE	0,002	NE	NE	NR	0	NR	0	NE	0	NE	0,033
1994	NE	0,018	NE	0,003	NE	0,002	NE	NE	NR	0	NR	0	NE	0	NE	0,032
1995	NE	0,029	NE	0,005	NE	0,003	NE	NE	NR	0	NR	0	NE	0	NE	0,051
1996	NE	0,037	NE	0,007	NE	0,004	NE	NE	NR	0	NR	0	NE	0	NE	0,066
1997	NE	0,035	NE	0,006	NE	0	NE	NE	NR	0	NR	0	NE	0	NE	0,062
1998	NE	0,038	NE	0,007	NE	0,004	NE	NE	NR	0	NR	0	NE	0	NE	0,067
1999	NE	0,036	NE	0,007	NE	0,004	NE	NE	NR	0	NR	0	NE	0	NE	0,064
2000	NE	0,033	NE	0,011	NE	0,004	NE	NE	NE	0	NE	0	NE	0	NE	0,063
2001	0,220	0,033	0,240	0,008	0,010	0,003	NA	NE	NA	0	NA	0	NA	0	0,530	0,062
2002	0,240	0,032	0,230	0,009	0,010	0,003	NA	NE	NA	0	NA	0	NA	0	0,550	0,059
2003	0,240	0,040	0,230	0,008	0,010	0,004	0	NE	0,001	0	0,001	0	0,001	0	0,550	0,068
2004	0,250	0,055	0,130	0,009	0,010	0,005	0	NE	0	0	0	0	0	0	0,460	0,090
2005	0,290	0,076	0,170	0,013	0,010	0,007	0	NE	0	0,001	0	0,001	0	0,001	0,580	0,122
2006	0,310	0,074	0,230	0,010	0,020	0,007	0	NE	0	0,001	0	0,001	0	0,001	0,670	0,116
2007	0,330	0,089	0,260	0,010	0,020	0,009	0	NE	0	0,001	0	0,001	0	0,001	0,740	0,121
2008		0,112		0,013		0,010		NE		0,001		0,001		0,001		0,138

Table 3.25 Emissions from domestic aviation (Cruise), Gg

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0,020	0,016	0	0	0	0,002		NE	NR	0	NR	0	0	0	0	0,003
1991	0,020	0,016	0	0	0	0,002		NE		0		0	0	0	0	0,003
1992	0,010	0,005	0	0	0	0,001		NE		0		0	0	0	0	0,001
1993	0,010	0,008	0	0	0	0,001		NE		0		0	0	0	0	0,002
1994	0,010	0,007	0	0	0	0,001		NE		0		0	0	0	0	0,001
1995	0,010	0,008	0	0	0	0,001		NE		0		0	0	0	0	0,002
1996	0,010	0,006	0	0	0	0,001		NE		0		0	0	0	0	0,001
1997	0,010	0,007	0	0	0	0,001		NE		0		0	0	0	0	0,001
1998	0,010	0,006	0	0	0	0,001		NE		0		0	0	0	0	0,001
1999	0,010	0,007	0	0	0	0,001		NE		0		0	0	0	0	0
2000	0,010	0,007	0	0	0	0,001	0	NE	0	0	0	0	0	0	0	0,001
2001	0,010	0,006	0	0	0	0,001	0	NE	0	0	0	0	0	0	0	0,001
2002	0,010	0,005	0	0	0	0	0	NE	0	0	0	0	0	0	0	0,001
2003	0,010	0,004	0	0	0	0	0	NE	0	0	0	0	0	0	0	0,001
2004	0,010	0,004	0	0	0	0	0	NE	0	0	0	0	0	0	0	0,001
2005	0,010	0,002	0	0	0	0	0	NE	0	0	0	0	0	0	0	0
2006	0	0,001	0	0	0	0	NE	NE	0	0	0	0	0	0	0	0
2007	0	0,001	0	0	0	0	0	NE	0	0	0	0	0	0	0	0
2008		0,003		0		0		NE		0		0		0		0,001

Table 3.26 Emissions from international aviation (Cruise), Gg

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0,440	0,369	0,020	0,014	0,030	0,029		NE	NR	0,006	NR	0,006	0	0,006	0,040	0,032
1991	0,450	0,369	0,020	0,014	0,030	0,029		NE		0,006		0,006	0	0,006	0,040	0,032
1992	0,150	0,123	0,010	0,005	0,010	0,010		NE		0,002		0,002	0	0,002	0,010	0,011
1993	0,220	0,194	0,010	0,008	0,020	0,015		NE		0,003		0,003	0	0,003	0,020	0,017
1994	0,180	0,158	0,010	0,006	0,010	0,012		NE		0,002		0,002	0	0,002	0,020	0,014
1995	0,200	0,180	0,010	0,007	0,020	0,014		NE		0,003		0,003	0	0,003	0,020	0,015
1996	0,190	0,145	0,010	0,006	0,010	0,011		NE		0,002		0,002	0	0,002	0,020	0,012
1997	0,260	0,227	0,010	0,009	0,020	0,002		NE		0,004		0,004	0	0,004	0,020	0,020
1998	0,190	0,141	0,010	0,005	0,010	0,011		NE		0,002		0,002	0	0,002	0,020	0,012
1999	0,260	0,223	0,010	0,009	0,020	0,017		NE		0,003		0,003	0	0,003	0,020	0,019
2000	0,260	0,217	0,010	0,008	0,020	0,017		NE	0	0,003	0	0,003	0	0,003	0,020	0,019
2001	0,190	0,152	0,010	0,006	0,010	0,012	NA	NE	NA	0,002	NA	0,002	NA	0,002	0,020	0,013
2002	0,220	0,182	0,010	0,007	0,020	0,014	NA	NE	NA	0,003	NA	0,003	NA	0,003	0,020	0,016
2003	0,220	0,172	0,010	0,007	0,020	0,013	0	NE	0,001	0,003	0,001	0,003	0,001	0,003	0,020	0,015
2004	0,340	0,290	0,010	0,011	0,030	0,023	0	NE	0	0,005	0	0,005	0	0,005	0,030	0,025
2005	0,590	0,499	0,020	0,019	0,050	0,039	0	NE	0	0,008	0	0,008	0	0,008	0,050	0,043
2006	0,390	0,300	0,020	0,012	0,030	0,023	0	NE	0	0,005	0	0,005	0	0,005	0,030	0,026
2007	0,610	0,509	0,020	0,020	0,050	0,040	NE	NE	0	0,008	0	0,008	0	0,008	0,050	0,044
2008		0,211		0,008		0,016		NE		0,003		0,003		0,003		0,018

3.3.4 Railway transport

Railway transport in Estonia is small emission source in transport sector. The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 4 %, 0,3 % and 0,2 % respectively in transport sector in 2008.

Emissions of railway transport sector are calculated by multiplying the statistical fuel consumption (Table 3.30) with respective emission factors (Table 3.27-3.29). Default emission factors for main pollutants and heavy metals are taken from *EMEP/EEA air pollutant emission inventory guidebook — 2009* and are presented in Table 3.27 and 3.28.

All the emissions are recalculated in period 1990-2008. Recalculations concern mainly using new emission factors for railway sector *(EMEP/EEA air pollutant emission inventory guidebook — 2009).*
The emissions of NOx, NMVOC and CO have decreased 44%, 46% and 54% in 2008 comparing with 1990.

Table 3.27 Emission factors for railway transport

	Unit	**NO_x**	**NMVOC**	**CO**	**NH_3**	**TSP**	**PM_{10}**	**$PM_{2,5}$**
Light fuel oil/ Diesel	kg/t	52,4	4,65	10,7	0,007	1,52	1,44	1,37
Coal	g/GJ	173	88,8	931	-	124	117	108

Table 3.28 Emission factors for heavy metal content in fuel

Fuel	***Unit***	**Cd**	**Cu**	**Cr**	**Ni**	**Se**	**Zn**
Gasoline	mg/kg	0,01	1,7	0,05	0,07	0,01	1
Light fuel oil/ Diesel	mg/kg	0,01	1,7	0,05	0,07	0,01	1
Coal	mg/GJ	1,8	13,5	17,5	13	1,8	200

Table 3.29 Sulphur content of fuel (by weight)

	1996	**2000**	**2005**	**2006**	**2008**
Gasoline	0,0165%	0,015%	0,005%	0,001%	
Diesel	0,04%	0,035%	0,005%		
Light fuel oil	0,5%	0,2%			0,1%

Table 3.30 Fuel consumption by railway sector

	Coal	**Diesel**	**Light fuel oil**
	TJ	*thousand tones*	*thousand tones*
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

Table 3.31 Emissions from railway transport (Gg)

	NO_x		**NMVOC**		**SO_2**		**NH_3**		**$PM_{2,5}$**		**PM_{10}**		**TSP**		**CO**	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	1,860	2,431	0,300	0,224	0,430	0,144	0	0	NR	0,076	NR	0,080	0,330	0,085	2,960	0,603
1991	1,740	2,278	0,210	0,213	0,440	0,163	0	0	NR	0,074	NR	0,079	0,340	0,083	0,720	0,593
1992	1,280	1,685	0,190	0,153	0,260	0,070	0	0	NR	0,049	NR	0,052	0,210	0,055	1,590	0,388
1993	1,320	1,791	0,160	0,163	0,270	0,075	0	0	NR	0,052	NR	0,055	0,210	0,058	0,360	0,413
1994	1,350	1,791	0,160	0,163	0,270	0,077	0	0	NR	0,053	NR	0,055	0,220	0,059	0,420	0,415
1995	1,330	1,736	0,160	0,157	0,250	0,062	0	0	NR	0,049	NR	0,052	0,200	0,055	0,390	0,389
1996	1,440	1,897	0,170	0,173	0,290	0,082	0	0	NR	0,056	NR	0,059	0,230	0,062	0,390	0,440
1997	1,320	1,736	0,150	0,157	0,250	0,060	0	0	NR	0,049	NR	0,052	0,200	0,055	0,360	0,388
1998	1,660	2,203	0,190	0,197	0,270	0,046	0	0	NR	0,059	NR	0,062	0,230	0,066	0,450	0,462
1999	1,800	2,411	0,210	0,214	0,270	0,040	0	0	NR	0,063	NR	0,067	0,240	0,070	0,490	0,495
2000	1,710	2,254	0,200	0,200	0,260	0,024	0	0	0,200	0,060	0,210	0,063	0,220	0,066	0,460	0,466
2001	1,580	2,097	0,190	0,187	0,250	0,032	0	0	0,200	0,056	0,200	0,059	0,200	0,062	0,430	0,435
2002	2,050	2,673	0,240	0,237	0,310	0,198	0	0	0,240	0,070	0,260	0,074	0,270	0,078	0,550	0,547
2003	1,780	2,358	0,210	0,209	0,270	0,169	0	0	0,211	0,062	0,222	0,065	0,233	0,068	0,480	0,482
2004	1,570	2,044	0,180	0,181	0,240	0,152	0	0	0,190	0,053	0,200	0,056	0,210	0,059	0,420	0,417
2005	1,650	2,201	0,190	0,195	0,250	0,168	0	0	0,200	0,058	0,210	0,060	0,220	0,064	0,450	0,499
2006	1,720	2,306	0,200	0,205	0,260	0,168	0	0	0,200	0,060	0,210	0,063	0,230	0,067	0,470	0,471
2007	1,420	1,939	0,170	0,172	0,220	0,121	0	0	0,170	0,051	0,180	0,053	0,190	0,056	0,380	0,396
2008		1,362		0,121		0,050		0		0,036		0,040		0,040		0,278

Table 3.32 Emissions of heavy metals from railway transport (Mg)

	Pb		Cd		Hg		As		Cr		Cu		Ni		Se		Zn	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0,080	0,002	0	0,001	0	0,001	0,010	0	0,050	0,004	0,090	0,08	0,05	0,005	0	0,001	0,080	0,070
1991	0,100	0,002	0	0,001	0	0,001	0,010	0,001	0,060	0,004	0,090	0,076	0,06	0,005	0	0,001	0,080	0,072
1992	0,030	0,001	0	0	0	0	0	0	0,020	0,002	0,060	0,055	0,02	0,003	0	0	0,040	0,042
1993	0,040	0,001	0	0	0	0	0	0	0,020	0,002	0,060	0,059	0,02	0,003	0	0	0,050	0,045
1994	0,040	0,001	0	0	0	0	0	0	0,020	0,002	0,060	0,059	0,02	0,003	0	0	0,050	0,045
1995	0,030	0,001	0	0	0	0	0	0	0,020	0,002	0,060	0,057	0,02	0,003	0	0	0,040	0,041
1996	0,040	0,001	0	0		0	0,010	0	0,030	0,003	0,070	0,062	0,03	0,003	0	0	0,050	0,048
1997	0,030	0	0	0	0	0	0	0	0,020	0,002	0,060	0,057	0,02	0,003	0	0	0,040	0,040
1998	0,010	0	0	0	0	0	0	0	0,010	0,002	0,070	0,072	0,01	0,003	0	0	0,050	0,045
1999	0	0	0	0	0	0	0	0	0	0,002	0	0,078	0,01	0,003	0	0	0	0,047
2000	NA	0	0	0	NA	0	0	0	0	0,002	0,070	0,073	0	0,003	0	0	0,040	0,044
2001	0,010	0	0	0	0	0	0	0	0,010	0,002	0,070	0,068	0,01	0,003	0	0	0,040	0,042
2002	0	0	0	0,001	0	0	0	0	0	0,003	0	0,087	0	0,004	0	0,001	0	0,051
2003	NA	0	NA	0	NA	0	0	0	0	0,002	0,080	0,077	0	0,003	0	0	0,040	0,045
2004	NA	0	NA	0	NA	0	NA	0	0	0,002	0,070	0,066	0	0,003	0	0	0,040	0,039
2005	NA	0	0	0	NA	0	0	0	0	0,002	0,070	0,071	0	0,003	0	0	0,040	0,042
2006	0	0	0	0	0	0	0	0	0	0,002	0	0,075	0	0,003	0	0	0	0,044
2007	0	0	0	0	0	0	0	0	0	0,002	0	0,063	0	0,003	0	0	0	0,037
2008		0		0		0		0		0,001		0,044		0,002		0		0,026

3.3.5 National navigation (shipping)

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 2008 were: NOx – 4,3 %, NMVOC – 3 %, CO – 1,2 %.

Emissions of national navigation sector are calculated by multiplying the statistical fuel consumption (Table 3.34) with respective emission factors (Table 3.28, 3.29, 3.33). Default emission factors for main pollutants are taken from *EMEP/EEA air pollutant emission inventory guidebook — 2009* and are presented in Table 3.33.

All the emissions are recalculated in period 1990-2008. Recalculations concern mainly using new emission factors for navigation sector *(EMEP/EEA air pollutant emission inventory guidebook — 2009)*. Detailed emission data is provided in tables 3.35 and 3.35.

Table 3.33 Emission factors for national navigation transport

	Unit	**NO_x**	**NMVOC**	**CO**	**NH_3**	**TSP**	**PM_{10}**	**$PM_{2,5}$**
Marine diesel oil/ marine gas oil	kg/t	37,088	7,177	19,248	0,007	4,423	4,423	4,423

Table 3.34 Fuel consumption by navigation sector (thousand tones)

	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

Table 3.35 Emissions from national navigation (Gg)

	NO_x		NMVOC		SO_2		NH3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0,300	0,260	0,030	0,050	0,040	0,070	0	0	NR	0,031	NR	0,031	0,030	0,031	0,080	0,135
1991	0,260	0,260	0,030	0,050	0,040	0,070	0	0	NR	0,031	NR	0,031	0,030	0,031	0,070	0,135
1992	0,210	0,185	0,020	0,036	0,030	0,050	0	0	NR	0,022	NR	0,022	0,020	0,022	0,050	0,096
1993	1,550	1,372	0,170	0,266	0,210	0,370	0	0	NR	0,164	NR	0,164	0,150	0,164	0,400	0,712
1994	1,500	0,148	0,170	0,029	0,210	0,040	0	0	NR	0,018	NR	0,018	0,150	0,018	0,380	0,077
1995	0,170	0,148	0,020	0,029	0,020	0,040	0	0	NR	0,018	NR	0,018	0,020	0,018	0,040	0,077
1996	0,300	0,260	0,030	0,050	0,040	0,070	0	0	NR	0,031	NR	0,031	0,030	0,031	0,080	0,135
1997	0,260	0,223	0,030	0,043	0,040	0,060	0	0	NR	0,027	NR	0,027	0,030	0,027	0,070	0,115
1998	0,250	0,223	0,030	0,043	0,040	0,060	0	0	NR	0,027	NR	0,027	0,020	0,027	0,060	0,115
1999	0,230	0,185	0,030	0,036	0,030	0,050	0	0	NR	0,022	NR	0,022	0,020	0,022	0,060	0,096
2000	0,330	0,260	0,040	0,050	0,050	0,028	0	0	0,030	0,031	0,030	0,031	0,030	0,031	0,080	0,135
2001	0,330	0,260	0,030	0,050	0,040	0,028	0	0	0,030	0,031	0,030	0,031	0,030	0,031	0,070	0,135
2002	0,450	0,408	0,050	0,079	0,070	0,044	0	0	0,040	0,049	0,040	0,049	0,040	0,049	0,120	0,212
2003	0,350	0,334	0,040	0,065	0,050	0,036	0	0	0,031	0,040	0,033	0,040	0,034	0,040	0,090	0,173
2004	0,350	0,297	0,040	0,057	0,050	0,032	0	0	0,030	0,035	0,030	0,035	0,030	0,035	0,090	0,154
2005	0,340	0,297	0,040	0,057	0,050	0,032	0	0	0,030	0,035	0,030	0,035	0,030	0,035	0,090	0,154
2006	0,460	0,408	0,050	0,079	0,070	0,044	0	0	0,040	0,049	0,040	0,049	0,050	0,049	0,120	0,212
2007	0,740	0,630	0,080	0,122	0,100	0,068	0	0	0,070	0,075	0,070	0,075	0,070	0,075	0,190	0,327
2008		0,742		0,144		0,080		0		0,088		0,088		0,088		0,385

3.36 Emissions of heavy metals from national navigation (Mg)

	Pb		Cd		Hg		As		Cr		Cu		Ni		Se		Zn	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0	0	0	0	0	0	0	0	0	0	0,010	0,012	0	0	0	0	0,010	0,007
1991	0	0	0	0	0	0	0	0	0	0	0,010	0,012	0	0	0	0	0,010	0,007
1992	0	0	0	0	0	0	0	0	0	0	0,010	0,009	0	0	0	0	0,000	0,005
1993	0	0	0	0	0	0	0	0	0	0,002	0,060	0,063	0	0,003	0	0	0,040	0,037
1994	0	0	0	0	0	0	0	0	0	0	0,060	0,007	0	0	0	0	0,040	0,004
1995	0	0	0	0	0	0	0	0	0	0	0,010	0,007	0	0	0	0	0,000	0,004
1996	0	0	0	0	0	0	0	0	0	0	0,010	0,012	0	0	0	0	0,010	0,007
1997	0	0	0	0	0	0	0	0	0	0	0,010	0,010	0	0	0	0	0,010	0,006
1998	0	0	0	0	0	0	0	0	0	0	0,010	0,010	0	0	0	0	0,010	0,006
1999	0	0	0	0	0	0	0	0	0	0	0,010	0,009	0	0	0	0	0,010	0,005
2000	0	0	0	0	0	0	0	0	0	0	0,010	0,012	0	0	0	0	0,010	0,007
2001	0	0	0	0	0	0	0	0	0	0	0,010	0,012	0	0,000	0	0	0	0,007
2002	0	0	0	0	0	0	0	0	0	0,001	0,020	0,019	0	0,001	0	0	0,010	0,011
2003	0	0	0	0	0	0	0	0	0	0	0,010	0,015	0	0,001	0	0	0,010	0,009
2004	0	0	0	0	0	0	0	0	0	0	0,010	0,014	0	0,001	0	0	0,010	0,008
2005	0	0	0	0	0	0	0	0	0	0	0,010	0,014	0	0,001	0	0	0,010	0,008
2006	0	0	0	0	0	0	0	0	0	0,001	0,020	0,019	0	0,001	0	0	0,010	0,011
2007	0	0	0	0	0	0	0	0	0	0,001	0,030	0,029	0	0,001	0	0	0,020	0,017
2008		0		0		0		0		0,001		0,034		0,001		0		0,020

3.3.6 Commercial/Institutional (mobile)

Commercial and institutional land-based mobile machinery contribute small share to total emissions of transport sector. Military sector is also included under transport sector. The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 2,5 %, 1,6 % and 0,7 % respectively in transport sector in 2008.

Emissions of commercial and institutional sector are calculated by multiplying the statistical fuel consumption (Table 3.39) with respective emission factors (Table 3.28, 3.29, 3.37, 3.38). Default emission factors for main pollutants are taken *from EMEP/EEA air pollutant emission inventory guidebook — 2009* and are presented in Table 3.37.

All the emissions are calculated in period 1990-2008. Previously submitted estimates of commercial/institutional sector were included under road transport. On the basis of TUT project additional information were available for this sector and therefore all household and gardening sector emissions have recalculated and reported separately. Detailed emission data is provided in table 3.40.

Table 3.37 Emission factors for commercial and institutional sector

	Unit	**NO_x**	**NMVOC**	**CO**	**NH_3**	**TSP**	**PM_{10}**	**$PM_{2,5}$**
Diesel	kg/t	32,792	3,385	10,722	0,008	2,086	2,086	2,086
Gasoline	kg/t	2,765	242,197	620,793	0,003	3,762	3,762	3,762

Table 3.38 Lead content in gasoline (g/l)

	1990	**Since 2000**
Leaded gasoline	0,013 g/l	0,003

Table 3.39 Fuel consumption by commercial and institutional sector (thousand tones)

	Gasoline	**Diesel**
1990	2	12
1991	2	15
1992	0	11
1993	1	3
1994	0	4
1995	0,61	9,22
1996	0,52	5,33
1997	0,43	4,36
1998	1,39	6,35
1999	1,49	6,46
2000	1,44	6,53
2001	1,41	6,64
2002	1,35	4,66
2003	1,17	6,79
2004	1,20	9,82

2005	0,20	10,89
2006	0,19	12,01
2007	0,14	12,19
2008	0,13	13,41

Table 3.40 Emissions from commercial/institutional sector

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb	Cd	Cr	Cu	Ni	Se	Zn
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
1990	0,399	0,525	0,010	0	0,033	0,033	0,033	1,370	0,026	0	0,024	0,001	0,001	0	0,014
1991	0,497	0,535	0,013	0	0,039	0,039	0,039	1,402	0,026	0	0,029	0,001	0,001	0	0,017
1992	0,361	0,037	0,009	0	0,023	0,023	0,023	0,118	0,000	0	0,019	0,001	0,001	0	0,011
1993	0,101	0,252	0,003	0	0,010	0,010	0,010	0,653	0,013	0	0,007	0	0	0	0,004
1994	0,131	0,014	0,003	0	0,008	0,008	0,008	0,043	0,000	0	0,007	0	0	0	0,004
1995	0,304	0,179	0,008	0	0,022	0,022	0,022	0,477	0,008	0	0,017	0	0,001	0	0,010
1996	0,176	0,144	0,004	0	0,013	0,013	0,013	0,379	0,007	0	0,010	0	0	0	0,006
1997	0,144	0,119	0,004	0	0,011	0,011	0,011	0,315	0,006	0	0,008	0	0	0	0,005
1998	0,212	0,357	0,006	0	0,018	0,018	0,018	0,928	0,018	0	0,013	0	0,001	0	0,008
1999	0,216	0,382	0,006	0	0,019	0,019	0,019	0,992	0,019	0	0,014	0	0,001	0	0,008
2000	0,218	0,372	0,005	0	0,019	0,019	0,019	0,966	0,007	0	0,014	0	0,001	0	0,008
2001	0,222	0,363	0,005	0	0,019	0,019	0,019	0,944	0,007	0	0,014	0	0,001	0	0,008
2002	0,156	0,344	0,004	0	0,015	0,015	0,015	0,890	0,007	0	0,010	0	0,001	0	0,006
2003	0,226	0,307	0,005	0	0,019	0,019	0,019	0,800	0,006	0	0,014	0	0,001	0	0,008
2004	0,325	0,323	0,007	0	0,025	0,025	0,025	0,847	0,006	0	0,019	0,001	0,001	0	0,011
2005	0,358	0,086	0,001	0	0,023	0,023	0,023	0,242	0,001	0	0,019	0,001	0,001	0	0,011
2006	0,394	0,087	0,001	0	0,026	0,026	0,026	0,248	0,001	0	0,021	0,001	0,001	0	0,012
2007	0,400	0,074	0,001	0	0,026	0,026	0,026	0,215	0,001	0	0,021	0,001	0,001	0	0,012
2008	0,440	0,077	0,001	0	0,028	0,028	0,028	0,225	0,001	0	0,023	0,001	0,001	0	0,014

3.3.7 Household and gardening (mobile)

Household and gardening sector includes various machinery which contributes small influence to total emissions in transport sector. The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 0,3%, 11,1 % and 8,6 % respectively in transport sector in 2008.

Emissions of households sector are calculated by multiplying the statistical fuel consumption (Table 3.42) with respective emission factors (Table 3.28, 3.29, 3.38, 3.41). Default emission factors for main pollutants are taken from *EMEP/EEA air pollutant emission inventory guidebook — 2009* and are presented in Table 3.41.

All the emissions are calculated in period 1990-2008. Previously submitted estimates of household and gardening sector were included under road transport. On the basis of TUT project additional information were available for this sector and therefore all household and gardening sector emissions have recalculated and reported separately.
The fuel consumpiton from household and gardening sector is calculated by following principle: 1% of final consumption in road transport is actually consumed in households sector in period 1990-1994, 1,5% in period 1995-1999 and 2% in period 2000-2008.
Therefore fuel consumption is continuously increasing and this leads to increase of NOx, NMVOC and CO emissions. Detailed emission data is provided in table 3.43.

Table 3.41 Emission factors for houselholds sector (Gg)

	Unit	**NO_x**	**NMVOC**	**CO**	**NH_3**	**TSP**	**PM_{10}**	**$PM_{2,5}$**
Diesel	kg/t	32,792	3,385	10,722	0,008	2,086	2,086	2,086
Gasoline: two-stroke	kg/t	7,117	17,602	770,368	0,004	0,157	0,157	0,157
Gasoline: four-stroke	kg/t	2,765	242,197	620,793	0,003	3,762	3,762	3,762

Table 3.42 Fuel consumption by household and gardening sector (thousand tones)

	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

Table 3.43 Emissions from household and gardening sector

	NO_x	NMVOC	SO_2	NH_3	$PM_{2,5}$	PM_{10}	TSP	CO	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Gg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg	Mg
1990	0,006	0,109	0	0	0,002	0,002	0,002	0,585	0	0	0	0	0	0,002	0	0	0,001
1991	0,005	0,123	0	0	0,002	0,002	0,002	0,661	0	0	0	0	0	0,002	0	0	0,001
1992	0,010	0,133	0	0	0,002	0,002	0,002	0,711	0	0	0	0	0	0,002	0	0	0,001
1993	0,015	0,145	0,001	0	0,003	0,003	0,003	0,775	0	0	0	0	0	0,002	0	0	0,001
1994	0,023	0,134	0,001	0	0,003	0,003	0,003	0,715	0	0	0	0	0	0,003	0	0	0,002
1995	0,035	0,268	0,001	0	0,006	0,006	0,006	1,427	0	0	0	0	0	0,005	0	0	0,003
1996	0,032	0,380	0,001	0	0,007	0,007	0,007	2,030	0	0	0	0	0	0,006	0	0	0,003
1997	0,040	0,404	0,002	0	0,008	0,008	0,008	2,157	0	0	0	0	0	0,007	0	0	0,004
1998	0,028	0,232	0,001	0	0,005	0,005	0,005	1,237	0	0	0	0	0	0,004	0	0	0,002
1999	0,038	0,377	0,002	0	0,007	0,007	0,007	2,011	0	0	0	0	0	0,006	0	0	0,004
2000	0,047	0,489	0,002	0	0,009	0,009	0,009	2,611	0	0	0	0	0	0,008	0	0	0,005
2001	0,052	0,603	0,002	0	0,011	0,011	0,011	3,223	0	0	0	0	0	0,009	0	0	0,006
2002	0,045	0,558	0,002	0	0,010	0,010	0,010	2,985	0	0	0	0	0	0,009	0	0	0,005
2003	0,050	0,551	0,002	0	0,010	0,010	0,010	2,945	0	0	0	0	0	0,009	0	0	0,005
2004	0,046	0,496	0,002	0	0,009	0,009	0,009	2,652	0	0	0	0	0	0,008	0	0	0,005
2005	0,045	0,470	0	0	0,009	0,009	0,009	2,513	0	0	0	0	0	0,008	0	0	0,004
2006	0,048	0,499	0	0	0,009	0,009	0,009	2,667	0	0	0	0	0	0,008	0	0	0,005
2007	0,051	0,525	0	0	0,010	0,010	0,010	2,806	0	0	0	0	0	0,008	0	0	0,005
2008	0,052	0,536	0	0	0,010	0,010	0,010	2,862	0	0	0	0	0	0,009	0	0	0,005

3.3.8 Agricultural machinery

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 12,7 %,4,4 % and 2,1 % respectively in transport sector in 2008.

Emissions of agricultural sector are calculated by multiplying the statistical fuel consumption (Table 3.45) with respective emission factors (Table 3.28, 3.29, 3.38, 3.44). Default emission factors for main pollutants are taken from *EMEP/EEA air pollutant emission inventory guidebook — 2009* and are presented in Table 3.44.

All the emissions are recalculated in period 1990-2008. Recalculations concern mainly using new emission factors for railway sector *(EMEP/EEA air pollutant emission inventory guidebook — 2009)*.
The emissions of NOx, NMVOC and CO have decreased 50%, 97 % and 96% comparing with 1990. Detailed emission data is provided in tables 3.46 and 3.47.

Table 3.44 Emission factors for agricultural machinery

	Unit	**NO_x**	**NMVOC**	**CO**	**NH_3**	**TSP**	**PM_{10}**	**$PM_{2,5}$**
Marine diesel oil/ marine gas oil	kg/t	37,088	7,177	19,248	0,007	4,423	4,423	4,423
Diesel	kg/t	35,043	3,366	10,939	0,008	1,738	1,738	1,738
Gasoline	kg/t	2,765	242,197	620,793	0,003	3,762	3,762	3,762

Table 3.45 Fuel consumption by agricultural machinery sector (thousand tones)

	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

Table 3.46 Emissions from agricultural sector (Gg)

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	6,350	4,377	2,680	6,227	0,760	0,189	0	0,001	NR	0,304	NR	0,304	0,720	0,304	38,110	16,25
1991	6,190	4,249	2,070	4,279	0,750	0,175	0	0,001	NR	0,269	NR	0,269	0,710	0,269	26,080	11,25
1992	4,580	3,166	1,910	4,417	0,550	0,141	0	0,001	NR	0,219	NR	0,219	0,520	0,219	26,980	11,53
1993	0,230	2,788	0,050	1,961	1,020	0,121	0	0,001	NR	0,164	NR	0,164	0,550	0,164	0,600	5,21
1994	2,040	1,440	0,360	0,380	0,250	0,070	0	0	NR	0,075	NR	0,075	0,240	0,075	1,890	1,069
1995	1,710	1,194	0,350	0,357	0,210	0,055	0	0	NR	0,063	NR	0,063	0,200	0,063	2,610	0,993
1996	1,900	1,337	0,380	0,612	0,230	0,068	0	0	NR	0,074	NR	0,074	0,220	0,074	2,770	1,657
1997	1,750	1,232	0,380	0,602	0,210	0,056	0	0	NR	0,068	NR	0,068	0,200	0,068	3,210	1,624
1998	1,870	1,267	0,430	0,606	0,220	0,075	0	0	NR	0,070	NR	0,070	0,220	0,070	3,870	1,635
1999	0,810	0,598	0,170	0,299	0,100	0,051	0	0	NR	0,033	NR	0,033	0,090	0,033	1,390	0,807
2000	1,260	0,914	0,180	0,330	0,150	0,058	0	0	0,130	0,049	0,140	0,049	0,150	0,049	0,400	0,905
2001	1,120	0,774	0,230	0,316	0,130	0,059	0	0	0,110	0,042	0,120	0,042	0,130	0,042	1,840	0,861
2002	3,670	2,548	0,620	0,487	0,430	0,195	0	0,001	0,390	0,130	0,410	0,130	0,430	0,130	3,100	1,415
2003	3,290	2,655	0,650	0,739	0,400	0,155	0	0,001	0,345	0,139	0,363	0,139	0,382	0,139	4,630	2,069
2004	2,820	2,414	0,410	0,958	0,340	0,127	0	0,001	0,300	0,131	0,310	0,131	0,330	0,131	0,900	2,613
2005	1,910	2,196	0,280	0,211	0,230	0,091	0	0,001	0,200	0,109	0,210	0,109	0,220	0,109	0,610	0,686
2006	1,730	2,093	0,250	0,201	0,210	0,071	0	0	0,180	0,104	0,190	0,104	0,200	0,104	0,550	0,653
2007	2,080	2,162	0,300	0,450	0,250	0,067	0	0	0,220	0,111	0,230	0,111	0,240	0,111	0,660	1,295
2008		2,210		0,212		0,039		0,001		0,110		0,110		0,110		0,690

Table 3.47 Emissions of heavy metals from agricultural sector (Mg)

	Pb		Cd		Cr		Cu		Ni		Se		Zn	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990		0,311	0	0,001	0,010	0,007	0,250	0,250	0,010	0,010	0	0,001	0,150	0,147
1991		0,208	0	0,001	0,010	0,007	0,230	0,231	0,010	0,010	0	0,001	0,140	0,136
1992		0,221	0	0,001	0,010	0,005	0,180	0,180	0,010	0,007	0	0,001	0,110	0,106
1993	0,120	0,091	0	0,001	0,030	0,004	0,020	0,146	0,280	0,006	0	0,001	0,250	0,086
1994		0,013	0	0	0	0,002	0,070	0,071	0	0,003	0	0	0,040	0,042
1995		0,013	0	0	0	0,002	0,060	0,060	0	0,002	0	0	0,040	0,035
1996	0	0,026	0	0	0	0,002	0,070	0,068	0	0,003	0	0	0,040	0,040
1997		0,026	0	0	0	0,002	0,060	0,063	0	0,003	0	0	0,040	0,037
1998		0,026	0	0	0	0,002	0,070	0,065	0	0,003	0	0	0,040	0,038
1999	0	0,013	0	0	0	0,001	0,030	0,031	0	0,001	0	0	0,020	0,018
2000	0	0,005	0	0	0	0,001	0,050	0,046	0	0,002	0	0	0,030	0,027
2001	0	0,005	0	0	0	0,001	0,040	0,039	0	0,002	0	0	0,020	0,023
2002	0	0,005	0	0,001	0	0,004	0,130	0,125	0,010	0,005	0	0,001	0,070	0,074
2003	0	0,010	0	0,001	0	0,004	0,110	0,132	0	0,005	0	0,001	0,070	0,078
2004	0	0,015	0	0,001	0	0,004	0,100	0,122	0	0,005	0	0,001	0,060	0,072
2005	0	0	0	0,001	0	0,003	0,060	0,107	0	0,004	0	0,001	0,040	0,063
2006	0	0	0	0,001	0	0,003	0,060	0,102	0	0,004	0	0,001	0,030	0,060
2007	0	0,005	0	0,001	0	0,003	0,070	0,106	0	0,004	0	0,001	0,040	0,063
2008		0		0,001		0,003		0,107		0,004		0,001		0,063

3.3.9 Industrial machinery

Industrial machinery sector includes mobile combustion in manufacturing industries and construction land-based. The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 5,4 %, 2 % and 0,9 % respectively in transport sector in 2008.

Emissions of industrial machinery are calculated by multiplying the statistical fuel consumption (Table 3.49) with respective emission factors (Table 3.28, 3.29, 3.38, 3.48). Default emission factors for main pollutants are taken from *EMEP/EEA air pollutant emission inventory guidebook — 2009* and are presented in Table 3.48.

All the emissions are recalculated in period 1990-2008. Recalculations concern mainly using new emission factors for industrial machinery sector *(EMEP/EEA air pollutant emission inventory guidebook — 2009)*.
The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have decreased comparing with 1990 by 82,2 %, 95,1% and 94,3% respectively. Detailed emission data is provided in tables 3.50 and 3.51.

Table 3.48 Emission factors for industrial machinery sector

	Unit	**NO_x**	**NMVOC**	**CO**	**NH_3**	**TSP**	**PM_{10}**	**$PM_{2,5}$**
Diesel	kg/t	32,792	3,385	10,722	0,008	2,086	2,086	2,086
Gasoline	kg/t	2,765	242,197	620,793	0,003	3,762	3,762	3,762

Table 3.49 Fuel consumption by industrial machinery sector (thousand tones)

	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

Table 3.50 Emissions from industrial machinery sector (Gg)

	NO_x		NMVOC		SO_2		NH_3		$PM_{2,5}$		PM_{10}		TSP		CO	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	1,110	5,329	0,530	2,002	0,140	0,132	0	0,001	NR	0,361	NR	0,361	0,130	0,361	7,900	5,462
1991	1,160	5,455	0,300	1,531	0,140	0,134	0	0,001	NR	0,361	NR	0,361	0,130	0,361	4,090	4,263
1992	0,560	2,960	0,170	1,031	0,070	0,073	0	0,001	NR	0,199	NR	0,199	0,060	0,199	2,630	2,827
1993	1,550	2,701	0,300	1,005	0,190	0,068	0	0,001	NR	0,183	NR	0,183	0,180	0,183	2,780	2,743
1994	0,530	2,731	0,100	0,524	0,070	0,069	0	0,001	NR	0,177	NR	0,177	0,060	0,177	0,850	1,513
1995	0,780	0,634	0,140	0,307	0,100	0,018	0	0	NR	0,044	NR	0,044	0,090	0,044	0,950	0,827
1996	0,510	1,228	0,110	0,369	0,060	0,033	0	0	NR	0,082	NR	0,082	0,060	0,082	1,180	1,021
1997	0,520	1,145	0,120	0,360	0,060	0,036	0	0	NR	0,076	NR	0,076	0,060	0,076	1,380	0,994
1998	0,740	0,950	0,110	0,582	0,090	0,050	0	0	NR	0,068	NR	0,068	0,090	0,068	0,380	1,551
1999	0,600	0,556	0,110	0,299	0,070	0,050	0	0	NR	0,039	NR	0,039	0,070	0,039	0,870	0,802
2000	0,570	0,494	0,110	0,293	0,070	0,024	0	0	0,060	0,035	0,063	0,035	0,066	0,035	0,970	0,781
2001	1,000	0,673	0,150	0,069	0,120	0,052	0	0	0,106	0,043	0,112	0,043	0,120	0,043	0,330	0,220
2002	1,150	0,699	0,250	0,314	0,140	0,042	0	0	0,120	0,048	0,126	0,048	0,130	0,048	2,790	0,848
2003	0,600	0,993	0,110	1,070	0,070	0,032	0	0	0,063	0,078	0,066	0,078	0,070	0,078	0,980	2,804
2004	1,240	0,855	0,180	0,330	0,150	0,019	0	0	0,130	0,058	0,140	0,058	0,150	0,058	0,400	0,900
2005	0,790	0,855	0,110	0,330	0,100	0,003	0	0	0,080	0,058	0,090	0,058	0,090	0,058	0,260	0,900
2006	0,610	1,019	0,090	0,347	0,080	0,003	0	0	0,060	0,068	0,070	0,068	0,070	0,068	0,200	0,953
2007	0,570	1,052	0,080	0,351	0,070	0,003	0	0	0,060	0,071	0,060	0,071	0,070	0,071	0,190	0,964
2008		0,951		0,098		0,003		0		0,060		0,060		0,060		0,311

Table 3.51 Emissions of heavy metals from industrial machinery sector (Mg)

	Pb		Cd		Cr		Cu		Ni		Se		Zn	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0	0,078	0	0,002	0	0,008	0,050	0,286	0	0,012	0	0,002	0,030	0,168
1991	0	0,052	0	0,002	0,001	0,009	0,040	0,289	0,002	0,012	0	0,002	0,030	0,170
1992	0	0,039	0	0,001	0,000	0,005	0,020	0,158	0,000	0,007	0	0,001	0,010	0,093
1993	0	0,039	0	0,001	0,002	0,004	0,060	0,145	0,002	0,006	NA	0,001	0,030	0,085
1994	0	0,013	0	0,001	0	0,004	0,020	0,143	0,001	0,006	0	0,001	0,010	0,084
1995	0	0,013	0	0	0,001	0,001	0,028	0,034	0,001	0,001	0	0	0,016	0,020
1996	0	0,013	0	0	0,001	0,002	0,019	0,065	0,001	0,003	0	0	0,011	0,038
1997	0	0,013	0	0	0,001	0,002	0,020	0,061	0,001	0,003	0	0	0,011	0,036
1998	0	0,026	0	0	0,001	0,002	0,026	0,052	0,001	0,002	0	0	0,015	0,031
1999	0	0,013	0	0	0,001	0,001	0,022	0,030	0,001	0,001	0	0	0,013	0,018
2000	0	0,005	0	0	0,001	0,001	0,020	0,027	0,001	0,001	0	0	0,012	0,016
2001	0	0,000	0	0	0,001	0,001	0,035	0,035	0,001	0,001	0	0	0,021	0,021
2002	0	0,005	0	0	0,001	0,001	0,043	0,038	0,002	0,002	0	0	0,025	0,022
2003	0	0,020	0	0	0,001	0,002	0,022	0,058	0,001	0,002	0	0	0,013	0,034
2004	0	0,005	0	0	0,001	0,001	0,043	0,046	0,002	0,002	0	0	0,025	0,027
2005	0	0,005	0	0	0,001	0,001	0,028	0,046	0,001	0,002	0	0	0,020	0,027
2006	0	0,005	0	0	0,001	0,002	0,020	0,054	0,001	0,002	0	0	0,010	0,032
2007	0	0,005	0	0	0,001	0,002	0,020	0,056	0,001	0,002	0	0	0,012	0,033
2008	0	0		0		0,001		0,049		0,002		0		0,029

3.3.10 International maritime navigation

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.

Emissions of international maritime navigation machinery are calculated by multiplying the statistical fuel consumption (Table 3.55) with 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 Table 3.52 and 3.53.

All the emissions are recalculated in period 1990-2008. Recalculations concern mainly using new emission factors for industrial machinery sector *(EMEP/EEA air pollutant emission inventory guidebook — 2009)*.
The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have increased approximately 45% comparing with 1990. Detailed emission data is provided in tables 3.56 and 3.57.

Table 3.52 Emission factors for international maritime navigation sector

	Unit	**NO_x**	**NMVOC**	**$PM_{2,5}$**	**PM_{10}**	**TSP**	**CO**
Marine diesel oil/ bunker fuel oil	kg/t	72	2,4	1,1	1,1	1,1	7,4

Table 3.53 Emission factors for heavy metal content in fuel

Fuel	***Unit***	**Pb**	**Cd**	**Cu**	**Cr**	**As**	**Hg**	**Ni**	**Se**	**Zn**
Marine diesel oil	g/t	0,1	0,01	0,05	0,04	0,05	0,05	0,07	0,2	0,5
Bunker fuel oil	g/t	0,2	0,03	0,5	0,2	0,5	0,02	30	0,4	0,9

Table 3.54 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 3.55 Fuel consumption from international maritime navigation sector (thousand tones)

	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

Table 3.56 Emissions from international maritime navigation sector (Gg)

	NO_x		**NMVOC**		**SO_2**		**NH_3**		**$PM_{2,5}$**		**PM_{10}**		**TSP**		**CO**	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	10,150	12,816	0,430	0,427	8,420	8,424	0	NE	NR	1,041	NR	1,041	0,890	1,041	1,320	1,317
1991	11,970	15,120	0,500	0,504	9,890	9,888	0	NE		1,222		1,222	1,180	1,222	1,550	1,554
1992	7,130	9,000	0,300	0,300	4,860	4,858	0	NE		0,597		0,597	0,660	0,597	0,930	0,925
1993	8,720	11,016	0,370	0,367	5,090	5,094	0	NE		0,622		0,622	0,780	0,622	1,130	1,132
1994	7,350	9,288	0,310	0,310	4,150	4,150	0	NE		0,506		0,506		0,506	0,950	0,955
1995	5,130	6,480	0,220	0,216	3,100	3,100	0	NE		0,379		0,379	0,460	0,379	0,670	0,666
1996	5,300	6,696	0,220	0,223	3,480	3,482	0	NE		0,427		0,427	0,490	0,427	0,690	0,688
1997	5,810	7,344	0,240	0,245	4,140	4,144	0	NE		0,510		0,510	0,550	0,510	0,750	0,755
1998	6,160	7,776	0,260	0,259	4,510	4,512	0	NE		0,556		0,556	0,590	0,556	0,800	0,799
1999	6,440	8,136	0,270	0,271	4,470	4,474	0	NE		0,550		0,550	0,600	0,550	0,840	0,836
2000	6,100	7,704	0,260	0,257	3,930	3,678	0	NE	0,500	0,482	0,530	0,482	0,560	0,482	0,790	0,792
2001	5,810	7,344	0,240	0,245	3,530	3,258	0	NE		0,431	0,490	0,431		0,431	0,750	0,755
2002	6,840	8,640	0,290	0,288	4,320	4,030	0	NE	0,560	0,530	0,460	0,530	0,620	0,530	0,890	0,888
2003	6,500	8,208	0,270	0,274	4,220	3,956	0	NE	0,538	0,517	0,567	0,517	0,597	0,517	0,840	0,844
2004	8,720	11,016	0,370	0,367	6,060	5,762	0	NE	0,740	0,745	0,780	0,745	0,820	0,745	1,130	1,132
2005	6,950	8,784	0,290	0,293	4,610	4,338	0	NE	0,580	0,565	0,610	0,565	0,640	0,565	0,900	0,903
2006	12,370	15,624	0,520	0,521	9,740	5,340	0	NE	1,090	1,202	1,140	1,202	1,200	1,202	1,610	1,606
2007	14,420	18,216	0,610	0,607	12,300	6,784	0	NE	1,300	1,522	1,370	1,522	1,440	1,522	1,870	1,872
2008		18,576		0,619		7,22		NE		1,617		1,617		1,617		1,909

Table 3.57 Emissions of heavy metals from international maritime navigation sector (Mg)

	Pb		**Cd**		**Hg**		**As**		**Cr**		**Cu**		**Ni**		**Se**		**Zn**	
	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal	Old	Recal
1990	0,030	0,033	0	0,005	0	0,004	0,080	0,077	0,030	0,031	0,080	0,077	0,010	4,532	0,070	0,066	0,150	0,149
1991	0,040	0,039	0,010	0,006	0,010	0,005	0,090	0,090	0,040	0,037	0,090	0,090	0,010	5,312	0,080	0,077	0,180	0,176
1992	0,020	0,021	0	0,003	0	0,004	0,040	0,043	0,020	0,018	0,040	0,043	0,010	2,463	0,040	0,041	0,100	0,095
1993	0,020	0,023	0	0,003	0,010	0,005	0,040	0,044	0,020	0,019	0,040	0,044	0,010	2,435	0,050	0,047	0,110	0,109
1994	0,020	0,019	0	0,003	0	0,005	0,040	0,036	0,020	0,016	0,040	0,036	0,010	1,954	0,040	0,039	0,090	0,091
1995	0,010	0,014	0	0,002	0	0,003	0,030	0,027	0,010	0,012	0,030	0,027	0,010	1,503	0,030	0,028	0,070	0,065
1996	0,020	0,015	0	0,002	0	0,003	0,030	0,031	0,010	0,013	0,030	0,031	0,010	1,742	0,030	0,030	0,070	0,070
1997	0,020	0,017	0	0,002	0	0,003	0,040	0,037	0,020	0,015	0,040	0,037	0,010	2,132	0,030	0,035	0,080	0,079
1998	0,020	0,019	0	0,003	0	0,003	0,040	0,041	0,020	0,017	0,040	0,041	0,010	2,342	0,040	0,037	0,090	0,085
1999	0,020	0,019	0	0,003	0	0,003	0,040	0,040	0,020	0,017	0,040	0,040	0,010	2,283	0,040	0,038	0,090	0,087

2000	0,020	0,017	0	0,002	0	0,003	0,030	0,035	0,010	0,015	0,030	0,035	0,010	1,953	0,030	0,034	0,080	0,080
2001	0,020	0,016	0	0,002	0	0,003	0,030	0,031	0,010	0,013	0,030	0,031	0,010	1,713	0,030	0,032	0,070	0,074
2002	0,020	0,019	0	0,003	0	0,004	0,040	0,038	0,020	0,016	0,040	0,038	0,010	2,133	0,040	0,038	0,090	0,088
2003	0,020	0,018	0	0,003	0	0,004	0,040	0,037	0,020	0,016	0,040	0,037	0,010	2,103	0,040	0,037	0,090	0,085
2004	0,030	0,026	0	0,004	0	0,005	0,050	0,054	0,020	0,023	0,050	0,054	0,010	3,094	0,050	0,051	0,120	0,118
2005	0,020	0,020	0	0,003	0	0,004	0,040	0,041	0,020	0,017	0,040	0,041	0,010	2,313	0,040	0,040	0,090	0,092
2006	0,040	0,039	0,010	0,006	0,010	0,006	0,090	0,088	0,040	0,036	0,090	0,088	0,020	5,163	0,080	0,078	0,180	0,177
2007	0,048	0,048	0,007	0,007	0,006	0,006	0,110	0,113	0,046	0,046	0,110	0,113	0,018	6,662	0,095	0,095	0,215	0,215
2008		0,050		0,007		0,006		0,12		0,048		0,120		7,141		0,099		0,224

3.4 Fugitive emissions (NFR 1.B)

3.4.1 Sources category description

Under fugitive emissions from fuels Estonia reports NMVOC, PM, CO, NH_3, NOx and SO_2 emissions from the following activities:

- Fugitive emissions from solid fuels (open mining activity, mainly explosive works)
- Distribution of oil products and natural gas
- Refining / storage

Table 3.58 Fugitive pollutants emission in 1990-2008

Year	Emission, Gg						
	NMVOC	**PM2,5**	**PM10**	**TSP**	**CO**	**NH3**	**SO2**
1990	7,79	NR	NR	NR	NE	NE	
1991	7,57	NR	NR	NR	NE	NE	
1992	4,26	NR	NR	NR	NE	NE	
1993	2,91	NR	NR	NR	NE	NE	
1994	3,95	NR	NR	NR	NE	NE	
1995	4,33	NR	NR	NR	NE	NE	
1996	4,88	NR	NR	NR	NE	NE	
1997	5,61	NR	NR	NR	NE	NE	
1998	5,12	NR	NR	NR	NE	NE	
1999	5,4	NR	NR	NR	NE	NE	
2000	7,43	0,01	0,05	0,11	0,2	0	0
2001	8,6	0,01	0,06	0,17	0,18	0	0
2002	7,85	0,01	0,08	0,16	0,27	0	0
2003	7,75	0,01	0,097	0,198	0,35	0	0
2004	9,3	0,01	0,07	0,14	0,26	0,01	0
2005	8,7	0,01	0,09	0,18	0,17	0,05	0
2006	7,49	0,01	0,11	0,22	0,25	0,06	0
2007	5,88	0,01	0,09	0,18	0,22	0,09	0,01

2008	5,442857	0,02024	0,10517	0,20226	0,27628	0,10183	0,01262

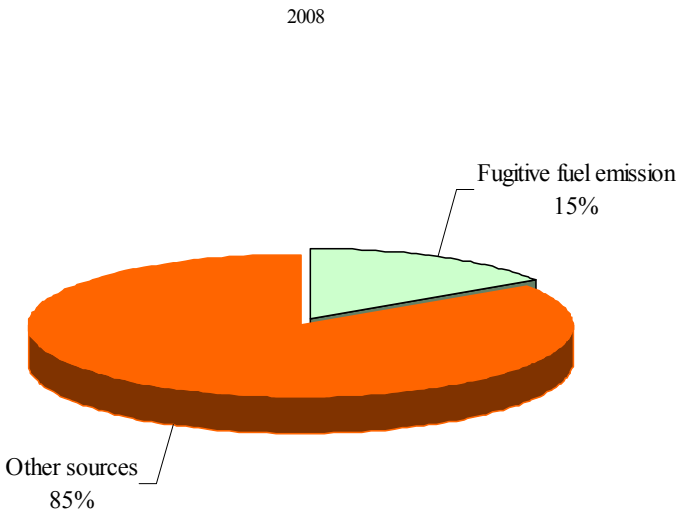


Figure 3.21 NMVOC emission distribution in 2008

NMVOC emission from this sector contribute in total country emission about 15% and has decrease by 30% comparing with 1990.

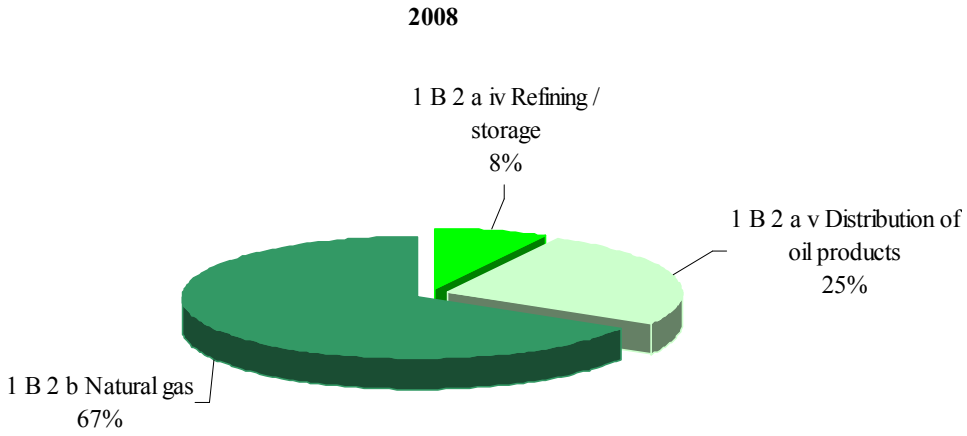


Figure 3.22 NMVOC emission distribution inside of fuel fugitive emission sector in 2008

The figure 3.22 is shown that natural gas distribution is main sources of NMVOC emission in fuel fugitive emission sector.

3.3.2 Methodological issues

Emissions data from oil shale mining and refining/storage are based on the facilities data.

EMEP/CORINAIR methodology is used to estimate fugitive NMVOC emissions from operations with gasoline in 1990 – 2005. Beginning from 2006 emission estimates is used facilities data (about 94% from total gasoline distribution in 2008) and than the rest part (energy balance data minus facilities gasoline data) is calculated as diffuse sources. Facilities are obligate to use the national method of NMVOC emission calculation Naftasaaduste laadimisel välisõhku eralduvate lenduvate orgaaniliste ühendite heitkoguste määramismeetodid - Elektrooniline Riigi Teataja.

Tabel 3.59 NMVOC emission factor for diffuse sources

	EF	
gasoline distribution	3,93	kg/Mg product
natural gas distribution	112	g/GJ

Tabel 3.60 Activities data used for the NMVOC calculation

Year	Gasoline	Natural gas
	Mt	PJ
1990	523	51,17
1991	463	51,4
1992	228	30,04
1993	235	14,92
1994	287	21,39
1995	248	24,39
1996	281	26,9
1997	305	26,13
1998	295	24,8
1999	280	24,13
2000	282	27,75
2001	310	29,8
2002	309	24,96
2003	300	27,51
2004	290,4	32,46
2005	291,3	33,48
2006	308	33,89
2007	323	33,71
2008	321	32,31

3.3.3 Sources-specific planned improvements

- To recalculate NMVOC emission from the natural gas distribution, because emission for this activity is overestimated (very high emission factor)
- To provide TSP and other pollutants emissions from oil shale mining for the previous years

4. Industrial processes (NFR 2)

4.1 Overview of sector

Manufacturing industry output volumes have doubled during the last five years. Manufacture of electrical and communications equipment, metal industry, production of machinery and equipment and chemical industry have shown rapid growth. Food and wood industries have contributed the most to the sales grows of the manufacturing industry during the last five years. (Economic survey of Estonia 2008, Ministry of Economic Affairs and Communications. Ministry of Finance. Tallinn 2009). The continuous modernisation of equipment in manufacturing industry has made it possible to significantly raise productivity and also on improvement of a state of environment.
The change in industrial production are shown in figure 4.1 (Estonian Environmental review 2009. Estonian Environment Information Centre, 2010)

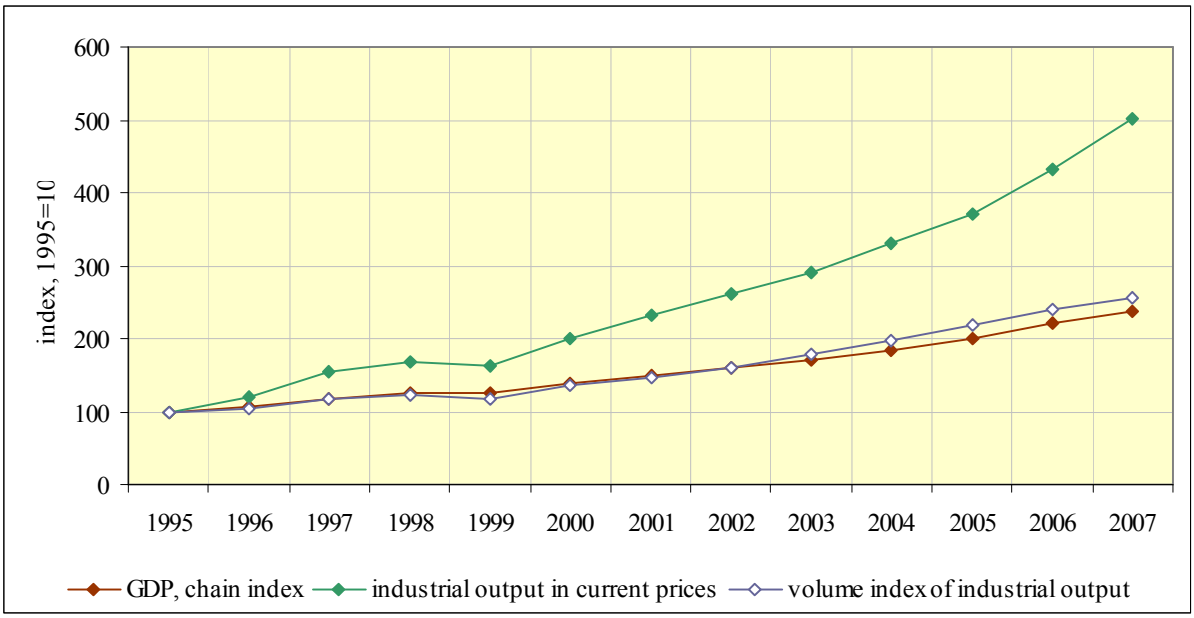


Figure 4.1 Change in industrial production in GDP in 1995-2007, as an index.

Manufacturing industry's output fell in 2008 as result of the decreasing demand in the domestic market. Exporting companies also experienced difficulties at the end of the year due to the global economic crisis. In 2008, especially by the end of the year, decreasing production volumes were noticeable practically all over Europe. Insufficient demand became the main problem for most Estonian industrial enterprises.
Emissions data from manufacturing 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 Guidebook emission factors (Tier 1 method).

In this chapter emissions from following categories are considered:

- Mineral industry (NFR 2A)
- Cemical industry (NFR 2B)
- Pulp, paper and food industries (NFR 2D
- Other industries (NFR 2G).

Table 4.1 Pollutants emission from industrial sector in 1990-2008

	Emissions, Gg								Mg
Year	NOx	NMVOC	SO2	NH3	PM2,5	PM10	TSP	CO	Pb
1990	0,19	15,30	0	0,53	NR	NR	0,94	0,34	
1991	0,10	14,12	0	0,46	NR	NR	0,10	0,30	0
1992	0,09	10,05	0	0,44	NR	NR	0,47	0,30	0
1993	0,05	5,33	0	0,12	NR	NR	0,15	0,01	0
1994	0,19	4,20	0	0,22	NR	NR	0,61	0,04	0
1995	0,07	5,29	0	0,24	NR	NR	0,49	0,00	0
1996	0,15	3,99	0	0,16	NR	NR	0,28	0,00	0
1997	0,15	3,87	0	0,12	NR	NR	0,14	0,01	0
1998	0,14	2,85	0	0,1	NR	NR	0,08	0,02	0
1999	0,19	1,57	0	0,14	NR	NR	0,18	0,00	0
2000	0,20	2,22	0,04	0,12	0,12	0,35	1,03	0,53	0,01
2001	0,34	1,40	0,08	0,14	0,15	0,45	1,30	0,51	0,01
2002	0,13	1,48	0,16	0,11	0,18	0,56	1,66	0,28	0,01
2003	0,16	2,03	0,15	0,12	0,20	0,59	1,71	0,29	0,00
2004	0,36	1,98	0,13	0,12	0,23	0,70	2,08	0,36	0,00
2005	0,18	1,79	0,13	0,20	0,21	0,64	1,88	0,34	0,00
2006	0,27	1,45	0,12	0,15	0,16	0,72	1,99	0,38	0,00
2007	0,25	1,20	0,02	0,13	0,21	0,65	1,97	0,44	0,00
2008	0,30	0,71	0,02	0,17	0,23	0,66	1,98	0,48	0,00

4.2 Mineral Products (NFR 2A)

4.2.1 Sources category description

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

- Cement production, NFR 2A1
- Lime production, NFR 2A

In Estonia the only one enterprise for cement manufacture 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 1450º C in a kiln. The ingredients react and turn into an intermediate product called clinker, which is then further mixed with gypsum and, in some cases, limestone, blast furnance 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 CO2, SOx, NOx 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).

In Estonia there are two facilities for the lime production, one of which annually presents the report on emissions (Nordkalk AS). 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.

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 1990-2008 was reduced to 99,7 %. If in 1990 the emission was 82,61 Gg (29,5% of total emission), than in 2008 – only 0,22 Gg (0,7% of total emission). Clinker production during the same period has grown on about 24%.

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 4.2 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						

Table 4.3 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	938000	0,60	0,563	185000	0,07	0,013	541401	0,2	0,108
1991	905000	0,60	0,543	207000	0,07	0,014	592206	0,2	
1992	483000	0,60	0,290	92000	0,07	0,006	350444	0,2	0,071
1993	354000	0,60	0,212	21000	0,07	0,001	139217	0,2	
1994	402500	0,60	0,242	18000	0,07	0,001	128283	0,2	0,026
1995	417600	0,60	0,251	16800	0,07	0,001	81343	0,2	
1996	387700	0,60	0,233	17400	0,07	0,001	68009	0,2	0,014
1997	422500	0,07	0,030	19500	0,07	0,001	62674	0,2	
1998	321300	0,07	0,022	32100	0,07	0,002	54674	0,2	0,011
1999	357700	0,07	0,025	23300	0,07	0,002	46139	0,2	
2000	329100	0,07	0,023	21200	0,07	0,001	45072	0,2	0,009
2001	404600	0,07	0,028	20000	0,07	0,001	54140	0,2	
2002	465900	0,07	0,033	21200	0,07	0,001	61608	0,2	0,012
2003	506300	0,07	0,035	32000	0,07	0,002	63741	0,2	0,013
2004	506300	0,07	0,035	32000	0,07	0,002	63741	0,2	0,013
2005	NA	0,07	NE	37200	0,07	0,002		0,2	NE
2006	848900	0,07	0,059	39700	0,07	0,003	82667	0,2	0,016
2007	936200	0,07	0,065	43500	0,07	0,003	143485	0,2	0,029
2008	806100			59400	0,07	0,004	113081	0,2	0,023

4.3 Chemical industry

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 Harju county. The largest companies are VKG Oil AS, Kiviõli Keemiatööstus OÜ (both of shale oils production), 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 charper.
Production of chemical industry increased by 12% in 2008, being one of the highest of all industrial sectors.
The share of NMVOC emission from chemical industry in total country emission was in 1990 about 19%, and in 2008 is almost equal 0 (Figure 4.2). The main reason of that - is decrease in manufacture of chemical production at the shale oil enterprises.

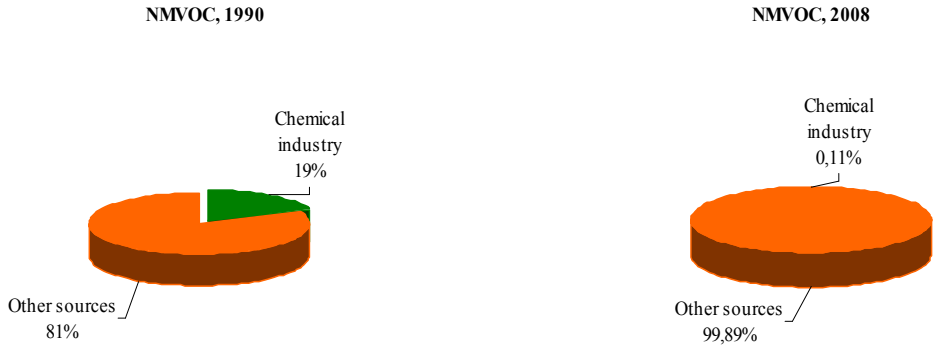


Figure 4.2 Distribution of NMVOC emission by activities in 1990 and 2008

4.3.2 Methodological issues

All lagerst 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, are 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 furnance and coal gasification or liquefaction).

Table 4.4 Pollutants emission from Chemical industry

	Emissions, Gg							
	NO_x	**NMVOC**	**SO_2**	**NH_3**	**CO**	**PM2,5**	**PM10**	**TSP**
1990	0,19	13,30	0,00	0,37	0,34	NR	NR	0,94
1991	0,10	12,33	0,00	0,30	0,30	NR	NR	0,10
1992	0,09	8,50	0,00	0,28	0,30	NR	NR	0,47
1993	0,05	3,50	0,00	0,08	0,01	NR	NR	0,15
1994	0,19	2,67	0,00	0,14	0,04	NR	NR	0,61
1995	0,07	3,53	0,00	0,14	0,00	NR	NR	0,49
1996	0,15	2,46	0,00	0,07	0,00	NR	NR	0,28
1997	0,15	2,39	0,00	0,06	0,01	NR	NR	0,14
1998	0,14	1,65	0,00	0,06	0,02	NR	NR	0,08
1999	0,19	0,79	0,00	0,09	0,00	NR	NR	0,18
2000	0,19	0,84	0,00	0,04	0,34	0,02	0,06	0,19
2001	0,31	0,77	0,01	0,03	0,32	0,02	0,05	0,15
2002	0,10	0,71	0,00	0,02	0,23	0,01	0,03	0,10
2003	0,13	1,07	0,01	0,05	0,27	0,02	0,05	0,15

2004	0,32	0,96	0,01	0,08	0,33	0,04	0,12	0,38
2005	0,16	0,72	0,00	0,13	0,29	0,03	0,10	0,31
2006	0,23	0,41	0,00	0,06	0,33	0,03	0,09	0,28
2007	0,20	0,12	0,00	0,07	0,36	0,02	0,07	0,23
2008	0,26	0,04	0,00	0,13	0,40	0,06	0,17	0,52

Table 4.5 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

4.4 Other industries

4.4.1 Sources category description

This chapter includes the pollutants emission from pulp and paper, food and drink, wood, furniture and other industries.

Pulp and paper industry is an industry with a long traditions, established in Estonia already in the 17th century. In the years 2002-2008 the output of paper industry grew by two time. Paper industry is a heavily concentrated industry in Estonia. Horizon Tselluloosi ja Paberi AS is the largest paper and carboard 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. Horizon 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 also the biggest industry in Estonia by production volume. During the last five years the output of food industry has increased by almost a half.

Table 4.6 Pollutants emission from other industries

	Emissions, Gg								**Mg**
	NO_x	**NMVOC**	**SO_2**	**NH_3**	**CO**	**PM2,5**	**PM10**	**TSP**	**Pb**
1990		2		0,16		NR	NR	NR	
1991		1,79		0,16		NR	NR	NR	
1992		1,55		0,16		NR	NR	NR	
1993		1,83		0,04		NR	NR	NR	
1994		1,53		0,08		NR	NR	NR	
1995		1,76		0,10		NR	NR	NR	
1996		1,53		0,09		NR	NR	NR	
1997		1,48		0,06		NR	NR	NR	
1998		1,20		0,04		NR	NR	NR	
1999		0,78		0,05		NR	NR	NR	
2000	0,01	0,81	0,04	0,07	0,15	0,03	0,07	0,18	0,01
2001	0,02	0,62	0,06	0,10	0,15	0,02	0,07	0,14	0,01
2002	0,03	0,73	0,16	0,08	0,05	0,05	0,16	0,43	0,01
2003	0,03	0,88	0,14	0,06	0,01	0,04	0,11	0,26	0,00
2004	0,03	0,95	0,12	0,04	0,02	0,04	0,12	0,29	0,00
2005	0,01	0,99	0,13	0,07	0,03	0,03	0,11	0,27	0,00
2006	0,03	0,96	0,12	0,09	0,02	0,04	0,12	0,32	0,00
2007	0,04	1,08	0,02	0,06	0,06	0,18	0,54	1,60	0,00
2008	0,04	0,67	0,02	0,04	0,06	0,16	0,45	1,34	0,00

4.4.2 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 Guidebook emission factors (Tier 1 method)

Table 4.7 NMVOC emission factors for food and drink industries

Foodstaffs	**Emission factors**	**Unit**
Bread	3000	g/Mg product
Wine	80	g/hl product
Beer	35	g/hl product
spirits	15000	g/hl product
Other spirits	400	g/hl product

Table 4.8 Activity data for Pulp and Paper & Food and Drink industries

	Cellulose	Pulp	Bread	Wine	Beer	Spirits	Other spirits
	Gg	Gg	Gg	thousand hl			
1990	68,4	NO	151	37	769	82	147
1991	..	NO	149,4	85	676	83	161
1992	..	NO	138,6	100	426	71	121
1993	..	NO	111,7	13	419	94	168
1994	..	NO	109,3	13	477	76	123
1995	6,7	NO	99,7	14	499,6	91	176
1996	20,7	NO	93,9	22	459	79	96
1997	35,5	NO	86,8	21,5	543	77	109
1998	44,1	NO	81,6	31	744	59	102
1999	49,5	NO	77,3	24	957	32	66
2000	54,4	NO	76,5	32,6	950,1	20,4	86,4
2001	51,7	NO	76,5	32,6	950,1	20,4	86,4
2002	65,3	NO	75,1	30,4	1015,2	24,1	115,2
2003	67,1	NO	72,4	34,5	1044,1	33,1	142,4
2004	68,6	NO	72,4	34,5	1040,2	38,3	172
2005	67,1	NO	72,8	60,7	1202,8	40	187,9
2006	69	67,3	72,4	77,4	1442,5	37,1	180,2
2007	64	121,2	80,2	53,5	1411,6	37,1	215
2008	61,6	138,6	65,8	38,8	1281,8	15,5	176

4.4.3 Sources-specific planned improvements

- In current inventory are not calculated emissions from NFR 2 A 6 Road paving with asphalt. At present this sector under developing.
- It is necessary to check the data on metal industries.
- To recalculate NMVOC emission for some years from food and drink industries according to the updated statistical data.
- To allocate emission from wood and furniture industries from NFR 2A7d and 2G 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 Sources category description

The Solvent and Other Product Use sector is one from the largest (after non-industrial combustion) pollution source of NMVOC in Estonia. This sector contributes 14% in total NMVOC emission (Figure 5.1).

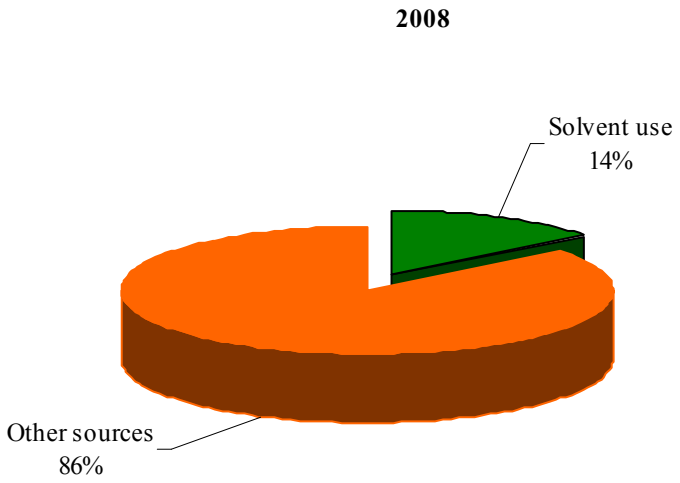


Figure 5.1 Share of Solvent Use sector in total national NMVOC emission

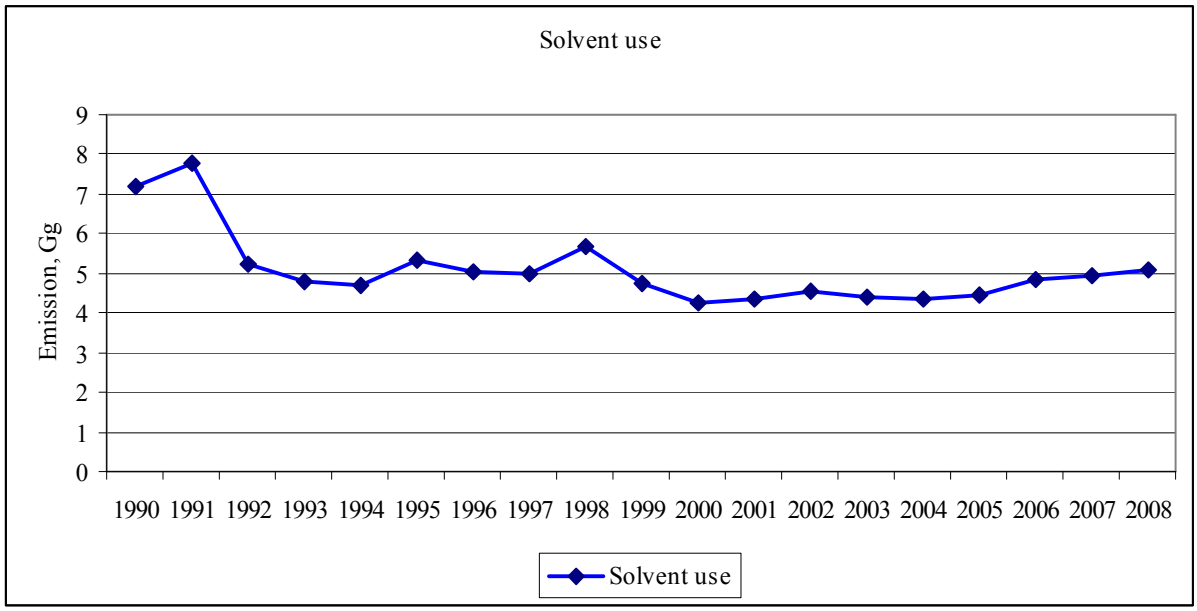


Figure 5.2 NMVOC emission from Solvent and Other Products Use sector in1990-2008

NMVOC emission from the solvent use activities has decreased in 2008 by 29% comparing with 1990, because number of population has decrease since 1990. The second reason is that is coming in force first period of determinate solvent concentrations into paint products, what is written, in Estonian legislation.

The sector is covering the following activities:

- Paint application in car repairing, boat building, coil coating, wood and other industries (Tier 3 method)
- Degreasing, dry cleaning and electronics ((Tier 3 method)
- Chemical products manufacturing or processing (Tier 3 method)
- Printing industry (Tier 3 method)
- Application of glues and adhesives (Tier 3 method)
- Preservation of wood (Tier 3 method)
- Other (Tier 3 method)
- Domestic solvent use (Tier 1 method)

At present emission estimates for this sector is in a stage of development and improvement. Most likely the data about emissions from this sector is underestimated, as are not considered total quantities used on Estonian territory chemicals (only facilities data)

5.2 Methodological issues

Emissions data from Solvent and Other Product Use sector are based on the facilities data (Tier 3 method) and only NMVOC emission for 3 D 2 Domestic solvent use are calculated as diffuse sources on the basis of statistical data and Guidebook emission factors (Tier 1 method). Emission factor for Domestic solvent use is 2590 g/inhabitant

Table 5.1 NMVOC emission from Solvent and Other Products Use sector

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
7,2	7,79	5,24	4,79	4,72	5,33	5,03	5,01	5,68	4,73	4,24	4,33	4,53	4,42	4,36	4,44	4,82	4,93	5,08

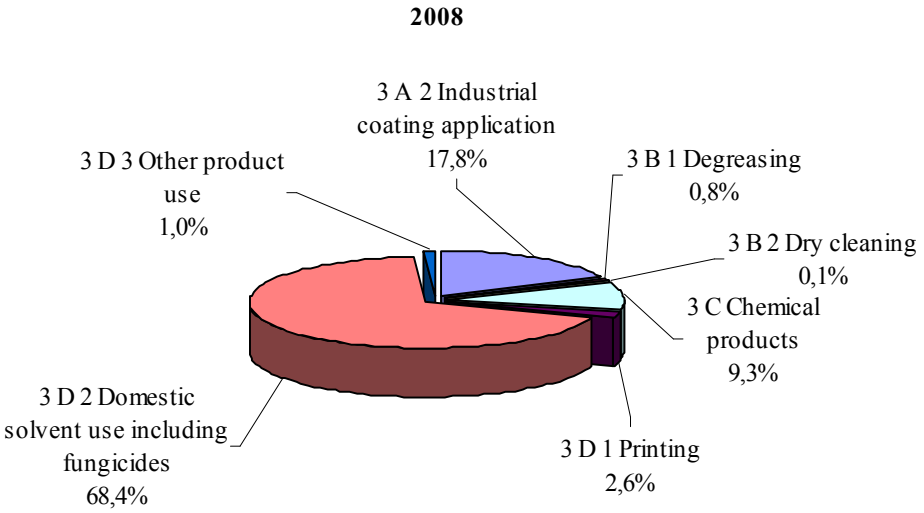


Figure 5.3 Share of different activities in total NMVOC Solvent use sector emission, 2008

5.3 Sources-specific planned improvements

- For improving data quality to introduce other method for emission estimating which based on the consumption with a product-related approach at national level.
- To provide uncertainty analysis
- To provide the detail description for each NFR code next, 2011 year submission

6. Agriculture (NFR 4)

6.1 Sources category description

NH_3, TSP, PM2,5 and PM10 emissions from agricultural sector are included in this chaper.

Ammonia emission from the agricultural sector has declined 60,7% compared with the 1990 year, mostly due to decreasing livestock population and to quantities of synthetic fertilizers applied on agricultural fields. The TSP emission has decreased 58%. The PM2,5 and PM10 emissions practically have not changed and remained at level of 2000.

The pollutants emission from agricultural sector is presented in table 6.1

Table 6.1 Pollutants emissions from agriculture, 1990-2008

Year	Emissions, Gg			
	NH_3	**PM2,5**	**PM10**	**TSP**

1990	25,43	NR	NR	4,23
1991	22,71	NR	NR	3,94
1992	18,27	NR	NR	3,43
1993	14,61	NR	NR	3,2
1994	13,56	NR	NR	3,18
1995	11,79	NR	NR	3,1
1996	10,7	NR	NR	2,9
1997	10,91	NR	NR	2,9
1998	10,87	NR	NR	2,91
1999	9,25	NR	NR	2,81
2000	9,28	0,067	0,379	2,185
2001	9,36	0,072	0,38	1,92
2002	8,99	0,068	0,374	1,785
2003	9,12	0,066	0,353	1,743
2004	9,2	0,069	0,355	1,71
2005	8,68	0,067	0,355	1,85
2006	8,71	0,065	0,34	1,78
2007	9,24	0,071	0,353	1,93
2008	9,54	0,065	0,352	1,773

The largest part of NH3 emissions comes from manure management – 72,9% and 27,1% from use of synthetic fertilizers (figure 6.1)

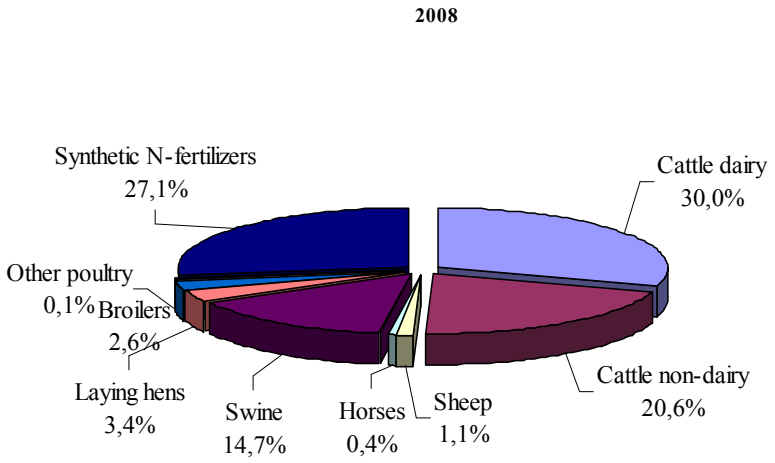


Figure 6.1 NH3 emission distribution by agriculture sector activities in 2008

The main polluter of particulates emission is agricultural crop operations – 63,4% (figure 6.2)
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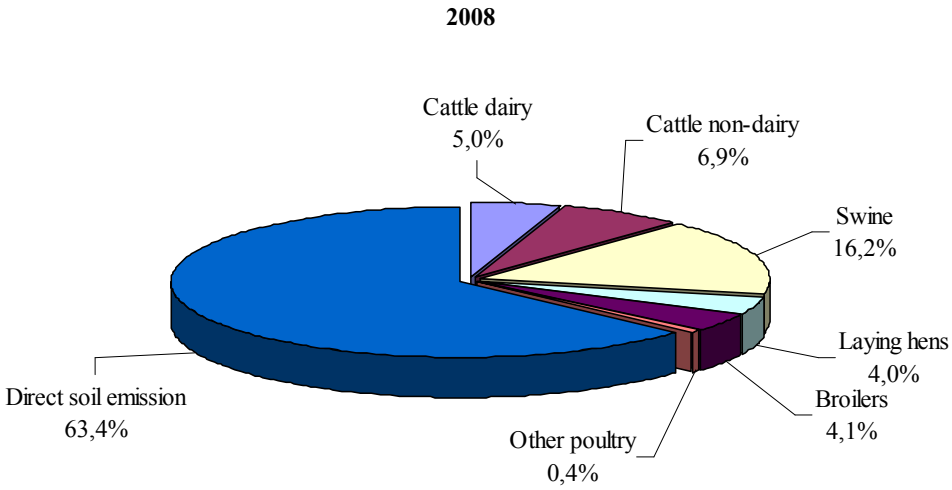

Figure 6.2 TSP emission from livestock and agricultural soils in 2008.

6.2 Methodological issues

A Tier 1 method is implemented to estimate ammonia and particulates emissions from agriculture.
The estimations were carried out for ammonia based on Guidebook emission factors and statistical data and for particulates estimates were used CEPMEIP emission factors.

Table 6.1 NH_3 and PM emission factors for agriculture

	Emission factor			
	NH3	**PM2,5**	**PM10**	**TSP**
	kg/capita	g/capita		
Cattle dairy	28,5	88.480	398.590	884.880
Cattle non-dairy	14,3	88.480	398.590	884.880
Sheep	1,34			
Horses	8			
Fattening pigs	6,39			
Sows	16,43			
Swine		78.470	353.500	784.780
Laying hens	0,37	8.290	37.360	82.950
Broilers	0,28	8.290	37.360	82.950
Other poultry	0,92	55.310	249.160	553.140
Synthetic N-fertilizers	72.857 g/kg product			
Arable land crops			100 g/ha	1880 g/ha

Table 6.2 Number of livestock, 1990-2008

Year	**Cattle dairy**	**Cattle non-dairy**	**Sheep**	**Horses**	**Swine**	**Poultry**

1990	280,7	477,1	139,8	8,6	859,9	6536,5
1991	264,3	444	142,8	7,8	798,6	5538,3
1992	253,4	361,2	124,3	6,6	541,1	3418,1
1993	226,7	236,5	83,3	5,2	424,3	3226,1
1994	211,4	208,1	61,5	5	459,8	3129,7
1995	185,4	185	49,8	4,6	448,8	2911,3
1996	171,6	171,4	39,2	4,2	298,4	2324,9
1997	167,7	157,9	35,6	4,2	306,3	2602
1998	158,6	148,9	30,8	3,9	326,4	2635,7
1999	138,4	128,9	30,9	3,9	285,7	2461,8
2000	131	121,8	32,2	4,2	300,2	2366,4
2001	128,6	131,9	32,4	5,5	345	2294,9
2002	115,6	138,3	33,8	5,3	340,8	2096,3
2003	116,8	140,4	34,3	5,8	344,6	1945,2
2004	116,5	133,3	41	5,1	340,1	2183
2005	112,8	136,7	52,4	4,8	346,5	1878,7
2006	108,4	136,4	66	4,9	345,8	1638,7
2007	103	137,5	76,4	5,3	379	1477,6
2008	100,4	137,5	81,8	5,3	364,9	1757,3

Table 6.3 Synthetic N-fertilizers use in 1990-2008

Year	Synthetic N-fertilizers, Gg
1990	71,7
1991	58,36
1992	58,36
1993	29,949
1994	26,068
1995	18,905
1996	16,56
1997	20,471
1998	24,932
1999	19,895
2000	22,396
2001	19,603
2002	16,7
2003	23,255
2004	24,833
2005	20,083
2006	22,61
2007	24,982
2008	35,455

6.3 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. 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

Pollutant	National emissions ceiling for 2010 (Gg)	Emission projection 2010	Emission projection 2015
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	Emission projection 2010	Emission projection 2015
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

In current plans Ministry of the Environment to develop the emission projection by 2020.

Annex

Table 1 Key sources categories for NO_x emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**11,942**	**34,72**
1 A 3 b iii Road transport:, Heavy duty vehicles	**6,355**	**53,20**
1 A 3 b i Road transport: Passenger cars	**4,311**	**65,73**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**2,320**	**72,48**
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	**2,210**	**78,90**
1 A 4 b i Residential: Stationary plants	**1,496**	**83,26**
1 A 3 c Railways	**1,362**	**87,22**
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	**0,951**	**89,98**
1 A 3 b ii Road transport:Light duty vehicles	**0,915**	**92,64**
1 A 3 d ii National navigation (Shipping)	**0,742**	**94,80**
1 A 4 a ii Commercial / institutional: Mobile	**0,440**	**96,08**
1 A 4 a i Commercial / institutional: Stationary	0,411	97,27
1 A 1 c Manufacture of solid fuels and other energy industries	0,353	98,30
2 B 1 Ammonia production	0,255	99,04
1 A 3 a i (i) International aviation (LTO)	0,112	99,37
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,080	99,60
1 A 4 b ii Residential: Household and gardening (mobile)	0,052	99,75
2 D 1 Pulp and paper	0,018	99,80
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,017	99,85
2 C 1 Iron and steel production	0,015	99,90
2 G Other production, consumption, storage, transportation or handling of bulk products	0,007	99,92
6 C b Industrial waste incineration (d)	0,006	99,93
1 A 3 b iv Road transport: Mopeds & motorcycles	0,006	99,95
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,004	99,96
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,003	99,97
2 A 2 Lime production	0,003	99,98
1 A 1 b Petroleum refining	0,003	99,99
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0,002	99,99
6 B Waste-water handling	0,001	100,00
2 C 5 e Other metal production	0,000	100,00
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0,000	100,00
6 C d Cremation	0,000	100,00
1 B 2 a iv Refining / storage	0,000	100,00

Table 2 Key sources categories for NMVOC emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**16,316**	**46,28**
1 B 2 b Natural gas	**3,630**	**56,58**
3 D 2 Domestic solvent use including fungicides	**3,472**	**66,42**
1 A 3 b i Road transport: Passenger cars	**2,667**	**73,99**
1 B 2 a v Distribution of oil products	**1,383**	**77,91**

1 A 1 c Manufacture of solid fuels and other energy industries	**1,291**	**81,57**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**0,941**	**84,25**
3 A 2 Industrial coating application	**0,904**	**86,81**
2 D 2 Food and drink	**0,574**	**88,44**
1 A 4 b ii Residential: Household and gardening (mobile)	**0,536**	**89,96**
3 C Chemical products	**0,473**	**91,30**
1 A 1 a Public electricity and heat production	**0,449**	**92,57**
1 A 3 b iii Road transport:, Heavy duty vehicles	**0,433**	**93,80**
1 B 2 a iv Refining / storage	**0,429**	**95,02**
1 A 3 b v Road transport: Gasoline evaporation	0,333	95,96
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,212	96,56
1 A 3 b ii Road transport:Light duty vehicles	0,160	97,02
1 A 3 d ii National navigation (Shipping)	0,144	97,43
3 D 1 Printing	0,134	97,81
1 A 3 c Railways	0,121	98,15
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,107	98,45
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0,098	98,73
1 A 4 a ii Commercial / institutional: Mobile	0,077	98,95
1 A 4 a i Commercial / institutional: Stationary	0,076	99,16
2 G Other production, consumption, storage, transportation or handling of bulk products	0,062	99,34
3 D 3 Other product use	0,051	99,48
3 B 1 Degreasing	0,039	99,59
1 A 3 b iv Road transport: Mopeds & motorcycles	0,035	99,69
2 B 5 a Other chemical industry	0,024	99,76
2 D 1 Pulp and paper	0,024	99,83
1 A 3 a i (i) International aviation (LTO)	0,013	99,87
2 B 5 b Storage, handling and transport of chemical products	0,011	99,90
2 C 1 Iron and steel production	0,008	99,92
2 B 1 Ammonia production	0,006	99,94
6 B Waste-water handling	0,006	99,95
6 D Other waste(e)	0,005	99,97
3 B 2 Dry cleaning	0,005	99,98
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0,003	99,99
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,001	100,00
6 C b Industrial waste incineration (d)	0,000	100,00
2 C 5 e Other metal production	0,000	100,00
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,000	100,00
1 A 1 b Petroleum refining	0,000	100,00
2 A 2 Lime production	0,000	100,00
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,000	100,00

Table 3 Key sources categories for SO_x emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**61,686**	**88,97**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**6,007**	**97,64**
1 A 1 c Manufacture of solid fuels and other energy industries	0,600	98,50
1 A 4 b i Residential: Stationary plants	0,463	99,17
1 A 4 a i Commercial / institutional: Stationary	0,263	99,55

1 A 3 d ii National navigation (Shipping)	0,080	99,66
1 A 3 c Railways	0,050	99,74
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,039	99,79
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,032	99,84
2 D 1 Pulp and paper	0,018	99,86
1 A 3 b i Road transport: Passenger cars	0,016	99,89
1 A 3 b iii Road transport:, Heavy duty vehicles	0,016	99,91
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,015	99,93
1 B 2 a iv Refining / storage	0,010	99,95
1 A 3 a i (i) International aviation (LTO)	0,010	99,96
1 A 3 b ii Road transport:Light duty vehicles	0,005	99,97
6 C b Industrial waste incineration (d)	0,005	99,97
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,005	99,98
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0,003	99,99
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,002	99,99
2 A 2 Lime production	0,002	99,99
2 B 1 Ammonia production	0,001	99,99
2 G Other production, consumption, storage, transportation or handling of bulk products	0,001	100,00
3 D 3 Other product use	0,001	100,00
1 A 4 a ii Commercial / institutional: Mobile	0,001	100,00
2 C 1 Iron and steel production	0,000	100,00
3 C Chemical products	0,000	100,00
6 B Waste-water handling	0,000	100,00
6 C d Cremation	0,000	100,00

Table 4 Key sources categories for NH_3 emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
4 B 1 a Cattle dairy	**2,861**	**28,05**
4 D 1 a Synthetic N-fertilizers	**2,583**	**53,37**
4 B 1 b Cattle non-dairy	**1,966**	**72,64**
4 B 8 Swine	**1,401**	**86,37**
4 B 9 a Laying hens	**0,320**	**89,50**
1 A 3 b i Road transport: Passenger cars	**0,300**	**92,45**
4 B 9 b Broilers	**0,246**	**94,86**
2 B 5 a Other chemical industry	**0,116**	**95,99**
4 B 3 Sheep	0,110	97,07
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,102	98,07
1 A 4 b i Residential: Stationary plants	0,066	98,71
4 B 6 Horses	0,042	99,13
2 C 5 e Other metal production	0,033	99,45
2 B 1 Ammonia production	0,016	99,61
4 B 9 d Other poultry	0,013	99,74
1 A 3 b ii Road transport:Light duty vehicles	0,010	99,83
2 G Other production, consumption, storage, transportation or handling of bulk products	0,009	99,92
1 A 3 b iii Road transport:, Heavy duty vehicles	0,003	99,95
3 C Chemical products	0,001	99,97
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,001	99,98
2 C 1 Iron and steel production	0,001	99,98
1 A 1 c Manufacture of solid fuels and other energy industries	0,001	99,99

1 B 2 a v Distribution of oil products	0,001	100,00
6 D Other waste(e)	0,000	100,00
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0,000	100,00

Table 5 Key sources categories for $PM_{2,5}$ emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**11,652**	**58,19**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**3,201**	**74,18**
1 A 1 a Public electricity and heat production	**3,192**	**90,12**
1 A 4 a i Commercial / institutional: Stationary	**0,359**	**91,91**
1 A 3 b i Road transport: Passenger cars	**0,230**	**93,06**
1 A 1 c Manufacture of solid fuels and other energy industries	**0,199**	**94,05**
1 A 3 b iii Road transport:, Heavy duty vehicles	**0,193**	**95,02**
2 G Other production, consumption, storage, transportation or handling of bulk products	0,117	95,60
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,110	96,15
1 A 3 b ii Road transport:Light duty vehicles	0,094	96,62
1 A 3 b vi Road transport: Automobile tyre and brake wear	0,092	97,08
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,090	97,53
1 A 3 d ii National navigation (Shipping)	0,088	97,97
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0,060	98,27
2 B 5 a Other chemical industry	0,057	98,56
1 A 3 b vii Road transport: Automobile road abrasion	0,051	98,81
1 A 3 c Railways	0,036	98,99
4 B 8 Swine	0,029	99,13
1 A 4 a ii Commercial / institutional: Mobile	0,028	99,27
2 D 1 Pulp and paper	0,024	99,39
2 C 1 Iron and steel production	0,021	99,50
2 A 2 Lime production	0,013	99,56
4 B 1 b Cattle non-dairy	0,012	99,62
1 B 2 a iv Refining / storage	0,011	99,68
1 A 4 b ii Residential: Household and gardening (mobile)	0,010	99,73
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,009	99,78
4 B 1 a Cattle dairy	0,009	99,82
4 B 9 b Broilers	0,007	99,86
4 B 9 a Laying hens	0,007	99,89
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,007	99,93
3 D 3 Other product use	0,003	99,94
3 A 2 Industrial coating application	0,002	99,95
3 D 1 Printing	0,002	99,96
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,002	99,97
1 A 3 a i (i) International aviation (LTO)	0,001	99,98
1 A 3 b iv Road transport: Mopeds & motorcycles	0,001	99,98
4 B 9 d Other poultry	0,001	99,99
3 C Chemical products	0,001	99,99
2 B 5 b Storage, handling and transport of chemical products	0,001	99,99
2 C 5 e Other metal production	0,000	100,00

Table 6 Key sources categories for PM_{10} emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**11,652**	**46,96**
1 A 1 a Public electricity and heat production	**6,129**	**71,66**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**3,764**	**86,83**
1 A 4 a i Commercial / institutional: Stationary	**0,448**	**88,64**
1 A 1 c Manufacture of solid fuels and other energy industries	**0,380**	**90,17**
2 G Other production, consumption, storage, transportation or handling of bulk products	**0,348**	**91,57**
1 A 3 b i Road transport: Passenger cars	**0,278**	**92,69**
1 A 3 b iii Road transport:, Heavy duty vehicles	**0,214**	**93,55**
1 A 3 b vi Road transport: Automobile tyre and brake wear	**0,171**	**94,24**
2 B 5 a Other chemical industry	**0,171**	**94,93**
4 B 8 Swine	**0,129**	**95,45**
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,110	95,89
1 A 3 b ii Road transport:Light duty vehicles	0,105	96,32
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,097	96,71
1 A 3 b vii Road transport: Automobile road abrasion	0,094	97,09
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,091	97,46
1 A 3 d ii National navigation (Shipping)	0,088	97,81
2 D 1 Pulp and paper	0,072	98,10
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0,060	98,34
4 D 1 a Synthetic N-fertilizers	0,060	98,58
4 B 1 b Cattle non-dairy	0,055	98,81
4 B 1 a Cattle dairy	0,040	98,97
2 A 2 Lime production	0,039	99,12
1 A 3 c Railways	0,037	99,27
4 B 9 b Broilers	0,033	99,41
4 B 9 a Laying hens	0,032	99,54
1 A 4 a ii Commercial / institutional: Mobile	0,028	99,65
2 C 1 Iron and steel production	0,027	99,76
1 B 2 a iv Refining / storage	0,014	99,81
1 A 4 b ii Residential: Household and gardening (mobile)	0,010	99,85
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,008	99,88
3 D 3 Other product use	0,006	99,91
3 A 2 Industrial coating application	0,005	99,93
3 D 1 Printing	0,005	99,95
4 B 9 d Other poultry	0,004	99,96
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,002	99,97
2 B 5 b Storage, handling and transport of chemical products	0,002	99,97
3 C Chemical products	0,001	99,98
2 C 5 e Other metal production	0,001	99,98
1 A 3 a i (i) International aviation (LTO)	0,001	99,99
1 A 3 b iv Road transport: Mopeds & motorcycles	0,001	99,99
3 B 1 Degreasing	0,001	100,00
2 D 2 Food and drink	0,001	100,00
2 A 1 Cement production	0,000	100,00
6 A Solid waste disposal on land	0,000	100,00

Table 7 Key sources categories for TSP emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**13,316**	**40,51**
1 A 1 a Public electricity and heat production	**7,930**	**64,64**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**4,931**	**79,64**
4 D 1 a Synthetic N-fertilizers	**1,124**	**83,06**
2 G Other production, consumption, storage, transportation or handling of bulk products	**1,067**	**86,30**
1 A 4 a i Commercial / institutional: Stationary	**0,697**	**88,42**
1 A 1 c Manufacture of solid fuels and other energy industries	**0,542**	**90,07**
2 B 5 a Other chemical industry	**0,518**	**91,65**
4 B 8 Swine	**0,286**	**92,52**
1 A 3 b i Road transport: Passenger cars	**0,278**	**93,37**
1 A 3 b vi Road transport: Automobile tyre and brake wear	**0,225**	**94,05**
2 D 1 Pulp and paper	**0,219**	**94,72**
1 A 3 b iii Road transport:, Heavy duty vehicles	**0,214**	**95,37**
1 A 3 b vii Road transport: Automobile road abrasion	0,189	95,94
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,186	96,51
4 B 1 b Cattle non-dairy	0,122	96,88
2 A 2 Lime production	0,119	97,24
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,110	97,58
1 A 3 b ii Road transport:Light duty vehicles	0,105	97,90
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,102	98,21
4 B 1 a Cattle dairy	0,089	98,48
1 A 3 d ii National navigation (Shipping)	0,088	98,74
4 B 9 b Broilers	0,073	98,97
4 B 9 a Laying hens	0,072	99,18
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0,060	99,37
2 C 1 Iron and steel production	0,044	99,50
1 A 3 c Railways	0,040	99,62
1 A 4 a ii Commercial / institutional: Mobile	0,028	99,71
1 B 2 a iv Refining / storage	0,017	99,76
3 D 3 Other product use	0,012	99,80
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,011	99,83
1 A 4 b ii Residential: Household and gardening (mobile)	0,010	99,86
3 A 2 Industrial coating application	0,009	99,89
3 D 1 Printing	0,009	99,92
4 B 9 d Other poultry	0,008	99,94
2 B 5 b Storage, handling and transport of chemical products	0,005	99,95
2 C 5 e Other metal production	0,003	99,96
3 C Chemical products	0,003	99,97
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,002	99,98
2 D 2 Food and drink	0,002	99,98
3 B 1 Degreasing	0,001	99,99
2 A 1 Cement 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
6 A Solid waste disposal on land	0,000	100,00
2 B 1 Ammonia production	0,000	100,00
6 C b Industrial waste incineration (d)	0,000	100,00
6 C d Cremation	0,000	100,00

Table 8 Key sources categories for CO emissions for 2008, level assessment

NFR code	2008 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**102,008**	**60,86**
1 A 3 b i Road transport: Passenger cars	**23,990**	**75,17**
1 A 1 c Manufacture of solid fuels and other energy industries	**16,213**	**84,84**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**9,371**	**90,43**
1 A 1 a Public electricity and heat production	**4,602**	**93,18**
1 A 4 b ii Residential: Household and gardening (mobile)	**2,862**	**94,89**
1 A 3 b iii Road transport:, Heavy duty vehicles	**2,225**	**96,21**
1 A 3 b ii Road transport:Light duty vehicles	1,593	97,16
1 A 4 a i Commercial / institutional: Stationary	1,108	97,83
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,690	98,24
1 A 3 b iv Road transport: Mopeds & motorcycles	0,565	98,57
1 A 3 d ii National navigation (Shipping)	0,385	98,80
2 B 5 a Other chemical industry	0,382	99,03
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0,311	99,22
1 A 3 c Railways	0,278	99,38
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0,260	99,54
1 A 4 a ii Commercial / institutional: Mobile	0,225	99,67
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,201	99,79
1 A 3 a i (i) International aviation (LTO)	0,138	99,87
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0,040	99,90
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,039	99,92
2 G Other production, consumption, storage, transportation or handling of bulk products	0,028	99,94
2 D 1 Pulp and paper	0,028	99,96
2 C 1 Iron and steel production	0,023	99,97
1 B 2 a iv Refining / storage	0,017	99,98
2 B 1 Ammonia production	0,016	99,99
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,005	99,99
3 C Chemical products	0,005	99,99
2 A 2 Lime production	0,003	100,00
6 C b Industrial waste incineration (d)	0,003	100,00
1 A 1 b Petroleum refining	0,002	100,00
6 B Waste-water handling	0,001	100,00
2 C 5 e Other metal production	0,001	100,00
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0,000	100,00
6 C d Cremation	0,000	100,00

Table 9 Key sources categories for Pb emissions for 2008, level assessment

NFR code	2008 (kg)	Cumulative Total
1 A 1 a Public electricity and heat production	**31,0030**	**90,39**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**1,1225**	**93,66**
1 A 3 b i Road transport: Passenger cars	**0,9050**	**96,30**
1 A 4 b i Residential: Stationary plants	0,6954	98,33
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0,3290	99,28

1 A 4 a i Commercial / institutional: Stationary	0,1540	99,73
1 A 3 b ii Road transport:Light duty vehicles	0,0500	99,88
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,0215	99,94
1 A 1 c Manufacture of solid fuels and other energy industries	0,0118	99,98
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,0024	99,98
1 A 3 b iii Road transport:, Heavy duty vehicles	0,0020	99,99
3 B 1 Degreasing	0,0011	99,99
1 A 4 a ii Commercial / institutional: Mobile	0,0010	100,00
2 G Other production, consumption, storage, transportation or handling of bulk products	0,0008	100,00
2 C 5 e Other metal production	0,0005	100,00
2 A 2 Lime production	0,0001	100,00
3 D 3 Other product use	0,0001	100,00

Table 10 Key sources categories for Cd emissions for 2008, level assessment

NFR code	2008 (kg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0,5226**	**84,77**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**0,0569**	**94,00**
1 A 4 b i Residential: Stationary plants	**0,0173**	**96,81**
1 A 3 b i Road transport: Passenger cars	0,0080	98,10
1 A 4 a i Commercial / institutional: Stationary	0,0049	98,90
1 A 3 b iii Road transport:, Heavy duty vehicles	0,0030	99,38
1 A 3 b ii Road transport:Light duty vehicles	0,0020	99,71
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0,0010	99,87
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,0004	99,94
1 A 1 c Manufacture of solid fuels and other energy industries	0,0003	99,98
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,0001	100,00
2 G Other production, consumption, storage, transportation or handling of bulk products	0,0000	100,00
2 A 2 Lime production	0,0000	100,00

Table 11 Key sources categories for Hg emissions for 2008, level assessment

NFR code	2008 (kg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0,5194**	**90,63**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**0,0334**	**96,45**
1 A 4 b i Residential: Stationary plants	0,0184	99,67
1 A 4 a i Commercial / institutional: Stationary	0,0016	99,96
1 A 1 c Manufacture of solid fuels and other energy industries	0,0002	99,99
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,0000	99,99
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0,0000	100,00
2 G Other production, consumption, storage, transportation or handling of bulk products	0,0000	100,00
2 A 2 Lime production	0,0000	100,00

Table 12 Key sources categories for PCB emissions for 2008, level assessment

NFR code	2008 (kg)	Cumulative Total
1 A 1 a Public electricity and heat production	**43,1379**	**84,79**
1 A 4 b i Residential: Stationary plants	**6,4200**	**97,41**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	1,0403	99,46
1 A 4 a i Commercial / institutional: Stationary	0,2028	99,85
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,0404	99,93
1 A 1 c Manufacture of solid fuels and other energy industries	0,0335	100,00

Table 13 Key sources categories for PCDD/PCDF emissions for 2008, level assessment

NFR code	2008 (g I-Teq)	Cumulative Total
1 A 1 a Public electricity and heat production	**2,252**	**44,53**
1 A 4 b i Residential: Stationary plants	**1,670**	**77,54**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**0,596**	**89,33**
6 C b Industrial waste incineration (d)	**0,430**	**97,82**
1 A 3 b i Road transport: Passenger cars	0,045	98,71
6 C a Clinical wasteincineration (d)	0,026	99,22
1 A 4 a i Commercial / institutional: Stationary	0,022	99,66
1 A 1 c Manufacture of solid fuels and other energy industries	0,012	99,89
2 A 2 Lime production	0,004	99,97
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0,002	100,00