2014

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ENVIRONMENT AGENCY

ESTONIAN INFORMATIVE INVENTORY REPORT 1990-2012

Submitted under the Convention on Long-Range Transboundary Air Pollution

Data sheet

Title: Estonian Informative Inventory Report 1990-2012

Date: March 14th 2014

Authors: Natalija Kohv, Helen Heintalu, Elo Mandel, Ardi Link
(Estonian Environment Agency)

Editor: Ardi Link

Contact: Elo Mandel
ESTONIAN ENVIRONMENT AGENCY
Mustamäe tee 33, 10616 Tallinn, Estonia
E-mail: Elo.Mandel@envir.ee

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ABBREVIATIONS

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

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

Pollutants

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

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

Units

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

Notation keys

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

EXECUTIVE SUMMARY

Estonia, as a party to the Convention on Long-range Transboundary Air Pollution (CLRTAP) is required to report annual emission data, projections of main pollutants, activity data and provide an Informative Inventory Report. The emissions data of all pollutants for the period 1990-2012 together with projections were submitted on 14th of February 2014. The first IIR was submitted in 2010.

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

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

Table 0.1 The status of recalculations in 2014 submission

NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1.A.1.a	Public electricity and heat production	Additionally calculated pollutants emission from the peat briquette	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP, CO, Pb Cd, Hg, As, Cr, Cu, Ni, Zn, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs	2011
1.A.3.b.i	Road transport: Passenger cars	Corrected fuel sold data and annual vehicle mileage	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Cd, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs	2011
		Small correction due to rounding errors in previous submission	Zn	2002-2003, 2005-2006, 2008-2010
		Small correction due to rounding errors in previous submission	SO_x	2002-2004, 2007-2008
		Small correction due to rounding errors in previous submission	Cr	2007
		Small correction due to rounding errors in previous submission	NO_x, NMVOC, CO	2005
1.A.3.b.ii	Road transport: Light duty vehicles	Corrected fuel sold data and annual vehicle mileage	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Cd, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs	2011
		Small correction due to	Zn	2002-2003,

NFR code	NFR name	Recalculation reasons	Pollutant	Recalculation period
		rounding errors in previous submission		2005-2006, 2008-2010
			SO_x	2002-2003, 2007
			Cr	2008
1.A.3.b.iii	Road transport: Heavy duty vehicles	Corrected fuel sold data and annual vehicle mileage	NO_x, NMVOC, $PM_{2.5}$, PM_{10}, TSP, CO, Cr, Ni, Zn, PCDD/F, Total PAHs	2002-2011
			NH_3, Cd, I(1,2,3-cd)p	2002-2004, 2006-2008, 2010-2011
			SO_x, Cu, B(b)f, B(k)f	2002-2008, 2010-2011
			B(a)p	2005-2008, 2010-2011
1.A.3.b.vi	Road transport: Automobile tyre and brake wear	Corrected annual vehicle mileage	$PM_{2.5}$, PM_{10}, TSP, Pb, Cr, Cu, Ni, Zn	2002-2011
			Cd	2006-2007, 2011
			Se	2006-2011
1.A.3.b.vii	Road transport: Automobile road abrasion	Corrected annual vehicle mileage	$PM_{2.5}$, PM_{10}, TSP	2002-2011
1.A.3.d.i(i)	International maritime navigation	Corrected the number of vessels, gross tonnage of vessels and some minor calculation mistakes which were made in previous years	NO_x, NMVOC, $PM_{2.5}$, PM_{10}, TSP	2005-2011
			SO_x	2008-2009
3.A.1	Decorative coating application	Correction of emission factor for NMVOC	NMVOC	1990-1999
3.D.3	Other product use	Corrections in statistical data	NMVOC	2011
4.B.9.b	Broilers	Correction of calculation	NH_3, PM_{10}, TSP	2011
6.D	Other waste(s)	Correction of activity data (amount of compost production from waste)	NH_3	1990-2011

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

The differences in total emissions between the 2013 and 2014 submissions are presented in Table 0.2.

Table 0.2 Difference between the 2013 and 2014 submissions (%)

Year	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP	Pb	Cd
1990	0.00	0.00	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1991	0.00	0.03	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1992	0.00	0.06	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1993	0.00	0.08	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1994	0.00	0.12	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1995	0.00	0.12	0.00	0.00	0.00	NR	NR	0.00	0.00	0.00
1996	0.00	0.15	0.00	-0.06	0.00	NR	NR	0.00	0.00	0.00
1997	0.00	0.16	0.00	-0.12	0.00	NR	NR	0.00	0.00	0.00
1998	0.00	0.19	0.00	-0.01	0.00	NR	NR	0.00	0.00	0.00
1999	0.00	0.19	0.00	-0.01	0.00	NR	NR	0.00	0.00	0.00
2000	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.00	0.00	-0.04	0.00	0.00	0.00	0.00	0.00	0.00
2002	-0.02	0.00	0.00	-0.22	0.00	0.00	0.00	0.00	0.00	0.00
2003	-0.01	0.00	0.00	-0.57	0.00	0.00	0.00	0.00	0.00	0.00
2004	-0.01	0.00	0.00	-0.78	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	-0.92	0.00	0.00	0.00	0.00	0.00	0.00
2006	-0.09	-0.01	0.00	-1.34	0.00	-0.01	-0.01	0.00	0.00	0.00
2007	-0.05	0.00	0.00	-1.38	0.00	0.00	0.00	0.00	0.00	0.00
2008	-0.03	0.00	0.00	-1.05	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	-1.04	0.00	0.00	0.00	0.00	0.00	0.00
2010	-0.03	0.00	0.00	-1.32	0.00	0.00	0.00	0.00	0.00	0.00
2011	-0.62	0.07	0.08	-0.92	0.11	0.11	0.31	0.05	-0.01	0.01

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs total	HCB	PCB
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1991	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1992	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1993	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1994	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1996	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1997	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1998	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1999	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2002	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
2003	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
2004	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006	0.00	0.00	0.00	-0.05	0.00	0.00	-3.72	0.00	0.00	0.00
2007	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2010	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00
2011	0.01	0.02	0.00	-0.79	0.10	-0.08	-0.02	0.02	0.00	0.00

Tables 0.3 and 0.4 show the differences in reported national totals for the entire territory with NECD and UNFCCC reports.

In comparison with NEC report there are insignificant distinctions in ammonia emissions (adjustment was made within the frame of CLRTAP report) that which will be modified in the final NEC report in December 2014.

In this section comparison with UNFCCC report is presented. At present two different databases are available in Estonia - air pollution (AP) and GHG. The differences in the emissions data mainly results from a different approach to inventories. The AP database is more complicated, it is built from down to top and contains data of the point sources (about 1,950, not only LPS) and diffuse sources. Different tools are used for data collection: national web interface point sources database OSIS, COPERT for the road transport. In GHG inventory emissions of non-direct GHG pollutants are calculated only at the national level and by using IPCC methodology. AP database is using data given by enterprises (measurements and calculations). Emission calculations from the point sources is based on national emission factors. For the emission calculations from the diffuse sources EEA/EMEP Guidebook emission factors are used, but it should be noted that some of the emission factors are different in the EEA/EMEP Guidebook to those in the IPCC Good Practice Guidance.

Estonia recognizes that work is needed to integrate our activity data and emission factors for Air Pollution and GHG inventories into a single consistent database and we are working under streamlining of AP and GHG emission reporting requirements.

Table 0.3 Differences of national total emissions between CLRTAP and UNFCCC reports

Year	NO_x			NMVOC			SO_x			CO		
	CLRTAP	UNFCC	%	CLRTAP	UNFCC	%	CLRTAP	UNFCC	%	CLRTAP	UNFCC	%
1990	73.62	77.20	**4.87**	70.17	53.80	**-23.33**	273.61	184.26	**-32.66**	226.58	189.98	**-16.15**
1991	67.92	72.16	**6.24**	66.87	51.63	**-22.80**	251.29	179.67	**-28.50**	225.99	186.48	**-17.48**
1992	43.71	45.94	**5.11**	45.03	34.83	**-22.65**	191.66	106.22	**-44.58**	127.10	101.49	**-20.15**
1993	39.51	39.36	**-0.38**	37.23	32.59	**-12.46**	155.90	69.45	**-55.45**	123.61	106.25	**-14.04**
1994	42.06	43.62	**3.70**	41.08	37.57	**-8.55**	150.23	72.98	**-51.42**	149.54	133.67	**-10.61**
1995	39.18	41.26	**5.32**	49.90	42.69	**-14.44**	116.11	76.83	**-33.83**	196.93	165.38	**-16.02**
1996	42.46	43.98	**3.58**	52.46	44.14	**-15.85**	125.14	85.46	**-31.71**	219.32	185.34	**-15.49**
1997	41.23	43.51	**5.52**	54.43	46.14	**-15.23**	116.21	84.47	**-27.31**	228.73	202.66	**-11.40**
1998	38.34	39.73	**3.63**	46.21	40.11	**-13.20**	104.31	76.16	**-26.99**	181.16	160.71	**-11.29**
1999	36.79	38.87	**5.65**	45.66	39.81	**-12.81**	97.61	73.81	**-24.38**	190.28	171.88	**-9.67**
2000	37.65	37.74	**0.24**	45.19	37.64	**-16.71**	96.96	84.61	**-12.74**	182.61	166.36	**-8.90**
2001	40.08	39.48	**-1.50**	44.91	37.57	**-16.34**	90.69	82.59	**-8.93**	188.47	173.18	**-8.11**
2002	41.05	38.50	**-6.23**	44.21	36.44	**-17.57**	86.99	81.36	**-6.47**	181.73	161.69	**-11.03**
2003	41.76	38.16	**-8.62**	43.07	37.03	**-14.03**	100.24	93.55	**-6.67**	174.27	157.05	**-9.88**
2004	39.17	36.65	**-6.44**	43.15	36.35	**-15.77**	88.24	87.68	**-0.64**	171.22	151.66	**-11.42**
2005	36.63	34.37	**-6.18**	40.14	33.99	**-15.33**	76.28	82.54	**8.21**	157.69	139.37	**-11.62**
2006	35.38	33.01	**-6.69**	38.34	33.95	**-11.44**	69.94	80.31	**14.84**	143.81	133.79	**-6.97**
2007	38.62	36.30	**-6.01**	38.54	36.80	**-4.51**	87.97	85.58	**-2.71**	162.70	149.07	**-8.38**
2008	35.79	32.92	**-8.00**	36.95	33.58	**-9.12**	69.37	78.10	**12.57**	166.75	145.50	**-12.74**
2009	30.25	28.12	**-7.04**	35.45	30.15	**-14.96**	54.83	64.16	**17.02**	168.26	146.17	**-13.12**
2010	36.74	33.65	**-8.40**	35.01	31.09	**-11.21**	83.21	75.10	**-9.75**	172.02	152.00	**-11.64**
2011	35.87	33.39	**-6.91**	33.13	30.82	**-6.97**	72.73	71.99	**-1.01**	147.93	136.75	**-7.56**
2012	32.37	31.82	**-1.68**	33.73	31.11	**-7.78**	40.58	69.96	**72.41**	162.36	140.48	**-13.48**

Table 0.4 Differences of national total emissions between CLRTAP and NECD reports

Year	NO_x			NMVOC			SO_x			NH_3		
	CLRTAP	NEC	%	CLRTAP	NEC	%	CLRTAP	NEC	%	CLRTAP	NEC	%
1990	73.62	73.62	**0.00**	70.17	70.19	**0.03**	273.61	273.61	**0.00**	24.59	24.59	**0.00**
1991	67.92	67.92	**0.00**	66.87	66.87	**0.00**	251.29	251.29	**0.00**	21.78	21.78	**0.00**
1992	43.71	43.71	**0.00**	45.03	45.03	**0.00**	191.66	191.66	**0.00**	19.10	19.10	**0.00**
1993	39.51	39.51	**0.00**	37.23	37.23	**0.00**	155.90	155.90	**0.00**	14.03	14.03	**0.00**
1994	42.06	42.06	**0.00**	41.08	41.08	**0.00**	150.23	150.23	**0.00**	13.16	13.16	**0.00**
1995	39.18	39.18	**0.00**	49.90	49.90	**0.00**	116.11	116.11	**0.00**	11.49	11.49	**0.00**
1996	42.46	42.46	**0.00**	52.46	52.46	**0.00**	125.14	125.14	**0.00**	10.38	10.39	**0.06**
1997	41.23	41.23	**0.00**	54.43	54.43	**0.00**	116.21	116.21	**0.00**	10.74	10.76	**0.12**
1998	38.34	38.34	**0.00**	46.21	46.21	**0.00**	104.31	104.31	**0.00**	10.84	10.84	**0.01**
1999	36.79	36.79	**0.00**	45.66	45.66	**0.00**	97.61	97.61	**0.00**	9.41	9.41	**0.01**
2000	37.65	37.65	**0.00**	45.19	45.19	**0.00**	96.96	96.96	**0.00**	9.51	9.51	**0.02**
2001	40.08	40.08	**0.00**	44.91	44.91	**0.00**	90.69	90.69	**0.00**	9.56	9.56	**0.04**
2002	41.05	41.05	**0.00**	44.21	44.21	**0.00**	86.99	86.99	**0.00**	8.84	8.86	**0.22**
2003	41.76	41.76	**0.00**	43.07	43.07	**0.00**	100.24	100.24	**0.00**	9.72	9.78	**0.57**
2004	39.17	39.17	**0.00**	43.15	43.15	**0.00**	88.24	88.24	**0.00**	10.00	10.08	**0.79**
2005	36.63	36.63	**0.00**	40.14	40.14	**0.00**	76.28	76.28	**0.00**	9.69	9.78	**0.93**
2006	35.38	35.38	**0.00**	38.34	38.34	**0.00**	69.94	69.94	**0.00**	9.84	9.97	**1.35**
2007	38.62	38.62	**0.00**	38.54	38.54	**0.00**	87.97	87.97	**0.00**	10.17	10.31	**1.40**
2008	35.79	35.79	**0.00**	36.95	36.95	**0.00**	69.37	69.37	**0.00**	10.79	10.90	**1.06**
2009	30.25	30.25	**0.00**	35.45	35.45	**0.00**	54.83	54.83	**0.00**	9.90	10.00	**1.05**
2010	36.74	36.74	**0.00**	35.01	35.01	**0.00**	83.21	83.21	**0.00**	10.12	10.26	**1.34**
2011	35.87	35.87	**0.00**	33.13	33.13	**0.00**	72.73	72.73	**0.00**	10.29	10.38	**0.90**
2012	32.37	32.37	**0.00**	33.73	33.73	**0.00**	40.58	40.58	**0.00**	10.75	10.85	**0.88**

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

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

Priorities for future inventory improvement:

- To recalculate the POPs emissions from combustion processes by using the national EF;
- To check the POPs emissions from waste incineration;
- To provide uncertainty analysis for all key sources;
- To check the activities data and emission factors in energy industries. The main problem – discrepancy of the data regarding fuel consumption between statistical energy balance and the reports of the enterprises;
- Using the Tier 2 or Tier 3 methods for emissions estimation from agriculture.

1. INTRODUCTION

1.1. National inventory background

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

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

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

Estonia's Informative Inventory Report is due by March 2014. The report contains information on Estonian emission inventories from 1990 to 2012. The inventories detail the anthropogenic emissions of main pollutants (SO_x, NO_x, NMVOC, NH_3 and CO), particulate matter (TSP, PM_{10}, $PM_{2.5}$), heavy metals (Pb, Cd, Hg, As, Cr, Cu, Ni, Zn,) and persistent organic pollutants (dioxins, HCB, PAHs, PCB). Projected emissions for sulphur dioxide, nitrogen oxides, ammonia, particulate matter and NMVOCs are reported for the year 2020.

Methods used to quantify emissions as well as data analysis and other additional information to understand the emission trends as required in the Guidelines are included in national Informative Inventory Reports (IIR) that are submitted annually.

1.2. Institutional arrangements for inventory preparation

The Ambient Air Protection Act regulates data collection and reporting. Methods for the calculation of emissions are laid down in several regulations of the Minister of the Environment. The Air Pollution Database consists of data on point sources (about 1,950 for 2012) and diffuse sources. Structure and emission calculations from small point sources and area sources are mainly based on the EMEP/EEA Air Pollutant Emission Inventory Guidebook.

The Estonian Environment Agency (EtEA) is responsible for collecting, analysing, storing, reporting and publishing environment-related information and data. The EtEA was established in June 1st, 2013 when two environmental organisations were joined together after reorganisation. The new agency will consolidate former Estonian Environment Information Centre and Estonian Meteorological and Hydrological Institute into a single organisation. The EtEA is a state agency administered by the Ministry of the Environment.

The Ambient Air Department is responsible for the preparation of air pollution inventory in Estonia.

The EtEA performs the final data quality control and assurance procedure before it is submitted. In preparation for the inventory and in compiling basic data, the EtEA cooperates with the Ministry of the Environment, the Ministry of Economic Affairs and Communications, the Ministry of Agriculture, Statistics Estonia and Estonian Environmental Research Centre (EERC).

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

1.3. The process of inventory preparation

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

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

Figure 1.1 The main activities of inventory preparation

The national database contains data for both point and diffuse sources of emissions. The emission inventory for the period of 1990–1999 is based on data pertaining to the large point sources and area sources. From 2000 to 2004, CollectER software was used to accumulate data (both point and area). In order to accumulate data on point sources, the Estonian Environment Information Centre created a new web-interface air emission data system for the point sources (OSIS) in 2004, where operators of point sources directly complete their annual air pollution reports. In 2000, there was data about 600 enterprises in the database; however, by 2012 the number had increased to 1,950.

The point sources information system contains data that is reported by the operators that have a pollution permit. Each facility submits data on the emissions of polluting substances together with data regarding burnt fuel, used solvents, liquid fuel distribution, etc. Operators are obliged to specify any data that relate to accidental releases where such information is available (deliberate, accidental, routine and non-routine). Data is presented on each source of pollution and on the facility as a whole. Emission data is available in SNAP (Source Nomenclature for Air Pollutants) and E-PRTR codes. The owners of point sources can directly add their calculated or measured annual emissions into the system or use OSIS calculation models, which use legally regulated estimation methodologies. The operator can also calculate emissions through the use of other available methods, though this should be co-ordinated with the Ministry of the Environment (regulated by the Ambient Air Protection Act). Operator shall indicate method of emission calculation.

Emissions for some air pollutants (POPs, in some case PM_{10} and $PM_{2.5}$) that are not included in the reporting requirements under the environmental permits are additionally calculated by Ambient Air Department and used in preparation of the national inventory.

After entering the report into the system, the local Environmental Board specialist confirms receipt of the report; at this point, final verification at the EtEA is carried out and the data are then ready for use in various reports (Figure 1.2).

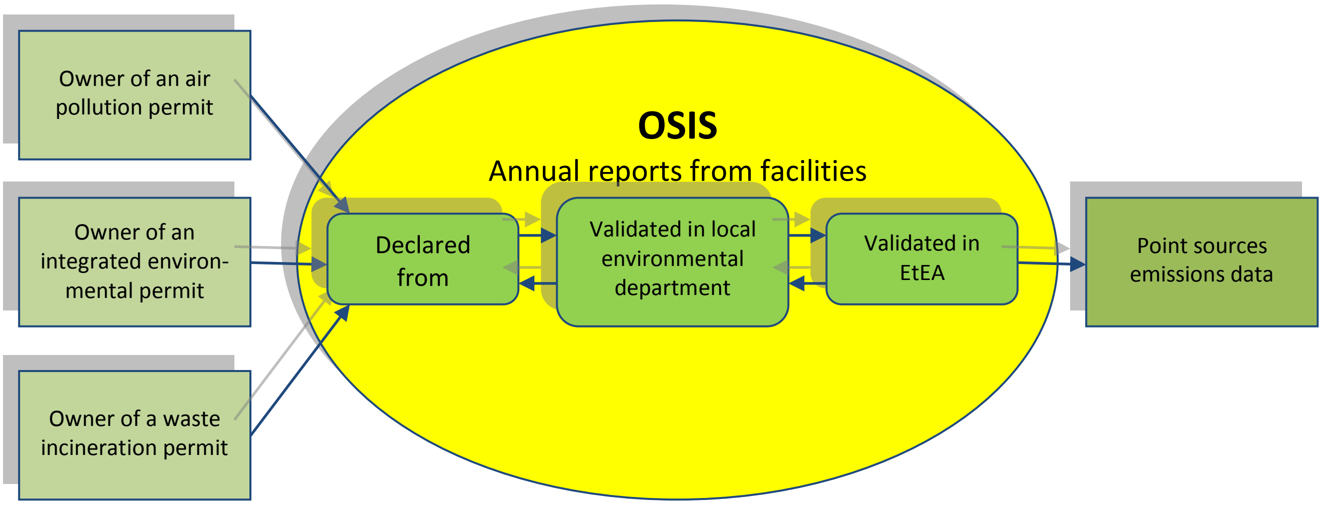


Figure 1.2 Validation of Estonian point sources data

The pollutant emissions from all diffuse sources have been calculated by EtEA. The main diffuse sources are combustion in residential sector, mobile sources, and agriculture, parts of solvent use and industrial activities and fugitive emissions from fuel consumption.

The non-direct GHG emissions (SO_2, NO_x, CO, NMVOC) and N_2O, CH_4 from road transport and NMVOC emissions from solvent use sector calculated by EtEA are used in reporting to the UNFCCC Secretariat and the EU CO_2 Monitoring Mechanism.

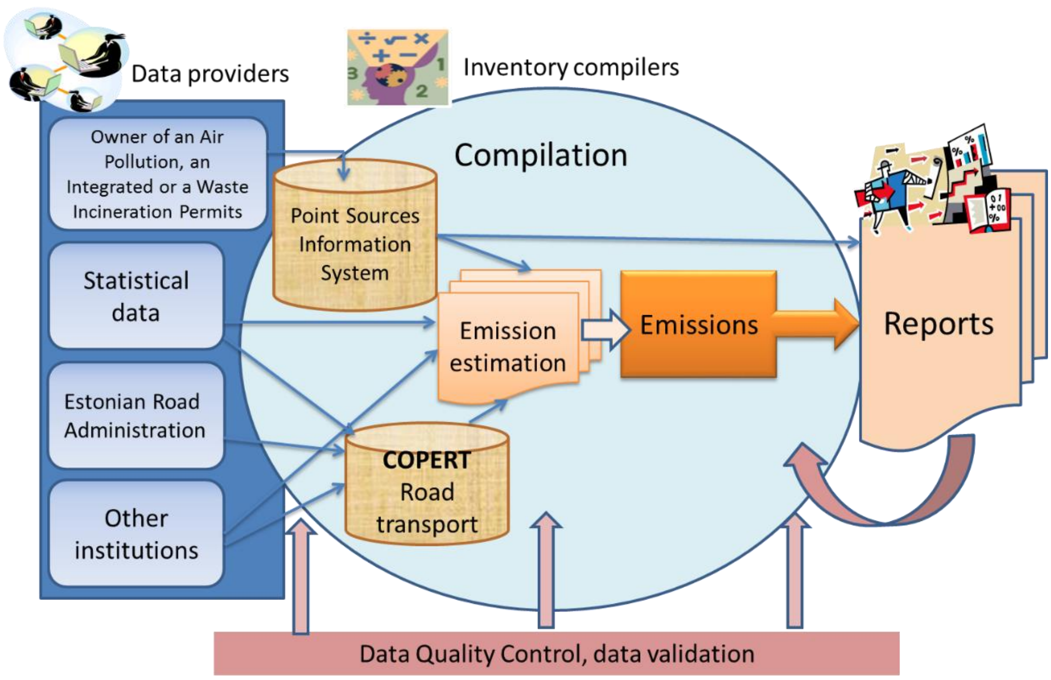


Figure 1.3 Air pollution inventory structure

1.4. Methods and data sources

The data reported by the operators, national specific emission factors or EMEP/EEA Emission Inventory Guidebook methodology for the emissions calculation from the diffuse sources are used in the preparation of emission inventories.

At present, the EtEA uses the CollectER tool for the calculation of emissions of diffuse sources from energy sector. The Statistical Office energy balance and fuel consumption by point sources are used in this calculation.

Diffuse sources Fuel = EB fuel – PS fuel

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

The detailed methods of emission calculation are described in each sector of the IIR.

1.5. Key Categories

This chapter presents the results of Estonian key sources analyses.

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

Key categories are the categories of emissions that have a significant influence on the total inventory in terms of the absolute level of emissions (certain year). The key categories are those that together represent 80% of the inventory level or trend. According to the study, for certain emissions ("Key sources analysis and uncertainty assessment of sulphur dioxide, nitrogen oxides and ammonia emissions in Estonia" Elo Mandel, Tallinn 2009) in 2007 there were no significant differences between the results of the level and trend assessment of key sources analysis. So, for 2012, only the level assessment was chosen.

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

The energy (1.A.1.a) and road transport (1.A.3.b.iii) sectors are the main sources of NO_x. Energy sector emissions are mainly from oil-shale power plants. The energy sector is also a key source for dioxins.

Combustion in residential plants (1.A.4.b.i) is also a main source of NMVOC (48.3%). Additionally, road transport (1.A.3.b.i), natural gas distribution (1.B.2.b), decorative coating application (3.A.1) and public electricity and heat productions (1.A.1.a) constitute key sources.

According to level assessment SO_2 emissions for 2012 from the energy sector are responsible for 82.6% of SO_2 emissions in 2012. The majority of these emissions come from two oil shale power plants in east Estonia (Eesti and Balti power plants).

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

The combustion in residential plants (1.A.4.b.i) is a key source for TSP, PM_{10} and $PM_{2.5}$. The influence of public electricity and heat productions (1.A.1.a) is also significant for them.

According to level assessment, 62.7% of CO emissions come from residential combustion plants (1.A.4.b.i). In addition, road transport (1.A.3.b.i) and the oil-shale industry (1.A.1.c) are the main polluters of CO. Combustion in the residential sector is also a key source for PCB and HCB.

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

Table 1.1 Results of key source analysis

Pollutant	Key sources categories (sorted from high to low from left to right)										Total (%)
NO_x	1 A 1 a	1 A 3 b iii	1 A 3 b i	1 A 4 c ii	1 A 2 f i	1 A 3 c					
	37.0%	16.9%	9.9%	8.0%	5.0%	4.9%					81.6%
NMVOC	1 A 4 b i	1 A 3 b i	3 A 1	1 B 2 a v	3 D 2	4 B 1 a	4 B 1 b	3 B 1	3 A 2	4 B 8	
	48.3%	4.8%	4.3%	4.0%	4.0%	3.9%	3.3%	3.0%	2.9%	2.7%	81.3%
SO_x	1 A 1 a										
	82.6%										82.6%
NH_3	4 B 1 a	4 D 1 a	4 B 1 b	4 B 8							
	30.6%	25.8%	16.8%	12.5%							85.7%
$PM_{2.5}$	1 A 4 b i	1 A 1 a									
	68.0%	15.4%									83.5%
PM_{10}	1 A 4 b i	1 A 1 a	1 A 2 f i								
	55.4%	23.1%	5.5%								84.0%
TSP	1 A 4 b i	1 A 1 a	1 A 2 f i								
	49.2%	26.9%	5.6%								81.7%
CO	1 A 4 b i	1 A 1 c	1 A 3 b i								
	62.7%	15.3%	9.1%								87.1%
Pb	1 A 1 a										
	94.8%										94.8%
Cd	1 A 1 a										
	92.2%										92.2%
Hg	1 A 1 a										
	95.9%										95.9%
As	1 A 1 a										
	99.0%										99.0%
Cr	1 A 1 a										
	94.7%										94.7%

Pollutant	Key sources categories (sorted from high to low from left to right)										Total (%)
Cu	1 A 1 a	1 A 3 b vi									
	47.5%	43.4%									90.9%
Ni	1 A 1 a										
	94.0%										94.0%
Zn	1 A 1 a										
	90.1%										90.1%
DIOX	1 A 1 a	1 A 4 b i									
	42.9%	42.1%									85.0%
benzo(a) pyrene	1 A 4 b i	1 A 1 a									
	78.5%	15.3%									93.8%
benzo(b) fluoranthene	1 A 4 b i	1 A 1 a									
	74.3%	18.3%									92.6%
benzo(k) fluoranthene	1 A 4 b i										
	81.2%										81.2%
Indeno(1,2,3-cd)pyrene	1 A 4 b i										
	83.0%										83.0%
PAH total 1-4	1 A 4 b i	1 A 1 a									
	78.4%	15.4%									93.8%
HCB	1 A 4 b i	1 A 1 a									
	54.1%	32.1%									86.3%
PCB	1 A 4 b i	1 A 1 a									
	64.6%	25.9%									90.6%

1.6. QA/QC and Verification methods

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

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

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

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

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

- **Data manipulation**
  Common statistical quality checking has been carried out.
- **Inventory compilation**
  Before submitting data to CEIP/EEA NFR formats have to been checked with RepDab.
- **Reporting**
- **Archiving**

1.7. General uncertainty evaluation

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

1.8. General Assessment of Completeness

Table 1.2 Sources not estimated (NE)

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

Table 1.3 Sources included elsewhere (IE)

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

2. POLLUTANTS EMISSION TRENDS

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

Estimates are available as follows:

- NO_x, SO_2, NH_3, NMVOC, CO, TSP: 1990-2012
- PM_{10} and $PM_{2.5}$: 2000-2012
- All heavy metals: 1990-2012
- POPs: 1999-2012

Table 2.1 Main pollutant emissions in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP
1990	73.616	70.175	273.609	24.591	226.579	NR	NR	277.332
1991	67.921	66.873	251.290	21.781	225.987	NR	NR	277.198
1992	43.705	45.032	191.662	19.102	127.103	NR	NR	248.692
1993	39.509	37.231	155.897	14.032	123.607	NR	NR	196.400
1994	42.064	41.077	150.235	13.164	149.537	NR	NR	174.873
1995	39.176	49.896	116.107	11.488	196.929	NR	NR	134.262
1996	42.458	52.457	125.139	10.379	219.320	NR	NR	123.534
1997	41.233	54.432	116.205	10.744	228.727	NR	NR	100.212
1998	38.336	46.206	104.315	10.838	181.156	NR	NR	88.517
1999	36.787	45.658	97.605	9.410	190.279	NR	NR	87.163
2000	37.651	45.188	96.959	9.509	182.610	21.238	37.352	74.775
2001	40.080	44.910	90.688	9.557	188.466	22.213	37.303	73.052
2002	41.055	44.212	86.989	8.845	181.734	22.759	33.366	52.507
2003	41.756	43.072	100.241	9.721	174.274	20.852	29.977	48.615
2004	39.173	43.154	88.244	10.003	171.218	22.079	30.170	45.915
2005	36.632	40.136	76.282	9.688	157.690	19.910	26.872	37.217
2006	35.381	38.337	69.937	9.838	143.813	15.226	20.415	27.906
2007	38.624	38.540	87.970	10.169	162.701	20.306	29.017	35.955
2008	35.785	36.948	69.375	10.786	166.749	19.995	25.389	31.645
2009	30.247	35.450	54.827	9.900	168.255	18.586	23.271	28.400
2010	36.737	35.014	83.215	10.120	172.017	23.299	31.830	37.579
2011	35.869	33.129	72.725	10.286	147.927	26.478	41.786	49.360
2012	32.367	33.732	40.579	10.755	162.363	17.082	20.974	26.974
trend 1990-2012, %	**-56.0**	**-51.9**	**-85.2**	**-56.3**	**-28.3**	**-19.6**	**-43.8**	**-90.3**

2.1. Sulphur dioxide

During the period of 1990-2012, the emissions of sulphur dioxide had decreased by about 85.2%, which was largely influenced by a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 156 PJ in 2012) (Figure and Table 2.1). The latter, in turn, was the result of a restructuring of the economy. Likewise, the export possibilities, regarding electricity, have also noticeably decreased. The use of local fuels (including wood, oil shale oil) and natural gas has been constantly increasing since 1993, while the relevance of heavy fuel oil, in the production of thermal energy, has reduced. The use of fuel with lower sulphur content was also the reason for a decrease in SO_2 emissions (with regard to fuel for road transport and heating). Other reason for decrease in emissions are given below.

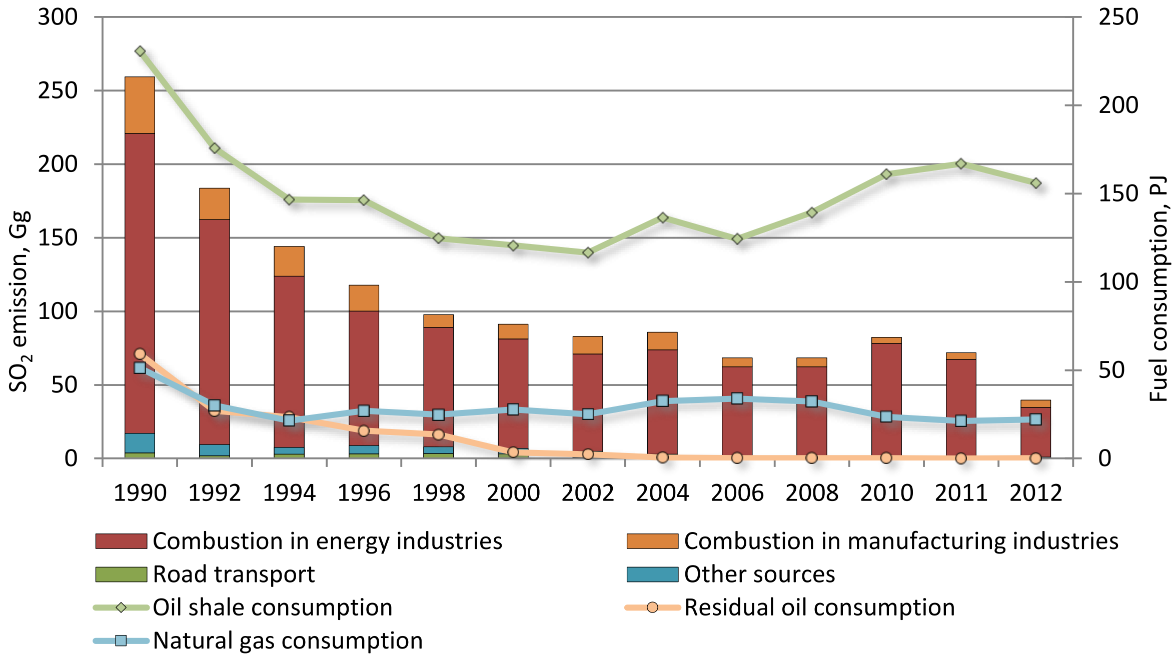


Figure 2.1 SO_2 emissions in the period 1990-2012

When Estonia became a member of the EU in 2004, Estonia took the responsibility with the Accession Treaty to the EU to make all efforts to ensure that in 2012 SO_2 emissions from oil shale fired combustion plants do not exceed 25,000 tonnes and progressively decrease thereafter. In 2012, SO_2 emissions had decreased about 44.2% compared to 2011 as a result of the decrease in electricity production for the same period. The other reason of emission decreasing - installing the semi-dry NID (Novel Integrated Desulphurisation) technology, which uses the fly ash in the gas itself and does not require any additional compounds to bind the SO_2.[1] On the energy units which hasn't been equipped with the clearing equipment, alternative methods of reduction of SO_2 emissions are used, such as water injection to furnaces of PC (old pulverised combustion boilers). Water injection lowers flame temperature and therefore improves conditions for sulphur capture with limestone included in oil shale.

[1] Eesti Energia. Environmental Reports 2009/2010, 2011 and 2012

The energy sector (NFR 1.A.1.a-c) is responsible for about 85.4% of total emissions (2012). The share of SO_2 emissions from the two large oil shale Narva Power Plants (PP) (Eesti and Balti) is about 61,5% of total emissions. The main reason for the drop in emissions from 2004 is the launch of two new boilers at the Narva PP that are based on circulating fluidized-bed (CFB) technology. The new boilers have reduced SO_2 emissions to virtually zero. Emissions have also been considerably reduced by shutting down the old blocks. Also, the new desulphurisation NID equipment design and installation process ensure that the desulphurisation equipment will be able to operate at the required levels of efficiency and reliability for the next 15 years. Eesti Energia continued working to install and fine-tune the NID technology-based emission reduction filters to cut SO_2 emissions from four generating units of the Eesti PP. This solution means that these filter equipped units will meet the tighter limits on sulphur emissions in flue gasses that will come in from 2016. Measures are also being taken to reduce nitrogen emissions and this will mean that the units will be able to work at full capacity after 2016, without limits. These scrubbers will also reduce the solid particle content of flue gases[2].

2.2. Nitrogen oxides

Emissions of nitrogen oxides have decreased by 56% compared to 1990. The reduction is mainly due to the decrease in energy production and the transport sector during the period of 1990-1993 (the consumption of petrol by road transport dropped 58% at this time and diesel by 45%. The increasing share of catalyst cars in more recent years was also a contributing factor in the reduction of NO_x emissions. The energy industry and road transport sector are the main sources of nitrogen oxide emissions – 37.7% and 29% respectively. The share of other mobile sources was 17.6% in 2012 (Figure 2.3).

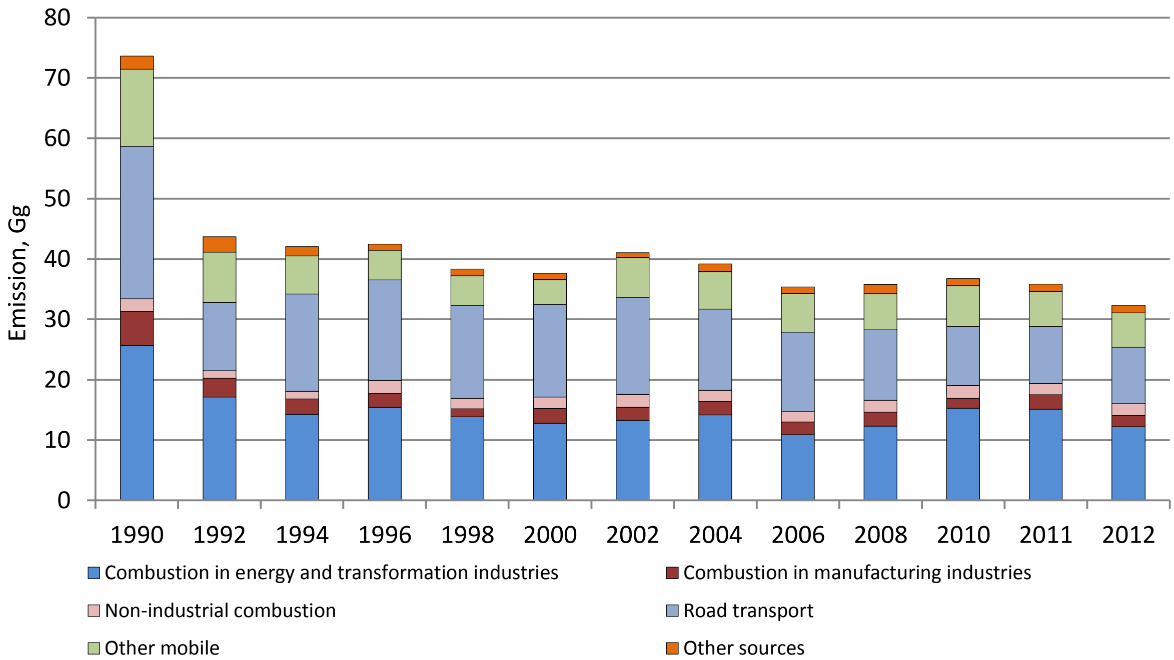


Figure 2.2 NO_x emissions in the period 1990-2012

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

In 2012, NO_x emissions had decreased about 9.8% compared to 2011 mainly due to the decreasing of electricity production for the same period.

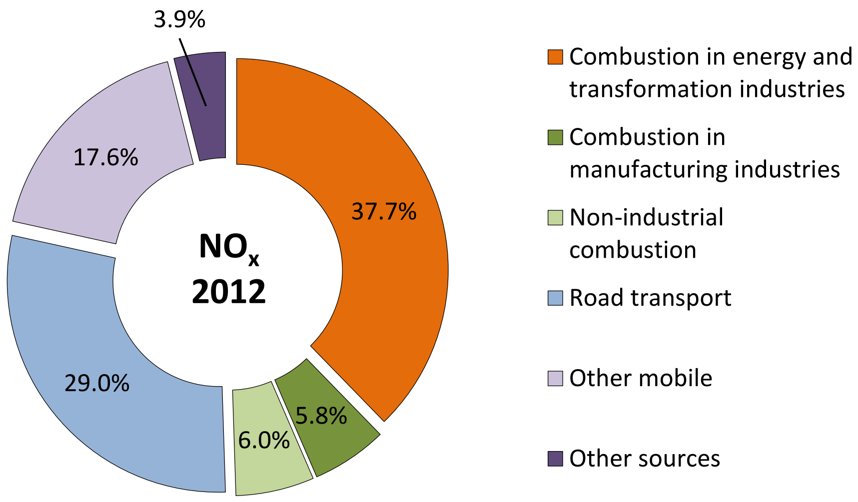


Figure 2.3 NO_x emissions by sources of pollution in 2012

2.3. Non-methane volatile compounds

In 2012, NMVOC emissions increased 5.7% compared to 2011 mainly due to increase in biomass consumption in residential combustion plants (Figure 2.4). The small decrease in emissions for the same period was observed in the road transport and liquid fuel distribution sectors.

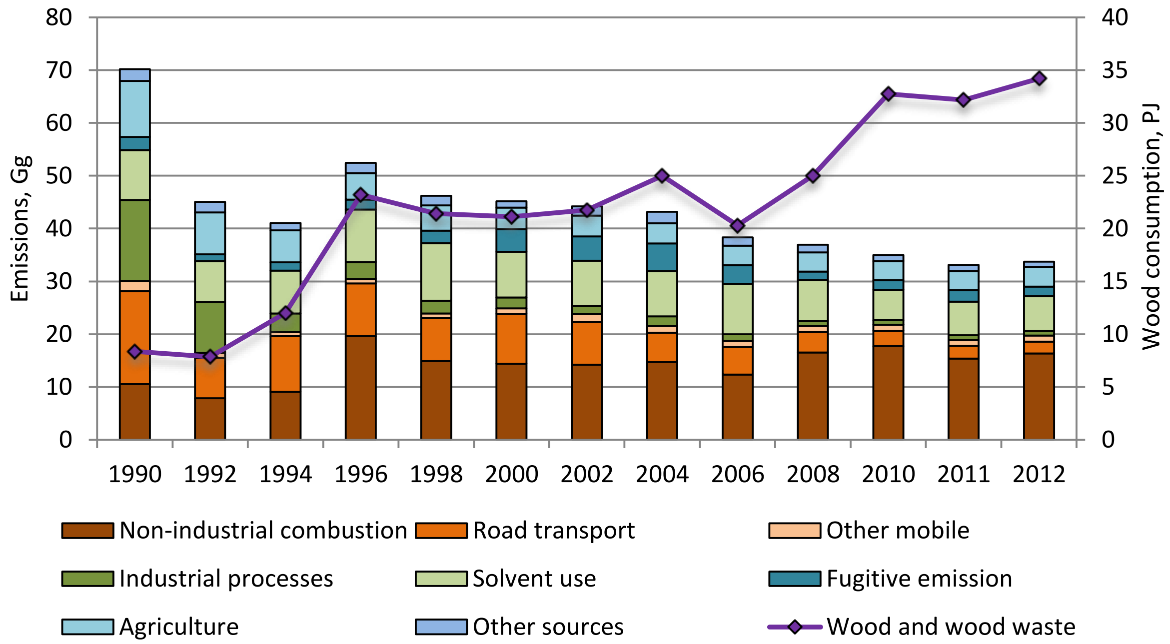


Figure 2.4 Emissions of non-methane volatile organic compounds in the period 1990-2012

The total emissions of non-methane volatile organic compounds decreased by 51.9% between 1990 and 2012. In 1990, the main polluters of NMVOC were road transport (25%) and industrial processes (22%), while in 2012 the dominant sources were non-industrial combustion (48%) and solvent use (19%) (Figure 2.5). The primary reason for this change was a decrease in the use of motor fuel in the transport sector and an increase in the consumption of diesel compared to petrol. Secondly, during 1990-2012, the manufacture of chemical products fell. Emissions from non-industrial fuel combustion (mainly in households) have increased since 1995. These are the results of the increasing tendency towards wood and wood waste combustion (the NMVOC emission factor for these fuels is much higher for the domestic stoves and higher than for other fuels combustion).

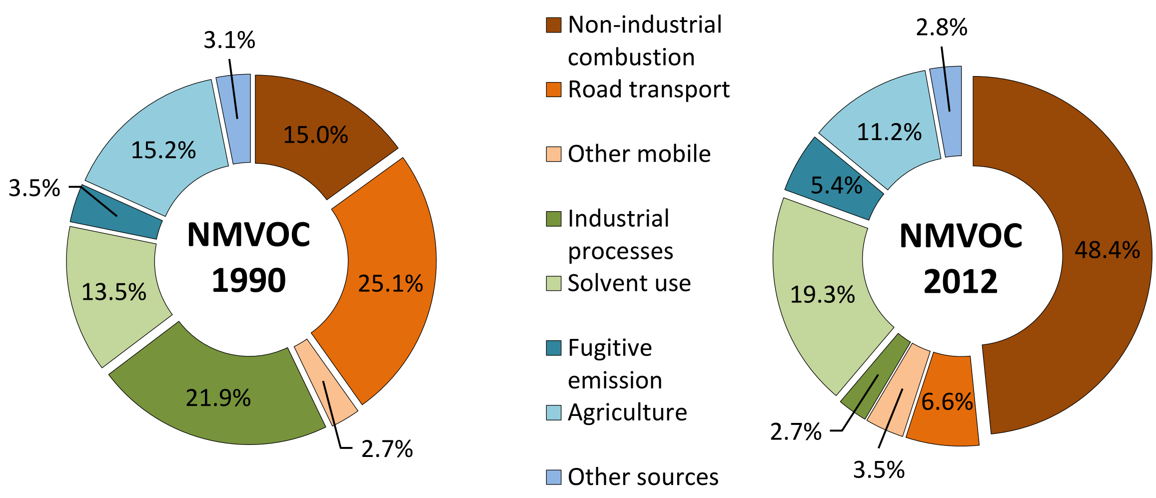


Figure 2.5 NMVOC emissions by sources of pollution in 1990 and 2012

2.4. Ammonia

Total NH_3 emissions decreased by 56.3% from 1990 to 2012 due to a reduction in the number of animals and use of fertilisers (Figure 2.6). Livestock manure management and mineral fertiliser use are the main sources of pollution regarding ammonia (about 94.3%). Road transport makes up 1.8% of total emissions and has increased in recent years due to a growth in new car usage. The share of fugitive emission from solid fuels (oil shale open cast mining, mainly explosive works) also about 2%. The total share industry and waste management makes about 1.3% of total ammonia emission (Figure 2.7).

In 2012 ammonia emissions increased by 4.4% compared to 2011 mainly due to increase in livestock and use of fertilisers during the same period.

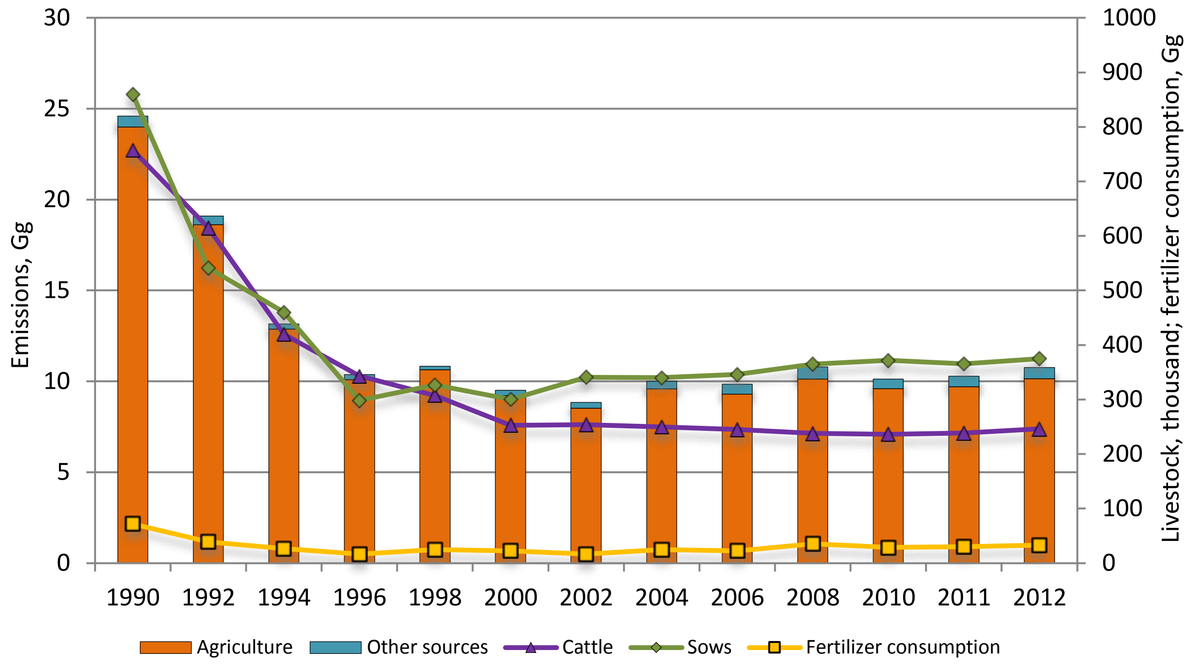


Figure 2.6 Emissions of ammonia in the period 1990-2012

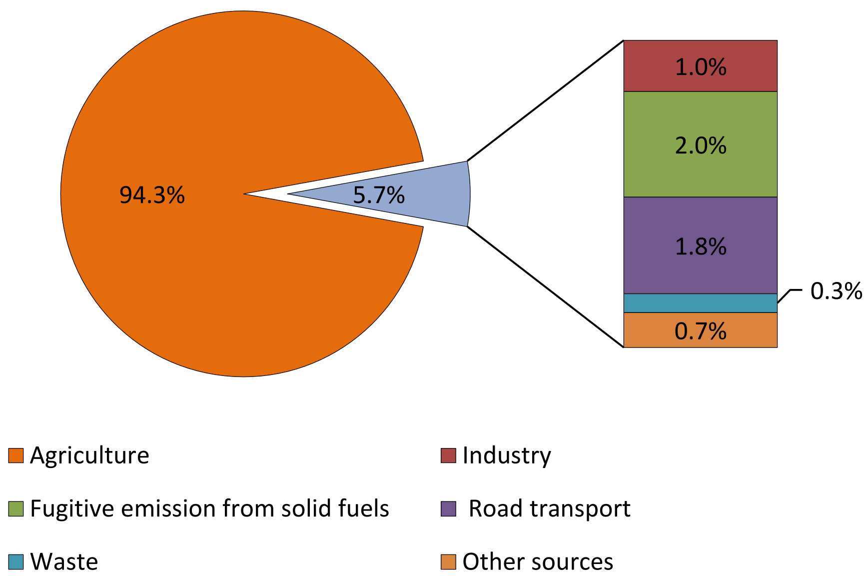


Figure 2.7 Ammonia emissions by sources of pollution in 2012

2.5. Carbon monoxide

In the period 1990-2012, the emissions of carbon monoxide decreased by 28.3%. That was among other things caused by the reduction in the use of vehicle fuels (especially from 1990 to 1992, and in recent years by a decrease in the number of cars using petrol. The increase in emissions from 1994 to 1996 is caused by growth of burning wood in household sector

(Figure 2.8). In 2012, the biggest polluters of CO were combustion in the non-industrial sector (about 63%, from which a large part is wood combustion in domestic sector), combustion in energy industry (19%, mainly from shale oil production industry – 83%) and road transport – 11% (Figure 2.9).

In 2012, carbon monoxide emission increased 8.9% compared to 2011 mainly due to increase of shale oil production in Eesti Energia Õlitööstus AS (Eesti Energia Oil Industry) plant and due to increase of biomass consumption in residential combustion plants (Figure 2.8).

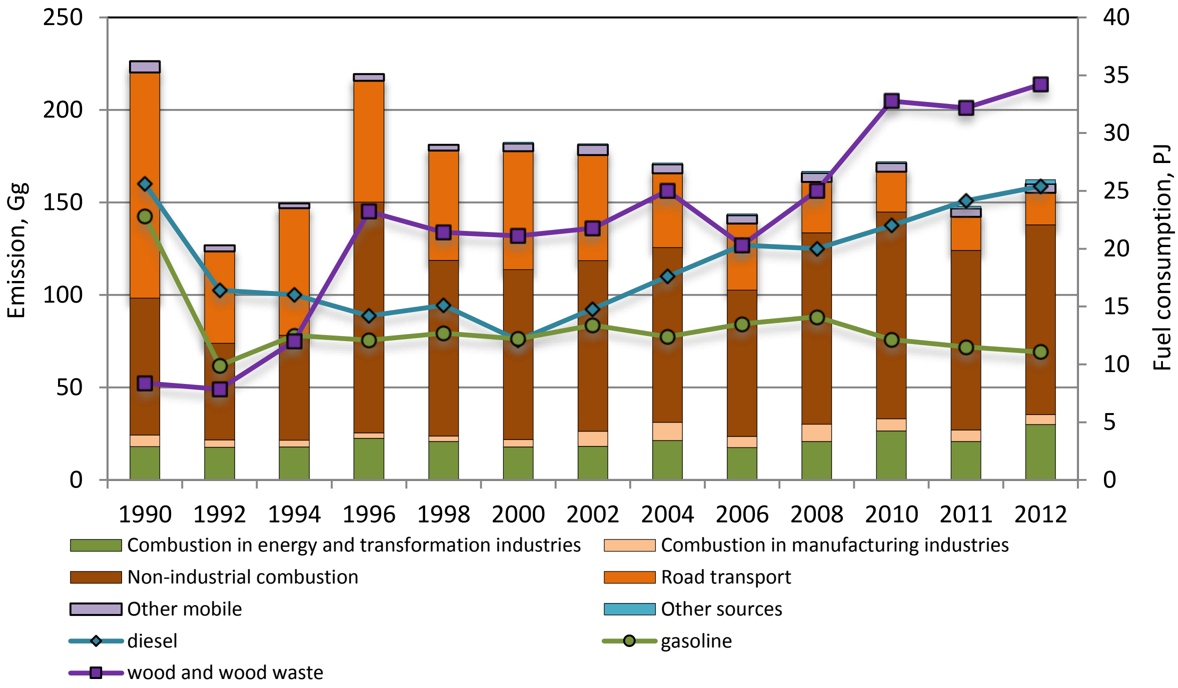


Figure 2.8 Emissions of carbon monoxide in the period 1990-2012

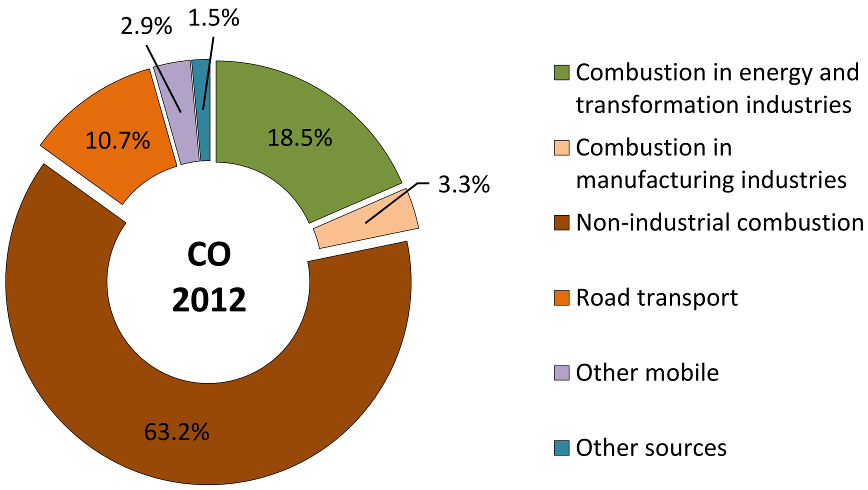


Figure 2.9 CO emissions by sources of pollution in 2012

2.6. Particulates

The emissions of TSP by sectors of pollution are shown in Figure 2.10.

In 1990-2012, TSP emission dropped significantly – by 90.3%. This is due to the increase in the efficiency of combustion devices and cleaning installations (especially in oil shale power plants and the cement factory – from 1990 to 1998) as well as the decrease in electricity production. The significant reduction of TSP emissions in 2012 compared to 2011 (45.4%) was mainly due to the decrease in electricity production by 49% in Baltic PP (Eesti Energia Narva Elektrijaamad AS) and also as a result of correcting the operation of electric precipitators on power units in the same power plant.

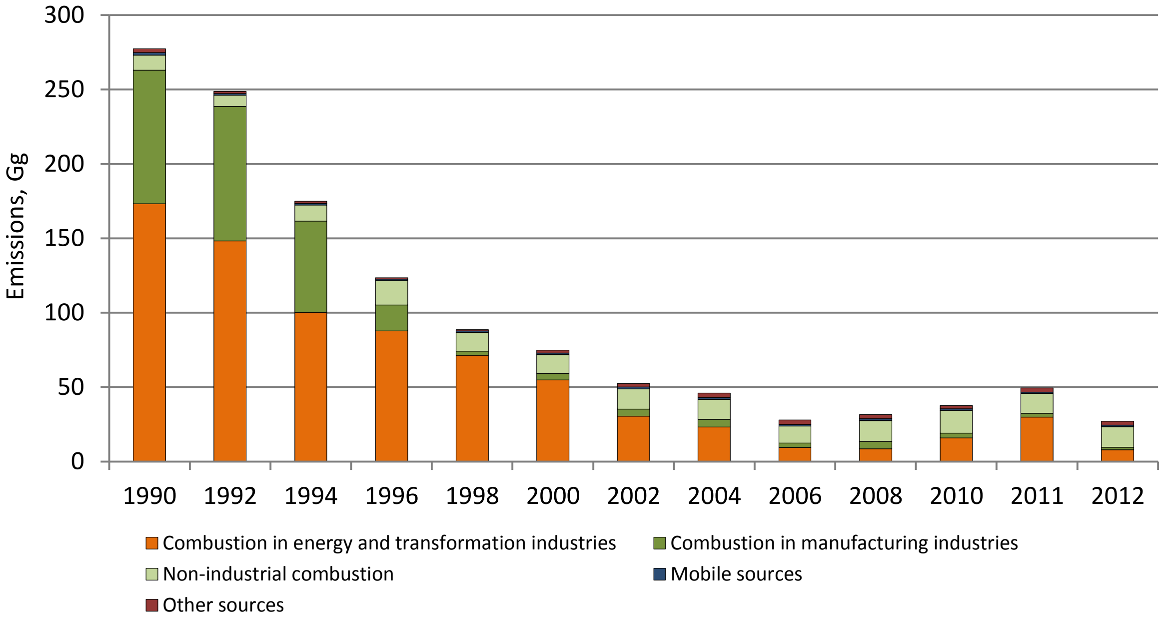


Figure 2.10 TSP emissions in the period 1990-2012

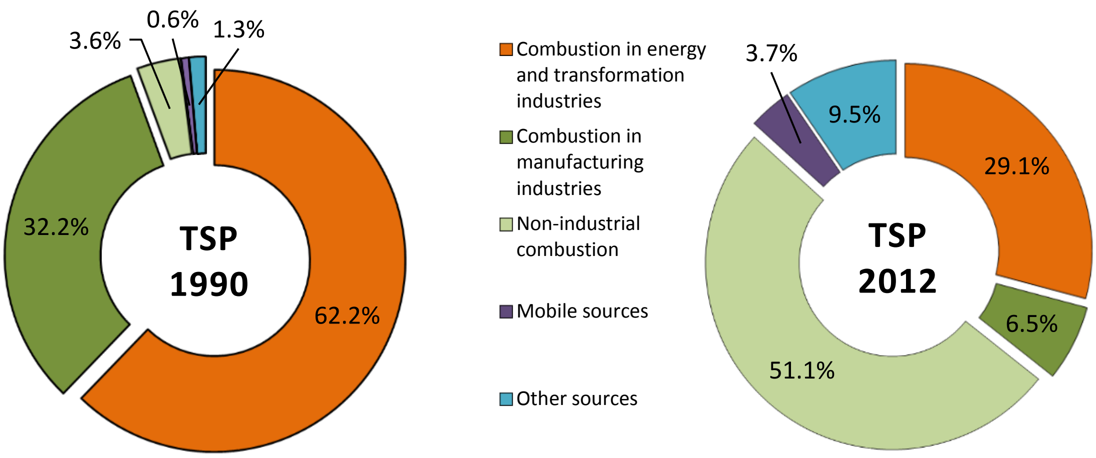


Figure 2.11 TSP emissions by sources of pollution in 1990 and 2012

In 1990, the main polluters of TSP were energy industry (62%) and combustion in manufacturing industries (32%). In 2012 the dominant source was non-industrial combustion (51%), while share of energy sector had decreased by 33% and share of industrial combustion had decreased by 27% comparing to 1990 (Figure 2.11). The main reasons for such changes are - increase of the share of wood combustion in domestic sector (high emission factor of particulates); modernisation of cleaning equipment at cement plant and decreasing of electricity production in one of the oil shale power plants. Other sources contribute into total emission by 9%, from which about 51% is agriculture.

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

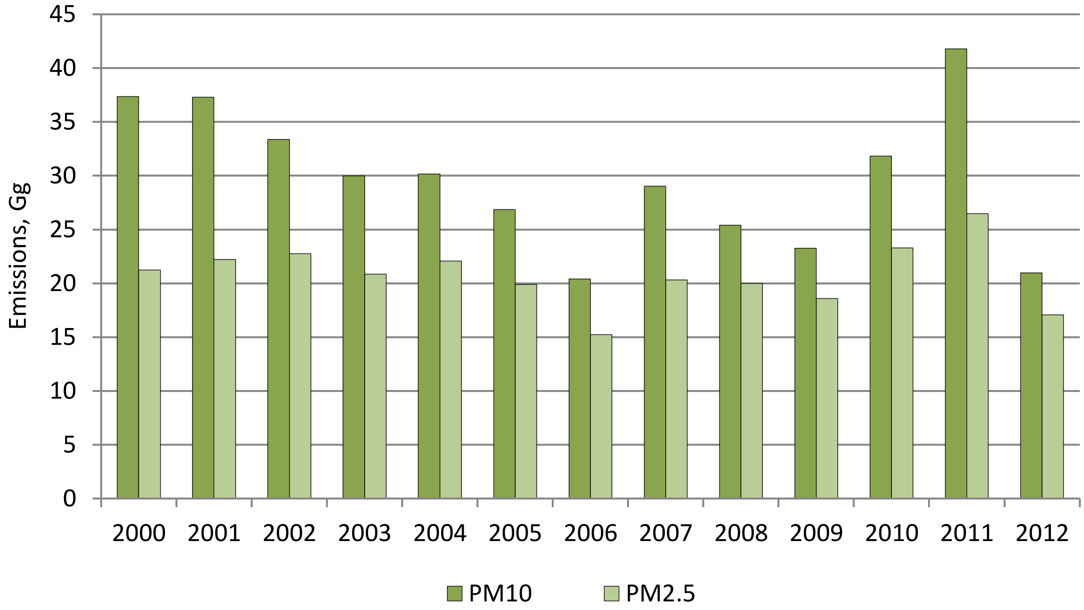


Figure 2.12 PM_{10} and $PM_{2.5}$ emissions in the period 2000-2012

In the period 2000-2012, the emissions of PM_{10} and $PM_{2.5}$ decreased by 43.8% and 19.6% respectively. The main reason for that is the decrease in electricity production.

The significant reducing of PM_{10} and $PM_{2.5}$ emissions in 2012 compared to 2011 (49.8% and 35.5% respectively) was mainly due to the decrease in electricity production by 49% in Baltic PP (Eesti Energia Narva Elektrijaamad AS) and also as a result of correcting the operation of electric precipitators on power units of the same power plant.

The primary sources of fine particulates (PM_{10}) emission in 2012 were non-industrial combustion (57%) and combustion in energy and transformation industries (25%, mainly oil shale combustion) (Figure 2.13). The distribution of $PM_{2.5}$ emissions by sources of pollution is also visible in Figure 2.13.

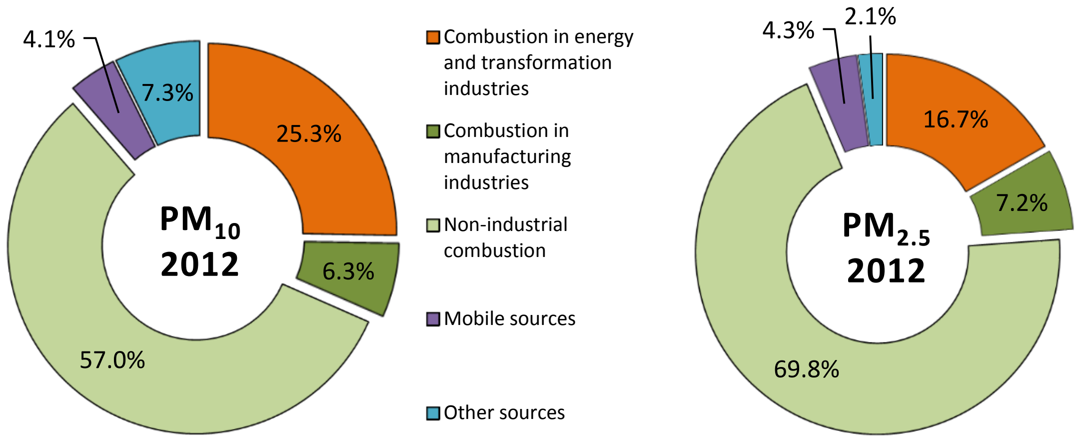


Figure 2.13 PM_{10} and $PM_{2.5}$ emission by activities in 2012

2.7. Heavy metals

In 1990-2012 emissions of heavy metals dropped significantly which is shown in Table 2.2 and Figure 2.14.

Heavy metals are mainly released by combustion in energy and transformation industries and from mobile sources. The energy industry (mainly oil shale power plants) is a big heavy metals polluter in Estonia. The emissions of lead decreased by 83.7% due to the modernisation of cleaning equipment at both the Narva power plant and Kunda Nordic Cement and due to the decrease in energy production. The other reason is that the use of leaded petrol was discontinued in Estonia in 2000. (Figure 2.16)

Table 2.2 Heavy metal emissions in the period 1990-2012 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	205.457	4.402	1.121	18.860	18.301	10.104	27.360	105.251
1991	188.138	4.201	1.021	16.451	15.957	9.361	25.926	96.366
1992	123.967	2.996	0.830	14.030	13.714	6.690	17.027	78.317
1993	102.451	2.217	0.640	10.840	10.377	5.451	14.343	60.746
1994	122.549	2.867	0.640	10.680	10.220	5.957	12.870	63.853
1995	85.442	1.956	0.600	10.070	9.662	5.085	10.501	58.492
1996	65.857	1.047	0.600	10.360	9.886	4.638	10.943	56.010
1997	46.438	1.067	0.600	10.200	9.600	4.605	9.823	55.599
1998	39.097	1.006	0.530	9.150	8.623	4.174	8.872	50.307
1999	39.025	0.946	0.500	8.710	8.224	4.028	7.650	48.222
2000	35.897	0.561	0.505	8.590	8.096	3.718	6.621	44.555
2001	36.324	0.548	0.500	8.390	7.972	3.996	6.495	44.434
2002	35.542	0.568	0.500	8.360	8.079	4.155	6.308	43.840
2003	37.580	0.628	0.580	10.110	9.525	4.477	6.795	52.440

	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
2004	36.308	0.588	0.540	9.790	9.098	4.489	6.732	52.209
2005	35.026	0.579	0.520	9.220	8.841	4.476	6.503	48.659
2006	31.481	0.549	0.520	8.590	8.218	4.358	5.833	44.291
2007	39.876	0.680	0.650	11.080	10.461	5.035	6.791	55.923
2008	34.933	0.612	0.573	9.415	9.000	4.635	5.996	49.068
2009	28.244	0.479	0.443	7.610	7.197	4.005	4.910	39.900
2010	38.733	0.667	0.631	10.974	10.236	4.887	6.653	55.883
2011	38.135	0.654	0.631	10.888	10.107	4.797	6.489	54.751
2012	33.583	0.578	0.555	9.606	8.947	4.478	5.703	48.700
trend 1990-2012, %	**-83.65**	**-86.88**	**-50.53**	**-49.07**	**-51.11**	**-55.68**	**-79.15**	**-53.73**

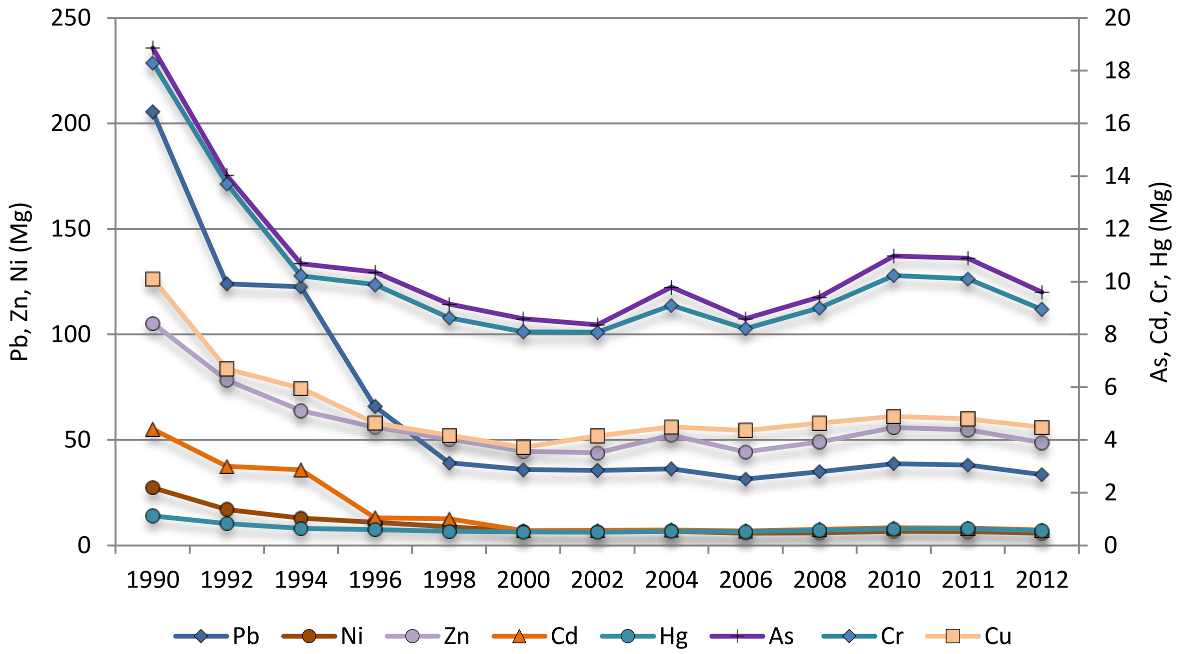


Figure 2.14 Heavy metals emissions in the period 1990-2012

The emissions of lead by sources of pollution in 1990 and 2012 are shown in Figure 2.15. The distribution of emission by sector has considerably changed over the last 20 years. If in 1990 the main sources of lead pollution were almost equally transport, energy and industrial combustion (mainly cement manufacturing) then in 2012 the main source of pollution was energy industry (mainly oil shale power plants).

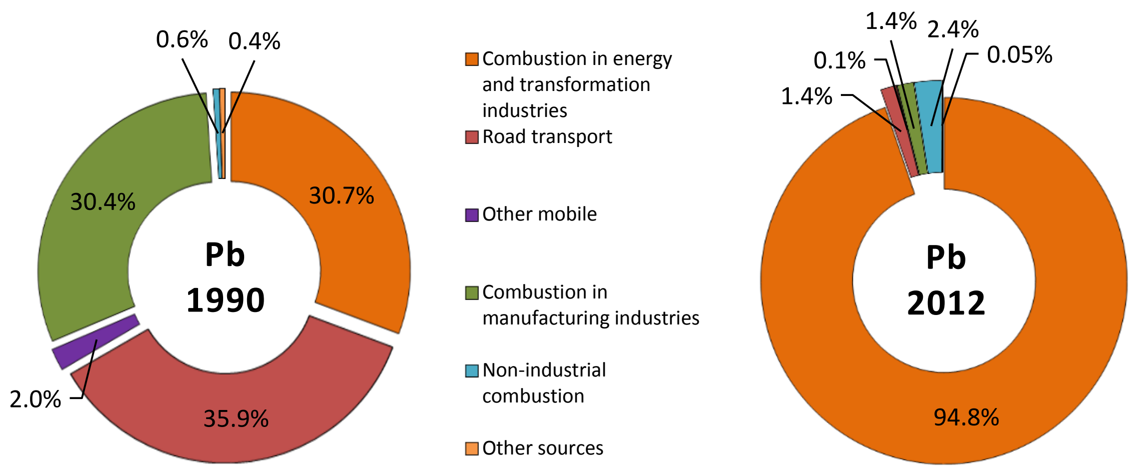


Figure 2.15 Lead emission by sources of pollution in 1990 and 2012

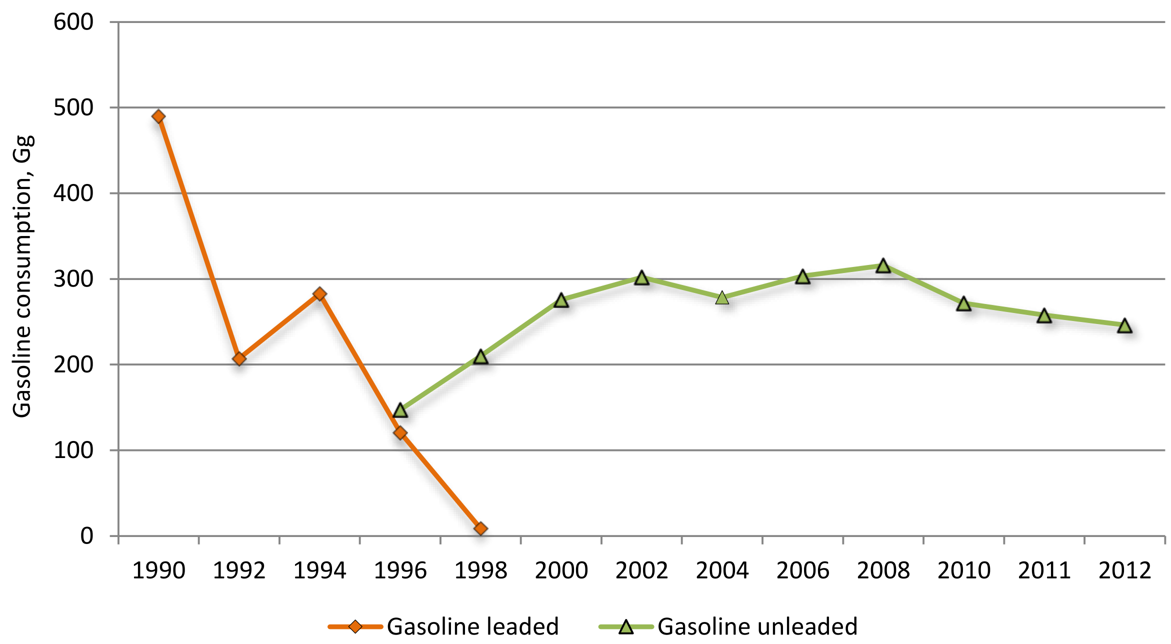


Figure 2.16 Gasoline consumption in 1990-2012

2.8. Persistent organic pollutants

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

Table 2.3 POPs emission in the period 1990-2012

	dioxines/ furanes	benzo(a) pyrene	benzo(b) fluoranthene	benzo(k) fluoranthene	Indeno (1,2,3-cd) pyrene	PAHs, total	HCB	PCB
	g I-Teq	Mg					kg	
1990	5.666	3.641	4.289	2.217	2.052	12.201	0.060	10.154
1991	5.413	3.531	4.208	2.145	1.992	11.876	0.060	10.190
1992	4.296	2.552	2.911	1.538	1.475	8.476	0.050	7.266
1993	3.554	2.142	2.411	1.309	1.266	7.128	0.040	10.569
1994	3.832	2.572	2.840	1.570	1.578	8.559	0.070	7.995
1995	4.528	4.359	4.756	2.640	2.727	14.481	0.120	9.190
1996	4.928	5.040	5.558	3.080	3.178	16.856	0.140	10.454
1997	4.832	5.005	5.506	3.048	3.165	16.725	0.140	10.325
1998	3.813	3.998	4.445	2.430	2.506	13.379	0.130	9.026
1999	3.454	3.861	4.298	2.346	2.423	12.929	0.120	8.154
2000	3.399	3.757	4.164	2.269	2.366	12.557	0.130	7.070
2001	3.539	3.727	4.186	2.261	2.338	12.511	0.140	9.613
2002	3.758	3.810	4.259	2.312	2.398	12.778	0.130	9.409
2003	4.125	3.953	4.422	2.371	2.483	13.230	0.146	10.256
2004	3.811	4.150	4.668	2.482	2.568	13.867	0.184	9.219
2005	3.373	3.771	4.278	2.232	2.308	12.589	0.150	8.883
2006	2.772	3.762	3.870	2.063	2.029	11.724	0.120	8.068
2007	4.909	3.943	4.351	2.413	2.519	13.226	0.130	7.957
2008	5.183	4.209	4.620	2.536	2.679	14.045	0.147	9.119
2009	4.867	4.517	4.981	2.712	2.862	15.072	0.173	9.666
2010	5.528	4.900	5.462	2.913	3.072	16.346	0.206	10.916
2011	5.428	4.266	4.766	2.539	2.672	14.244	0.177	9.801
2012	3.964	4.478	4.990	2.678	2.814	14.960	0.185	9.593
trend 1990-2012, %	**-30.05**	**23.01**	**16.34**	**20.81**	**37.11**	**22.62**	**207.53**	**-5.52**

In the period 1990-2012 dioxin and PCB emissions have decreased by about 30% and 5.5% respectively. All other POPs have increased for the same period. The main source of PCB emission is oil shale combustion, and it directly depends on the amount of burned fuel. The main sources of dioxin emission are the energy sector (43%, includes also waste combustion as fuel), wood and wood waste combustion in the domestic sector (43%), combustion in industry (5%, includes also waste combustion as fuel, mainly in cement manufacturing industry), and industrial/hospital waste incineration. (Figures 2.17 and 2.18).

Emissions of PAHs and HCB have increased during the same period due to increase in biomass consumption in the energy and residential sectors (22.6% and 207.5% respectively). The main contributor into total emissions is residential sector (79% and 56% respectively) (Figures 2.19 and 2.20). In the second place is the energy industry. It is possible to note that PAHs emission factor for different sectors varies - higher for households, but in case of HCB the emission factors are identical in all sectors. At present national POPs emission factors are under development for households and other combustion activities.

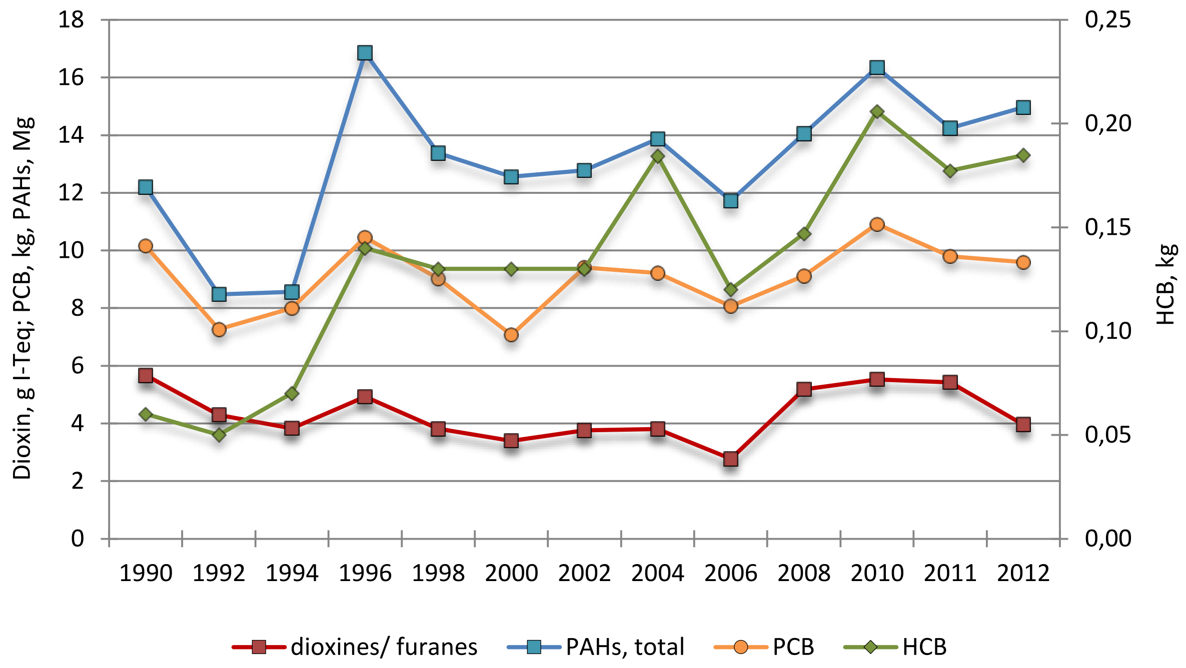


Figure 2.17 POPs emissions in the period 1990-2012

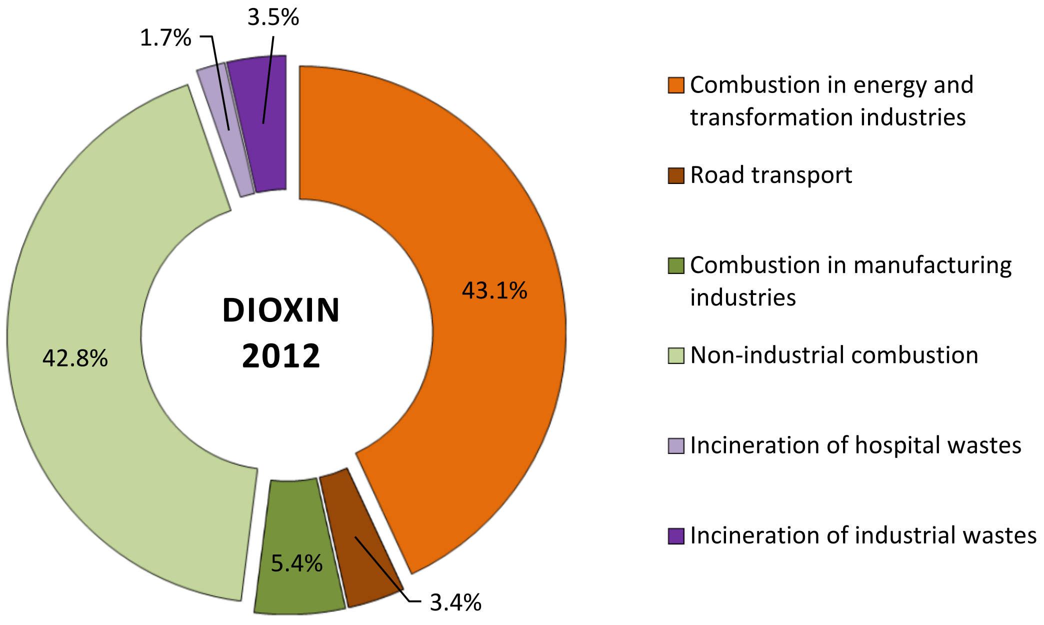


Figure 2.18 Dioxin emission by activities in 2012

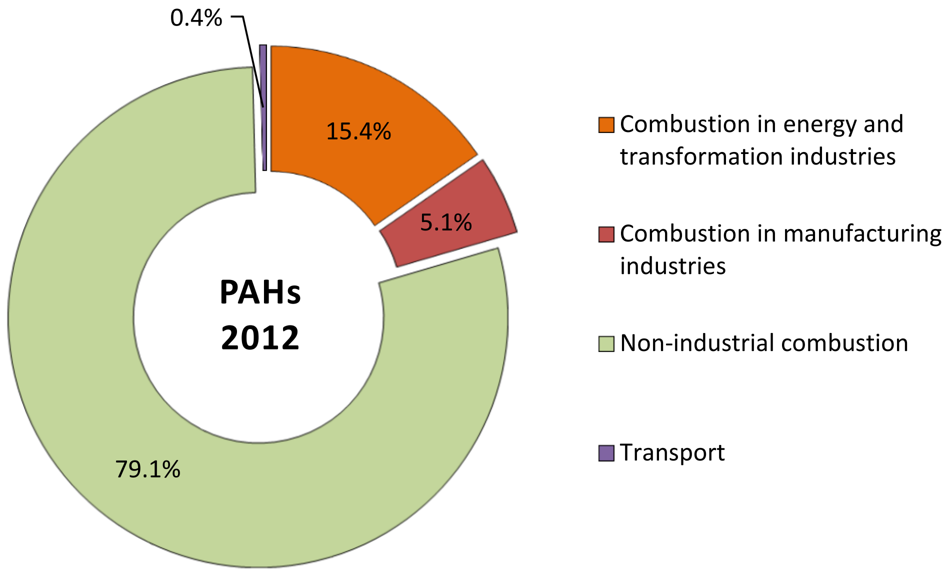


Figure 2.19 PAHs emission by activities in 2012

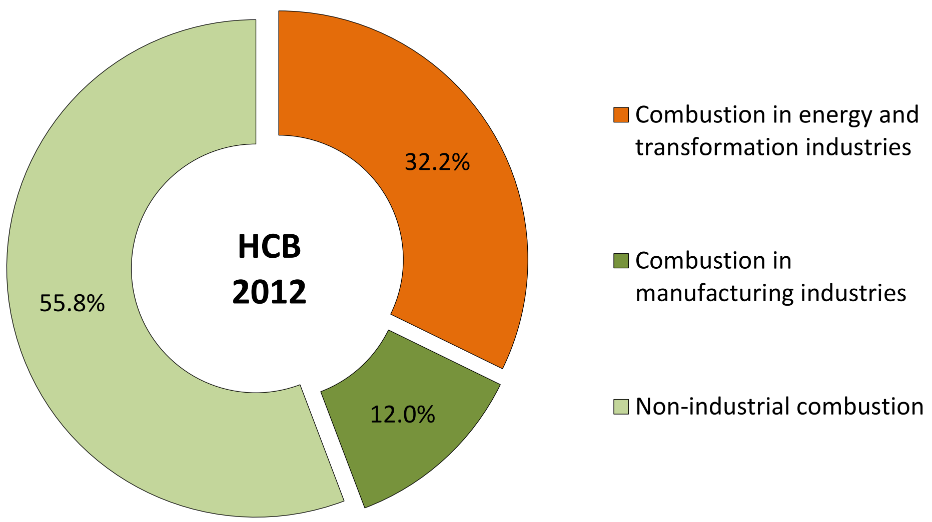


Figure 2.20 HCB emission by activities in 2012

3. ENERGY SECTOR (NFR 1)

3.1. Overview of the sector

The energy sector is the main source of SO_2, NO_x, CO, particulates, HM and POPs in Estonia. In 2012, the energy sector contributed 99.9% of total SO_2 emissions, 96.1% of total NO_x emissions, 91.7% of TSP emissions, 99.8% of total CO emissions and 99.97% of Pb emissions (Figure 3.5, 3.6 and Table 3.1). During the period 1990-2012, the emissions of sulphur dioxide from the energy sector decreased by approximately 85.2% and the emissions of nitrogen oxides by about 56.5% resulting from a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 156 PJ in 2012) (Figures 3.1 and 3.2). The decreasing of SO_2 and NO_x emissions in 2012 compared to 2011 was by 44.3% and 10.3% respectively, which was due to the decrease in electricity production for the same period and also the installation of the semi-dry NID (Novel Integrated Desulphurisation) technology in the Eesti Energia Narva Elektrijaamad AS (Estonian PP), which uses the fly ash in the gas itself and does not require any additional compounds to bind the SO_2. On the energy units which hasn't been equipped with the clearing equipment, alternative methods of reduction of SO_2 emissions are used, such as water injection to furnaces of PC (old pulverised combustion boilers). Water injection lowers flame temperature and therefore improves conditions for sulphur capture with limestone included in oil shale.

The decrease of TSP emissions by 47.4% was mainly due to the reduction of electricity production by 49% in Baltic PP (Eesti Energia Narva Elektrijaamad AS) and also as a result of correcting the operation of electric precipitators on power units in the same power plant (Table 3.1).

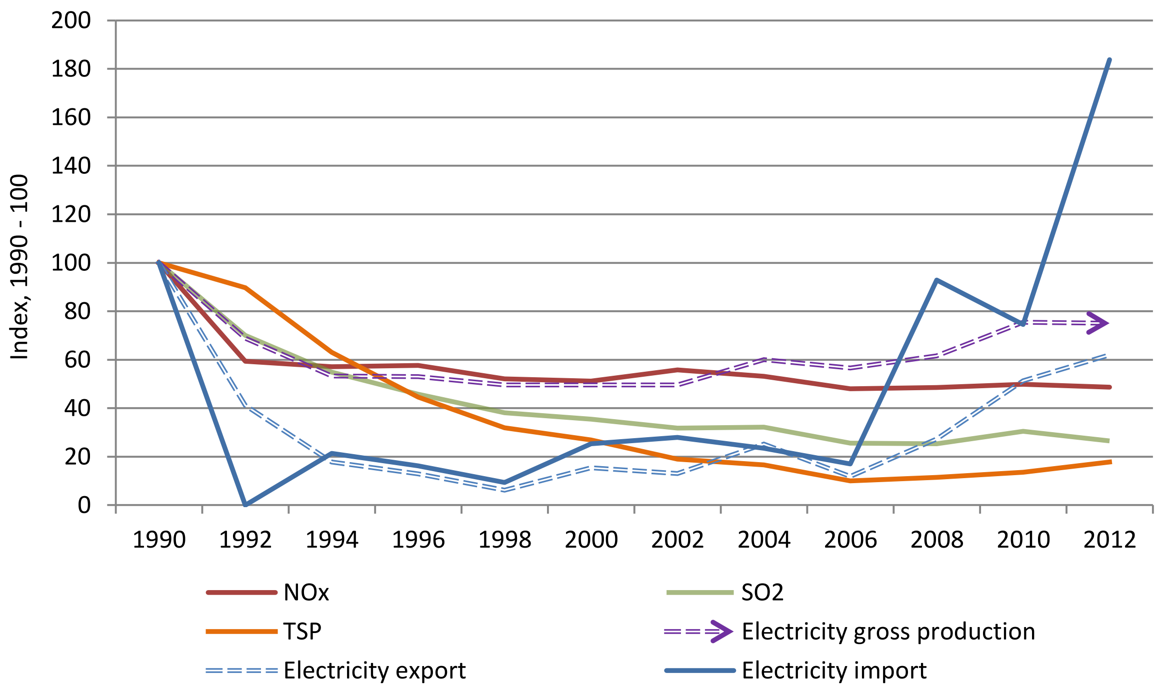


Figure 3.1 Pollutants emissions, electricity production and export in 1990-2012

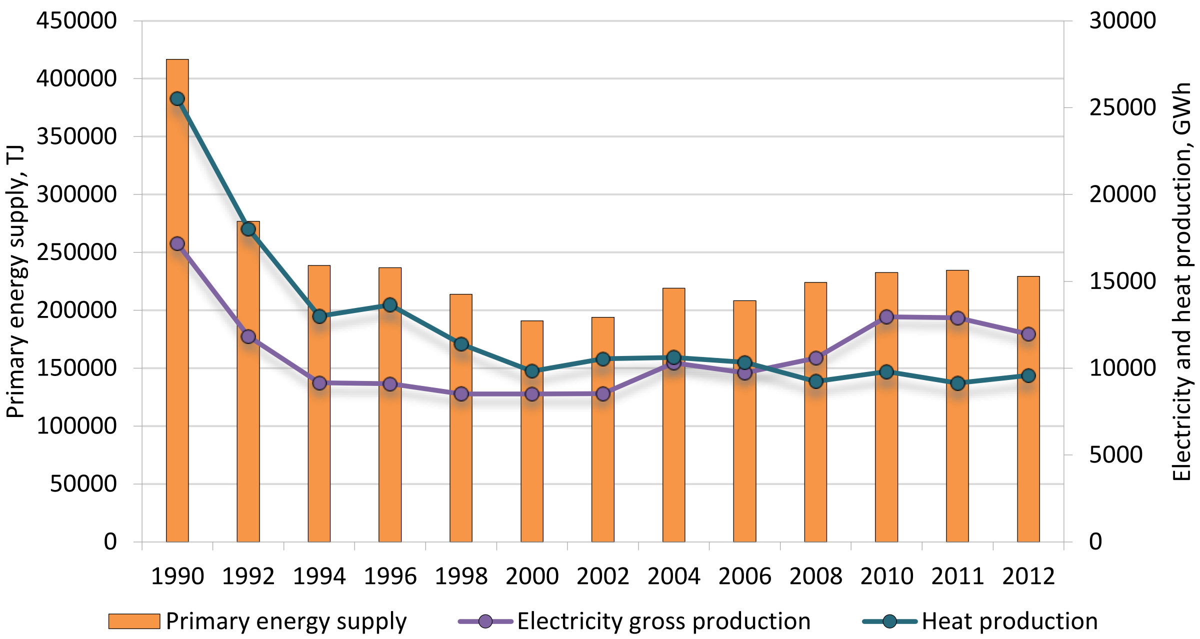


Figure 3.2 Total energy supply, electricity and heat production in the period of 1990-2012

Estonia is relatively rich in natural resources, both mineral and biological. It is a unique country whose energy production depends primarily on the use of oil shale. In 2012, the share of domestic fuels – oil shale, wood and peat – accounted for about 80.8% (from which oil shale is about 82%) of the primary energy supply. Imported fuels (natural gas, fuel oils, coal and motor fuels) made up 18.6% (Figure 3.3). Renewals formed 14.8% of the gross inland consumption in 2012, with wood fuel prevailing. In Estonia renewable energy is generated from hydro- and wind energy as well as from biomass. Since electricity generation has accelerated in hydroelectric power plants and wind parks, the proportion of renewable energy has increased. In 2012, the production of wind and hydro energy increased by 19.5% compared to 2011. The generation of hydro energy has been stable over the past three years. In 2005, electricity generated from renewable energy sources was only 1.3%, but in 2012 – 15.2%. The growth was due to the enlargement of the existing wind parks and the commissioning of new wood fuel-based combined heat and power plants. In 2012, the share of biofuels in total fuel consumption in transport was 0.84 % (Annual energy statistics, Statistical database). In 2012, 48% of the primary energy was used for the production of electricity and 17% for heat generation.

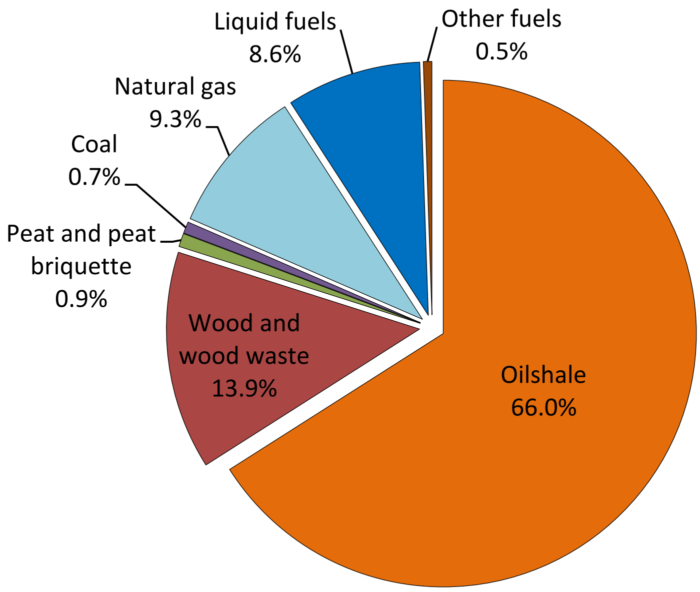


Figure 3.3 Structure of primary energy supply in Estonia in 2012

Domestic fuels have a large share in Estonia's total energy resources and in the balance of primary energy and are mainly based on oil shale. In 2012, 18.8 million tons of oil shale was produced, which is 0.3% more than in 2011. The majority of oil shale is consumed in power plants and as raw material for shale oil. The demand for shale oil in Estonia and in external markets increased the production of shale oil by about 7%. Nearly 80% of the production was exported – 11% more than in 2011. More than one third (34%) of this amount was exported to the Netherlands, following Belgium and Denmark. The production of peat fuels decreased significantly in 2012 due to bad weather conditions. Compared to 2011, there was almost a twofold decrease in the production of both milled peat and peat briquettes (Greenhouse Gas Emissions in Estonia 1990-2012, National Inventory Report under the UNFCCC and the Kyoto Protocol, Tallinn 2014).

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

Upon joining the European Union, Estonia assumed the obligation to decrease annual SO_2 emissions to 25,000 tonnes in 2012. In order to do that, in the beginning of 2012 was completed five-year research and testing project by installing unique desulphurisation systems on four generating units of the Eesti PP. The taken obligations were fulfilled and emission of sulphur dioxide from Narva PP did not exceed 25 thousand tons in 2012.

Table 3.1 Pollutant emissions from the energy sector in the period 1990-2012

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg								Mg	
1990	71.46	34.76	273.61	0.06	NR	NR	274.85	226.24	205.46	4.40
1991	66.21	33.27	251.29	0.05	NR	NR	275.74	225.69	188.14	4.20
1992	41.14	19.73	191.66	0.04	NR	NR	247.22	126.80	123.97	3.00
1993	38.00	19.10	155.90	0.04	NR	NR	195.41	123.60	102.45	2.22
1994	40.51	23.38	150.23	0.06	NR	NR	173.44	149.50	122.55	2.87
1995	38.14	30.74	116.11	0.10	NR	NR	133.01	196.93	85.44	1.96
1996	41.48	34.32	125.14	0.12	NR	NR	122.59	219.32	65.86	1.05
1997	40.19	36.12	116.21	0.13	NR	NR	99.39	228.72	46.44	1.07
1998	37.22	28.08	104.31	0.11	NR	NR	87.75	181.14	39.10	1.01
1999	35.76	29.54	97.61	0.12	NR	NR	86.38	190.28	39.03	0.95
2000	36.61	30.14	96.92	0.17	20.96	35.97	73.09	182.08	35.89	0.56
2001	39.01	31.29	90.61	0.20	21.90	35.96	71.11	187.95	36.31	0.55
2002	40.24	30.21	86.83	0.22	22.40	31.84	50.16	181.44	35.53	0.57
2003	40.81	28.71	100.08	0.22	20.50	28.44	46.20	173.96	37.58	0.63
2004	37.90	28.83	88.06	0.29	21.68	28.44	43.05	170.86	36.07	0.59
2005	35.67	25.65	76.13	0.31	19.52	25.03	34.61	157.34	34.76	0.58
2006	34.30	23.74	69.82	0.35	14.91	18.46	25.18	143.42	31.27	0.55
2007	37.40	24.86	87.94	0.41	19.93	27.01	33.21	162.24	39.87	0.68
2008	34.28	24.58	69.35	0.42	19.60	23.60	28.89	166.26	34.93	0.61
2009	29.18	24.52	54.78	0.39	18.24	21.72	26.41	167.79	28.24	0.48
2010	35.62	24.73	83.17	0.40	23.00	30.43	35.67	171.54	38.72	0.67
2011	34.68	22.12	72.69	0.45	26.14	40.34	47.02	147.49	38.12	0.65
2012	31.11	22.49	40.53	0.47	16.84	19.66	24.74	162.02	33.57	0.58
1990-2012, %	**-56.5**	**-35.3**	**-85.2**	**699.0**	**-19.7**	**-45.3**	**-91.0**	**-28.4**	**-83.7**	**-86.9**

	Hg	As	Cr	Cu	Ni	Zn	PAH	Dioxines	HCB	PCB
	Mg							g I-Teq	kg	
1990	1.12	18.86	18.30	10.10	27.36	105.25	12.20	5.20	0.06	10.15
1991	1.02	16.45	15.96	9.36	25.93	96.37	11.88	4.94	0.06	10.19
1992	0.83	14.03	13.71	6.69	17.03	78.32	8.48	3.84	0.05	7.27
1993	0.64	10.84	10.38	5.45	14.34	60.75	7.13	3.10	0.04	10.57
1994	0.64	10.68	10.22	5.96	12.87	63.85	8.56	3.39	0.07	7.99
1995	0.60	10.07	9.66	5.09	10.50	58.49	14.48	4.10	0.12	9.19
1996	0.60	10.36	9.89	4.64	10.94	56.01	16.86	4.50	0.14	10.45
1997	0.60	10.20	9.60	4.60	9.82	55.60	16.72	4.21	0.14	10.32
1998	0.53	9.15	8.62	4.17	8.87	50.31	13.38	3.25	0.13	9.03
1999	0.50	8.71	8.22	4.03	7.65	48.22	12.93	3.16	0.12	8.15
2000	0.51	8.59	8.09	3.71	6.62	44.53	12.56	3.00	0.13	7.07
2001	0.50	8.39	7.95	4.00	6.48	44.37	12.51	3.18	0.14	9.61
2002	0.50	8.36	8.04	4.13	6.27	43.70	12.78	3.14	0.13	9.41
2003	0.58	10.11	9.52	4.47	6.79	52.32	13.23	3.64	0.15	10.25
2004	0.54	9.79	9.10	4.49	6.73	52.21	13.87	3.15	0.18	9.22
2005	0.52	9.22	8.77	4.46	6.47	48.64	12.59	2.73	0.15	8.88
2006	0.52	8.59	8.16	4.34	5.81	44.28	11.72	2.72	0.12	8.07
2007	0.65	11.08	10.40	5.02	6.77	55.91	13.23	4.61	0.13	7.96
2008	0.57	9.42	8.92	4.63	5.95	49.07	14.05	4.72	0.15	9.12
2009	0.44	7.61	7.15	3.98	4.90	39.90	15.07	4.28	0.17	9.67

	Hg	As	Cr	Cu	Ni	Zn	PAH	Dioxines	HCB	PCB
	Mg							g I-Teq	kg	
2010	0.63	10.97	10.15	4.87	6.64	55.88	16.35	5.21	0.21	10.92
2011	0.63	10.89	10.02	4.78	6.47	54.75	14.24	5.07	0.18	9.80
2012	0.55	9.61	8.93	4.47	5.70	48.70	14.96	3.75	0.18	9.59
1990-2012, %	**-50.6**	**-49.1**	**-51.2**	**-55.8**	**-79.2**	**-53.7**	**22.6**	**-27.8**	**207.5**	**-5.5**

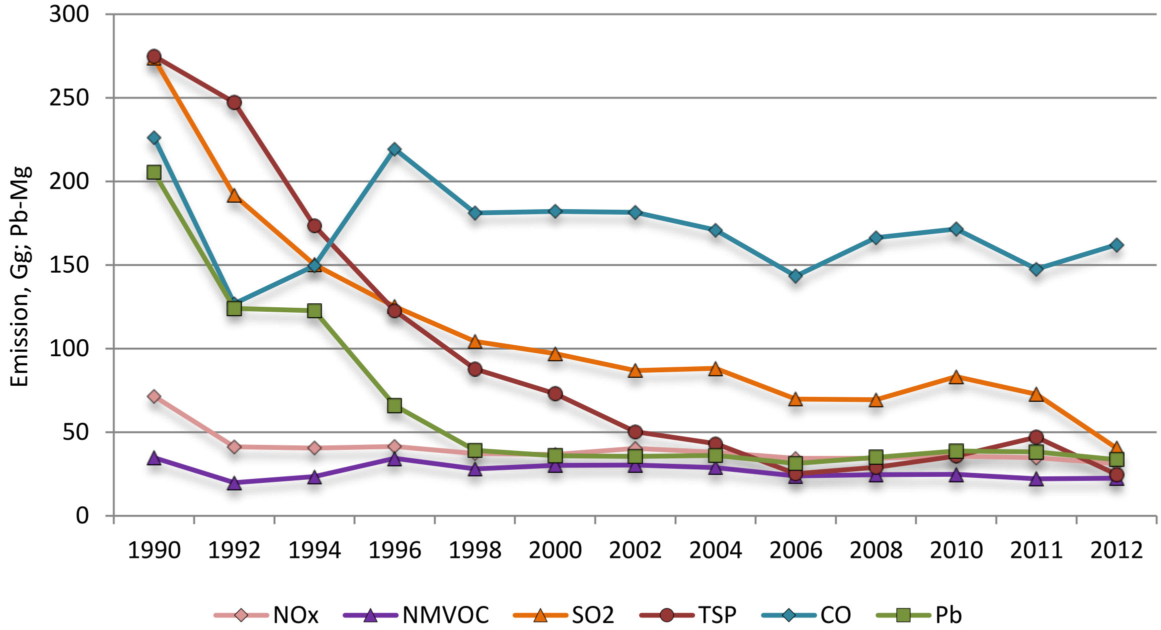


Figure 3.4 Pollutant emissions from the energy industry in the period 1990-2012

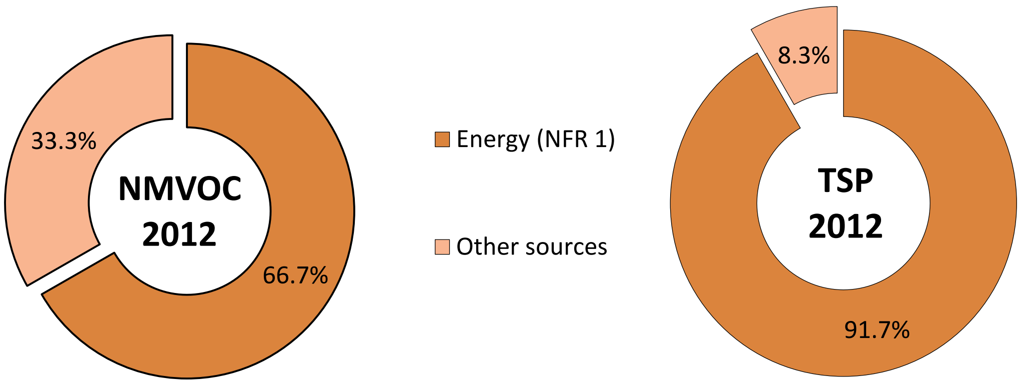


Figure 3.5 Share of NMVOC and TSP emissions from the energy sector in total emissions in 2012

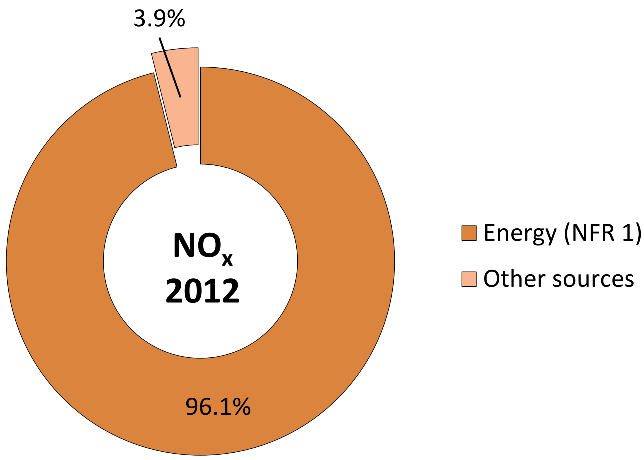


Figure 3.6 Share of NO_x emissions from the energy sector as a percentage of total emissions in 2012

3.2. Stationary fuel combustion

3.2.1. Sources category description

Table 3.2 Stationary fuel combustion activities

NFR	Source	Description	Emissions reported
1.A.1	**Energy Industries**		
	a. Public electricity and heat production	Includes emissions from public power and district heating plants on the basis of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	b. Petroleum refining	Includes emissions from process furnace in the oil shale industry. Only two point sources data.	NMVOC, NO_x, CO
	c. Manufacture of solid fuels and other energy industries	Includes emissions from solid fuel transformation plants. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1.A.2	**Stationary combustion in manufacturing industries and construction**		
	a. Iron and steel	Includes emissions from processes with contact (SNAP 030303). Only point sources data.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, As, Cr, Cu, Ni, Zn
	b. Non-ferrous metals	Includes emissions from processes with contact (SNAP 030307 - secondary lead production, 030308 - secondary zinc production, 030310 - secondary aluminium production). Only point sources data.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, As, Cr, Cu, Zn
	c. Chemicals	Includes emissions from combustion plants of this activity reported by 8 operators.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, As, Cr, Cu, Zn

NFR	Source	Description	Emissions reported
	d. Pulp, Paper and Print	Includes emissions from combustion plants of this activity reported by 14 operators.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, As, Cr, Cu, Ni, Zn
	e. Food processing, beverages and tobacco	Includes emissions from combustion plants and other stationary equipment of this activity reported by 60 operators.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM
	f.i Other	Includes emissions from all boilers in the manufacturing industry, other processes with contact: cement, lime, glass, bricks and other productions. (SNAP 0301, 030311-030326). Data of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1.A.4	**Non-industrial combustion plants**		
	a.i Commercial / institutional: Stationary	Includes emissions from boilers or other equipment in the commercial sector. Data of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	b.i Residential: Stationary plants	Includes emissions from boilers and other equipment in the residential sector. Only diffuse sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	c.i Agriculture/Forestry/Fishing: Stationary	Includes emissions from boilers and other equipment in the agriculture and foresty sectors. Data of point and diffuse sources.	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1.A.5.a	**Other stationary (including military)**		IE, reported under 1.A.4.a.i

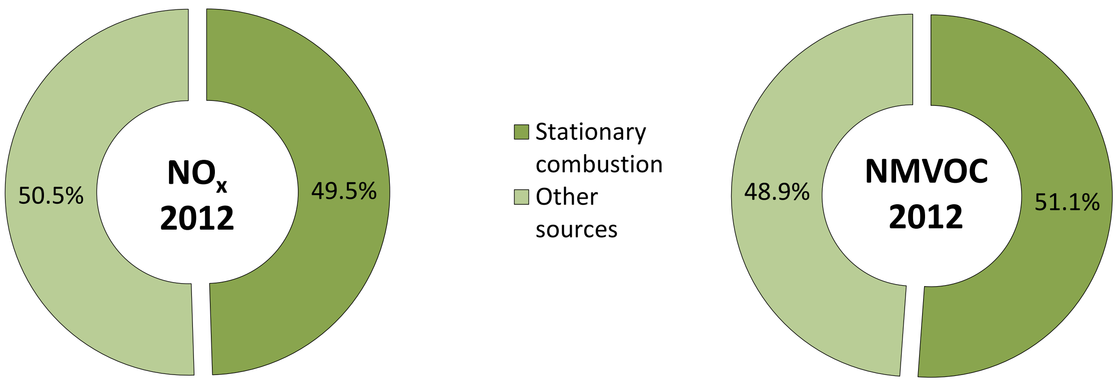


Figure 3.7 NO_x and NMVOC emissions from stationary fuel combustion and other sources in 2012

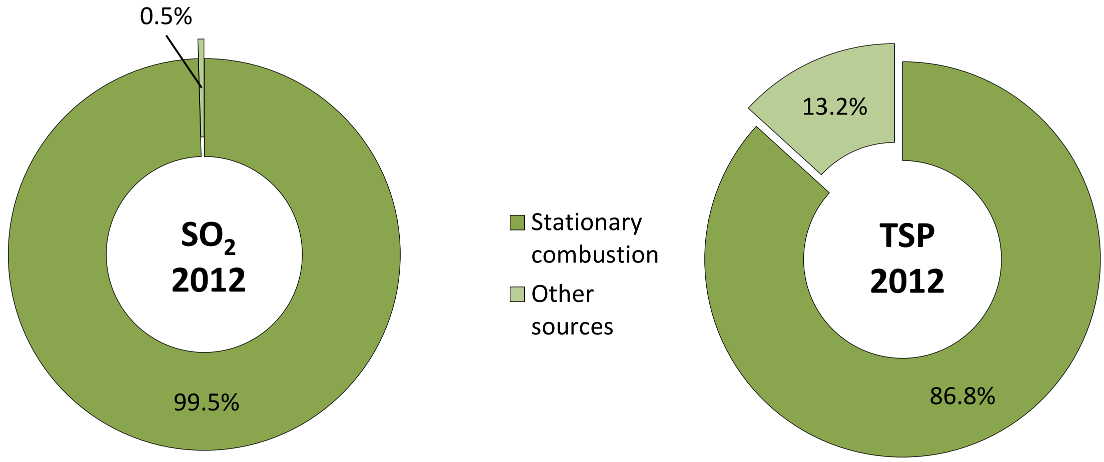


Figure 3.8 SO_2 and TSP emissions from stationary fuel combustion and other sources in 2012

Table 3.3 Pollutant emissions from stationary fuel combustion in the period 1990-2012

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	Gg								Mg	
1990	33.43	12.77	266.71	0.04	NR	NR	273.13	98.26	126.73	4.39
1991	30.51	12.35	244.67	0.03	NR	NR	274.09	98.52	118.44	4.19
1992	21.51	9.85	187.72	0.03	NR	NR	246.27	73.93	89.64	2.99
1993	16.75	8.32	151.61	0.03	NR	NR	194.25	63.99	67.36	2.21
1994	18.08	10.43	146.16	0.04	NR	NR	172.35	78.31	79.53	2.86
1995	18.28	18.47	112.46	0.07	NR	NR	132.00	130.35	60.65	1.95
1996	19.89	21.56	121.27	0.08	NR	NR	121.58	150.26	44.15	1.04
1997	18.30	21.22	112.32	0.08	NR	NR	98.33	146.13	36.60	1.06
1998	16.94	16.68	100.33	0.06	NR	NR	86.73	118.71	33.03	1.00
1999	16.12	16.05	94.09	0.06	NR	NR	85.43	113.19	31.47	0.94
2000	17.14	15.31	93.77	0.06	20.06	34.94	71.88	113.67	30.86	0.56
2001	18.15	15.28	89.70	0.06	21.11	35.01	69.91	115.21	30.33	0.54
2002	17.55	15.96	85.72	0.07	21.42	30.67	48.78	118.55	29.99	0.56
2003	20.00	16.39	99.37	0.06	19.57	27.31	44.84	121.29	35.31	0.62
2004	18.26	16.84	87.45	0.06	20.69	27.28	41.69	125.56	33.96	0.58
2005	16.22	14.89	75.75	0.05	18.58	23.89	33.25	114.84	32.62	0.57
2006	14.70	13.88	69.48	0.05	13.96	17.29	23.76	102.59	29.80	0.54
2007	18.17	17.04	87.62	0.06	18.97	25.84	31.80	124.11	38.33	0.67
2008	16.61	17.94	69.07	0.07	18.70	22.48	27.53	133.55	33.34	0.60
2009	13.95	18.27	54.62	0.07	17.44	20.72	25.16	138.28	26.84	0.47
2010	19.05	18.86	83.03	0.07	22.16	29.35	34.32	144.78	38.20	0.66
2011	19.39	16.44	72.48	0.06	25.34	39.30	45.69	124.08	37.64	0.65
2012	16.02	17.25	40.38	0.07	16.00	18.59	23.40	137.89	33.09	0.57
1990-2012, %	**-52.1**	**35.1**	**-84.9**	**65.0**	**-20.3**	**-46.8**	**-91.4**	**40.3**	**-73.9**	**-87.1**

	Hg	As	Cr	Cu	Ni	Zn	PAH 4 total	Dioxines	HCB	PCB
	Mg							g I-Teq	kg	
1990	1.12	18.86	18.17	7.35	27.31	102.66	12.11	4.97	0.06	10.13
1991	1.02	16.45	15.84	6.87	25.88	93.99	11.79	4.72	0.06	10.17
1992	0.83	14.03	13.65	5.31	17.00	77.08	8.43	3.74	0.05	7.26
1993	0.64	10.84	10.31	3.96	14.31	59.39	7.08	3.00	0.04	10.56
1994	0.64	10.68	10.14	4.32	12.84	62.26	8.51	3.25	0.07	7.99
1995	0.60	10.07	9.59	3.65	10.48	57.02	14.44	3.97	0.12	9.18
1996	0.60	10.36	9.81	3.10	10.92	54.45	16.81	4.35	0.14	10.44
1997	0.60	10.20	9.52	2.99	9.80	53.94	16.68	4.06	0.14	10.32
1998	0.53	9.15	8.55	2.69	8.85	48.85	13.34	3.14	0.13	9.02
1999	0.50	8.71	8.15	2.54	7.63	46.69	12.89	3.03	0.12	8.15
2000	0.51	8.59	8.01	2.18	6.60	42.99	12.52	2.86	0.13	7.07
2001	0.50	8.39	7.86	2.16	6.46	42.50	12.47	3.01	0.14	9.61
2002	0.50	8.36	7.94	2.14	6.24	41.72	12.73	2.98	0.13	9.41
2003	0.58	10.11	9.42	2.54	6.75	50.39	13.18	3.49	0.15	10.25
2004	0.54	9.79	9.00	2.52	6.70	50.24	13.82	3.00	0.18	9.22
2005	0.52	9.22	8.67	2.44	6.44	46.59	12.54	2.58	0.15	8.88
2006	0.52	8.59	8.05	2.18	5.78	42.08	11.67	2.56	0.12	8.07
2007	0.65	11.08	10.28	2.75	6.74	53.59	13.17	4.44	0.13	7.96
2008	0.57	9.42	8.81	2.39	5.92	46.79	13.99	4.55	0.15	9.12
2009	0.44	7.61	7.05	1.98	4.87	37.85	15.02	4.13	0.17	9.66
2010	0.63	10.97	10.05	2.73	6.61	53.75	16.29	5.06	0.21	10.91
2011	0.63	10.89	9.91	2.65	6.44	52.64	14.19	4.92	0.18	9.80
2012	0.55	9.61	8.82	2.25	5.66	46.50	14.90	3.62	0.18	9.59
1990-2012, %	**-50.5**	**-49.1**	**-51.5**	**-69.3**	**-79.3**	**-54.7**	**23.0**	**-27.2**	**207.7**	**-5.3**

Energy related activities (without transport) are the most significant contributors to SO_2 emissions – 99.5% in 2012. The share of mobile sources in total emissions is very small – 0.28% (Figure 3.8 and 3.9, includes in other sources). Estonian oil shale is high-ash shale (up to 46%), with low net caloric value (8.4-9.0 MJ/kg) and sulphur content of 1.4% to 1.8%. Two different combustion technologies, the old pulverized combustion of oil shale and the new circulated fluidized bed combustion technology are currently used in the Estonian power plants. In the combined heat and power block of the Balti PP, around 10% of the fuel used is biomass, which is burned together with oil shale. This has significantly increased the proportion of renewable energy both in the Eesti Energia AS portfolio and in overall electricity production in Estonia. Each year, the new power block produces 130-140 GWh of renewable energy, enough to cover 2% of annual electricity consumption in Estonia. Renewable energy from biofuel in the Narva PP provides enough electricity to cover the annual consumption of 50,000 Estonian families. (Eesti Energia)

The oil shale power plants contribute about 56.9% to total SO_2 emissions. The share of oil shale power plants into total SO_2 emission has decreased by 21% compared to 2011.

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

In 2012 the desulphurisation equipment was finally installed in four blocks of Eesti PP. Eesti Energia AS also completed the building of an additional lime dosing system.

Studies and tests conducted in 2009 and 2010 showed that the nitrogen oxides emissions can also be cut below the limits permitted in the stricter environmental requirements that will enter into force in 2016 and in 2012 the equipment (nitrogen oxides scrubbers) to reduce NO_X emissions of the Eesti PP was started to be installed. (Eesti Energia)

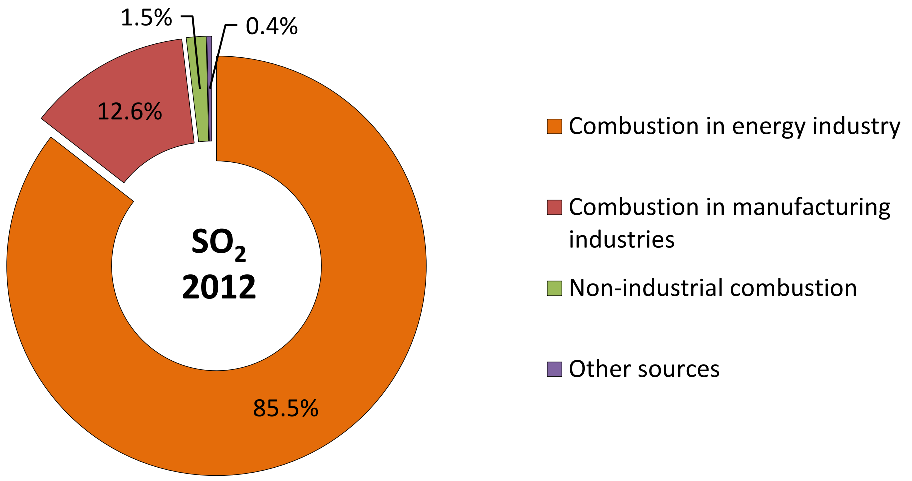


Figure 3.9 SO_2 emissions by sources of pollution in 2012

Non-industrial combustion is responsible for about 95% of total NMVOC emissions in stationary combustion, for about 74% of CO and 59% of TSP emissions (Figures 3.10, 3.13, 3.14). Combustion in energy and transformation industries is responsible for 86% of SO_2 and for the 22% of CO emissions in stationary combustion (thus the main part of carbon monoxide is emitted from Narva shale oil production plant and it has increased during the last year as a result of increasing shale oil production) (Figure 3.10, 3.12, 3.14).

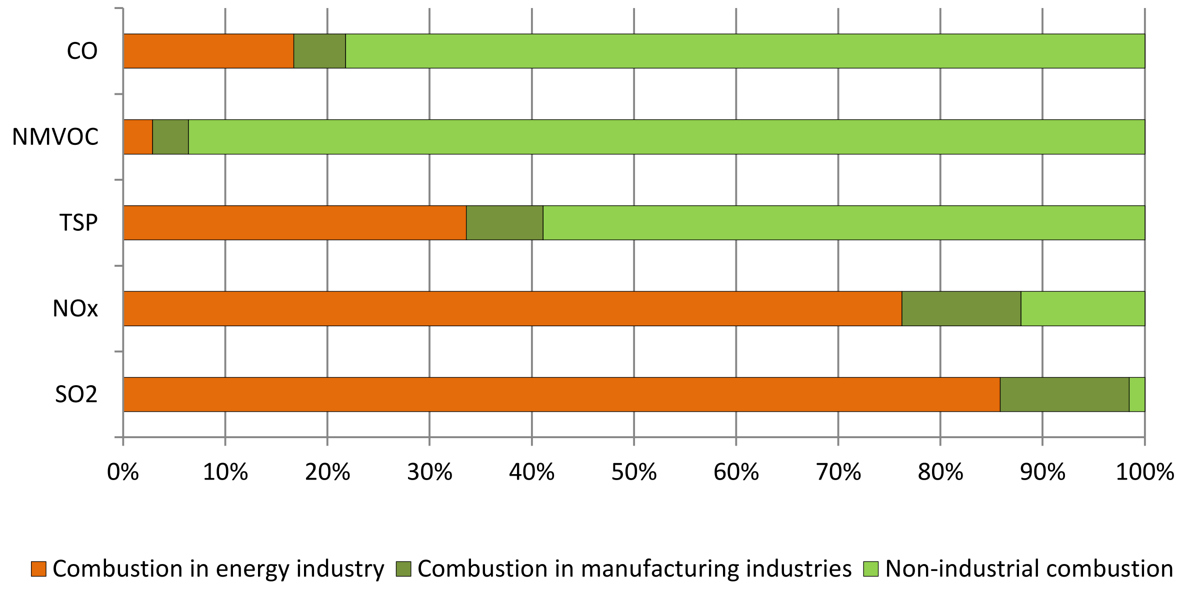


Figure 3.10 Distribution of pollutants emissions by sector in stationary combustion in 2012

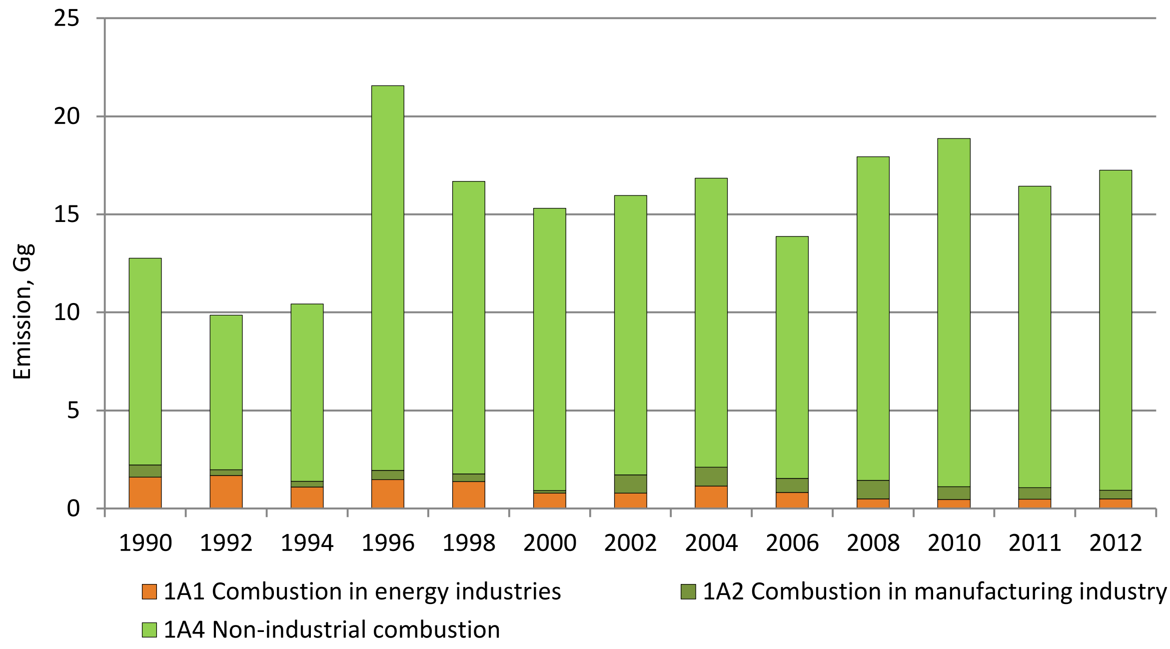


Figure 3.11 Distribution of NMVOC emissions by sector in stationary combustion in the period 1990-2012

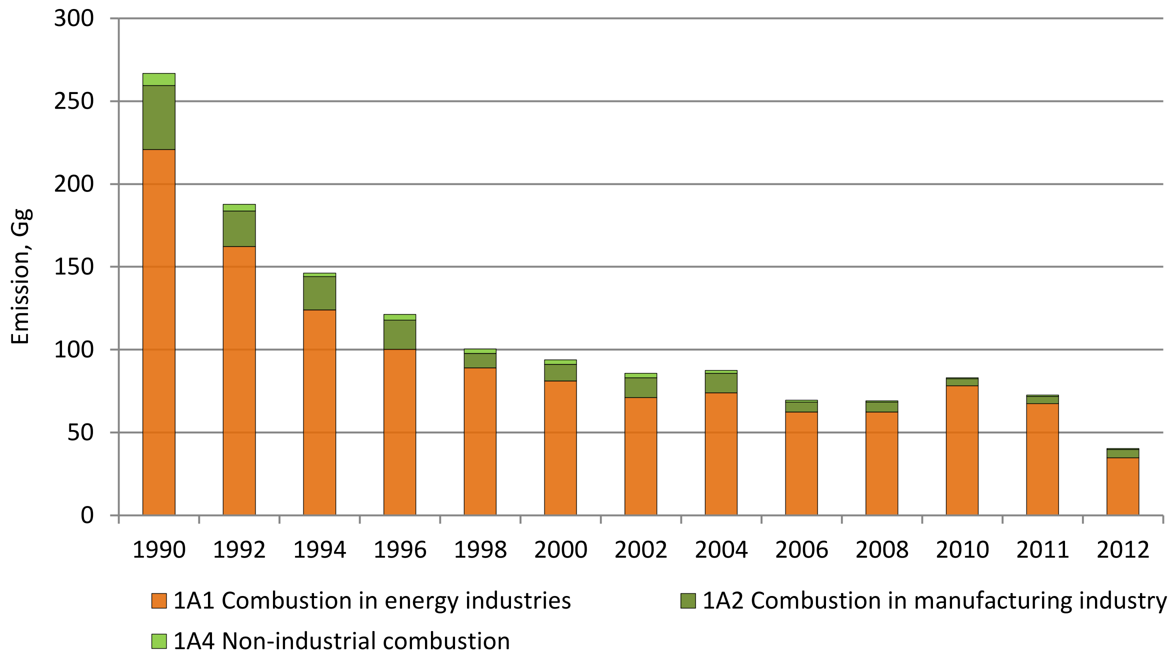


Figure 3.12 Distribution of SO_2 emissions by sector in stationary combustion in the period 1990-2012

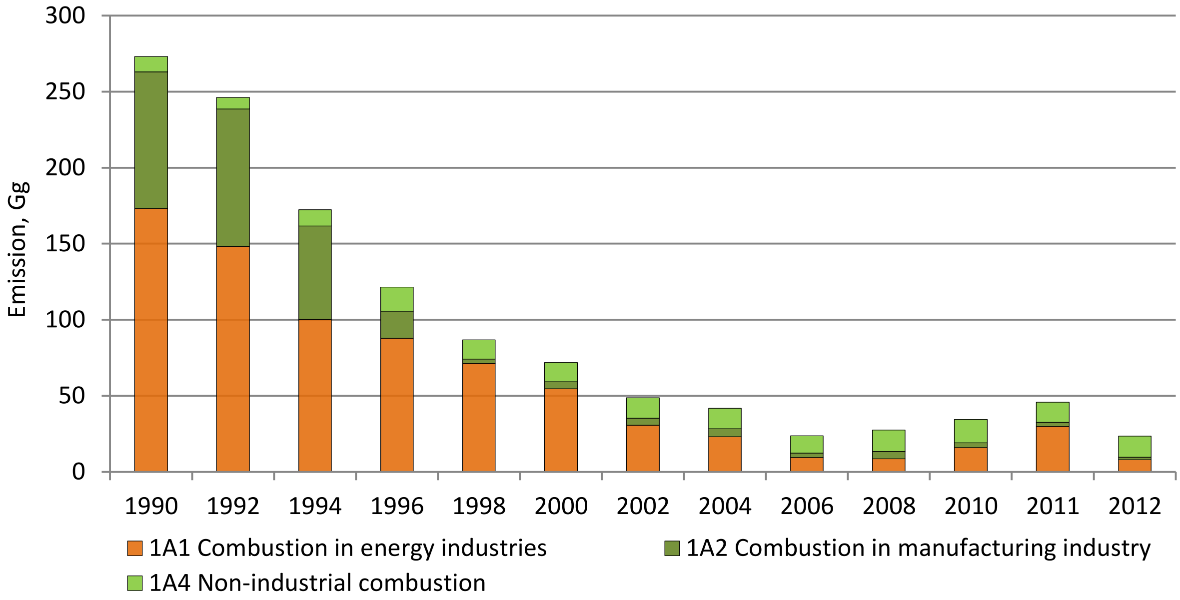


Figure 3.13 Distribution of TSP emissions by sector in stationary combustion in the period 1990-2012

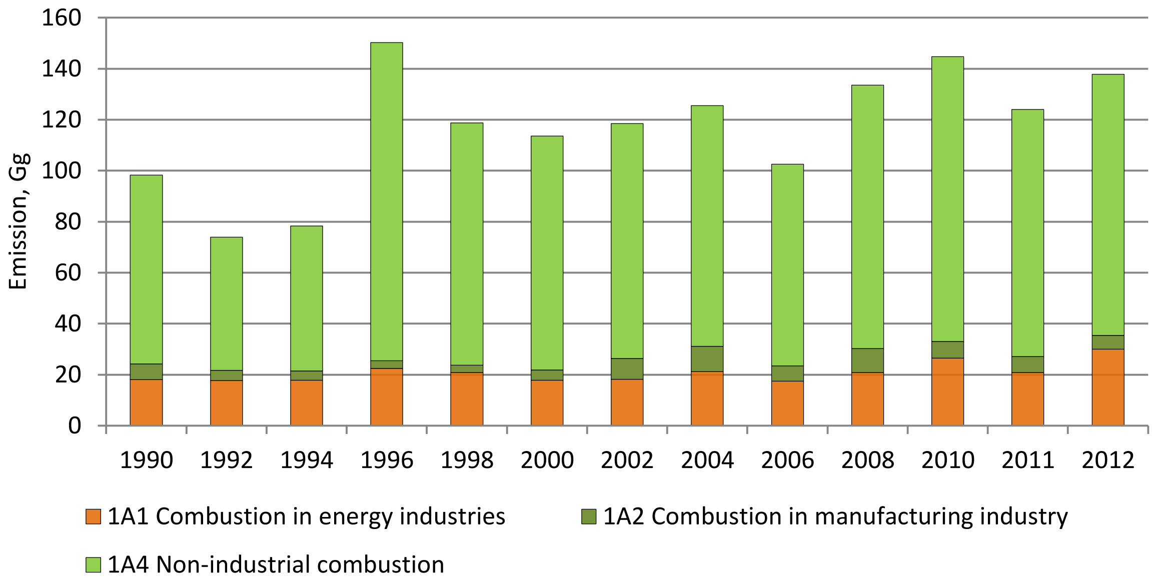


Figure 3.14 Distribution of CO emissions by sector in stationary combustion in the period 1990-2012

3.2.2. Methodological issues

NFR 1.A.1.a Public electricity and heat production**, NFR 1.A.2.f.i** Other Stationary combustion in manufacturing industries and construction, and **NFR 1.A.4.a.i, c.i** Non-industrial combustion plants (stationary combustion related to commercial and agriculture) include pollutants emission data from point sources (PS) reported by operators and from diffuse sources. Emissions from the point sources are calculated on the basis of measurements or the combined method (measurements plus calculations) or on the basis of national emission factors is used.

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

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

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

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

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

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

Eesti Energia Õlitööstus AS operates an industrial plant producing liquid fuels from oil shale. This plant is the only one of its kind in the world and uses the efficient Enefit-140 solid heat carrier system, which was developed and patented by Eesti Energia engineers. Eesti Energia Õlitööstus produces liquid fuels and retort gas, which is used in electricity production in the Narva power plants. Oil Industry produces about one million barrels of liquid fuels per year. Currently, about one fifth of the oil shale mined in Estonia is used in the production of fuel oil and chemicals. In 2009, Eesti Energia started building a new oil plant with Enefit-280 technology, which is cleaner and more reliable and has a higher production capacity. This new generation of technology has been developed jointly by Eesti Energia and the international engineering company Outotec. The new Enefit-280 plant produced its first oil in December 2012 and the operation of the plant will increase step-by-step to the designed parameters. Eesti Energia is planning to expand its oil business and to build a hydrogen processing complex by 2016, creating a business that can produce liquid fuels that are of higher quality than the current shale oil and that will meet all the legal requirements for use as motor fuel.

NFR 1.A.2.a Iron and steel include emissions from processes with contact and combustion plants of this activity reported by four operators. Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.2.b Non-ferrous metals include emissions from processes with contact (secondary lead, zinc and aluminium production) and combustion plants of this activity reported by five operators. Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.2.c Chemicals include emissions from combustion plants of this activity reported by 8 operators. Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.2.d Pulp, Paper and Print include emissions from combustion plants of this activity reported by 14 operators. Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.2.e Food processing, beverages and tobacco include emissions from combustion plants and other stationary equipment of this activity reported by 60 operators. Emissions are calculated on the basis of measurements or the combined method (measurements plus calculations) is used.

NFR 1.A.2.f.i Other include emissions from all boilers in the manufacturing industry (excluding NFR 1.A.2a-e), other processes with contact: cement, lime, glass, bricks and other productions (SNAP 0301, 030311-030326). Data about point and diffuse sources. Emissions from the point sources are calculated on the basis of measurements or the combined method (measurements plus calculations) is used. Emissions of the main pollutants and heavy metals from diffuse sources are calculated on the basis of national emission factor and POPs on the basis of EEA/EMEP Guidebook.

NFR 1.A.4.a.i – c.i Commercial / institutional: Stationary and Agriculture/Forestry/Fishing: Stationary includes pollutant emissions from combustion processes in this sector. Data about point and diffuse sources. Emissions from the point sources are calculated on the basis of measurements or the combined method (measurements plus calculations) is used. Emissions of the main pollutants and heavy metals from diffuse sources are calculated on the base national emission factor and POPs on the base of EEA/EMEP Guidebook.

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

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

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

Diffuse sources Fuel = EB fuel – PS fuel

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

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

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

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

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

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

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

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

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

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

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

Fuel /purification equipment	Heavy metals EF							
	Hg	Cd	Pb	Cu	Zn	As	Cr	Ni
Coal								
- no control	5	30	700	100	230	90	400	400
- cyclone	5	10	200			20	80	80
- electrostatic precipitator	5	5	40			5	10	10
Oil shale								
- electrostatic precipitator	5	5	300	20	410	90	80	50

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

The SO_2 emissions are calculated by formula:

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

B – fuel consumption,

S^r – sulphur content in fuel,

η – retention of sulphur in ash.

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

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

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

Table 3.9 Pollutant emission factors for NFR 1.A.4.b.i

Pollutant	Units	Coal	Wood, peat	Gaseous fuels	Liquid fuels
SO_2	g/GJ	900	10	0	138
NO_x	g/GJ	130	80	60	70
NH_3	g/GJ	0	4	0	0
CO	g/GJ	5300	6100	30	60
NMVOC	g/GJ	490	980	10	15
TSP	g/GJ	450	800	1	8
PM_{10}	g/GJ	400	700	1	5
$PM_{2.5}$	g/GJ	400	700	1	5
As	mg/GJ	2	1	NA	1

Pollutant	Units	Coal	Wood, peat	Gaseous fuels	Liquid fuels
Cd	mg/GJ	2	1	NA	1
Cr	mg/GJ	11	3	NA	16
Cu	mg/GJ	22	9	NA	8
Hg	mg/GJ	7	1	NA	1
Ni	mg/GJ	13	4	NA	240
Pb	mg/GJ	130	40	NA	16
Zn	mg/GJ	220	130	NA	9
Dioxin	ng/GJ	70	100	1.5	10
Benzo(a)pyrene	mg/GJ	230	210	NA	22
Benzo(b)fluoranthene	mg/GJ	330	220	NA	26
Benzo(k)fluoranthene	mg/GJ	130	130	NA	13
Indeno(1,2,3_cd)pyrene	mg/GJ	110	140	NA	15
HCB	mg/GJ	0.0006	0.00634	NA	0

Activity data

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

Table 3.10 Fuel consumption in stationary fuel combustion in the period 1990-2012 (PJ)

	Liquid fuels	Solid fuels	Biomass	Gas
1990	68.14	242.83	8.37	40.61
1991	64.99	226.34	8.21	42.36
1992	36.07	188.36	7.86	23.42
1993	34.97	148.61	7.38	11.79
1994	32.27	147.05	12	14.89
1995	22.62	142.65	20.01	17.32
1996	23.08	149.43	23.22	19.9
1997	20.67	147.28	24.27	19.24
1998	19.75	125.48	21.42	17.86
1999	18.26	115.4	20.5	17.44
2000	10.69	123.02	20.63	21.78
2001	11.28	119.11	21.94	23.33
2002	9.67	123.45	21.77	23.32
2003	9.13	138.39	23.85	24.05
2004	9.53	142.88	25.01	23.53
2005	8.26	138.48	24.22	23.55
2006	6.31	134.29	20.05	23.35
2007	5.46	164.07	22.85	26.13
2008	5.22	141.09	25.02	27.41
2009	4.75	132	27.42	20.67
2010	5.94	167.58	32.79	23.48
2011	6.01	174.75	31.24	21.17
2012	5.69	151.42	34.22	21.38

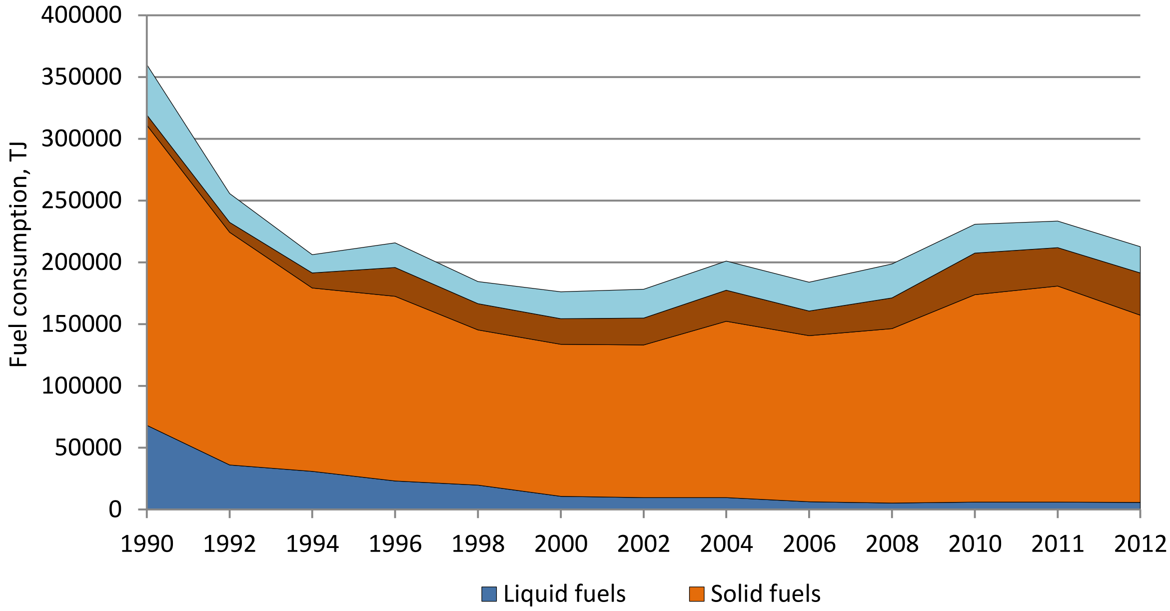


Figure 3.15 Fuel consumption by stationary combustion in the period of 1990-2012

3.2.3. Sources-specific QA/QC and verification

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

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

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

No some improvements were made in this reporting year.

3.2.4. Sources-specific planned improvements

- To improve the QA/QC procedure.
- To recalculate POPs emissions from NFR 1.A.4.b.i residential combustion sector according to updated national emission factors.
- To provide uncertainty analysis.

3.3. Transport

3.3.1. Overview of the sector

Table 3.11 Transport sector reporting activities

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

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

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

The transport sector is a major contributor to national emissions. The transport sector includes road transport which is the largest and most important emission source (Figure 3.17). The share of mobile sources in total national emissions in 2012 was the following: NO_x – 46.6%, NMVOC – 10.1% and CO – 13.6%. The share of other pollutants is not so significant. Emissions of most compounds have decreased throughout the time series, mainly due to the stricter emission standards for road vehicles. The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have decreased compared to 1990 by 60.4%, 82.5% and 82.7% respectively. The trend of the emissions of these categories is given in Figures 3.17, Tables 3.12-3.14.

Some recalculations have been made for the following sectors: road transport, agricultural sector and international maritime navigation.

The main reasons for recalculations were the following: correction of emission factors and sulphur content in fuels and activity data for the road transport sector. Recalculations led to a change in total emissions. A detailed overview is given in each transport subsector and Chapter 9.

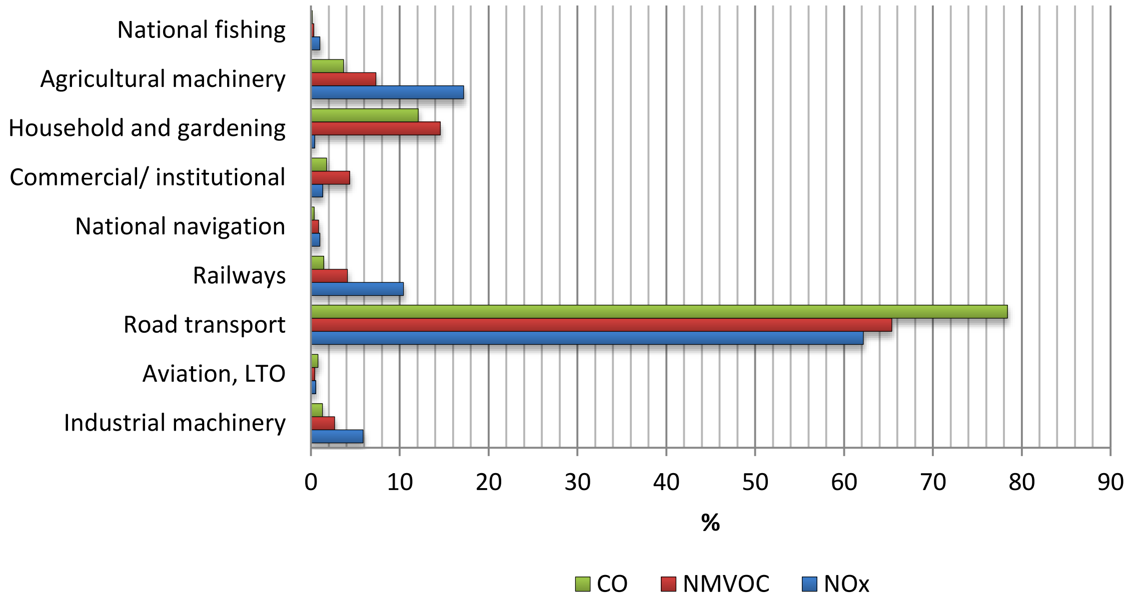


Figure 3.16 NO_x, NMVOC and CO emissions from the transport sector in 2012

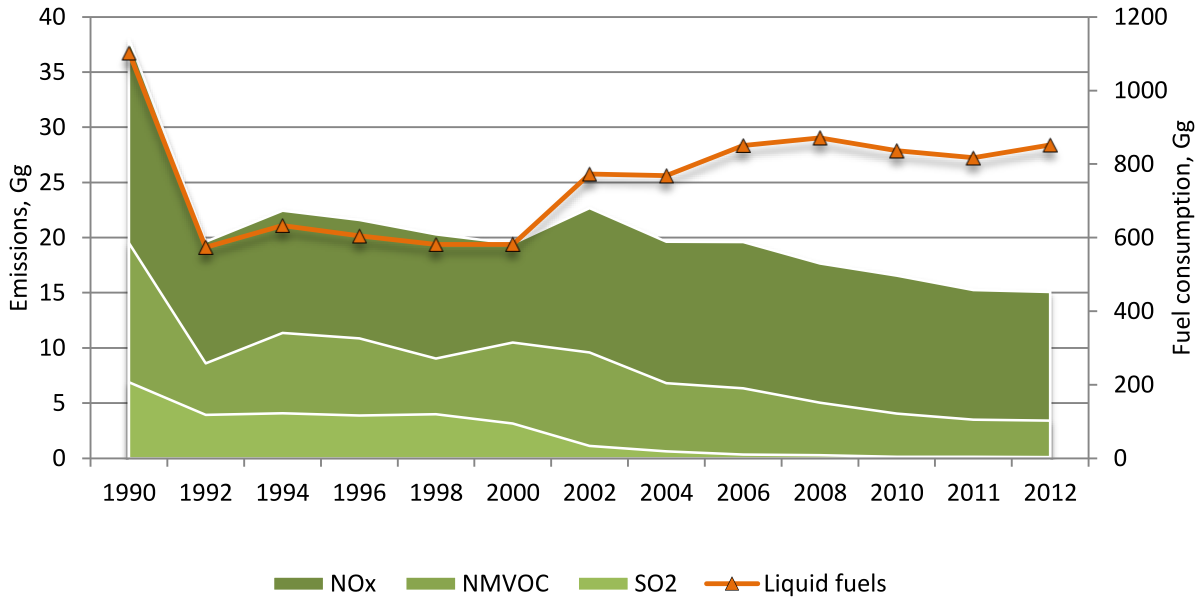


Figure 3.17 NO_x, NMVOC and SO_2 emissions from the transport sector in the period 1990-2012

Table 3.12 Total emissions from the transport sector in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	38.030	19.517	6.899	0.019	NR	NR	1.721	127.979
1991	35.699	18.683	6.620	0.018	NR	NR	1.653	127.167
1992	19.630	8.603	3.942	0.009	NR	NR	0.955	52.872
1993	21.254	9.502	4.287	0.013	NR	NR	1.158	59.606
1994	22.429	11.363	4.075	0.024	NR	NR	1.093	71.187
1995	19.860	10.638	3.647	0.030	NR	NR	1.013	66.579
1996	21.588	10.854	3.869	0.040	NR	NR	1.014	69.060
1997	21.892	12.184	3.885	0.051	NR	NR	1.058	82.587
1998	20.281	9.023	3.985	0.048	NR	NR	1.024	62.426
1999	19.642	10.751	3.515	0.063	NR	NR	0.946	77.089
2000	19.460	10.498	3.149	0.112	0.895	0.985	1.098	68.210
2001	20.853	10.810	0.908	0.141	0.781	0.890	1.025	72.556
2002	22.677	9.594	1.109	0.147	0.970	1.083	1.222	62.623
2003	20.797	7.925	0.711	0.161	0.923	1.032	1.162	52.323
2004	19.640	6.808	0.614	0.224	0.975	1.087	1.221	45.037
2005	19.444	6.471	0.382	0.214	0.931	1.047	1.179	42.328
2006	19.593	6.342	0.335	0.241	0.935	1.059	1.201	40.583
2007	19.217	5.901	0.309	0.256	0.950	1.080	1.229	37.914
2008	17.649	5.045	0.262	0.254	0.882	1.010	1.161	32.434
2009	15.193	4.564	0.139	0.228	0.731	0.847	0.981	29.335
2010	16.538	4.050	0.128	0.215	0.772	0.894	1.040	26.567
2011	15.258	3.496	0.134	0.208	0.710	0.832	0.978	22.592
2012	15.074	3.410	0.112	0.195	0.727	0.854	1.006	22.115
trend 1990-2012, %	**-60.4**	**-82.5**	**-98.4**	**917.5**	**-18.8**	**-13.3**	**-41.6**	**-82.7**

Table 3.13 Total emissions of heavy metals from the transport sector in the period 1990-2012

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg		kg		Mg				
1990	78.727	0.012	0.940	0.476	0.131	2.754	0.050	0.006	2.591
1991	69.698	0.011	1.130	0.572	0.118	2.491	0.048	0.006	2.376
1992	34.327	0.006	0.387	0.196	0.064	1.380	0.027	0.003	1.237
1993	35.089	0.007	0.419	0.212	0.069	1.491	0.029	0.003	1.356
1994	43.019	0.007	0.435	0.220	0.080	1.637	0.027	0.003	1.593
1995	24.788	0.006	0.308	0.156	0.073	1.433	0.022	0.002	1.468
1996	21.707	0.007	0.466	0.236	0.077	1.537	0.024	0.003	1.561
1997	9.841	0.007	0.292	0.148	0.081	1.615	0.024	0.003	1.660
1998	6.064	0.006	0.111	0.056	0.074	1.480	0.023	0.002	1.462
1999	7.552	0.006	0.024	0.012	0.075	1.490	0.021	0.002	1.535
2000	5.027	0.006	0.047	0.024	0.077	1.528	0.022	0.002	1.547
2001	5.984	0.008	0.063	0.032	0.093	1.841	0.026	0.003	1.875
2002	5.542	0.008	0.008	0.004	0.100	1.998	0.030	0.003	1.985
2003	2.270	0.008	0.200	0.267	0.096	1.929	0.036	0.004	1.933
2004	2.108	0.008	0.141	0.188	0.099	1.972	0.034	0.004	1.974
2005	2.136	0.009	0.126	0.168	0.102	2.014	0.034	0.004	2.049
2006	1.470	0.009	0.064	0.085	0.109	2.158	0.034	0.004	2.201
2007	1.544	0.010	0.063	0.084	0.116	2.273	0.035	0.004	2.325
2008	1.590	0.009	0.131	0.174	0.114	2.245	0.037	0.004	2.271
2009	1.402	0.009	0.170	0.227	0.102	2.003	0.035	0.004	2.044
2010	0.516	0.009	0.103	0.137	0.108	2.143	0.035	0.004	2.135

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg		kg		Mg				
2011	0.480	0.009	0.054	0.071	0.108	2.126	0.032	0.004	2.114
2012	0.486	0.009	0.057	0.076	0.113	2.212	0.033	0.004	2.202
trend 1990-2012, %	**-99.4**	**-24.9**	**-93.9**	**-83.9**	**-13.2**	**-19.7**	**-33.1**	**-37.5**	**-15.0**

Table 3.14 Total emissions of POPs from the transport sector in the period 1990-2012

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					g	kg	
1990	0.226	0.022	0.040	0.017	0.012	0.091	0.074	NA	0.020
1991	0.223	0.022	0.039	0.015	0.012	0.088	0.089	NA	0.024
1992	0.096	0.012	0.022	0.008	0.005	0.047	0.030	NA	0.008
1993	0.104	0.013	0.023	0.009	0.006	0.051	0.033	NA	0.009
1994	0.142	0.012	0.021	0.010	0.008	0.050	0.034	NA	0.009
1995	0.128	0.009	0.017	0.010	0.007	0.042	0.024	NA	0.007
1996	0.148	0.010	0.019	0.010	0.008	0.047	0.037	NA	0.010
1997	0.152	0.009	0.018	0.010	0.007	0.045	0.023	NA	0.006
1998	0.111	0.008	0.016	0.010	0.006	0.040	0.009	NA	0.002
1999	0.132	0.007	0.014	0.009	0.006	0.037	0.002	NA	0.001
2000	0.137	0.007	0.014	0.009	0.006	0.037	0.004	NA	0.001
2001	0.167	0.008	0.017	0.011	0.008	0.043	0.005	NA	0.001
2002	0.156	0.011	0.020	0.012	0.008	0.050	0.001	NA	0.000
2003	0.151	0.010	0.019	0.011	0.007	0.048	0.535	NA	0.003
2004	0.149	0.011	0.019	0.012	0.008	0.049	0.377	NA	0.002
2005	0.152	0.011	0.019	0.012	0.008	0.050	0.336	NA	0.002
2006	0.160	0.012	0.021	0.013	0.009	0.055	0.170	NA	0.001
2007	0.168	0.013	0.022	0.013	0.009	0.057	0.168	NA	0.001
2008	0.169	0.012	0.021	0.013	0.009	0.055	0.348	NA	0.002
2009	0.153	0.011	0.019	0.012	0.008	0.050	0.453	NA	0.002
2010	0.148	0.013	0.021	0.013	0.009	0.056	0.274	NA	0.001
2011	0.143	0.012	0.021	0.013	0.009	0.055	0.143	NA	0.001
2012	0.137	0.013	0.022	0.014	0.010	0.059	0.153	NA	0.001
trend 1990-2012, %	**-39.6**	**-38.7**	**-45.2**	**-16.4**	**-20.7**	**-35.0**	**106.6**	**NA**	**-96.4**

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

3.3.2.1. Source category description

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

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

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

- 1.A.3.a.i (ii) International aviation (Cruise)

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

The aviation sector has quite a minor share in total emissions. The total contribution of aircraft LTO emissions to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 0.5%, 0.4% and 0.8% respectively, in the transport sector in 2012. Other pollutants have an even smaller share.

Aviation emissions reflect the level of overall aviation activity. The growth of air travel for the past decades has been noticeable. During the period 1990-2012, the emission of NO_x, NMVOC and CO from LTO phase increased 58%, 22.6%, 48.1% respectively (Figure 3.18-3.20, Table 3.15), mainly due to changes in fuel consumption and number of landing and take-off operations. This is roughly in line with the trends in the number of air passengers and freight transported over the same period (Figure 3.22). Figures 3.18-3.20 illustrate the importance of international aviation sector which contributes majority of the emissions from aviation sector.

The emissions of NO_x decreased in 2012 compared to 2011 by 4.9% respectively. This decrease in emissions can be explained by the fact that the share of different aircraft types varies every year and therefore average emission factor (Table 3.17) changes from year to year. At the same time NMVOC and CO emissions increased by 13.5 and 7.9% respectively. The growth of fuel consumption and the number of landing and take-off operations by 20.6% and 18.9% respectively (Figure 3.18-3.20, 3.22, Tables 3.15-3.16, 3.19) was the reason for an increase.

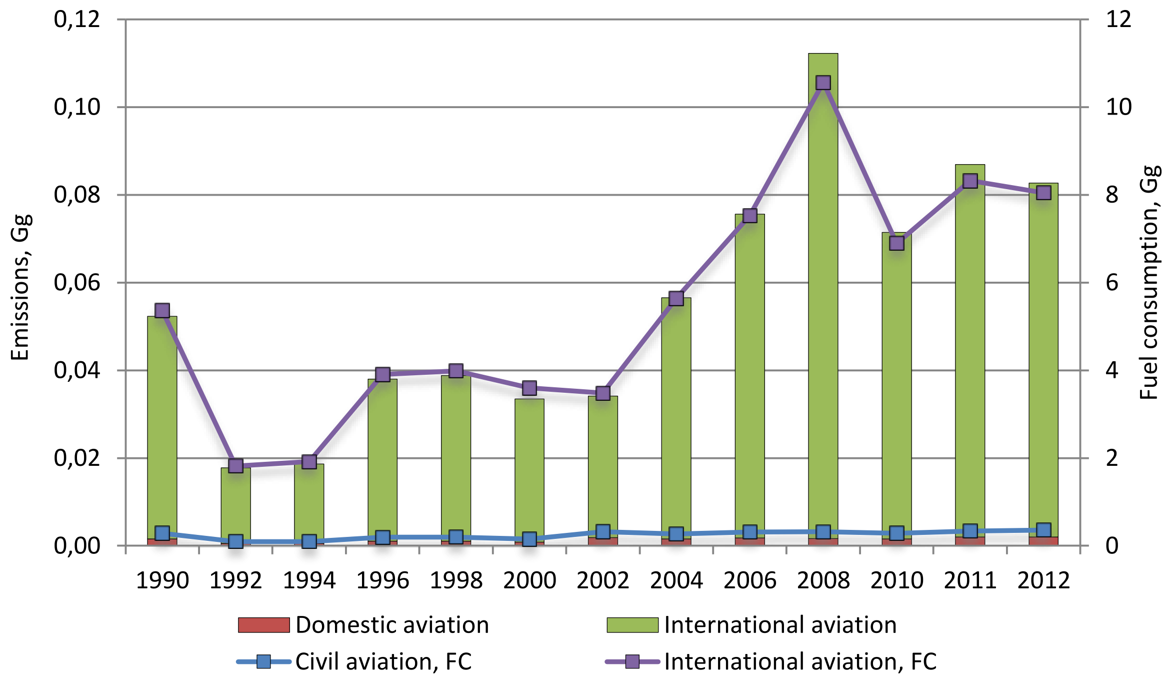


Figure 3.18 NO_x emissions from the LTO-cycle in the period 1990-2012

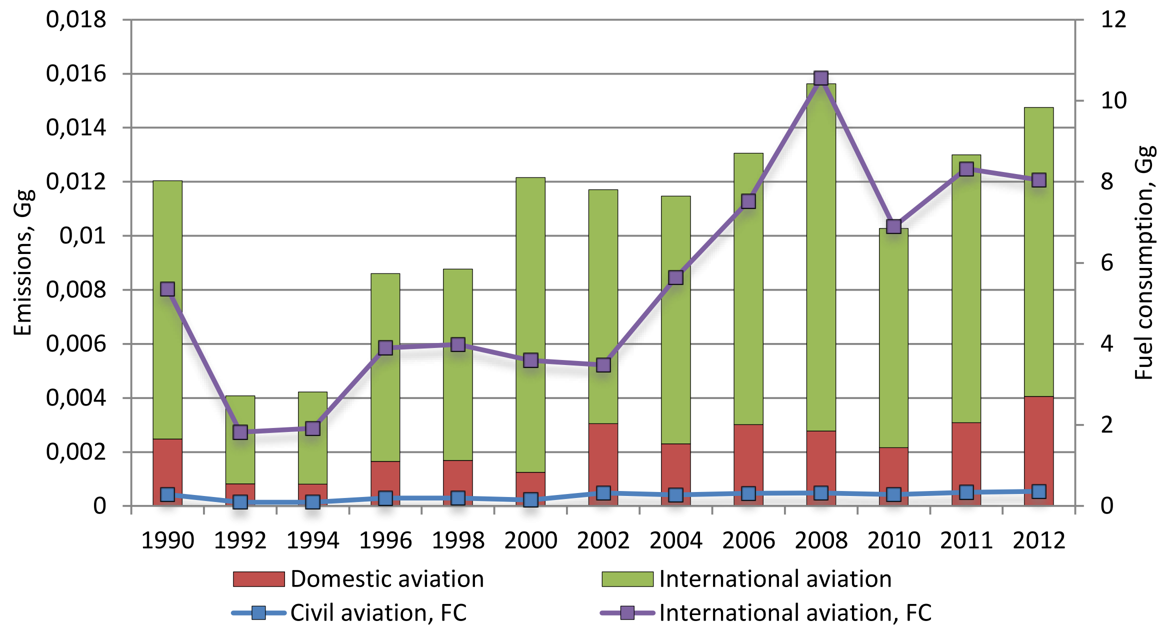


Figure 3.19 NMVOC emissions from the LTO-cycle in the period 1990-2012

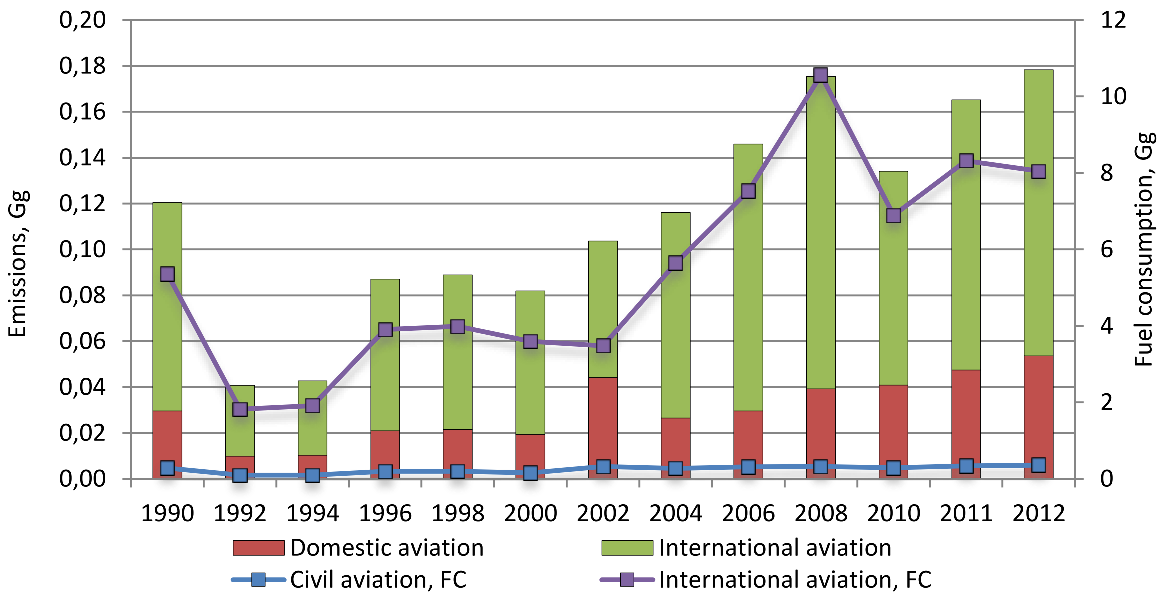


Figure 3.20 CO emissions from the LTO-cycle in the period 1990-2012

Table 3.15 Emissions from the LTO-cycle in the aviation sector in the period 1990-2012

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

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg				Mg			Gg
1998	0.039	0.009	0.004	NA	NR	NR	0.289	0.089
1999	0.037	0.008	0.004	NA	NR	NR	0.275	0.084
2000	0.033	0.012	0.004	NA	0.314	0.314	0.314	0.082
2001	0.033	0.010	0.004	NA	0.282	0.282	0.282	0.078
2002	0.034	0.012	0.004	NA	0.272	0.272	0.272	0.104
2003	0.042	0.010	0.004	NA	0.330	0.330	0.330	0.103
2004	0.057	0.011	0.006	NA	0.441	0.441	0.441	0.116
2005	0.078	0.015	0.008	NA	0.652	0.652	0.652	0.155
2006	0.076	0.013	0.008	NA	0.642	0.642	0.642	0.146
2007	0.090	0.013	0.009	NA	0.780	0.780	0.780	0.156
2008	0.112	0.016	0.010	NA	0.941	0.941	0.941	0.175
2009	0.075	0.010	0.007	NA	0.603	0.603	0.603	0.129
2010	0.071	0.010	0.007	NA	0.558	0.558	0.558	0.134
2011	0.087	0.013	0.008	NA	0.638	0.638	0.638	0.165
2012	0.083	0.015	0.008	NA	0.465	0.465	0.465	0.178
trend 1990-2012, %	**58.0**	**22.6**	**36.2**	**NA**	**48.3**	**48.3**	**18.7**	**48.1**

Table 3.16 Emissions from the cruise phase in aviation sector in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.385	0.015	0.030	NA	NR	NR	0.006	0.035
1991	0.385	0.015	0.030	NA	NR	NR	0.006	0.035
1992	0.128	0.005	0.010	NA	NR	NR	0.002	0.012
1993	0.206	0.008	0.016	NA	NR	NR	0.003	0.019
1994	0.165	0.006	0.013	NA	NR	NR	0.003	0.015
1995	0.190	0.007	0.015	NA	NR	NR	0.003	0.017
1996	0.153	0.006	0.012	NA	NR	NR	0.002	0.014
1997	0.237	0.009	0.019	NA	NR	NR	0.004	0.021
1998	0.147	0.006	0.012	NA	NR	NR	0.002	0.013
1999	0.230	0.009	0.018	NA	NR	NR	0.004	0.021
2000	0.224	0.009	0.018	NA	0.004	0.004	0.004	0.020
2001	0.158	0.006	0.012	NA	0.002	0.002	0.002	0.014
2002	0.187	0.007	0.015	NA	0.003	0.003	0.003	0.017
2003	0.177	0.007	0.014	NA	0.003	0.003	0.003	0.016
2004	0.298	0.011	0.023	NA	0.005	0.005	0.005	0.027
2005	0.501	0.020	0.039	NA	0.008	0.008	0.008	0.043
2006	0.301	0.012	0.024	NA	0.005	0.005	0.005	0.026
2007	0.511	0.020	0.040	NA	0.008	0.008	0.008	0.044
2008	0.216	0.008	0.017	NA	0.003	0.003	0.003	0.019
2009	0.321	0.012	0.025	NA	0.005	0.005	0.005	0.028
2010	0.376	0.015	0.029	NA	0.006	0.006	0.006	0.033
2011	0.320	0.012	0.025	NA	0.005	0.005	0.005	0.028
2012	0.369	0.014	0.029	NA	0.006	0.006	0.006	0.032
trend 1990-2012, %	**-4.2**	**-2.7**	**-4.6**	**NA**	**64.3**	**64.3**	**-4.6**	**-6.5**

3.3.2.2. Methodological issues

Emissions calculations from the LTO cycle are based on the Tier 2 method and cruise emission calculations Tier 1 (EMEP/EEA air pollutant emission inventory guidebook 2013).

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

Cruise energy usage is estimated as the difference between the total fuel use from aviation fuel sale statistics and the total calculated LTO fuel use (Table 3.19). Fuel-based cruise emission factors are taken from the 2013 guidebook as a single set for an average aircraft (Table 3.18). Finally, when given the fuel related cruise emission factors, total domestic and international energy use and emissions can be calculated. All the calculations are made by using the following equations:

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

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

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

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

Detailed aircraft type data with take-off and landing activity is supplied by 7 Estonian airports. Estonian aircraft movement statistics count landing and take-off as two different activities. However methodology defines both one landing and one take-off as a full LTO cycle. Therefore statistical aircraft movement data is divided in two (Figure 3.21).

The methodology requires information on the number of LTO's grouped by representative aircraft types (Table 3.17). This kind of detailed knowledge is hard to obtain (individual aircraft with their specific engines) and therefore data is an aggregated level for practical reasons (Figure 3.22). Assumptions are made if missing data exist in some situations.

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

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

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

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

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

1. *EMEP/EEA. (2009). EMEP/EEA air pollutant emission inventory guidebook 2009. Technical guidance to prepare national emission inventories. Technical report No 9/2009;*
2. *ICAO (1995): Engine exhaust emissions databank. First edition. Doc 9646-AN/943. (Updated January 2012).*
3. *IPCC. (2006). 2006 IPCC Guidelines for National Greenhouse Gas Inventories. [Eggelston. S., Buendia. L., Miwa. K., Ngara. T., Tanabe. K (eds)]. Hayama: Institute of Global Environmental Strategies (IGES). Volume 2: Energy.*
4. *Rindlisbacher. T. (2007): Aircraft Piston Engine Emissions Summary Report, Reference: 0/3/33/33-05-003.022.*
5. *Rindlisbacher. T. (2009): Guidance on the Determination of Helicopter Emissions, Edition 1, Reference: 0/3/33/33-05-20. FOCA, Bern.*

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

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

Table 3.19 Fuel consumption in the aviation sector in the period 1990-2012 (Gg)

	Domestic LTO	Domestic cruise	International LTO	International cruise	Total
1990	0.285	1.515	5.358	28.842	36.000
1991	0.285	1.515	5.358	28.842	36.000
1992	0.095	0.505	1.821	9.579	12.000
1993	0.096	1.124	1.943	15.157	18.320
1994	0.095	0.725	1.917	12.333	15.070
1995	0.150	0.971	3.041	14.059	18.221
1996	0.194	0.817	3.902	11.298	16.211
1997	0.181	0.952	3.657	17.750	22.540
1998	0.198	0.616	3.987	10.987	15.788
1999	0.188	0.672	3.784	17.418	22.062
2000	0.153	0.638	3.596	16.982	21.369
2001	0.170	0.608	3.562	11.871	16.211
2002	0.322	0.480	3.480	14.253	18.535
2003	0.333	0.415	4.142	13.478	18.368
2004	0.273	0.792	5.640	22.651	29.356
2005	0.308	0.239	7.568	38.987	47.102
2006	0.314	0.090	7.523	23.436	31.363
2007	0.291	0.126	8.966	39.791	49.174
2008	0.321	0.402	10.560	16.539	27.822
2009	0.284	0.267	7.134	24.901	32.586
2010	0.287	0.277	6.893	29.138	36.595
2011	0.339	0.532	8.319	24.536	33.726
2012	0.360	0.731	8.046	28.216	37.353

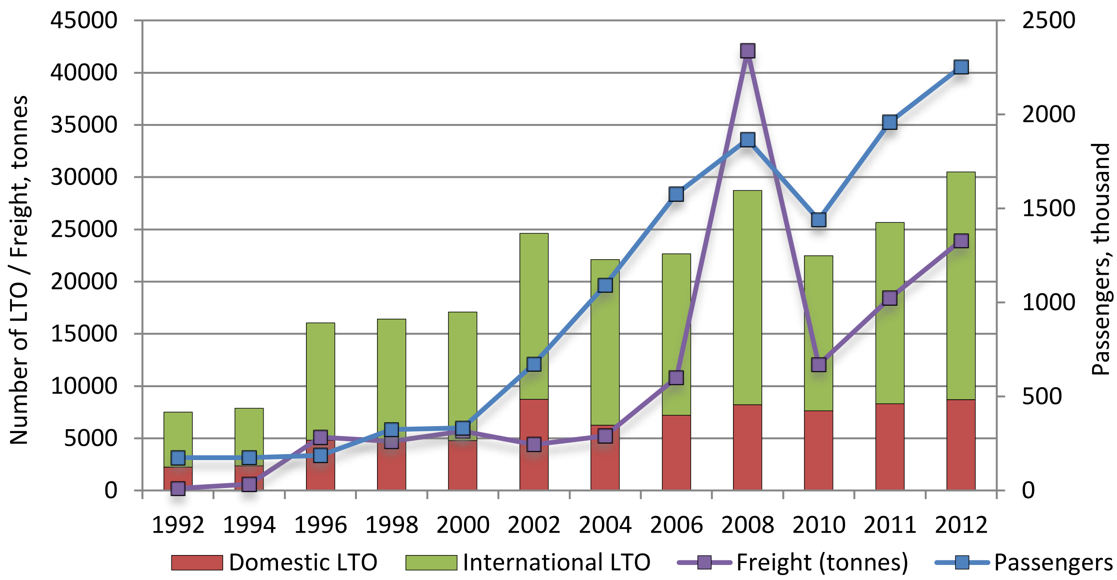


Figure 3.21 Number of LTO-cycles, passenger numbers and freight transported in the period 1990-2012

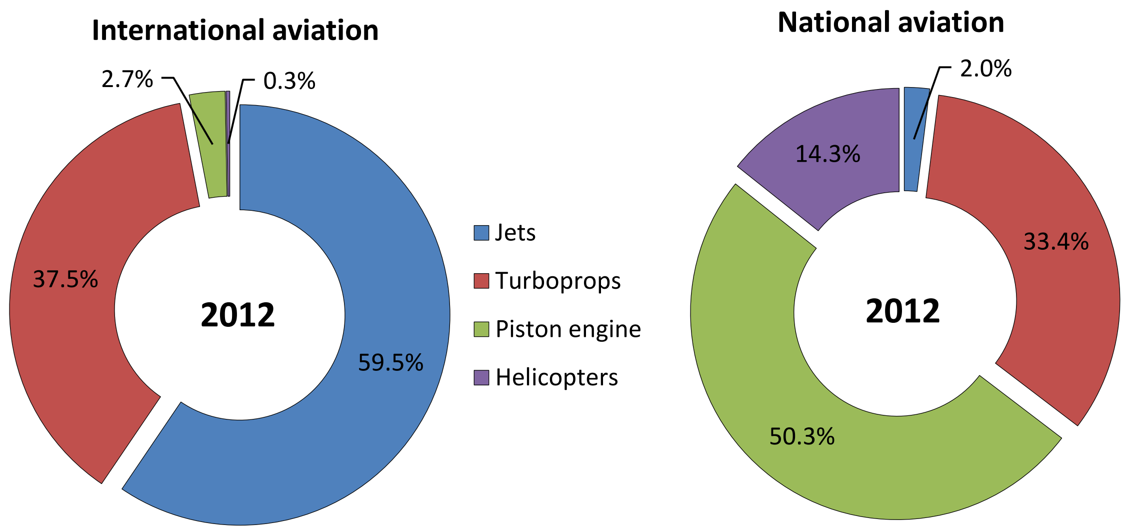


Figure 3.22 The share of different aircraft types in domestic and international civil aviation in 2012

3.3.2.3. Source-specific QA/QC and verification

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

3.3.2.4. Source-specific planned improvements

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

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

3.3.3.1. Source category description

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

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

Road transport contributed to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide by 62.2%, 65.4% and 78.4% respectively, in 2012. Emissions from the main pollutants and particulate matter have decreased significantly throughout the time series with the exception of NH_3. The decrease in emissions has mainly been caused by the stricter emission standards for road vehicles. The lead emissions from road transport have decreased about 99.4% since 1990 (Figure 3.27). The reduction of emissions is connected with the prohibition on leaded gasoline in 2000. The share of road transport in total Pb emissions was 1.4% in 2012. Reduction of sulphur content in fuels has given a substantial decrease of SO_2 emissions in the road transport sector (Figure 3.26). In 2001, the sulphur content was reduced from 5000 ppm (diesel) and 1000 ppm (gasoline) to 500 ppm and since that, sulphur content in fuel was reduced step by step even more. Currently, all road transport fuels are sulphur free (sulphur content less than 10 ppm). Therefore, SO_x emissions have decreased by 99.7% between 1990 and 2012.

The total emissions from road transport have not changed much in 2012 compared to 2011. Although there have been an increase in number of vehicles, average annual mileage and fuel consumption by 3.7%, 4.7% and 5.2% respectively. There has no big change in emissions due to the number of new vehicles which are designed to reduce both energy consumption and pollutant emissions.

In the figures below (Figures 3.23-3.27), a detailed overview of NO_x, NMVOC, CO, SO_x and Pb emission sources in the road transport sector is provided. All the emission trends are presented in Tables 3.20-3.22.

Fuel consumption has changed over the decades in the road transport sector. In the 1990s, gasoline consumption dominated, but from 2003 we can see the continuous growth in diesel consumption in road transport (Figure 3.28). This trend can be explained by the fact that the popularity of vehicles with gasoline engines has declined in recent years, and diesel engines dominate due to their greater fuel efficiency and torque compared to gasoline engines. Since 1990, the number of gasoline passenger cars and light duty vehicles equipped with catalytic converters has increased, resulting in decreasing emissions of e.g. NO_x and NMVOC by 63% and 87% respectively between 1990 and 2012. Diesel engines are the main power source in heavy-duty trucks and buses, and their share is rapidly growing in passenger cars as well.

Therefore, the reasons for emission reductions were a 51% decrease in gasoline consumption during the period 1990-2012 and an increasing amount of new cars that are designed to reduce both energy consumption and pollutant emissions, as a result of new technologies.

In addition, over the last few years, steps have been taken to use biofuels in road transport. The share of biofuels in fuels for road transport accounted for 0.03% in 2005 and increased to 0.8% in 2012 (Table 3.28).

Recalculations

All the emissions from the transport sector for the period 2002-2011 are recalculated. The main reasons for the recalculations are: correction of activity data (fuel sold data and average annual mileage) for the road transport sector. An overview of the updated data is given in Chapter 9.

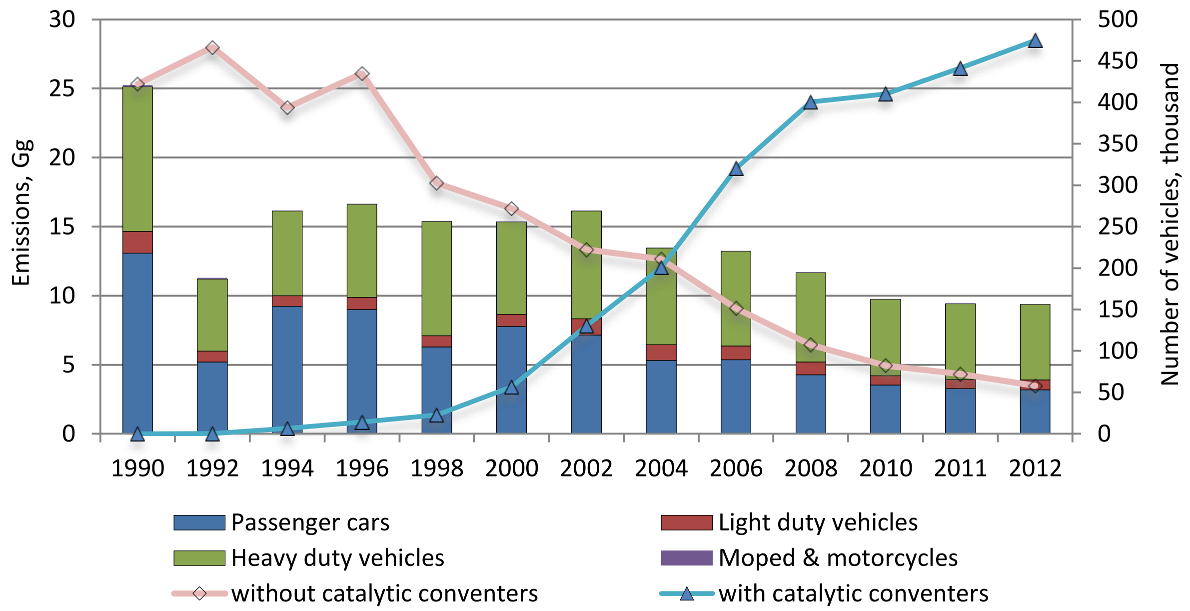


Figure 3.23 NO_x emissions from road transport in the period 1990-2012

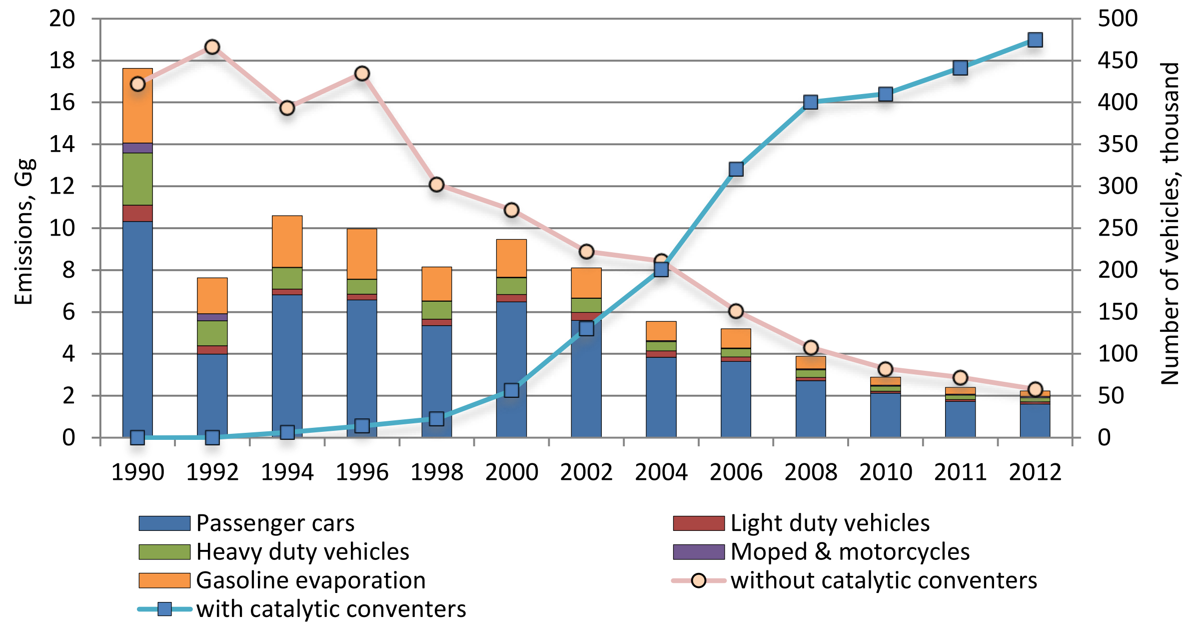


Figure 3.24 NMVOC emissions from road transport in the period 1990-2012

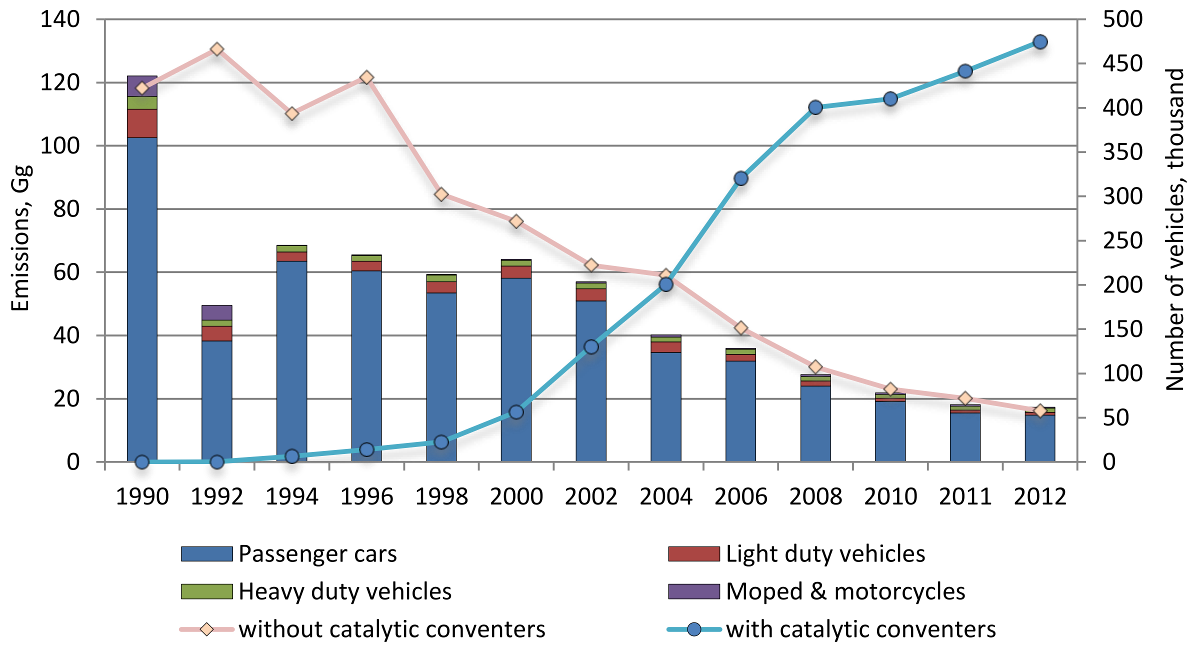


Figure 3.25 CO emissions from road transport in the period 1990-2012

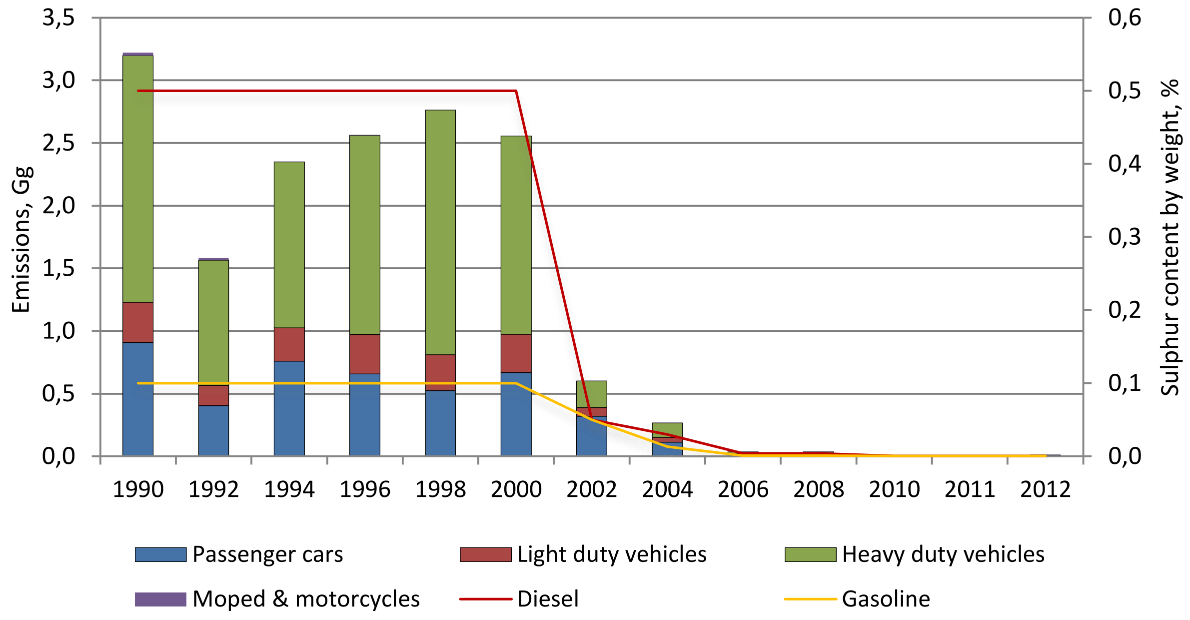


Figure 3.26 SO_2 emissions from road transport in the period 1990-2012

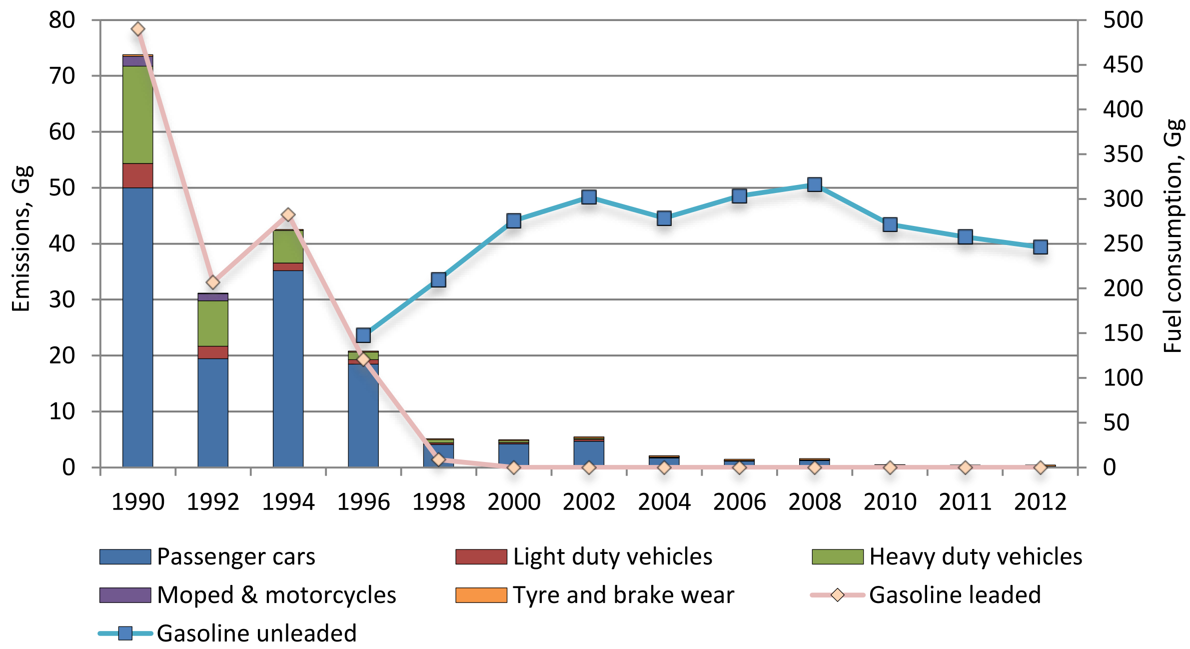


Figure 3.27 Pb emissions from road transport in the period 1990-2012

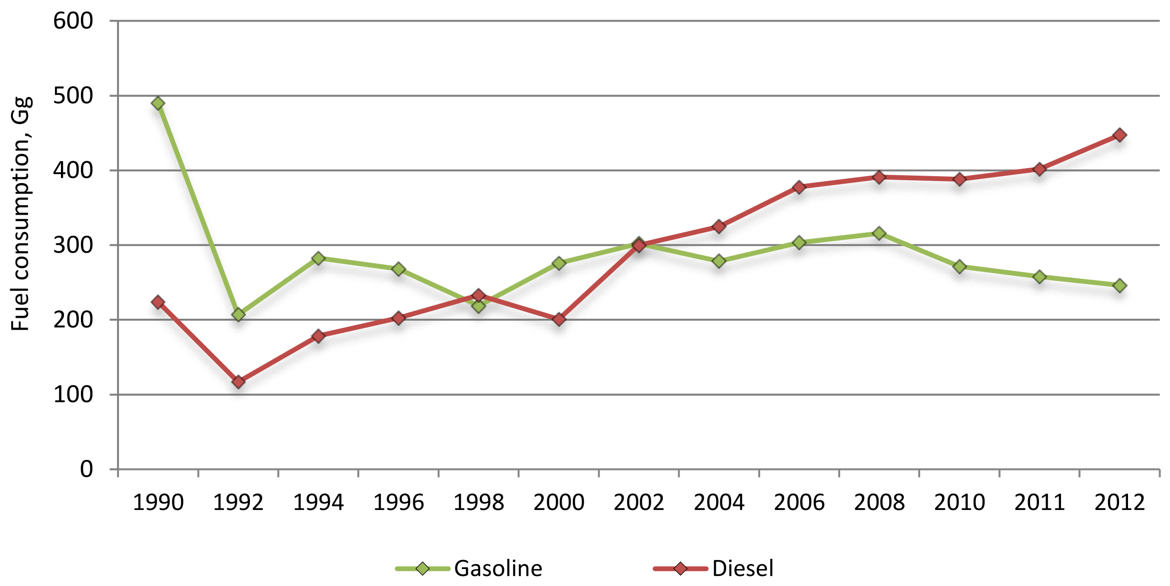


Figure 3.28 Gasoline and diesel consumption in the road transport sector in the period 1990-2012

Table 3.20 Emissions from road transport in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	25.250	17.631	3.220	0.016	NR	NR	1.018	122.056
1991	22.949	16.782	2.930	0.015	NR	NR	0.942	121.144
1992	11.294	7.633	1.583	0.007	NR	NR	0.509	49.562
1993	12.446	8.118	1.859	0.011	NR	NR	0.608	55.237
1994	16.147	10.599	2.350	0.022	NR	NR	0.759	68.550
1995	15.786	9.725	2.598	0.029	NR	NR	0.812	63.319
1996	16.632	9.970	2.561	0.039	NR	NR	0.759	65.492
1997	17.350	11.321	2.700	0.050	NR	NR	0.825	79.040
1998	15.387	8.155	2.765	0.047	NR	NR	0.790	59.370
1999	15.632	9.857	2.587	0.062	NR	NR	0.767	73.653
2000	15.350	9.468	2.558	0.111	0.713	0.800	0.910	64.102
2001	16.780	9.653	0.581	0.140	0.587	0.694	0.826	67.794
2002	16.150	8.102	0.602	0.146	0.657	0.767	0.901	57.005
2003	13.905	6.502	0.293	0.160	0.603	0.708	0.835	46.869
2004	13.453	5.555	0.267	0.223	0.683	0.792	0.923	40.176
2005	13.283	5.380	0.063	0.213	0.646	0.758	0.888	37.946
2006	13.212	5.194	0.036	0.240	0.626	0.746	0.885	35.965
2007	12.858	4.715	0.037	0.255	0.617	0.744	0.890	33.096
2008	11.672	3.882	0.036	0.253	0.554	0.680	0.829	27.628
2009	9.534	3.313	0.012	0.227	0.464	0.576	0.707	24.406
2010	9.745	2.894	0.006	0.214	0.459	0.577	0.719	21.922
2011	9.417	2.408	0.008	0.207	0.437	0.557	0.699	18.125
2012	9.372	2.229	0.009	0.194	0.454	0.579	0.728	17.338
trend 1990-2012, %	**-62.9**	**-87.4**	**-99.7**	**1082.9**	**-36.4**	**-27.6**	**-28.5**	**-85.8**

Table 3.21 Emissions of heavy metals from road transport in the period 1990-2012 (Mg)

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
1990	73.785	0.008	NE	NE	0.112	2.152	0.024	0.002	2.214
1991	66.237	0.008	NE	NE	0.098	1.887	0.021	0.002	1.994
1992	31.167	0.004	NE	NE	0.051	0.991	0.011	0.001	0.999
1993	33.265	0.004	NE	NE	0.057	1.087	0.012	0.001	1.108
1994	42.559	0.005	NE	NE	0.071	1.351	0.015	0.001	1.414
1995	24.026	0.005	NE	NE	0.067	1.258	0.014	0.001	1.357
1996	20.813	0.005	NE	NE	0.070	1.320	0.015	0.001	1.422
1997	8.922	0.006	NE	NE	0.075	1.416	0.016	0.001	1.536
1998	5.104	0.005	NE	NE	0.068	1.273	0.014	0.001	1.338
1999	6.743	0.005	NE	NE	0.070	1.329	0.015	0.001	1.440
2000	4.944	0.005	NE	NE	0.072	1.359	0.015	0.001	1.446
2001	5.902	0.007	NE	NE	0.088	1.669	0.018	0.002	1.773
2002	5.445	0.007	NE	NE	0.091	1.717	0.019	0.002	1.819
2003	2.127	0.007	NE	NE	0.088	1.644	0.018	0.002	1.761
2004	2.065	0.007	NE	NE	0.092	1.712	0.019	0.002	1.818
2005	2.112	0.007	NE	NE	0.094	1.758	0.019	0.002	1.896
2006	1.444	0.008	NE	NE	0.101	1.887	0.021	0.002	2.040
2007	1.516	0.008	NE	NE	0.107	1.998	0.022	0.002	2.162
2008	1.569	0.008	NE	NE	0.107	1.988	0.022	0.002	2.116
2009	1.372	0.007	NE	NE	0.095	1.770	0.019	0.002	1.904
2010	0.490	0.007	NE	NE	0.100	1.861	0.020	0.002	1.967
2011	0.459	0.007	NE	NE	0.101	1.874	0.020	0.002	1.965
2012	0.458	0.008	NE	NE	0.106	1.963	0.021	0.002	2.054
trend 1990-2012, %	**-99.4**	**-9.1**	**NE**	**NE**	**-4.9**	**-8.8**	**-9.9**	**-3.4**	**-7.2**

Table 3.22 Total emissions of POPs from road transport in the period 1990-2012

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

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					kg		
2010	0.147	0.008	0.013	0.012	0.008	0.041	NE	NA	NE
2011	0.142	0.008	0.013	0.012	0.009	0.042	NE	NA	NE
2012	0.137	0.009	0.015	0.013	0.009	0.046	NE	NA	NE
trend 1990-2012, %	**-32.5**	**58.5**	**-4.2**	**4.6**	**-1.7**	**7.1**	**NE**	**NA**	**NE**

3.3.3.2. Methodological issues

1) Fuel combustion

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

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

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

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

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

Where,

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

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

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

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

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

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

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

Where:

E_{SO2} – emissions of SO_2,

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

FC – fuel consumption.

Table 3.23 Sulphur content of fuel (by weight %)

Fuel	1990	2001	2003	2004	2005	2006
Gasoline	0.1	0.05	0.015	0.013	0.005	0.001
Diesel	0.5	0.05	0.035	0.030	0.005	0.004
Fuel	**2007**	**2009**	**2010**	**2011**	**2012**	
Gasoline	0.0008	0.0008	0.00051	0.00055	0.00065	
Diesel	0.0040	0.0010	0.00048	0.00062	0.00071	

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

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

Where:

E_{Pb} – emissions of Pb

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

FC – fuel consumption

Table 3.24 Lead content in gasoline (g/l)

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

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

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

Where:

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

FC – fuel consumption

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

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

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

	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	5,601.3	687.2	1,584.3	317.1	8,189.9
1991	5,612.3	668.1	1,195.8	230.5	7,706.7
1992	2,278.0	346.9	783.4	230.0	3,638.3
1993	2,619.9	377.9	831.4	223.3	4,052.6
1994	4,224.7	421.8	843.9	5.1	5,495.4
1995	3,880.1	446.8	842.7	7.7	5,177.3
1996	4,172.4	494.9	850.3	10.0	5,527.6
1997	4,396.3	555.4	923.7	12.8	5,888.3
1998	3,165.2	455.9	1,064.4	10.5	4,696.0
1999	4,012.0	512.2	902.4	14.5	5,441.1
2000	4,125.7	505.5	899.8	15.9	5,546.9
2001	5,271.2	729.3	1,011.3	16.2	7,028.1
2002	5,176.5	872.8	1,053.0	17.3	7,119.6
2003	5,219.5	825.3	941.0	19.3	7,005.1
2004	5,419.8	958.5	942.1	32.8	7,353.2
2005	5,801.9	958.9	898.4	10.7	7,669.8
2006	6,451.1	950.0	939.1	19.2	8,359.4
2007	6,989.5	978.5	960.7	28.1	8,956.6
2008	6,829.0	965.6	995.8	29.8	8,820.2
2009	6,546.7	727.4	818.5	26.6	8,119.2
2010	6,455.7	763.6	981.0	28.0	8,227.3
2011	6,457.7	776.1	997.9	25.1	8,256.8
2012	6,711.2	857.6	1,041.1	33.9	8,643.8

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

	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
1990	240.9	31.1	44.5	105.7	422.2
1991	261.1	35.4	50.3	100.2	447.0
1992	283.5	34.2	48.8	100.0	466.5
1993	317.4	34.0	48.8	97.1	497.3
1994	337.8	24.7	35.4	2.2	400.1
1995	383.4	30.1	42.5	3.3	459.3
1996	378.3	28.4	37.9	4.2	448.8
1997	381.5	27.9	36.8	5.4	451.6
1998	264.8	19.6	36.3	4.4	325.1
1999	295.7	21.2	31.1	6.1	354.2
2000	273.1	19.5	29.1	6.7	328.5
2001	273.9	26.4	30.9	6.8	338.0
2002	285.8	29.6	29.9	7.3	352.5
2003	314.4	32.5	30.0	8.1	385.0
2004	335.1	36.8	30.5	9.1	411.5
2005	354.7	33.5	26.0	3.5	417.7
2006	402.1	36.3	29.1	4.2	471.7
2007	429.2	37.5	29.5	5.8	502.0
2008	436.3	38.5	27.1	6.0	507.9
2009	424.0	36.9	27.0	6.7	494.7
2010	422.1	36.3	26.9	7.4	492.7
2011	440.2	37.9	27.2	8.1	513.4
2012	452.2	39.1	26.9	14.3	532.6

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

	Gasoline	Diesel	Bioethanol	Biodiesel
1990	490.16	223.95	-	-
1991	440.05	205.00	-	-
1992	206.98	116.86	-	-
1993	220.89	141.70	-	-
1994	282.63	178.45	-	-
1995	242.96	211.25	-	-
1996	268.09	202.46	-	-
1997	298.91	210.25	-	-
1998	218.62	232.76	-	-
1999	274.61	203.74	-	-
2000	275.70	200.65	-	-
2001	328.79	251.76	-	-
2002	302.07	299.76	-	-
2003	288.95	294.77	-	-
2004	278.49	324.74	-	-
2005	284.61	347.73	0.00	0.17
2006	202.18	376.55	0.00	1.23
2007	317.94	404.25	0.02	0.57
2008	313.76	387.96	2.15	3.15
2009	287.71	346.47	0.15	1.82
2010	264.64	384.63	6.86	3.57
2011	251.77	401.07	5.93	0.72
2012	240.55	447.38	5.63	0.00

2) Automobile tyre wear, brake wear and road abrasion

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

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

Automobile tyre and brake wear calculations are based on the Tier 2 method and using the COPERT model (EMEP/CORINAIR Emission Inventory Guidebook 2013).

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

3) Gasoline evaporation

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

Gasoline evaporation calculations are based on the Tier 3 method and using the COPERT model (EMEP/CORINAIR Emission Inventory Guidebook 2013).

3.3.3.3. Source-specific QA/QC and verification

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

3.3.3.4. Source-specific planned improvements

Include more detailed vehicle subsectors in the calculations: mopeds, hybrid and LPG/CNG vehicles. Specify activity data and make recalculations, if necessary.

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

3.3.4.1. Source category description

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

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 10.4%, 4.1% and 1.5% respectively, in the transport sector in 2012.

The emissions of NO_x, NMVOC and CO have decreased compared to 1990 by 35.3%, 37.9 and 46.8% respectively. The trend of all the emissions is given in Tables 3.29-3.31.

Emissions from rail primarily originate from the combustion of diesel and light fuel oil by locomotives. Since emissions from the railway sector are calculated according to the Tier 1 method, which takes into account the amount of fuel consumed and default emission factors, the deviations of time series can be explained by statistical fuel consumption deviations in the railway sector. As shown in Figure 3.29, freight turnover shows similar changes; therefore, all the emissions are directly influenced by freight rail activity.

Fuel consumption decreased by 11.8% in 2012 compared to 2011; as a result, all emissions have decreased by the same percentage.

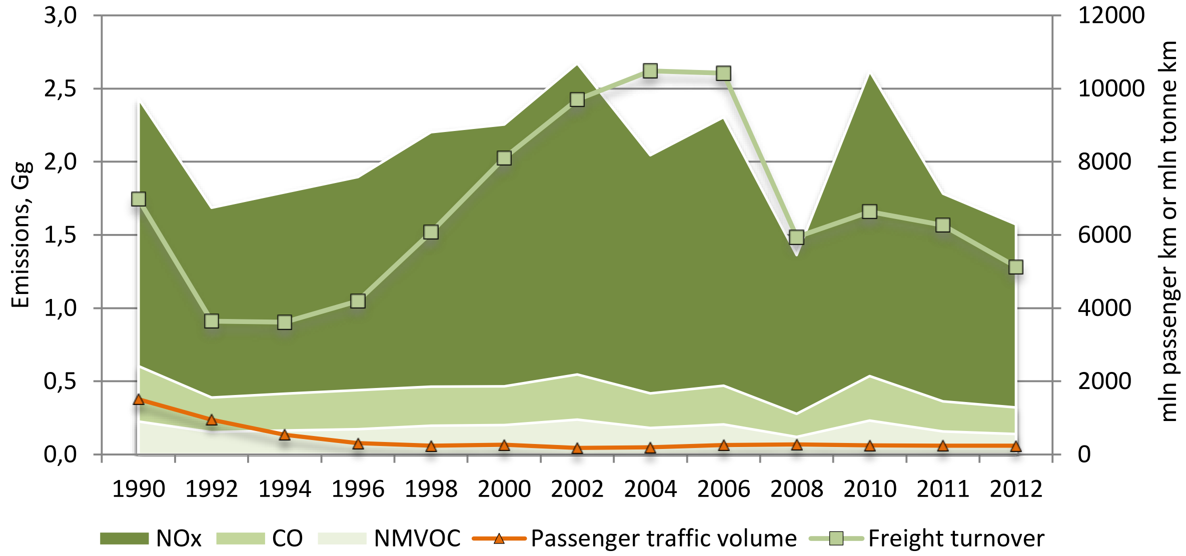


Figure 3.29 NO_x, NMVOC and CO emissions from the railway sector in the period 1990-2012

Table 3.29 Emissions from railway transport in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	2.431	0.224	0.567	0.000	NR	NR	0.085	0.603
1991	2.278	0.213	0.559	0.000	NR	NR	0.083	0.593
1992	1.685	0.153	0.364	0.000	NR	NR	0.055	0.388
1993	1.791	0.163	0.388	0.000	NR	NR	0.058	0.413
1994	1.791	0.163	0.390	0.000	NR	NR	0.059	0.415

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1995	1.736	0.157	0.365	0.000	NR	NR	0.055	0.389
1996	1.897	0.173	0.413	0.000	NR	NR	0.062	0.440
1997	1.736	0.157	0.363	0.000	NR	NR	0.055	0.388
1998	2.203	0.197	0.433	0.000	NR	NR	0.066	0.462
1999	2.411	0.214	0.463	0.000	NR	NR	0.070	0.495
2000	2.254	0.200	0.177	0.000	0.060	0.063	0.066	0.466
2001	2.097	0.187	0.167	0.000	0.056	0.059	0.062	0.435
2002	2.673	0.237	0.199	0.000	0.070	0.074	0.078	0.547
2003	2.358	0.209	0.170	0.000	0.062	0.065	0.068	0.482
2004	2.044	0.181	0.153	0.000	0.053	0.056	0.059	0.417
2005	2.201	0.195	0.168	0.000	0.058	0.060	0.064	0.449
2006	2.306	0.205	0.168	0.000	0.060	0.063	0.067	0.471
2007	1.939	0.172	0.121	0.000	0.051	0.053	0.056	0.396
2008	1.362	0.121	0.050	0.000	0.036	0.037	0.040	0.278
2009	1.834	0.163	0.050	0.000	0.048	0.050	0.053	0.375
2010	2.620	0.233	0.070	0.000	0.069	0.072	0.076	0.535
2011	1.782	0.158	0.068	0.000	0.047	0.049	0.052	0.364
2012	1.572	0.140	0.060	0.000	0.041	0.043	0.046	0.321
trend 1990-2012, %	**-35.3**	**-37.9**	**-89.4**	**-34.8**	**-31.0**	**-31.0**	**-46.1**	**-46.8**

Table 3.30 Emissions of heavy metals from railway transport in the period 1990-2012

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg	kg			Mg			kg	Mg
1990	0.016	0.674	0.940	0.476	0.004	0.080	0.005	0.674	0.070
1991	0.019	0.687	1.130	0.572	0.004	0.076	0.005	0.687	0.072
1992	0.007	0.408	0.387	0.196	0.002	0.055	0.003	0.408	0.042
1993	0.007	0.435	0.419	0.212	0.002	0.059	0.003	0.435	0.045
1994	0.007	0.439	0.435	0.220	0.002	0.059	0.003	0.439	0.045
1995	0.005	0.400	0.308	0.156	0.002	0.057	0.003	0.400	0.041
1996	0.008	0.466	0.466	0.236	0.003	0.062	0.003	0.466	0.048
1997	0.005	0.397	0.292	0.148	0.002	0.057	0.003	0.397	0.040
1998	0.002	0.445	0.111	0.056	0.002	0.072	0.003	0.445	0.045
1999	0.000	0.465	0.024	0.012	0.002	0.078	0.003	0.465	0.047
2000	0.001	0.441	0.047	0.024	0.002	0.073	0.003	0.441	0.044
2001	0.001	0.414	0.063	0.032	0.002	0.068	0.003	0.414	0.042
2002	0.000	0.512	0.008	0.004	0.003	0.087	0.004	0.512	0.051
2003	0.000	0.450	0.000	0.000	0.002	0.077	0.003	0.450	0.045
2004	0.000	0.390	0.000	0.000	0.002	0.066	0.003	0.390	0.039
2005	0.000	0.420	0.000	0.000	0.002	0.071	0.003	0.420	0.042
2006	0.000	0.440	0.000	0.000	0.002	0.075	0.003	0.440	0.044
2007	0.000	0.370	0.000	0.000	0.002	0.063	0.003	0.370	0.037
2008	0.000	0.260	0.000	0.000	0.001	0.044	0.002	0.260	0.026
2009	0.000	0.350	0.000	0.000	0.002	0.060	0.002	0.350	0.035
2010	0.000	0.500	0.000	0.000	0.003	0.085	0.004	0.500	0.050
2011	0.000	0.340	0.000	0.000	0.002	0.058	0.002	0.340	0.034
2012	0.000	0.300	0.000	0.000	0.002	0.051	0.002	0.300	0.030
trend 1990-2012, %	**-100.0**	**-55.5**	**-100.0**	**-100.0**	**-61.6**	**-36.5**	**-55.9**	**-55.5**	**-57.0**

Table 3.31 Emissions of POPs from railway transport in the period 1990-2012

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg					g	kg	
1990	0.024	0.007	0.009	0.004	0.003	0.023	0.074	NA	0.020
1991	0.029	0.008	0.011	0.005	0.003	0.026	0.089	NA	0.024
1992	0.010	0.003	0.004	0.002	0.001	0.011	0.030	NA	0.008
1993	0.011	0.003	0.005	0.002	0.001	0.012	0.033	NA	0.009
1994	0.011	0.004	0.005	0.002	0.001	0.012	0.034	NA	0.009
1995	0.008	0.003	0.004	0.002	0.001	0.010	0.024	NA	0.007
1996	0.012	0.004	0.005	0.003	0.001	0.013	0.037	NA	0.010
1997	0.008	0.003	0.004	0.002	0.001	0.009	0.023	NA	0.006
1998	0.003	0.002	0.003	0.002	0.001	0.007	0.009	NA	0.002
1999	0.001	0.002	0.002	0.002	0.000	0.006	0.002	NA	0.001
2000	0.001	0.002	0.003	0.002	0.000	0.006	0.004	NA	0.001
2001	0.002	0.002	0.002	0.002	0.000	0.006	0.005	NA	0.001
2002	0.000	0.002	0.003	0.002	0.000	0.006	0.001	NA	0.000
2003	0.000	0.001	0.002	0.002	0.000	0.006	0.000	NA	0.000
2004	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	0.000
2005	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	0.000
2006	0.000	0.001	0.002	0.002	0.000	0.005	0.000	NA	0.000
2007	0.000	0.001	0.002	0.001	0.000	0.005	0.000	NA	0.000
2008	0.000	0.001	0.001	0.001	0.000	0.003	0.000	NA	0.000
2009	0.000	0.001	0.002	0.001	0.000	0.004	0.000	NA	0.000
2010	0.000	0.002	0.003	0.002	0.000	0.006	0.000	NA	0.000
2011	0.000	0.001	0.002	0.001	0.000	0.004	0.000	NA	0.000
2012	0.000	0.001	0.002	0.001	0.000	0.004	0.000	NA	0.000
trend 1990-2012, %	**-100.0**	**-86.8**	**-83.9**	**-76.6**	**-90.8**	**-84.1**	**-100.0**	**NA**	**-100.0**

3.3.4.2. Methodological issues

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

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

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

Where:

E_{SO2} – emissions of SO_2

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

FC – fuel consumption

Table 3.32 Emission factors for railway transport

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

Table 3.33 Emission factors for heavy metals

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

Table 3.34 Emission factors for POPs

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

Table 3.35 Sulphur content of fuel (by weight %)

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

Table 3.36 Fuel consumption in the railway sector in the period 1990-2012

	Coal	Diesel	Light fuel oil
	TJ	Gg	
1990	119	0	46
1991	143	0	43
1992	49	0	32
1993	53	0	34
1994	55	0	34
1995	39	0	33
1996	59	0	36
1997	37	0	33
1998	14	0	42
1999	3	0	46
2000	6	0	43
2001	8	0	40
2002	1	2	49
2003	0	3	42
2004	0	1	38
2005	0	0	42
2006	0	2	42

	Coal	Diesel	Light fuel oil
	TJ	Gg	
2007	0	7	30
2008	0	1	25
2009	0	10	25
2010	0	15	35
2011	0	34	0
2012	0	30	0

3.3.4.3. Source-specific QA/QC and verification

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

3.3.4.4. Source-specific planned improvements

There are currently no improvements planned for this sector.

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

3.3.5.1. Source category description

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

National navigation in Estonia is also a small emission source in the transport sector. The share of navigation transport in total transport emissions in 2012 was: NO_x – 1.0%, NMVOC – 0.9%, CO – 0.4%. Detailed emission data are provided in Tables 3.37-3.39.

Deviations of time series can be explained by changing statistical fuel consumption in the national navigation sector (Figure 3.30). Fuel consumption decreased 20% in 2012 compared to 2011; therefore, all the emissions decreased to the same extent.

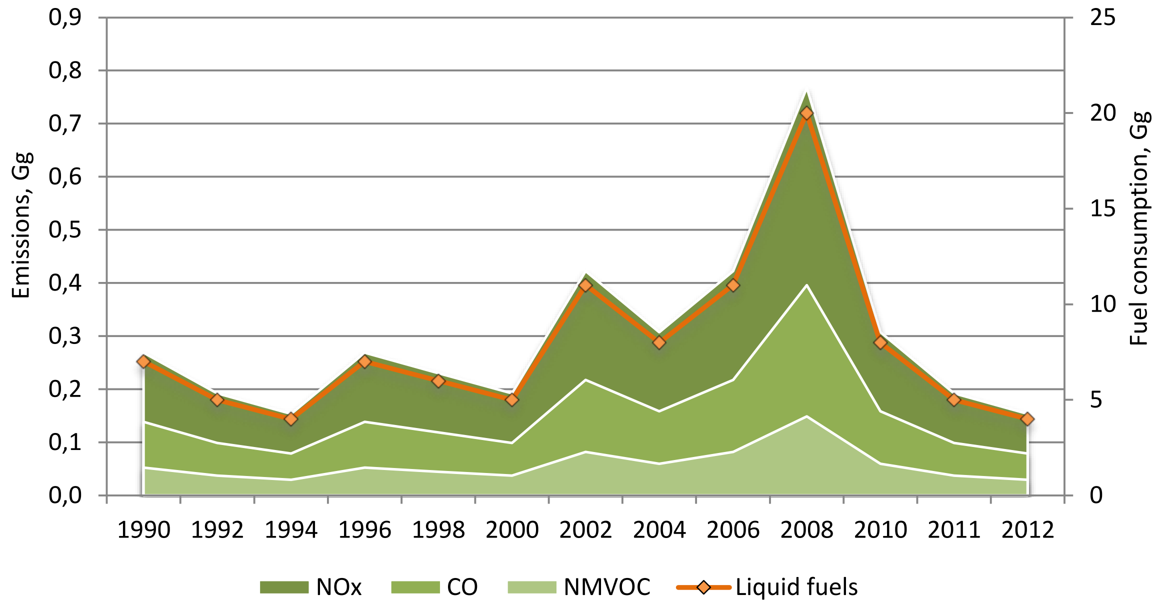


Figure 3.30 NO_x, NMVOC and CO emissions from the national navigation sector in the period 1990-2012

Table 3.37 Emissions from national navigation in the period 1990-2012

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg			Mg	Gg			
1990	0.269	0.052	0.070	0.049	NR	NR	0.032	0.139
1991	0.269	0.052	0.070	0.049	NR	NR	0.032	0.139
1992	0.192	0.037	0.050	0.035	NR	NR	0.023	0.099
1993	1.421	0.276	0.370	0.259	NR	NR	0.170	0.733
1994	0.154	0.030	0.040	0.028	NR	NR	0.018	0.079
1995	0.154	0.030	0.040	0.028	NR	NR	0.018	0.079
1996	0.269	0.052	0.070	0.049	NR	NR	0.032	0.139
1997	0.230	0.045	0.060	0.042	NR	NR	0.028	0.119
1998	0.230	0.045	0.060	0.042	NR	NR	0.028	0.119
1999	0.192	0.037	0.050	0.035	NR	NR	0.023	0.099
2000	0.192	0.037	0.020	0.035	0.023	0.023	0.023	0.099
2001	0.269	0.052	0.028	0.049	0.032	0.032	0.032	0.139
2002	0.422	0.082	0.044	0.077	0.051	0.051	0.051	0.218
2003	0.346	0.067	0.036	0.063	0.041	0.041	0.041	0.178
2004	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.158
2005	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.158
2006	0.422	0.082	0.044	0.077	0.051	0.051	0.051	0.218
2007	0.653	0.127	0.068	0.119	0.078	0.078	0.078	0.337
2008	0.768	0.149	0.080	0.140	0.092	0.092	0.092	0.396
2009	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.158
2010	0.307	0.060	0.016	0.056	0.037	0.037	0.037	0.158
2011	0.192	0.037	0.010	0.035	0.023	0.023	0.023	0.099
2012	0.154	0.030	0.008	0.028	0.018	0.018	0.018	0.079
trend 1990-2012, %	**-42.9**	**-42.9**	**-88.6**	**-42.9**	**-20.0**	**-20.0**	**-42.9**	**-42.9**

Table 3.38 Emissions of heavy metals from national navigation in the period 1990-2012

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	kg					Mg	kg		Mg
1990	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1991	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1992	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
1993	NA	0.370	NA	NA	1.850	0.063	2.590	0.370	0.037
1994	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
1995	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
1996	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
1997	NA	0.060	NA	NA	0.300	0.010	0.420	0.060	0.006
1998	NA	0.060	NA	NA	0.300	0.010	0.420	0.060	0.006
1999	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
2000	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
2001	NA	0.070	NA	NA	0.350	0.012	0.490	0.070	0.007
2002	NA	0.110	NA	NA	0.550	0.019	0.770	0.110	0.011
2003	NA	0.090	NA	NA	0.450	0.015	0.630	0.090	0.009
2004	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2005	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2006	NA	0.110	NA	NA	0.550	0.019	0.770	0.110	0.011
2007	NA	0.170	NA	NA	0.850	0.029	1.190	0.170	0.017
2008	NA	0.200	NA	NA	1.000	0.034	1.400	0.200	0.020
2009	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2010	NA	0.080	NA	NA	0.400	0.014	0.560	0.080	0.008
2011	NA	0.050	NA	NA	0.250	0.009	0.350	0.050	0.005
2012	NA	0.040	NA	NA	0.200	0.007	0.280	0.040	0.004
trend 1990-2012, %	**NA**	**-42.9**	**NA**	**NA**	**-42.9**	**-42.9**	**-42.9**	**-42.9**	**-42.9**

Table 3.39 Emissions of POPs from national navigation in the period 1990-2012

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

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg							
2011	NA	0.150	0.250	NA	NA	0.400	NA	NA	NA
2012	NA	0.120	0.200	NA	NA	0.320	NA	NA	NA
trend 1990-2012, %	**NA**	**-42.9**	**-42.9**	**NA**	**NA**	**-42.9**	**NA**	**NA**	**NA**

3.3.5.2. Methodological issues

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

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

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

Where:

E_{SO2} – emissions of SO_2

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

FC – fuel consumption

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

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

Table 3.41 Emission factors for heavy metals and PAHs

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

Table 3.42 Sulphur content of fuel (by weight %)

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

Table 3.43 Fuel consumption in the navigation sector in the period 1990-2012 (Gg)

	Light fuel oil	Diesel
1990	0	7
1991	0	7
1992	0	5
1993	32	5
1994	0	4
1995	0	4
1996	0	7
1997	0	6
1998	0	6
1999	0	5
2000	2	5
2001	2	5
2002	4	7
2003	2	7
2004	2	6
2005	0	8
2006	5	6
2007	12	5
2008	13	7
2009	2	6
2010	2	6
2011	0	5
2012	0	4

3.3.5.3. Source-specific QA/QC and verification

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

3.3.5.4. Source-specific planned improvements

There are currently no improvements planned for this sector.

3.3.6. Other non-road mobile machinery

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

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

3.3.6.1. Source category description

Other non-road machinery includes following sectors and activities:

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

The total contributions to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 25.8%, 29.2% and 19.0% respectively, in the transport sector in 2012.

All the emissions have decreased in the period 1990 to 2012, but slightly increased in 2012 compared to 2011. Deviations of time series can be explained by changing statistical fuel consumption in the non-road machinery sector (Figures 3.31-3.33) and the share of some specific sector in total non-road machinery emissions.

The most important deployment of mobile machinery is the use in the agricultural and industrial sector, which are responsible for approximately 88% of total energy use, where diesel is the dominant fuel type, with 86% of energy use in 2012.

Recalculations

Minor correction has been made in agricultural sector for 2011. Recalculations concern using corrected fuel consumption data. An overview of the updated data is given in Chapter 9.

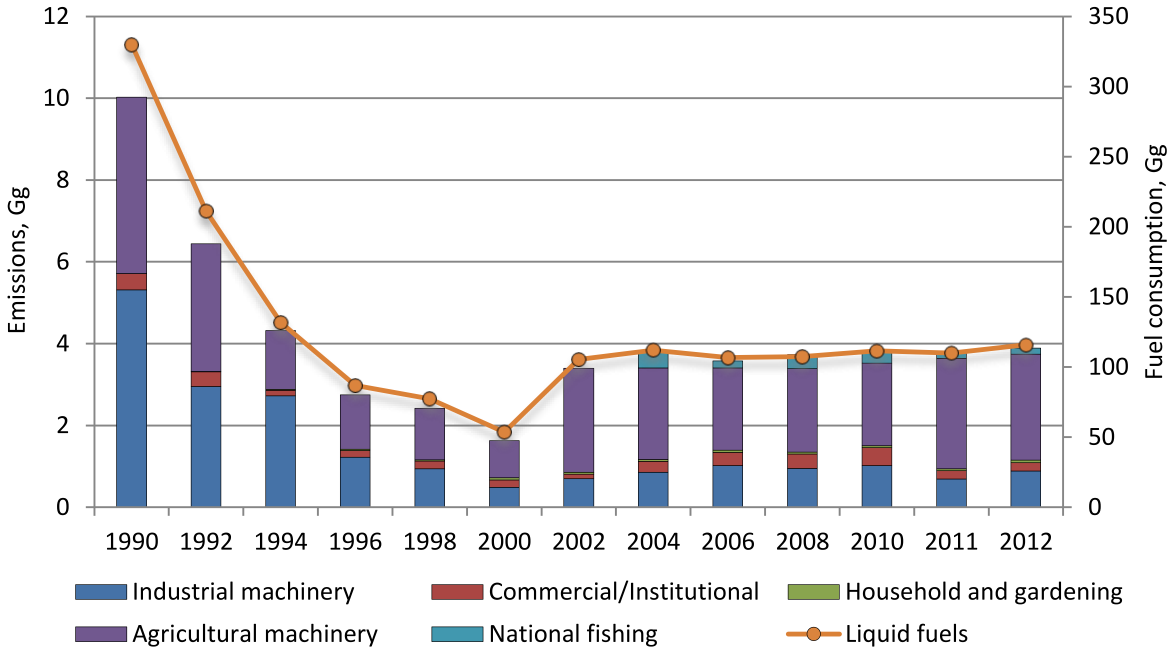


Figure 3.31 NO_x emissions from other non-road machinery in the period 1990-2012

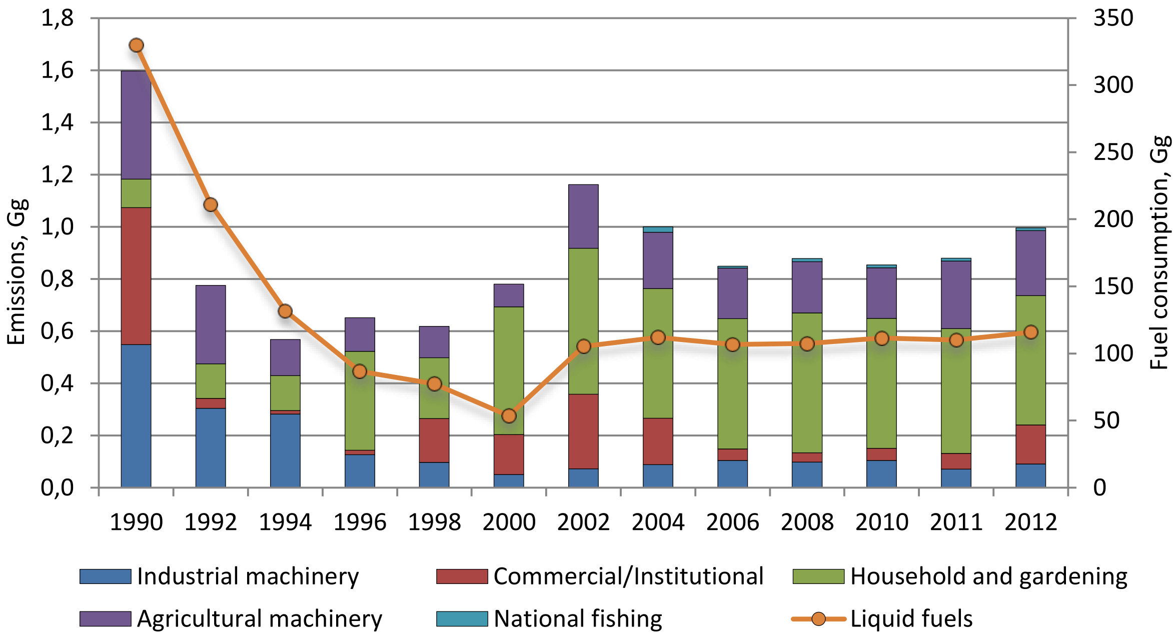


Figure 3.32 NMVOC emissions from other non-road machinery in the period 1990-2012

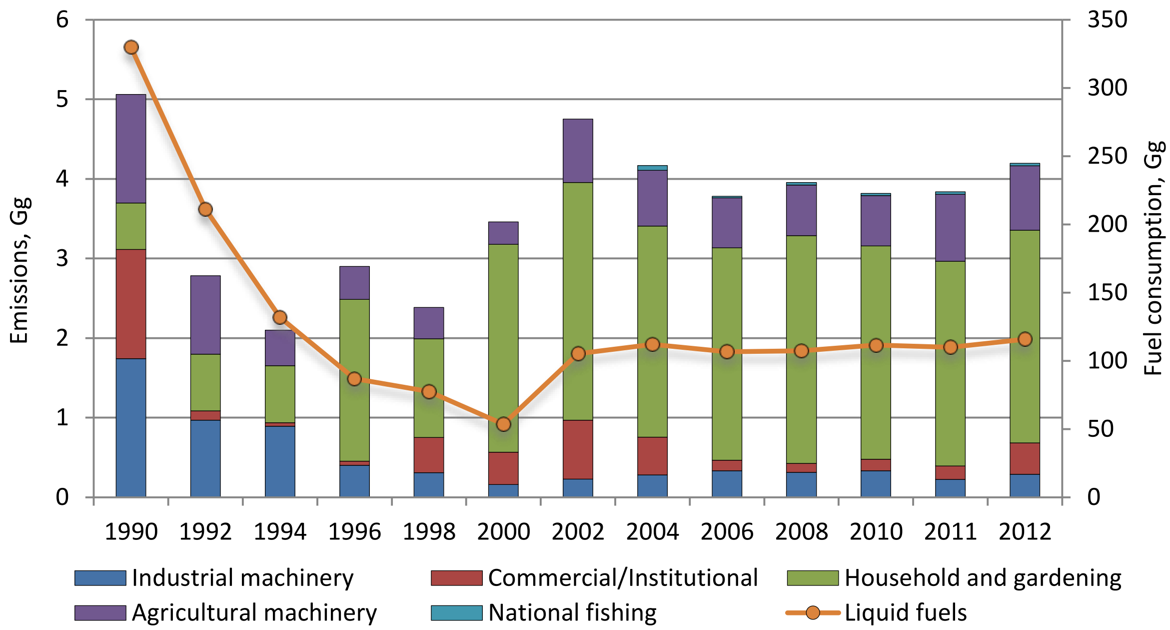


Figure 3.33 CO emissions from other non-road machinery in the period 1990-2012

Table 3.44 Emissions from other non-road machinery in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	10.028	1.597	3.036	0.002	NR	NR	0.586	5.061
1991	10.151	1.625	3.056	0.002	NR	NR	0.596	5.171
1992	6.441	0.775	1.943	0.002	NR	NR	0.368	2.783
1993	5.577	0.942	1.668	0.001	NR	NR	0.321	3.180
1994	4.319	0.568	1.293	0.001	NR	NR	0.256	2.100
1995	2.155	0.720	0.640	0.001	NR	NR	0.127	2.724
1996	2.753	0.651	0.821	0.001	NR	NR	0.161	2.902
1997	2.540	0.653	0.758	0.001	NR	NR	0.149	2.959
1998	2.421	0.619	0.723	0.001	NR	NR	0.141	2.385
1999	1.370	0.634	0.412	0.000	NR	NR	0.085	2.758
2000	1.630	0.780	0.390	0.000	0.099	0.099	0.099	3.461
2001	1.673	0.909	0.129	0.000	0.105	0.105	0.105	4.110
2002	3.399	1.162	0.261	0.001	0.192	0.192	0.192	4.750
2003	4.147	1.136	0.207	0.001	0.217	0.217	0.217	4.692
2004	3.780	1.000	0.157	0.001	0.201	0.201	0.201	4.170
2005	3.575	0.821	0.111	0.001	0.190	0.190	0.190	3.619
2006	3.577	0.849	0.079	0.001	0.198	0.198	0.198	3.783
2007	3.677	0.875	0.074	0.001	0.204	0.204	0.204	3.929
2008	3.734	0.878	0.086	0.001	0.200	0.200	0.200	3.957
2009	3.444	1.019	0.038	0.001	0.182	0.183	0.183	4.268
2010	3.795	0.854	0.028	0.001	0.207	0.207	0.207	3.817
2011	3.780	0.880	0.040	0.001	0.203	0.203	0.203	3.839
2012	3.894	0.997	0.027	0.001	0.213	0.213	0.213	4.198
trend 1990-2012, %	**-67.2**	**-37.6**	**-99.1**	**-63.2**	**114.9**	**114.9**	**-63.6**	**-17.0**

Table 3.45 Emissions of heavy metals from other non-road machinery in the period 1990-2012

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	Mg		kg		Mg				
1990	4.926	0.003	0.000	0.000	0.015	0.510	0.021	0.003	0.300
1991	3.443	0.003	0.000	0.000	0.015	0.517	0.021	0.003	0.304
1992	3.153	0.002	0.000	0.000	0.010	0.325	0.013	0.002	0.191
1993	1.817	0.002	0.000	0.000	0.008	0.283	0.012	0.002	0.167
1994	0.453	0.001	0.000	0.000	0.006	0.221	0.009	0.001	0.130
1995	0.756	0.001	0.000	0.000	0.003	0.112	0.005	0.001	0.066
1996	0.887	0.001	0.000	0.000	0.004	0.142	0.006	0.001	0.084
1997	0.914	0.001	0.000	0.000	0.004	0.132	0.005	0.001	0.078
1998	0.958	0.001	0.000	0.000	0.004	0.125	0.005	0.001	0.073
1999	0.809	0.000	0.000	0.000	0.002	0.074	0.003	0.000	0.044
2000	0.082	0.001	0.000	0.000	0.003	0.088	0.004	0.001	0.052
2001	0.081	0.001	0.000	0.000	0.003	0.092	0.004	0.001	0.054
2002	0.096	0.001	0.000	0.000	0.005	0.176	0.007	0.001	0.103
2003	0.143	0.001	0.200	0.267	0.006	0.193	0.014	0.002	0.118
2004	0.043	0.001	0.141	0.188	0.005	0.180	0.012	0.002	0.109
2005	0.024	0.001	0.126	0.168	0.005	0.170	0.011	0.001	0.103
2006	0.026	0.001	0.064	0.085	0.005	0.178	0.009	0.001	0.106
2007	0.028	0.001	0.063	0.084	0.005	0.183	0.010	0.001	0.109
2008	0.022	0.001	0.131	0.174	0.005	0.179	0.012	0.001	0.108
2009	0.030	0.001	0.170	0.227	0.005	0.160	0.012	0.001	0.098
2010	0.026	0.001	0.103	0.137	0.005	0.183	0.011	0.001	0.110
2011	0.021	0.001	0.054	0.071	0.005	0.185	0.009	0.001	0.110
2012	0.028	0.001	0.057	0.076	0.006	0.191	0.010	0.001	0.114
trend 1990-2012, %	**-99.4**	**-62.2**	**NA**	**NA**	**-62.2**	**-62.5**	**-53.7**	**-56.5**	**-62.1**

Table 3.46 Emissions of POPs from other non-road machinery in the period 1990-2012

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

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	mg I-Teq	Mg					kg		
2010	0.445	0.003	0.005	NA	NA	0.008	0.274	NA	1.302
2011	0.232	0.003	0.005	NA	NA	0.009	0.143	NA	0.679
2012	0.248	0.003	0.006	NA	NA	0.009	0.153	NA	0.726
trend 1990-2012, %	**NA**	**-62.5**	**-63.1**	**NA**	**NA**	**-62.8**	**NA**	**NA**	**NA**

3.3.6.2. Methodological issues

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

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

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

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

Where:

E_{SO2} – emissions of SO_2

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

S – percentage sulphur content in fuel (%)

FC – fuel consumption

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

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

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

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

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

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

Table 3.49 Emission factors for POPs

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

Table 3.50 Sulphur content of fuel (by weight %)

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

Table 3.51 Lead content in fuel

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

Table 3.52 Total fuel consumption in other mobile sectors in the period 1990-2012

	Diesel	Light fuel oil	Gasoline	Total
1990	288.050	9.000	32.840	329.890
1991	293.000	8.000	22.950	323.950
1992	183.140	7.000	21.020	211.160
1993	158.300	6.104	12.110	176.514
1994	124.550	4.184	3.020	131.754
1995	59.750	3.255	5.040	68.045
1996	76.540	4.353	5.910	86.803
1997	70.750	3.840	6.090	80.680
1998	63.236	7.814	6.385	77.435
1999	32.264	7.881	5.393	45.538
2000	31.351	15.969	6.296	53.616
2001	24.243	24.519	6.214	54.976
2002	46.062	51.852	7.418	105.332
2003	78.115	33.564	11.040	122.719
2004	80.022	23.641	8.424	112.087
2005	76.926	21.672	4.694	103.292
2006	84.979	16.609	5.129	106.717
2007	88.831	15.682	5.556	110.069
2008	86.522	16.667	4.185	107.374
2009	87.679	5.139	5.880	98.698
2010	95.519	10.891	5.063	111.473
2011	89.362	16.425	4.203	109.990
2012	99.796	10.581	5.487	115.864

3.3.6.3. Source-specific QA/QC and verification

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

3.3.6.4. Source-specific planned improvements

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

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

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

3.3.7.1. Source category description

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

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide have increased approximately 19.6%, 31.5% and 28.1% compared to 1990. Sulphur oxide emissions have decreased 47.4% due to stricter rules for sulphur content in fuels used by ships. Detailed emission data are provided in Tables 3.53-3.55.

Deviations of time series can be explained by changing statistical fuel consumption in the international navigation sector (Figure 3.34).

Recalculations

All the NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10} and TSP emissions are recalculated for the period 2005-2011. An overview of the updated data is given in Chapter 9.

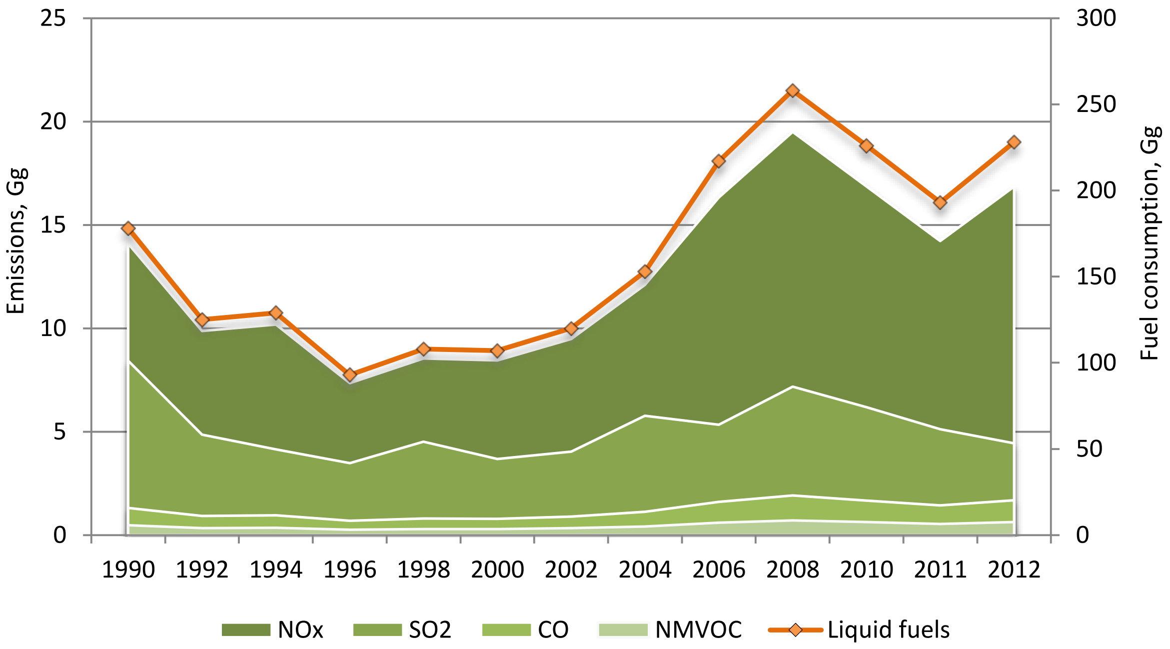


Figure 3.34 NO_x, NMVOC, SO_2 and CO emissions from the international navigation sector in the period 1990-2012

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

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	14.094	0.483	8.424	NE	NR	NR	0.977	1.317
1991	16.627	0.570	9.888	NE	NR	NR	1.147	1.554
1992	9.878	0.342	4.858	NE	NR	NR	0.573	0.925
1993	12.075	0.420	5.094	NE	NR	NR	0.610	1.132
1994	10.179	0.355	4.150	NE	NR	NR	0.499	0.955
1995	7.105	0.247	3.100	NE	NR	NR	0.370	0.666
1996	7.347	0.255	3.482	NE	NR	NR	0.412	0.688
1997	8.064	0.279	4.144	NE	NR	NR	0.487	0.755
1998	8.540	0.295	4.512	NE	NR	NR	0.529	0.799
1999	8.931	0.309	4.474	NE	NR	NR	0.527	0.836
2000	8.452	0.293	3.678	NE	0.423	0.466	0.466	0.792
2001	8.053	0.280	3.258	NE	0.382	0.421	0.421	0.755
2002	9.477	0.329	4.030	NE	0.466	0.514	0.514	0.888
2003	9.005	0.312	3.956	NE	0.454	0.500	0.500	0.844
2004	12.093	0.418	5.762	NE	0.647	0.714	0.714	1.132
2005	8.810	0.345	4.338	NE	0.491	0.522	0.522	0.903
2006	16.330	0.602	5.340	NE	1.023	1.110	1.110	1.606
2007	19.140	0.697	6.784	NE	1.283	1.397	1.397	1.872
2008	19.496	0.708	7.180	NE	1.355	1.477	1.477	1.909
2009	17.319	0.633	6.480	NE	1.220	1.329	1.329	1.702
2010	16.864	0.623	6.192	NE	1.173	1.274	1.274	1.672
2011	14.218	0.535	5.118	NE	0.975	1.055	1.055	1.428
2012	16.855	0.636	4.432	NE	0.910	0.977	0.977	1.687
trend 1990-2012, %	**19.6**	**31.5**	**-47.4**	**NE**	**115.2**	**109.7**	**0.1**	**28.1**

Table 3.54 Emissions of heavy metals from the international maritime navigation sector in the period 1990-2012 (Mg)

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

	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
2012	0.037	0.004	0.005	0.100	0.107	0.253	4.630	0.038	0.274
trend 1990-2012, %	**19.7**	**12.5**	**41.5**	**-3.6**	**-3.2**	**19.1**	**-4.7**	**11.7**	**28.1**

Table 3.55 Emissions of POPs from the international maritime navigation in the period 1990-2012

	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	HCH	PCB
	g I-Teq	Mg							
1990	0.074	NE	NE	NE	NE	NE	0.023	NE	0.096
1991	0.087	NE	NE	NE	NE	NE	0.027	NE	0.113
1992	0.044	NE	NE	NE	NE	NE	0.015	NE	0.063
1993	0.047	NE	NE	NE	NE	NE	0.017	NE	0.074
1994	0.039	NE	NE	NE	NE	NE	0.014	NE	0.061
1995	0.029	NE	NE	NE	NE	NE	0.010	NE	0.044
1996	0.032	NE	NE	NE	NE	NE	0.011	NE	0.046
1997	0.037	NE	NE	NE	NE	NE	0.012	NE	0.052
1998	0.041	NE	NE	NE	NE	NE	0.013	NE	0.056
1999	0.041	NE	NE	NE	NE	NE	0.014	NE	0.057
2000	0.036	NE	NE	NE	NE	NE	0.012	NE	0.053
2001	0.033	NE	NE	NE	NE	NE	0.012	NE	0.050
2002	0.040	NE	NE	NE	NE	NE	0.014	NE	0.059
2003	0.039	NE	NE	NE	NE	NE	0.013	NE	0.057
2004	0.055	NE	NE	NE	NE	NE	0.018	NE	0.078
2005	0.042	NA	NA	NA	NA	NA	0.014	NA	0.061
2006	0.087	NA	NA	NA	NA	NA	0.028	NA	0.115
2007	0.108	NA	NA	NA	NA	NA	0.034	NA	0.138
2008	0.114	NA	NA	NA	NA	NA	0.035	NA	0.143
2009	0.103	NA	NA	NA	NA	NA	0.031	NA	0.128
2010	0.099	NA	NA	NA	NA	NA	0.030	NA	0.125
2011	0.083	NA	NA	NA	NA	NA	0.026	NA	0.105
2012	0.078	NA	NA	NA	NA	NA	0.027	NA	0.114
trend 1990-2012, %	4.6	NA	NA	NA	NA	NA	14.9	NA	18.0

3.3.7.2. Methodological issues

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

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

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

Equation:

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

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

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

Table 3.57 Emission factors for heavy metals and PAHs

	Pb	Cd	Cu	Cr	As	Hg	Ni	Se	Zn	PCDD/F	HCB	PCB's
	g/t									TEQ µg/t	mg/t	
Bunker fuel oil	0.18	0.02	1.25	0.72	0.68	0.002	32	0.21	1.2	0.47	0.14	0.57
Marine diesel oil	0.13	0.01	0.88	0.05	0.04	0.030	1	0.10	1.2	0.13	0.08	0.38

Table 3.58 Sulphur content of fuel (by weight %)

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

Table 3.59 Fuel consumption in the international maritime navigation sector in the period 1990-2012 (Gg)

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

	Bunker fuel oil	Marine diesel oil
2011	169	24
2012	142	86

3.3.7.3. Source-specific QA/QC and verification

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

3.3.7.4. Source-specific planned improvements

No source-specific improvements are planned.

3.4. Fugitive emissions (NFR 1.B)

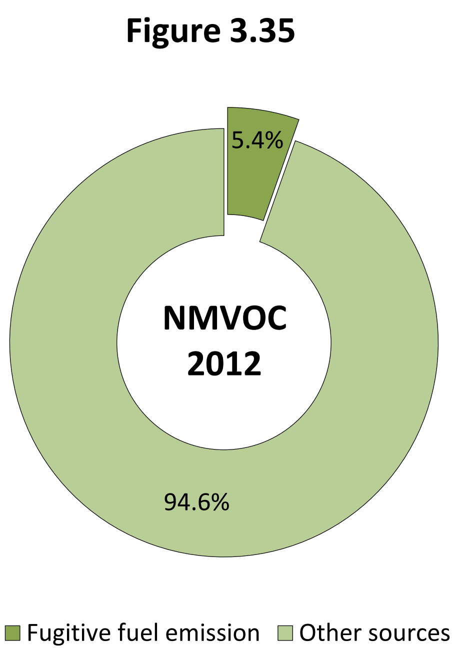
3.4.1. Overview of the sector

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

Table 3.60 Fugitive emissions activities

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

NMVOC emissions from this sector contribute about 5.4% to total national emissions and have decreased by 26.3% up to 2012 compared to 1990 and by 16.3% compared to 2011 due to decreasing emissions from terminals (Figure 3.35 and Table 3.61). Emissions of other pollutants are very small compared to the emissions from the other sectors.



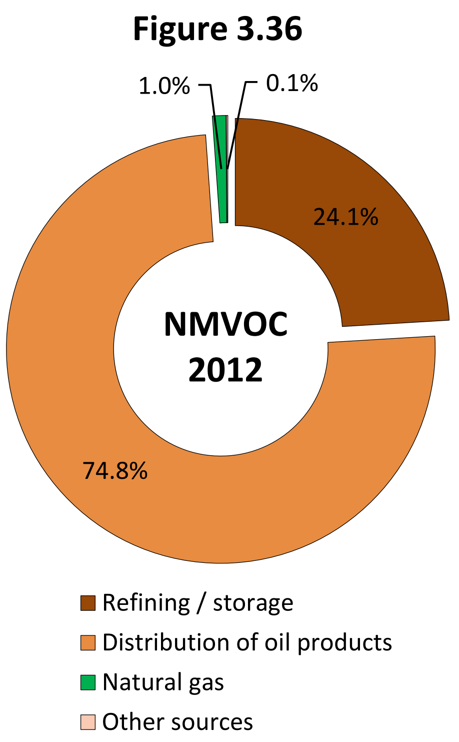


Figure 3.35 NMVOC emission distribution in 2012

Figure 3.36 NMVOC emission distribution within the fuel fugitive emission sector in 2012

Figure 3.36 shows that the distribution of oil products is a main source of NMVOC emissions in the fuel fugitive emissions sector (74.8%).

Table 3.61 Fugitive emission in the period 1990-2012 (Gg)

	NMVOC	$PM_{2.5}$	PM_{10}	TSP	NO_x	CO	NH_3	SO_2
1990	2.474	NR	NR	NR				
1991	2.239	NR	NR	NR				
1992	1.275	NR	NR	NR				
1993	1.275	NR	NR	NR				
1994	1.583	NR	NR	NR				
1995	1.632	NR	NR	NR				
1996	1.911	NR	NR	NR				
1997	2.721	NR	NR	NR				
1998	2.380	NR	NR	NR				
1999	2.740	NR	NR	NR				
2000	4.326	0.010	0.050	0.110	0.010	0.200		
2001	5.197	0.010	0.060	0.170	0.010	0.180		
2002	4.649	0.010	0.080	0.160	0.010	0.270		
2003	4.404	0.010	0.097	0.198	0.010	0.350		
2004	5.184	0.010	0.070	0.140	0.000	0.260	0.010	
2005	4.284	0.010	0.090	0.180	0.010	0.170	0.050	
2006	3.516	0.010	0.110	0.220	0.010	0.250	0.060	

	NMVOC	$PM_{2.5}$	PM_{10}	TSP	NO_x	CO	NH_3	SO_2
2007	1.922	0.010	0.090	0.180	0.010	0.220	0.090	0.010
2008	1.593	0.020	0.105	0.202	0.017	0.276	0.102	0.013
2009	1.684	0.062	0.158	0.267	0.036	0.168	0.089	0.026
2010	1.818	0.069	0.188	0.309	0.035	0.188	0.115	0.018
2011	2.179	0.087	0.211	0.351	0.032	0.813	0.175	0.076
2012	1.824	0.115	0.215	0.329	0.019	2.011	0.212	0.038
trend 1990-2012, %	**-26.3**	**1047.2**	**330.5**	**199.4**	**89.0**	**905.3**	**2016.5**	**282.2**

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

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

3.4.2.1. Source category description

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

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

In Estonia, oil terminals and service stations must have permits when the total loading turnover exceeds 2000 m^3 per year[3]. That means only the smallest service stations are regarded as diffuse sources. Emissions from oil terminals are based on the facilities data. 18 terminals presented reports on emissions in 2012. In the table below, NMVOC emissions from gasoline distribution and terminals are presented.

Table 3.62 NMVOC emissions from liquid fuel distribution in the period 1990-2012 (Gg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Gasoline distribution	2.055	1.820	0.896	0.924	1.124	0.971	1.100	1.199	1.159	1.100	1.108	1.122
Terminals	0.323	0.323	0.323	0.323	0.418	0.625	0.771	1.483	1.184	1.594	3.157	4.012
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	
Gasoline distribution	0.856	0.657	0.628	0.467	0.482	0.514	0.508	0.467	0.447	0.478	0.511	
Terminals	3.645	3.695	3.910	3.199	2.626	1.200	0.629	0.799	0.644	1.265	0.854	

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

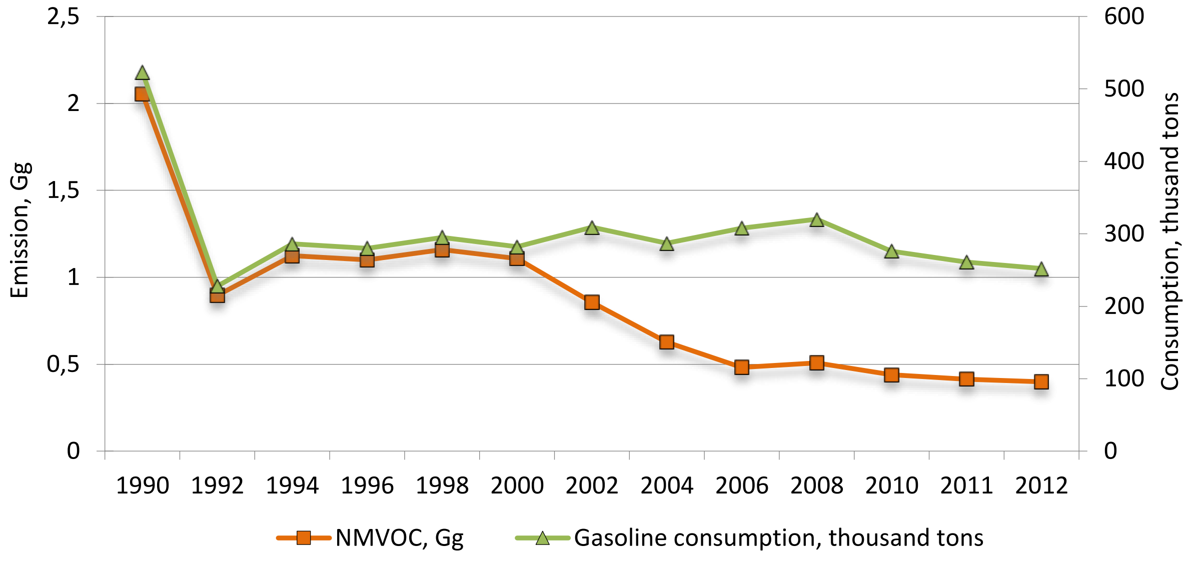


Figure 3.37 NMVOC emission and gasoline distribution in the period 1990-2012

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

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

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

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

3.4.2.2. Methodological issues

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

From 2005, facilities data are used in emission estimates (about 88.3% from total gasoline distribution in 2012). Facilities are obligate to use the national method for NMVOC emission calculation Naftasaaduste laadimisel välisõhku eralduvate lenduvate orgaaniliste ühendite heitkoguste määramismeetodid - Elektrooniline Riigi Teataja

In the period 2005-2012, activity data relating to point sources is available and activity data for emission calculations from diffuse sources is calculated using the following method:

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

Emission factors for diffuse sources

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

1) For the period 1990-2000, the emission factor from Corinair 2007 is applied (3930 g NMVOC/Mg of total gasoline handled);
    - For 2001 – 3350 g/Mg
    - For 2002 – 2770 g/Mg
    - For 2003–2004 – 2190 g/Mg
2) For the period 2005-2012, the Tier 2 technology specific emission factors for Service Stations from the EMEP/EEA Guidebook 2009 is applied. As the majority of the emissions at service stations are from gasoline storage and refuelling (compared to emissions from gasoil), emission factors are only provided for gasoline.

Abatement

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

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

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

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

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

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

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

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

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

[4] www.emhi.ee

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

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

RVP for gasoline is up to 74.6 kPa.

TVP = 74.6 x $10^{(0.000007047x74.6+0.0132)*5+(0.0002311x74.6-0.5236)}$ = 27.2 kPa

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

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

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

Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products					
Category	**Emission source**	**NMVOC emission factor, g/m³ throughput/kPa TVP**	**Abatement efficiency ($\eta_{abatement}$), %**	**True Vapour Pressure (TVP), kPa**	**NMVOC emission factor for gasoline, g/m³ throughput**
Gasoline in service stations	Storage tank Filling with no Stage 1.B	24	95%	27.2	33
	Storage tank Breathing	3	-	27.2	82
	Automobile refuelling with no emission controls in operation	37	-	27.2	1006
	Automobile refuelling Drips and minor spillage	2	-	27.2	54
	Emission factor for all the activities total	**66**	**-**	-	**1175**

Activity data

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

Table 3.65 Consumption of motor gasoline in the period 1990-2012 (thousand tonnes)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
Gasoline consumption	523	463	228	235	286	247	280	305	295	280	282	335
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	
Gasoline consumption	309	300	287	290	308	323	320	293	276	261	252	

3.4.2.3. Sources-specific QA/QC and verification

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

3.4.2.4. Sources-specific planned improvements

It is planned to check the annual average RVP of gasoline.

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

3.4.3.1. Source category description

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

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

Natural gas is imported into Estonia from Russia and from the Inčukalns underground gas storage in Latvia (Figure 3.38).

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

Figure 3.38 Map of high-pressure gas distribution pipelines in Estonia

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

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

Table 3.66 NMVOC emissions from gas distribution in the period 1990-2012 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
NMVOC	0.096	0.096	0.056	0.028	0.041	0.036	0.040	0.039	0.037	0.036	0.031	0.033
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	
NMVOC	0.028	0.032	0.036	0.028	0.028	0.028	0.027	0.018	0.019	0.018	0.019	

[5] Eesti Gaas. Annual Report 2006

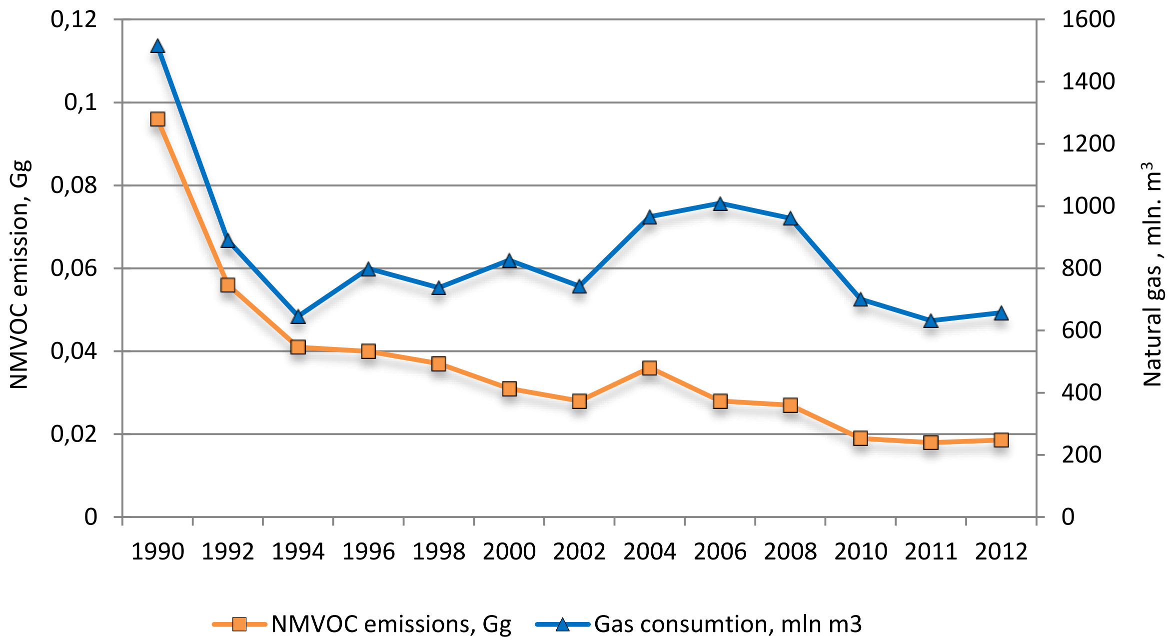


Figure 3.39 NMVOC emission from natural gas distribution in the period 1990-2012

3.4.3.2. Methodological issues

Emission factors

For NMVOC calculations from gas distribution the IPCC Guidelines for National Greenhouse Gas Inventories (2006) are used.

Tier 1 emission factors are used (Equation 1).

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

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

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

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

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

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

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

Category	Sub-category	Emission source	IPCC Code	NMVOC				
				1990	1995	2000	2005-2012	Units of measure
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b.iii.4	1.6E-05	1.3E-05	9.6E-06	7.0E-06	Gg per 10^6 m^3 of marketable gas
		Venting	1.B.2.b.i	1.1E-05	8.7E-06	6.4E-06	4.6E-06	Gg per 10^6 m^3 of marketable gas
Gas Distribution	All	All	1.B.2.b.iii.5	3.6E-05	2.9E-05	2.2E-05	1.6E-05	Gg per 10^6 m^3 of utility sales
Total	-	-	-	**6.3E-05**	**5.0E-05**	**3.8E-05**	**2.8E-05**	**Gg per 10^6 m^3 of utility sales**

Activity data

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

Table 3.69 Gas consumption in the period 1990-2012 (mln m^3)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Gas consumption	1516	1521	890	441	646	723	799	778	738	719	826	887
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	
Gas consumption	743	847	966	997	1009	1003	961	653	701	632	657	

3.4.3.3. Sources-specific QA/QC and verification

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

3.4.3.4. Sources-specific planned improvements

The next planned improvement is to provide uncertainty analysis.

4. INDUSTRIAL PROCESSES (NFR 2)

4.1. Overview of sector

4.1.1. Description

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

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

Table 4.1 Industrial processes reporting activities

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

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

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

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

The share of industry sources into total emissions in 2012 was: TSP – 3.1%, NMVOC – 2.7%, NH_3 - 1% and PM_{10} – 1.2%. The shares of other pollutants were not so significant. The emissions of NMVOC, NH_3 and NO_x have decreased in comparison with 1990 by 94%, 80.5% and 75%, respectively. The emissions of $NO_{x,}$ TSP and CO decreased in 2012 compared to 2011 by 25%, 14% and 20% in the results of the mineral and metal production for the same period. The emissions of NH_3 increased in 2012 compared to 2011 by 11% due to resumption of fertilizer production in Nitrofert AS factory.

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

Table 4.2 Pollutant emissions from the industrial sector in the period 1990-2012

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb
	Gg								Mg
1990	0.190	15.335	NA	0.530	NR	NR	0.940	0.340	NA
1991	0.100	13.894	NA	0.460	NR	NR	0.100	0.300	NA
1992	0.090	9.600	NA	0.440	NR	NR	0.470	0.300	NA
1993	0.050	4.405	NA	0.120	NR	NR	0.150	0.010	NA
1994	0.190	3.513	NA	0.220	NR	NR	0.610	0.040	NA
1995	0.070	4.377	NA	0.240	NR	NR	0.490	NA	NA
1996	0.150	3.191	NA	0.160	NR	NR	0.280	NA	NA
1997	0.150	3.142	NA	0.120	NR	NR	0.140	0.010	NA
1998	0.140	2.400	NA	0.100	NR	NR	0.080	0.020	NA
1999	0.190	1.457	NA	0.140	NR	NR	0.180	NA	NA
2000	0.200	2.080	0.040	0.120	0.123	0.383	1.095	0.530	0.010
2001	0.340	1.449	0.080	0.140	0.153	0.481	1.362	0.510	0.010
2002	0.130	1.513	0.160	0.110	0.184	0.602	1.743	0.280	0.010
2003	0.161	1.932	0.150	0.120	0.205	0.656	1.848	0.290	NA
2004	0.360	1.846	0.130	0.120	0.240	0.800	2.279	0.360	NA
2005	0.180	1.573	0.130	0.200	0.219	0.727	2.053	0.340	NA
2006	0.270	1.303	0.120	0.157	0.170	0.825	2.199	0.380	0.001
2007	0.250	1.072	0.020	0.138	0.222	0.771	2.211	0.440	0.001
2008	0.298	0.959	0.022	0.181	0.245	0.779	2.215	0.481	0.001
2009	0.058	0.881	0.025	0.083	0.210	0.609	1.460	0.424	0.006
2010	0.037	0.861	0.029	0.070	0.157	0.435	1.338	0.461	0.014
2011	0.062	0.919	0.022	0.093	0.185	0.417	1.006	0.420	0.011
2012	0.047	0.909	0.001	0.103	0.095	0.253	0.859	0.336	0.010
trend 1990-2012, %	**-75.5**	**-94.1**		**-80.5**	**-22.5**	**-34.0**	**-8.6**	**-1.2**	

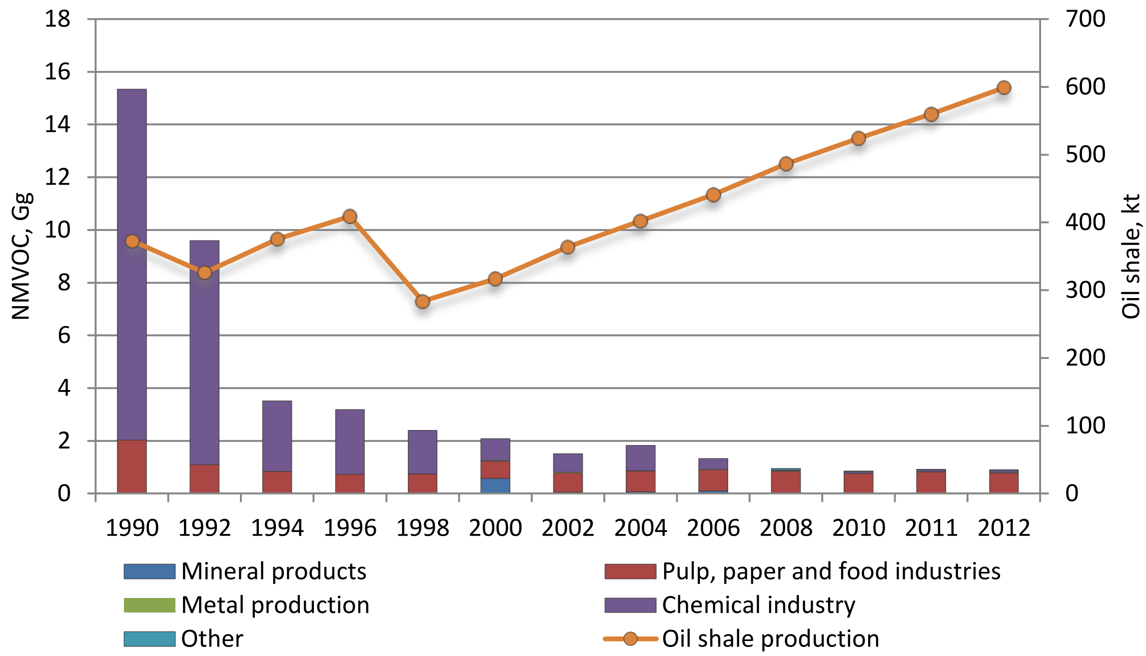


Figure 4.1 NMVOC emissions and oil shale production from the industrial sector in the period 1990-2012

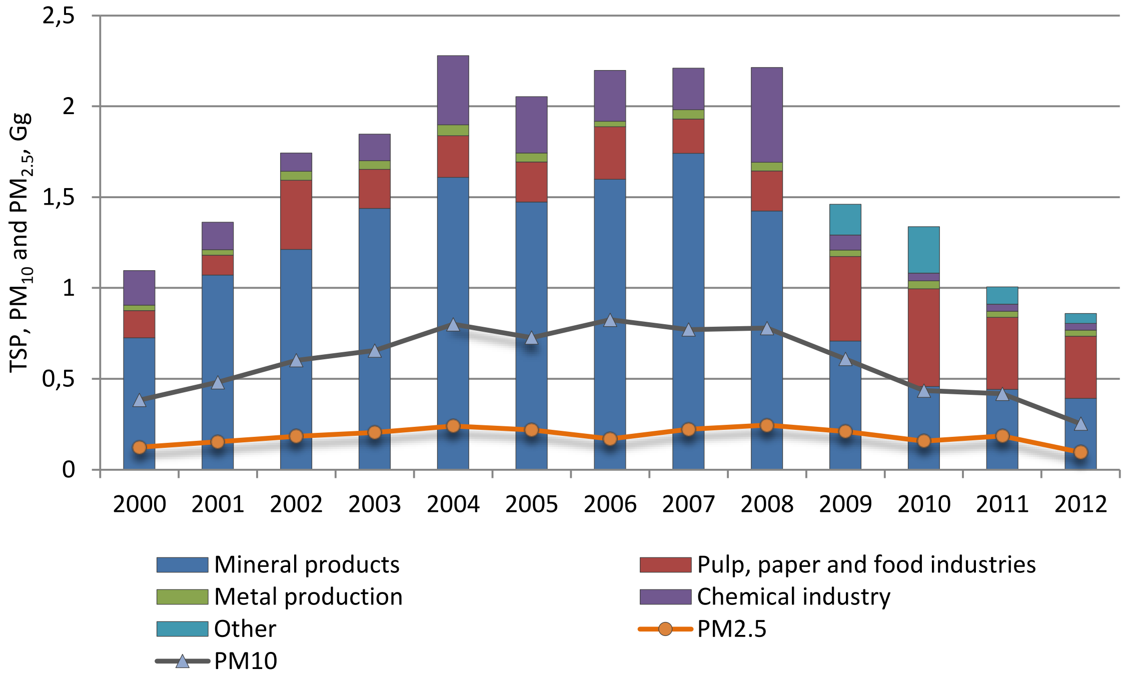


Figure 4.2 PM emissions from the industrial sector in the period 2000-2012

4.2. Mineral Products (NFR 2.A)

4.2.1. Sources category description

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

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

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

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

The quarrying and mining of minerals in Estonia includes limestone and dolomite extraction as well as crushed stone production (Paekivitoodete Tehase OÜ, Saare Dolomiit-Väokivi OÜ etc).

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

Table 4.3 Pollutant emissions from mineral products in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	NA	0.027	NA	NA	NR	NR	NA	NA
1991	NA	0.023	NA	NA	NR	NR	NA	NA
1992	NA	0.003	NA	NA	NR	NR	NA	NA
1993	NA	0.006	NA	NA	NR	NR	NA	NA
1994	NA	0.006	NA	NA	NR	NR	NA	NA
1995	NA	0.008	NA	NA	NR	NR	NA	NA
1996	NA	0.008	NA	NA	NR	NR	NA	NA
1997	NA	0.007	NA	NA	NR	NR	NA	NA
1998	NA	0.008	NA	NA	NR	NR	NA	NA
1999	NA	0.011	NA	NA	NR	NR	NA	NA
2000	NA	0.581	NA	0.010	0.073	0.253	0.725	0.040
2001	0.010	0.019	0.0100	0.010	0.113	0.361	1.072	0.040
2002	NA	0.058	NA	0.010	0.124	0.412	1.213	NA
2003	NA	0.104	NA	0.010	0.151	0.499	1.439	0.010
2004	0.010	0.070	NA	NA	0.160	0.560	1.609	0.010
2005	0.010	0.099	NA	NA	0.159	0.517	1.473	0.020
2006	0.010	0.104	NA	NA	0.100	0.615	1.599	0.030
2007	0.010	0.024	NA	NA	0.022	0.161	0.381	NA
2008	NA	0.024	0.0020	NA	0.025	0.158	0.357	0.003
2009	0.007	0.016	0.0010	NA	0.067	0.263	0.707	0.006
2010	0.006	0.018	0.0004	NA	0.043	0.168	0.459	0.005
2011	0.010	0.020	0.0009	NA	0.043	0.170	0.441	0.008
2012	0.008	0.018	0.0009	0.000	0.036	0.097	0.392	0.007

4.2.2. Methodological issues

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

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

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

Table 4.4 Clinker production and heavy metal emission factors

	Clinker, thousand tonnes	Heavy metals EF, g/t of clinker					
		Pb	Cd	Hg	Cu	Ni	Zn
1990	790.0	78.125	4.060	0.088	2.687	0.313	18.000
1991	773.0	78.125	4.060	0.088	2.687	0.313	18.000
1992	517.0	78.125	4.060	0.088	2.687	0.313	18.000
1993	378.0	78.125	4.060	0.088	2.687	0.313	18.000
1994	540.0	78.125	4.060	0.088	2.687	0.313	18.000
1995	571.0	43.750	2.275	0.049	1.505	0.175	10.080
1996	590.0	12.500	0.650	0.014	0.430	0.050	2.880
1997	651.0	0.780	0.040	0.004	0.030	0.003	0.180
1998	659.0	0.780	0.040	0.004	0.030	0.003	0.180
1999	590.0	0.780	0.040	0.004	0.030	0.003	0.180
2000	620.0	0.780	0.040	0.004	0.030	0.003	0.180
2001	629.0	0.780	0.040	0.004	0.030	0.003	0.180
2002	590.0	0.780	0.040	0.004	0.030	0.003	0.180
2003	560.0	0.780	0.040	0.004	0.030	0.003	0.180
2004	623.0						
2005	636.0						
2006	705.0						
2007	1043.0						
2008	1040.0						
2009	448.5						
2010	536.7						
2011	719.0						
2012	714.6						

Table 4.5 Dioxin emission factors for the cement industry

	Cement			Lime			Bricks and tiles		
	production, tonnes	EF, µg I-TEQ/t	emission, g	production, tonnes	EF, µg I-TEQ/t	emission, g	production, tonnes	EF, µg I-TEQ/t	emission, g
1990	938,000	0.060	0.563	185,000	0.07	0.0130	541,401	0.2	0.108
1991	905,000	0.060	0.543	207,000	0.07	0.0140	592,206	0.2	
1992	483,000	0.060	0.290	92,000	0.07	0.0060	350,444	0.2	0.071
1993	354,000	0.060	0.212	21,000	0.07	0.0010	139,217	0.2	
1994	402,500	0.060	0.242	18,000	0.07	0.0010	128,283	0.2	0.026
1995	417,600	0.060	0.251	16,800	0.07	0.0010	81,343	0.2	
1996	387,700	0.060	0.233	17,400	0.07	0.0010	68,009	0.2	0.014
1997	422,500	0.070	0.030	19,500	0.07	0.0010	62,674	0.2	
1998	321,300	0.070	0.022	32,100	0.07	0.0020	54,674	0.2	0.011
1999	357,700	0.070	0.025	23,300	0.07	0.0020	46,139	0.2	
2000	329,100	0.070	0.023	21,200	0.07	0.0010	45,072	0.2	0.009
2001	404,600	0.070	0.028	20,000	0.07	0,0010	54,140	0.2	
2002	465,900	0.070	0.033	21,200	0.07	0.0010	61,608	0.2	0.012
2003	506,300	0.070	0.035	32,000	0.07	0.0020	63,741	0.2	0.013
2004	506,300	0.070	0,035	32,000	0.07	0.0020	63,741	0.2	0.003
2005	NA	0.070	NE	37,200	0.07	0.0020	NA	0.2	NE
2006	848,900	0.099	0.059	39,700	0.07	0.0030	82,667	0.2	0.016
2007	936,200	0.070	0.065	43,500	0.07	0.0030	143,485	0.2	0.029
2008	806,100	0.003	0.056	59,400	0.07	0.0040	113,081	0.2	0.023
2009	326,000	0.003	0.023	30,200	0.07	0.0040	38,938	0.2	0.007
2010	536,700	0.004	0.037	27,200	0.07	0.0019	56,500	0.2	0.011
2011	719,002	0.004	0.037	36,100	0.07	0.0019	84,544	0.2	0.011
2012	714,600	0.004	0.037	72,000	0.07	0.0019		0.2	0.011

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

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

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

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

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

Activity data

Information regarding asphalt production and laying is available from the Estonian Asphalt Pavement Association (www.asfaldiliit.ee) for the years 1990-2012 (Table 4.7). According to the Asphalt Pavement Association, all production companies but not all asphalt laying companies are members of the association. The value of the asphalt produced is higher than the quantity of laid asphalt. For that reason, asphalt production values are used for emission calculations from road paving with asphalt.

Table 4.7 Activity data for NMVOC emission calculations from asphalt production in the period 1990-2012 (tonnes)

	Produced Asphalt Mixtures
1990	1,711,000
1991	1,433,000
1992	167,000
1993	359,000
1994	345,000
1995	475,000
1996	472,000
1997	419,000
1998	509,000
1999	707,000
2000	667,000
2001	568,000
2002	1,132,000
2003	865,000
2004	1,103,000
2005	1,164,000
2006	1,481,908
2007	1,486,572
2008	1,506,846
2009	1,174,624
2010	1,118,187
2011	1,277,793
2012	1,128,815

Information regarding constructions is available from Statistics Estonia (www.stat.ee) for the years 2000-2012 (Table 4.8). The historical data (1990-1999) for TSP calculations are not available. There is also no statistical information regarding the demolition of buildings, so only data pertaining to construction were used.

Table 4.8 Activity data for PM emission calculations from the construction sector in the period 2000-2012 (m^2 floor area)

	Dwelling	Non-residential building
2000	78,862.5	324,243.6
2001	70,701.1	309,140.8
2002	112,661.9	399,996.3
2003	217,048.5	639,150.8
2004	277,072.3	952,474.1
2005	325,565.0	743,899.4
2006	391,999.5	896,644.2
2007	566,674.9	920,778.8
2008	458,415.2	1,004,572.0
2009	304,982.2	797,777.0
2010	237,818.0	425,393.0
2011	205,922.7	326,307.0
2012	233,432.6	473,582.6

4.3. Chemical industry (NFR 2.B)

4.3.1. Sources category description

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

At the end of 2012, after a three years of break, Estonia's only producer of fertiliser Nitrofert AS started working again.

The share of NMVOC emissions from the chemical industry in total country emissions was about 22% in 1990, and 0.2% in 2012 (Figure 4.3). The main reason for this is a decrease in the manufacturing of chemical production at shale oil enterprises. Emissions from the chemical industry sector are presented in Table 4.9.

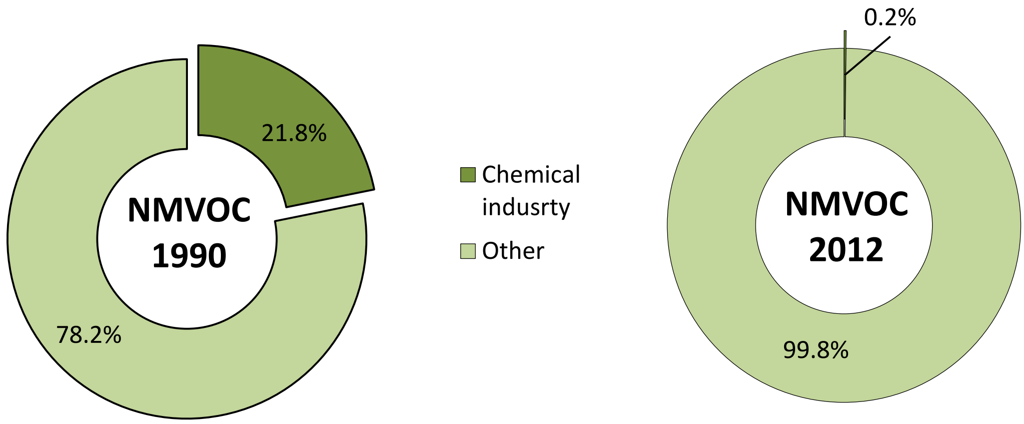


Figure 4.3 Distribution of NMVOC emissions by activities in 1990 and 2012

Table 4.9 Emissions from the chemical industry in the period 1990-2012 (Gg)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	0.190	13.300	NA	0.370	NR	NR	0.940	0.340
1991	0.100	12.330	NA	0.300	NR	NR	0.100	0.300
1992	0.090	8.500	NA	0.280	NR	NR	0.470	0.300
1993	0.050	3.500	NA	0.080	NR	NR	0.150	0.010
1994	0.190	2.670	NA	0.140	NR	NR	0.610	0.040
1995	0.070	3.530	NA	0.140	NR	NR	0.490	NA
1996	0.150	2.460	NA	0.070	NR	NR	0.280	NA
1997	0.150	2.390	NA	0.060	NR	NR	0.140	0.010
1998	0.140	1.650	NA	0.060	NR	NR	0.080	0.020
1999	0.190	0.790	NA	0.090	NR	NR	0.180	NA
2000	0.190	0.840	NA	0.040	0.020	0.060	0.190	0.340
2001	0.310	0.770	0.010	0.030	0.020	0.050	0.150	0.320
2002	0.100	0.710	NA	0.020	0.010	0.030	0.100	0.230
2003	0.130	1.065	0.010	0.050	0.016	0.048	0.146	0.270
2004	0.320	0.960	0.010	0.080	0.040	0.120	0.380	0.330
2005	0.160	0.720	NA	0.130	0.030	0.100	0.310	0.290
2006	0.230	0.410	NA	0.060	0.030	0.090	0.280	0.330
2007	0.200	0.120	NA	0.071	0.020	0.070	0.230	0.360
2008	0.255	0.041	0.001	0.132	0.057	0.172	0.522	0.398
2009	0.025	0.068	NA	0.012	0.009	0.027	0.083	0.364
2010	NA	0.071	NA	0.010	0.005	0.014	0.042	0.405
2011	NA	0.073	NA	0.017	0.004	0.013	0.038	0.374
2012	0.024	0.073	0.000	0.023	0.004	0.012	0.036	0.305
trend 1990-2012, %		**-99.5**		**-93.8**	**-80.1**	**-80.1**	**-96.1**	**-10.2**

4.3.2. Methodological issues

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

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

Table 4.10 Main chemicals and fuel production in the period 1990-2012 (kt)

	Ammonia	Oil shale	Benzene	Toluene	Coke
1990	294	..	91.5	40.1	..
1991	270	..	..	..	..
1992	140	..	..	..	..
1993	55	..	..	..	..
1994	180	..	..	..	..
1995	201	..	49.3	21.1	..
1996	203	..	34.3	11.2	..
1997	206	..	37.5	10.8	..
1998	211	..	23.8	4.6	..
1999	199	..	14.5	4.5	..
2000	177	169.3	13.5	4.6	23.0
2001	183	281.7	6.5	1.5	27.0
2002	47	301.8	0	0	30.0
2003	98	317.6	0	0	30.0
2004	202	340.0	0	0	35.6
2005	213	367.4	0	0	38.7
2006	211	389.2	0	0	40.0
2007	202	436.6	0	0	39.7
2008	209	444.8	0	0	34.6
2009	..	489.3	0	0	21.4
2010	..	524.3	0	0	22.4
2011	..	559.9	0	0	24.4
2012	..	598.9	0	0	26.3

4.4. Metal Production (NFR 2.C)

4.4.1. Sources category description

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

Emissions from the metal industry are presented in Table 4.11.

Table 4.11 Emissions from the metal production sector in the period 1990-2012 (Gg)

	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1990	NA	NA	0.160	NR	NR	NA	NA
1991	NA	NA	0.160	NR	NR	NA	NA
1992	NA	NA	0.160	NR	NR	NA	NA
1993	NA	NA	0.040	NR	NR	NA	NA
1994	NA	NA	0.080	NR	NR	NA	NA
1995	NA	NA	0.100	NR	NR	NA	NA
1996	NA	NA	0.090	NR	NR	NA	NA
1997	NA	NA	0.060	NR	NR	NA	NA
1998	NA	NA	0.040	NR	NR	NA	NA
1999	NA	NA	0.050	NR	NR	NA	NA
2000	NA	0.010	0.040	0.010	0.020	0.030	0.010
2001	0.010	0.010	0.080	0.010	0.030	0.030	0.010
2002	0.010	0.020	0.060	0.010	0.040	0.050	0.010
2003	0.011	0.015	0.050	0.014	0.038	0.048	0.010
2004	0.010	0.010	0.030	0.020	0.050	0.060	0.020
2005	0.010	0.010	0.060	0.010	0.040	0.050	0.010
2006	0.030	0.010	0.080	0.010	0.030	0.030	0.020
2007	0.020	0.010	0.060	0.010	0.040	0.050	0.020
2008	0.015	0.008	0.034	0.021	0.028	0.048	0.023
2009	0.008	0.004	0.066	0.017	0.022	0.035	0.012
2010	0.013	0.006	0.052	0.021	0.020	0.044	0.009
2011	0.014	0.008	0.070	0.016	0.021	0.033	0.009
2012	0.014	0.007	0.072	0.012	0.014	0.034	0.009

4.4.2. Methodological issues

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

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

4.5.1. Sources category description

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

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

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

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

Table 4.12 Pollutant emissions from the pulp, paper and food industries in the period 1990-2012 (Gg)

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

	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP	CO
2007	0.010	0.848	0.020	0.020	0.060	0.190	0.020
2008	0.018	0.823	0.018	0.024	0.073	0.221	0.028
2009	0.017	0.767	0.024	0.098	0.240	0.466	0.027
2010	0.018	0.743	0.028	0.059	0.177	0.538	0.028
2011	0.038	0.798	0.020	0.112	0.184	0.398	0.015
2012	0.000	0.767	0.000	0.038	0.114	0.343	0.000

4.5.2. Methodological issues

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

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

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

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

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

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

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

There are also some permitted fish processing companies (mainly smoking) that report NMVOC emissions. Some permit applications were studied (Maseko and Spratfil in Harju and Ida-Viru County) and it was found that NMVOC emission originates from smoke generators as a result of incomplete combustion and not from fish processing itself. Therefore, these emissions are different from the calculated NMVOC emission, which primarily occur from the cooking of meat, fish and poultry, releasing mainly fats and oils and their degradation products.

Table 4.13 NMVOC emission factors for the food and drink industries

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

Activity data

Information regarding food and drink production is available from Statistics Estonia (www.stat.ee) for the years 1990-2012 (Tables 4.14-4.15).

Table 4.14 Activity data for the food industries in the period 1990-2012 (thousand tonnes)

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

	Bread and pastry	Flour confectionery	Meat total (slaughter weight)	Fish total	Solid cooking fats	Margarine	Concentrated feeding stuffs
2010	73.7	8.4	75.4	95.95	..	..	203.0
2011	77.0	9.5	80.6	81.30	..	..	216.2
2012	76.7	8.0	78.4	67.8	..	..	210.1

Table 4.15 Activity data for the drinks industries in the period 1990-2012 (thousand hl)

	Wine of fruits and berries	Beer	Crude spirits	Distilled spirits
1990	37.0	769.0	82.0	147.0
1991	50.9	675.5	83.4	160.5
1992	20.5	425.7	70.7	120.9
1993	13.0	419.3	94.1	168.4
1994	12.8	476.9	76.1	123.0
1995	14.0	499.6	91.0	176.0
1996	22.0	459.0	79.0	96.0
1997	21.5	543.0	77.0	109.0
1998	31.0	744.0	59.0	102.0
1999	24.0	957.0	32.0	66.0
2000	32.6	950.1	20.4	86.4
2001	30.4	1,015.2	24.1	115.2
2002	34.3	1,044.1	33.1	142.4
2003	34.5	1,040.2	38.3	173.1
2004	60.7	1,202.8	40.0	187.9
2005	88.8	1,342.5	37.1	167.9
2006	77.5	1,431.1	61.6	183.1
2007	53.5	1,411.6	39.3	216.0
2008	38.8	1,281.8	15.5	202.8
2009	40.4	1,223.0	1.3	186.6
2010	64.7	1,291.7	0.1	150.7
2011	73.3	1,358.8	13.3	169.2
2012	96.3	1,460.0	4.5	182.0

4.6. Source-specific QA/QC and verification

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

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

4.7. Sources-specific planned improvements

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

5. SOLVENT AND OTHER PRODUCT USE (NFR 3)

5.1. Overview of the sector

5.1.1. Description

This chapter describes emissions from solvents and other product use. The use of solvents and products containing solvents results in emissions of non-methane volatile organic compounds (NMVOC) when emitted into the atmosphere. In addition to solvents, this sector also includes the emissions of particulate matter from painting, tobacco smoking and use of fireworks under NFR 3.D.3. Also, heavy metals, CO, NO_x and POP emissions are calculated from tobacco smoking.

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

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

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

Table 5.1 Activities and emissions reported from the solvent and other product use sector in 2012

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

NFR	Source	Description	Emissions reported
		paints, inks and glues manufacturing, textile finishing, leather tanning and other use of solvents.	
3.D	**Other product use**		
	1. Printing	Emissions from solvents in printing houses.	NMVOC, TSP
	2. Domestic solvent use including fungisides	NMVOC emissions from domestic solvent use.	NMVOC
	3. Other product use	Includes emissions from oil extraction, application of glues and adhesives, preservation of wood, use of tobacco and other solvent use.	NMVOC, NO_x, NH_3, TSP, PM_{10}, $PM_{2.5}$, CO, Pb, Cd, Hg, As, Cr, Cu, PCDD/PCDF, PAHs (Total)

5.1.2. Quantitative overview of NMVOCs

In 2012, the solvent and other product use sector was the largest pollution source of NMVOC emissions in Estonia after the non-industrial combustion and it accounted for over 19% of total NMVOC emissions. The largest share was for decorative coating application at 22.1%, with the others being domestic solvent use at 20.5%, degreasing 15.7%, industrial coating application 15.2%, other product use 14.0%, printing 7.2%, chemical products 5.2% and dry cleaning 0.1% (Figure 5.1).

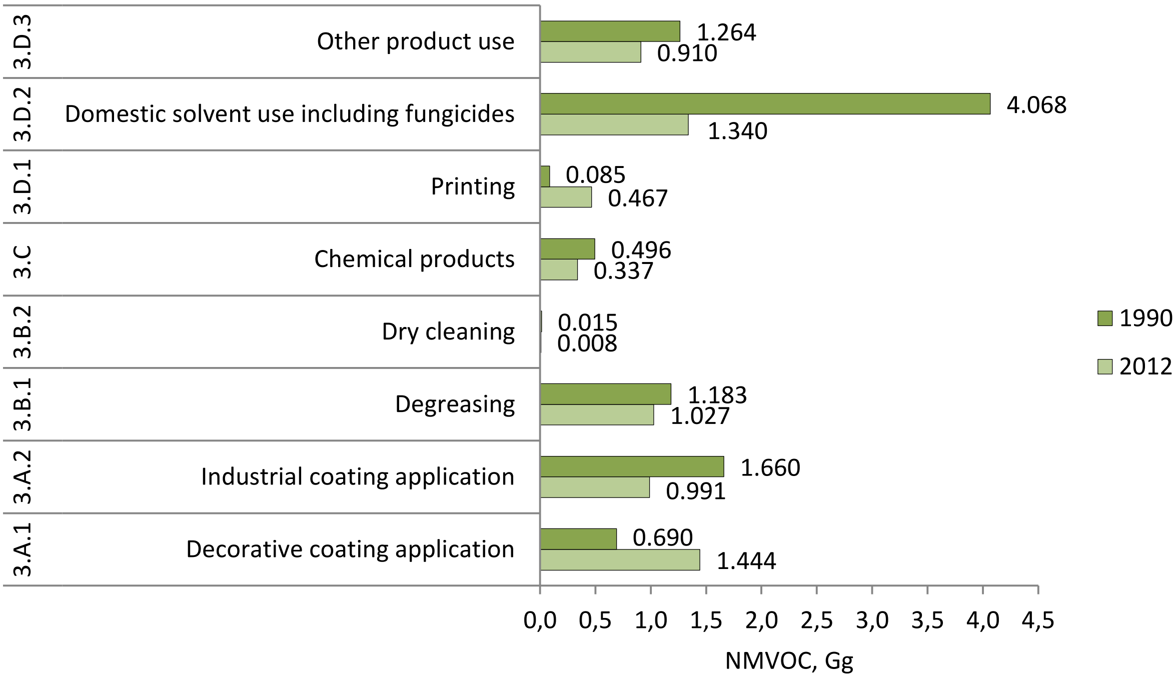


Figure 5.1 NMVOC emissions by sectors in 1990 and 2012

There has been a decrease in trends in NMVOC emissions from solvent and other product use in recent years. Since 1990, NMVOC emissions have decreased in the NFR 3 sector by 31% (Figure 5.2). The trend in emissions is determined, in order of importance, by categories 3.A (Paint Application) and 3.D (Other Product Use). Two major categories where the decreasing of NMVOC emissions has occurred in recent years include paint application

(3.A.1) and other product use (3.D.3). The fluctuation of NMVOC emissions in the period 1990-2012 has mostly occurred due to the welfare of the economic state of the country. The decrease in emissions between 1991 and 1993 was due to the renewed independece of the Estonian Republic and the cessation of large-scale production that was distinctive to the Soviet Union. Between 1993 and 1998, the economic growth induced the growing usage of NMVOC containing paints in decorative and industrial coating applications. At the end of 1998, the world was struck by an economic crisis that affected the construction sector and this had a knock-on effect on the usage of decorative coatings. From 2001, the economy began to grow again until 2008, when the world suffered its worst ever economic depression. As a result, by the year 2010, NMVOC emissions fell 40% in comparison with 2006 (Figure 5.3). In 2011 there was a slight increase in NMVOC emissions by 10.9%, which means that the bottom of the emissions has been reached and henceforward the emissions will start to rise again. In 2004 and 2005 Estonia adopted directives 1999/13/EC and 2004/42/EC into its legislation, but it seems that the economic growth at the time did not have a significant affect on decrease in NMVOC emissions and they grew steadily until the economic depression. One reason why the possible positive effect of the legislation did not manifest on the graph is because the emissions from the point sources that are calculated more precisely by the facilities than the emissions from the diffuse sources, represent only about 20% of total NMVOC emissions.

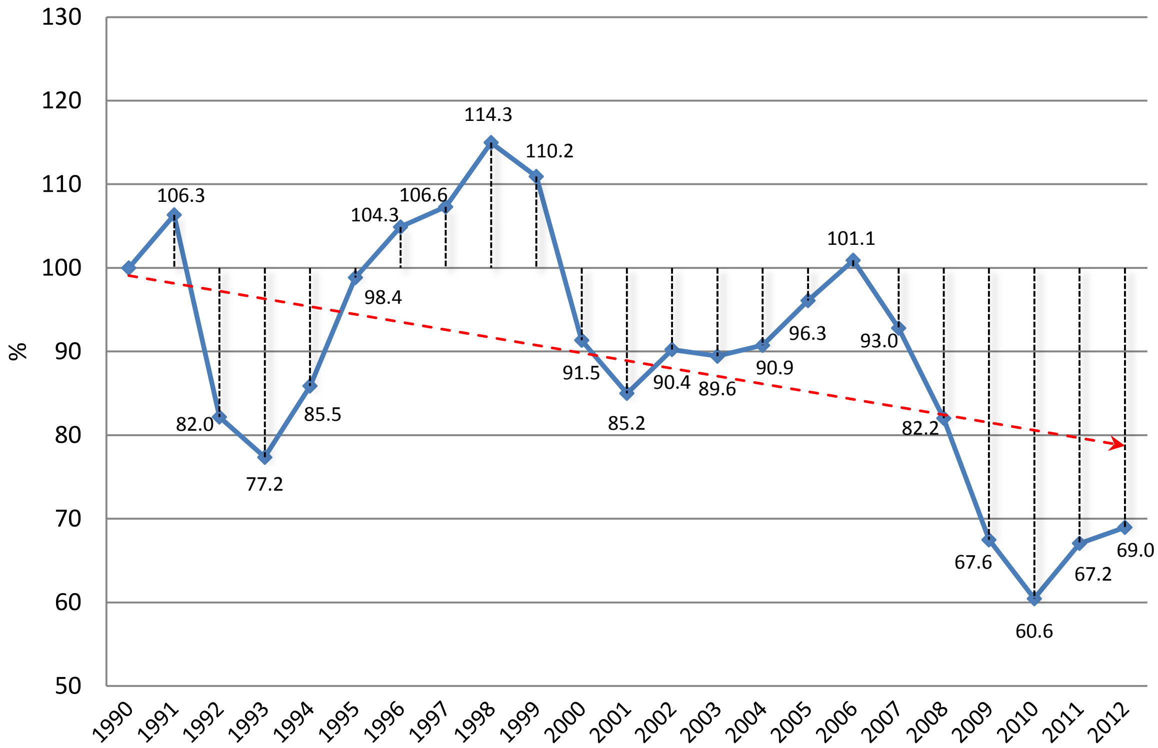


Figure 5.2 The dynamics of NMVOC emissions from the solvent and other product use sector in the period 1990-2012 (base year is 1990)

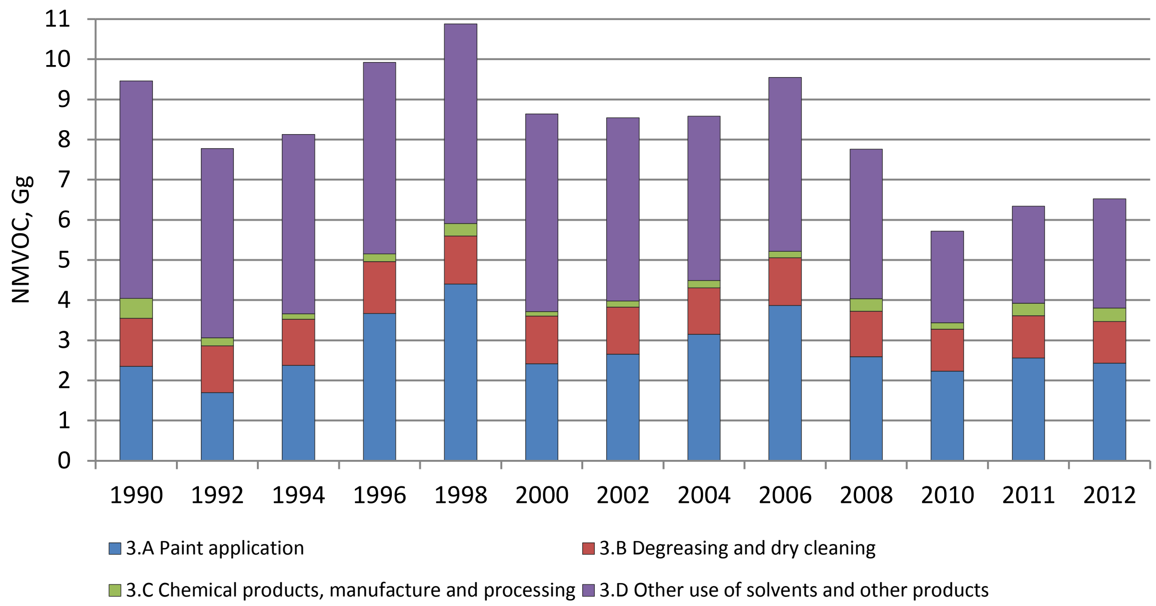


Figure 5.3 NMVOC emissions from the solvent and other product use sector in the period 1990-2012

Table 5.2 NMVOC emissions in the period 1990-2012 reported under NFR 3 (Gg)

Sector	3.A.1	3.A.2	3.A.3	3.B.1	3.B.2	3.C	3.D.1	3.D.2	3.D.3
1990	0.690	1.660	IE[1]	1.183	0.015	0.496	0.085	4.068	1.264
1991	0.751	2.017	IE[1]	1.169	0.012	0.615	0.071	4.060	1.365
1992	0.995	0.705	IE[1]	1.149	0.011	0.201	0.058	4.027	0.628
1993	1.018	0.550	IE[1]	1.124	0.012	0.135	0.062	3.914	0.505
1994	1.845	0.529	IE[1]	1.136	0.018	0.135	0.097	3.825	0.540
1995	2.214	1.010	IE[1]	1.157	0.025	0.250	0.136	3.751	0.810
1996	2.818	0.851	IE[1]	1.258	0.030	0.197	0.132	3.691	0.949
1997	3.196	0.898	IE[1]	1.223	0.005	0.192	0.190	3.642	0.808
1998	3.118	1.281	IE[1]	1.178	0.024	0.307	0.209	3.608	1.154
1999	3.150	0.974	IE[1]	1.173	0.050	0.217	0.250	3.572	1.111
2000	1.913	0.505	IE[1]	1.139	0.050	0.107	0.263	3.554	1.111
2001	1.817	0.447	IE[1]	1.097	0.047	0.113	0.306	3.103	1.113
2002	2.035	0.617	IE[1]	1.118	0.056	0.151	0.334	2.654	1.574
2003	2.220	0.558	IE[1]	1.096	0.064	0.127	0.412	2.224	1.763
2004	2.528	0.623	IE[1]	1.093	0.064	0.184	0.583	1.783	1.728
2005	2.891	0.733	IE[1]	1.093	0.062	0.125	0.774	1.348	2.065
2006	2.953	0.914	IE[1]	1.124	0.065	0.158	0.666	1.345	2.323
2007	2.747	1.017	IE[1]	1.094	0.054	0.265	0.491	1.342	1.772
2008	1.639	0.950	IE[1]	1.084	0.051	0.314	0.773	1.341	1.607
2009	1.434	0.622	IE[1]	1.008	0.022	0.497	0.228	1.340	1.233
2010	1.470	0.622	IE[1]	1.029	0.012	0.164	0.354	1.340	0.587
2011	1.696	0.863	IE[1]	1.035	0.019	0.313	0.344	1.340	0.734
2012	1.444	0.991	IE[1]	1.027	0.008	0.337	0.467	1.340	0.910

[1] Included in 3.A.1

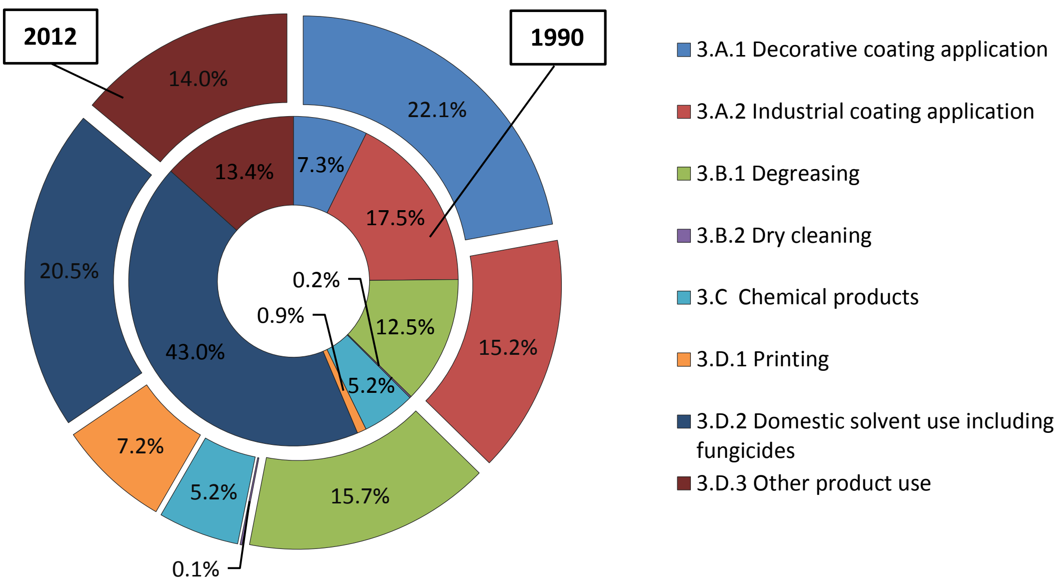


Figure 5.4 The share of NMVOC emissions in 1990 and 2012 by NFR 3 subcategory codes

5.1.3. Methods

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

Table 5.3 Information sources for the NMVOC inventory under NFR 3

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

NFR	Product group	SNAP	Activity where used	Reference	NMVOC emission factors
3.B.1	Degreasing: Solvents in products	060200	Degreasing (vapour and cold cleaning)	Statistics Estonia	460 g/kg cleaning products (vapour)*; 0.7 kg/person/year (cold)*
		060201	Metal degreasing (regarded as vapour cleaning)	Reported by operators	
		060203	Electronic components manufacturing	Reported by operators	
		060204	Other industrial cleaning	Reported by operators	
3.B.2	Dry cleaning: Chlorinated solvents in products	060202	Dry cleaning	Statistics Estonia; reported by operators	400 g/kg solvent use*
3.C	Solvents in chemical products manufacture and processing	060301	Polyester processing	Not included	
		060302	Polyvinylchloride processing	Not included	
		060303	Polyurethane processing	Reported by operators	
		060304	Polystyrene foam processing	Reported by operators	
		060305	Rubber processing	Reported by operators	
		060306	Pharmaceutical products manufacturing	Not included	
		060307	Paints manufacturing	Reported by operators	
		060308	Inks manufacturing	Reported by operators	
		060309	Glues manufacturing	Reported by operators	
		060310	Asphalt blowing	Not included	
		060311	Adhesive, magnetic tapes, films and photographs manufacturing	Not included	
		060312	Textile finishing	Reported by operators	
		060313	Leather tanning	Reported by operators	
		060314	Other	Reported by operators	
3.D.1	Solvents in printing houses	060403	Printing industry	Statistics Estonia; reported by operators	500 g/kg ink*
3.D.2	Personal care, household cleaning agents, motor & vehicle cleaning agents, adhesives and sealants	060408	Domestic solvent use (other than paint application)	Statistics Estonia	1 kg/person/year*
3.D.3	Solvents in other product use	060401	Glass wool enduction	Not included	
		060402	Mineral wool enduction	Not included	
		060404	Fat, edible and	Reported by operators	

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

*EF's for diffuse sources

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

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

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

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

5.2. Paint Application (NFR 3.A)

5.2.1. Source category description

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

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

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

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

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

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

By 2012, NMVOC emissions from this sector had increased by 3.6% compared to 1990.

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

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

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

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

- Paint application: domestic use (SNAP activity 060104)

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

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

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

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

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

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

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

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

5.2.2. Methodological issues

The Tier 1 default emission factors have been taken from the online version of the GAINS model (IIASA, 2008). A (rounded) weighted average emission factor over all the countries in the model have been derived from dividing total NMVOC emissions by total paint use. Data for the year 2000 has been used in order to estimate an average emission factor to describe the situation; however, care should be taken when applying this emission factor. Due to EU directive 2004/42/EC, which came into force on 1 January 2007, it is no longer permitted to bring decorative or vehicle refinishing paint products to the market with a VOC content that exceeds the maximum for those product categories in EU Member States. For non-EU countries, however, emissions may be significantly higher than the estimate provided here. This has been taken into account in the 95% confidence intervals. These are expert judgements based on former values and the more specific implied emission factors from GAINS.

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

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

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

For the years 2000-2012, EMEP Guidebook 2009 Tier 1 emission factor 150 g/kg paint applied is used for calculations. The following equation is applied:

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

Where:

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

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

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

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

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

Precise division by solvent borne and water borne paint production is not known. The ratio is estimated by production for the year 2000, when approximately 55% of paint produced was solvent borne and 45% was water borne. By also taking import and export data into account, it was estimated that 58% of decorative paint used in 1995 was solvent borne and 42% of paint was water borne.

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

(58% x 350 g/kg + 42% x 33 g/kg) / 100% = 217 g/kg of paint

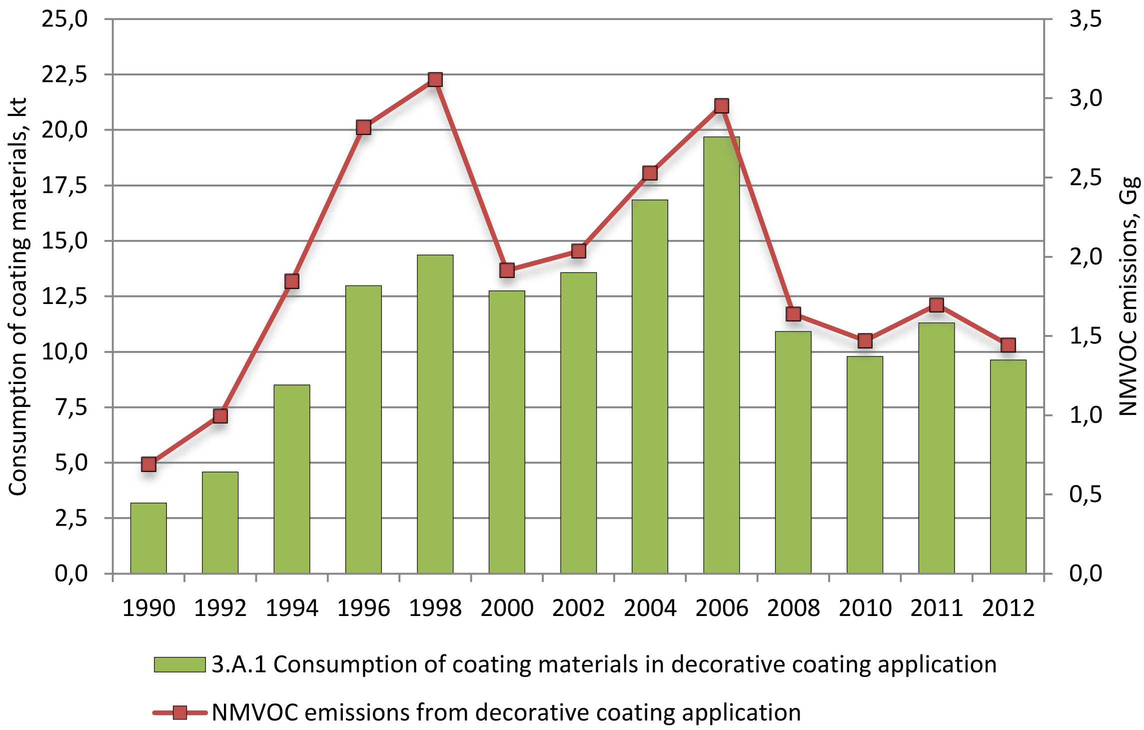


Figure 5.5 Consumption of coating materials and NMVOC emissions from decorative coating application in the period 1990-2012

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

For the years 2000-2012, EMEP Guidebook 2009 Tier 1 emission factor 400 g/kg paint applied is used for calculations. The following equation is applied:

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

Where:

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

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

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

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

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

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

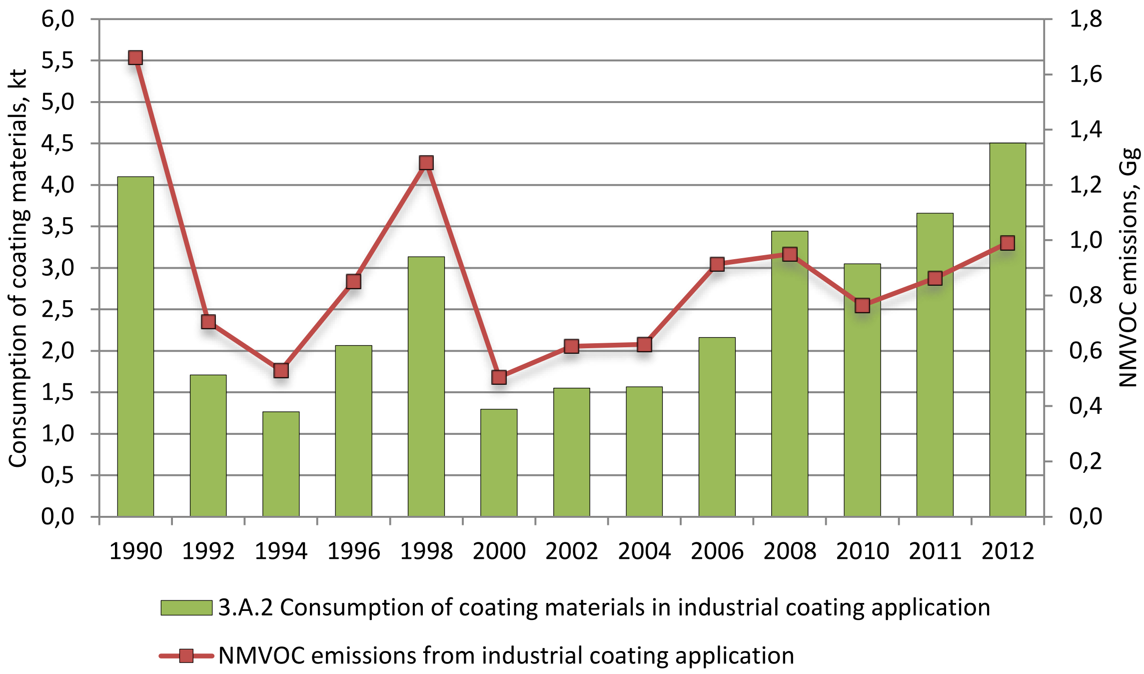


Figure 5.6 Consumption of coating materials and NMVOC emissions from industrial coating application in the period 1990-2012

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

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

5.2.2.3. Activity data

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

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

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

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

The expert opinion was received from Benefit AS, which is the leading car body and car paint shops technology and materials supplier in Estonia. The total amount of paint used for car repairing in Estonia is estimated to have risen from 100 tonnes in 1990 up to 198.2 tonnes in 2012. As this is a rough estimate, the annual growth is estimated to be equal.

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

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

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

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

Data regarding paint use in point sources is available in the OSIS database for the years 2006-2012.

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

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

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

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

- Sales division by companies and private customers depends on the marketing policy of the store,
- A change in the division between 1995 and 2012 also depends on the marketing policy,
- In the years 2004-2007, an increase of paint use was mainly caused by the rapid increase in developments and construction; the increased use of paint was mainly caused by professional painters and construction companies.

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

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

Therefore, the following assumptions were made:

- For the years 1990-2003 and 2008-2012, it is estimated that up to 60% of paint went to professional painters and the remaining 40% to private customers;
- Consumption among private consumers in 2005-2007 is assumed to be equal to consumption in 2000, and the remaining part is deemed used by professional painters and construction companies. 2004 is a transitional year between 2003 and 2005.

Table 5.4 NMVOC emissions and the consumption of coating materials from paint application by SNAP codes in the period 1990-2012

SNAP code	060103		060104	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	0.414	1.908	0.276	1.272
1991	0.450	2.076	0.300	1.384
1992	0.597	2.752	0.398	1.835
1993	0.611	2.813	0.407	1.876
1994	1.107	5.101	0.738	3.401
1995	1.328	6.122	0.886	4.081
1996	1.691	7.790	1.127	5.194
1997	1.918	8.838	1.279	5.892
1998	1.871	8.620	1.247	5.747
1999	1.890	8.710	1.260	5.807
2000	1.148	7.654	0.765	5.102
2001	1.090	7.266	0.727	4.844
2002	1.221	8.139	0.814	5.426
2003	1.332	8.881	0.888	5.920
2004	1.688	11.250	0.840	5.600
2005	2.126	14.169	0.765	5.100
2006	2.188	14.588	0.765	5.100
2007	1.982	13.213	0.765	5.100
2008	0.983	6.554	0.655	4.370
2009	0.861	5.737	0.574	3.825
2010	0.882	5.880	0.588	3.920
2011	1.018	6.786	0.679	4.524
2012	0.867	5.777	0.578	3.851

Table 5.5 NMVOC emissions and consumption of coating materials from paint application by SNAP codes in the period 1990-2012

SNAP code	060100		060101		060102		060106		060107		060108	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	1.575	3.938	NA	NA	0.060	0.100	IE[1]	IE[1]	IE[1]	IE[1]	0.025	0.063
1991	1.955	4.887	NA	NA	0.063	0.104	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
1992	0.639	1.598	NA	NA	0.065	0.109	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
1993	0.428	1.071	NA	NA	0.068	0.113	IE[1]	IE[1]	0.054	0.135	IE[1]	IE[1]
1994	0.430	1.076	NA	NA	0.071	0.118	IE[1]	IE[1]	0.027	0.067	0.001	0.004

SNAP code	060100		060101		060102		060106		060107		060108	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1995	0.795	1.989	NA	NA	0.073	0.122	IE[1]	IE[1]	0.047	0.119	0.094	0.236
1996	0.626	1.565	NA	NA	0.076	0.126	IE[1]	IE[1]	0.037	0.093	0.112	0.280
1997	0.610	1.526	NA	NA	0.078	0.131	IE[1]	IE[1]	0.097	0.243	0.112	0.280
1998	0.976	2.439	NA	NA	0.081	0.135	IE[1]	IE[1]	0.110	0.276	0.113	0.284
1999	0.689	1.721	NA	NA	0.084	0.140	IE[1]	IE[1]	0.088	0.220	0.113	0.284
2000	-	-	NA	NA	0.058	0.178	0.117	0.292	0.119	0.298	0.211	0.528
2001	-	-	NA	NA	0.059	0.175	0.116	0.290	0.218	0.544	0.054	0.136
2002	-	-	NA	NA	0.061	0.161	0.080	0.201	0.244	0.611	0.231	0.577
2003	-	-	NA	NA	0.063	0.164	0.082	0.206	0.184	0.461	0.229	0.572
2004	-	-	NA	NA	0.065	0.170	0.137	0.342	0.209	0.523	0.212	0.530
2005	-	-	0.002	0.004	0.066	0.169	0.131	0.329	0.184	0.459	0.350	0.874
2006	-	-	0.003	0.006	0.068	0.170	0.171	0.505	0.407	0.828	0.265	0.650
2007	-	-	0.002	0.002	0.072	0.178	0.357	1.126	0.439	1.191	0.147	0.659
2008	-	-	NO	NO	0.073	0.183	0.335	1.024	0.369	1.188	0.173	1.050
2009	-	-	NO	NO	0.075	0.187	0.160	0.477	0.302	1.362	0.085	0.343
2010	-	-	NO	NO	0.076	0.191	0.157	0.575	0.409	1.552	0.123	0.730
2011	-	-	NO	NO	0.077	0.196	0.135	0.470	0.463	2.056	0.188	0.938
2012	-	-	NO	NO	0.078	0.204	0.109	0.385	0.539	2.723	0.267	1.198

[1] Included under SNAP 060100

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

5.2.3. Source-specific QA/QC and verification

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

5.2.4. Source-specific planned improvements

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

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

5.3.1. Source category description

5.3.1.1. Degreasing (NFR 3.B.1)

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

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

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

In 2012, NMVOC emissions from the NFR 3.B sector had decreased by 13.2% in comparison to the year 1990.

5.3.1.1.1. Vapour cleaning

The most common organic solvents for vapour cleaning are:

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

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

5.3.1.1.2. Cold cleaning

The two basic types of cold cleaners are maintenance and manufacturing. Cold cleaners are batch loaded, non-boiling solvent degreasers, usually providing the simplest and least expensive method of metal cleaning. Maintenance cold cleaners are smaller, more numerous, and generally use petroleum solvents as mineral spirits (petroleum distillates and Stoddard solvents).

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

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

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

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

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

5.3.2. Methodological issues

5.3.2.1. Degreasing

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

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

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

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

5.3.2.1.1. Emission factor for vapour cleaning

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

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

Where:

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

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

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

5.3.2.1.2. Emission factor for cold cleaning

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

5.3.2.1.3. Activity data

Vapour cleaning operations

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

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

The consumption of organic solvents is estimated by the import and export data from Statistics Estonia (by relevant CN codes). Data regarding import and export is not available for the years 1990-1994; therefore, these amounts were calculated by the change of percentage of the current prices in the industrial production of chemicals and chemical products in that period. There is no information available regarding production for the years 1990-2005. The OSIS database provides some information regarding xylenes production between 2006 and 2012.

Cold cleaning operations

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

Data regarding population by counties is available from Statistics Estonia.

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

5.3.2.1.4. Results

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

Between 2006 and 2012, activity data regarding solvent use for degreasing in point sources was gathered in the OSIS database.

For the years 2006-2012, activity data for calculations is calculated as follows:

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

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

Table 5.6 NMVOC emissions and the consumption of solvents from degreasing by SNAP codes in the period 1990-2012

SNAP code	060200		060200		060201		060203		060204	
Year	NMVOC (vapour cleaning), Gg	Activity data, kt	NMVOC (cold cleaning), Gg	Activity data, mln.inhab.	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	0.084	0.183	1.099	1.571	NA	NA	NA	NA	NA	NA
1991	0.071	0.155	1.097	1.568	NA	NA	NA	NA	NA	NA
1992	0.061	0.132	1.088	1.555	NA	NA	NA	NA	NA	NA
1993	0.067	0.145	1.058	1.511	NA	NA	NA	NA	NA	NA
1994	0.102	0.223	1.034	1.477	NA	NA	NA	NA	NA	NA
1995	0.143	0.312	1.014	1.448	NA	NA	NA	NA	NA	NA
1996	0.260	0.566	0.998	1.425	NA	NA	NA	NA	NA	NA
1997	0.239	0.519	0.984	1.406	NA	NA	NA	NA	NA	NA
1998	0.203	0.440	0.975	1.393	NA	NA	NA	NA	NA	NA
1999	0.207	0.451	0.965	1.379	NA	NA	NA	NA	NA	NA
2000	0.178	0.387	0.960	1.372	NA	NA	0.001	0.001	NA	NA
2001	0.137	0.298	0.957	1.367	0.0007	0.0015	0.002	0.004	0.00061	0.00133
2002	0.160	0.347	0.953	1.361	0.0026	0.0057	0.002	0.005	0.00048	0.00104
2003	0.142	0.308	0.949	1.356	0.0025	0.0053	0.002	0.005	0.00057	0.00124
2004	0.141	0.306	0.946	1.351	0.0031	0.0068	0.003	0.006	0.00006	0.00013
2005	0.146	0.318	0.943	1.348	0.0003	0.0007	0.003	0.006	0.00051	0.00111
2006	0.157	0.342	0.941	1.345	0.0015	0.0028	0.018	0.056	0.00518	0.00582
2007	0.128	0.277	0.940	1.342	0.0048	0.0059	0.009	0.021	0.01300	0.01413
2008	0.099	0.216	0.939	1.341	0.0005	0.0006	0.013	0.026	0.03204	0.03824
2009	0.046	0.099	0.938	1.340	0.0059	0.0067	0.005	0.008	0.01243	0.01840
2010	0.058	0.127	0.938	1.340	0.0115	0.0119	0.005	0.008	0.01587	0.01989
2011	0.057	0.124	0.938	1.340	0.0074	0.0075	0.005	0.008	0.02707	0.02822
2012	0.041	0.089	0.938	1.340	0.0051	0.0062	0.003	0.008	0.04020	0.03620

For the SNAP code 060201, emissions and solvent consumption are based on the reported data from the point sources for the period 2001-2012. For the SNAP code 060202 for the years 2000 and 2001, only statistical data is used and for 2002 to 2012 both statistical and reported data is used. For the SNAP codes 060203 and 060204, only data reported for point sources is used for the period 2000-2012.

5.3.2.2. Dry Cleaning

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

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

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

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

5.3.2.2.1. Situation in Estonia

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

Main findings:

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

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

Questions and answers are given in the table below.

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

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

5.3.2.2.2. Activity data

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

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

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

Used solvent goes to hazardous waste companies.

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

According to OSIS, no production of tetrachloroethylene/perchloroethylene is reported for the years 2006-2012.

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

5.3.2.2.3. Results

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

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

Table 5.8 NMVOC emissions and the consumption of solvents from dry cleaning by SNAP codes in the period 1990-2012

SNAP code	060202	
Year	**NMVOC, Gg**	**Activity data, kt**
1990	0.015	0.036
1991	0.012	0.031
1992	0.011	0.026
1993	0.012	0.029
1994	0.018	0.044
1995	0.025	0.062
1996	0.030	0.076
1997	0.005	0.012
1998	0.024	0.060
1999	0.050	0.124
2000	0.050	0.126
2001	0.047	0.117
2002	0.056	0.131
2003	0.064	0.152
2004	0.064	0.153
2005	0.062	0.149
2006	0.065	0.158
2007	0.054	0.131
2008	0.051	0.124
2009	0.022	0.052
2010	0.012	0.026
2011	0.019	0.042
2012	0.008	0.016

5.3.3. Source-specific QA/QC and verification

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

5.3.4. Source-specific planned improvements

No major improvements are planned for the next submission.

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

5.4.1. Source category description

This chapter covers emissions from the use of chemical products. These include many activities such as paints, inks, glues and adhesives manufacturing, polyurethane and polystyrene foam processing, tyre production, fat, edible and non-edible oil extraction and more. However, many of these activities are considered insignificant. For example, total NMVOC emissions from these activities contributed just 1% to total national NMVOC emissions in 2012 and only 5.2% to the whole NRF 3 sector.

By 2012, NMVOC emissions from the NFR 3.C sector have decreased 32% compared to the year 1990.

5.4.2. Methodological issues

This sector includes emissions from polyurethane, polystyrene foam and rubber processing, paints, inks and glues manufacturing, textile finishing, leather tanning and other chemical products manufacturing or processing activities under SNAP 060314. All emission estimates for the years 2006-2012 from the NFR 3.C sector are based on emission data reported by operators in the OSIS database, and because of that they are divided by different SNAP codes. At present, only total NMVOC emissions for the years 1990-2005 are known without any activity data. Also, for some activities, the activity data are unknown for the period 2006-2012.

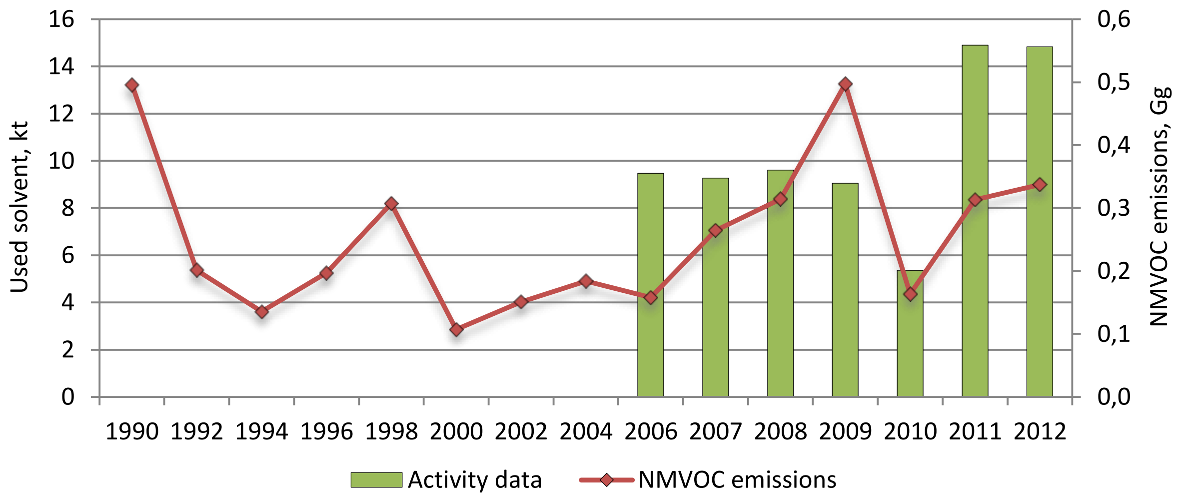


Figure 5.7 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period 1990-2012

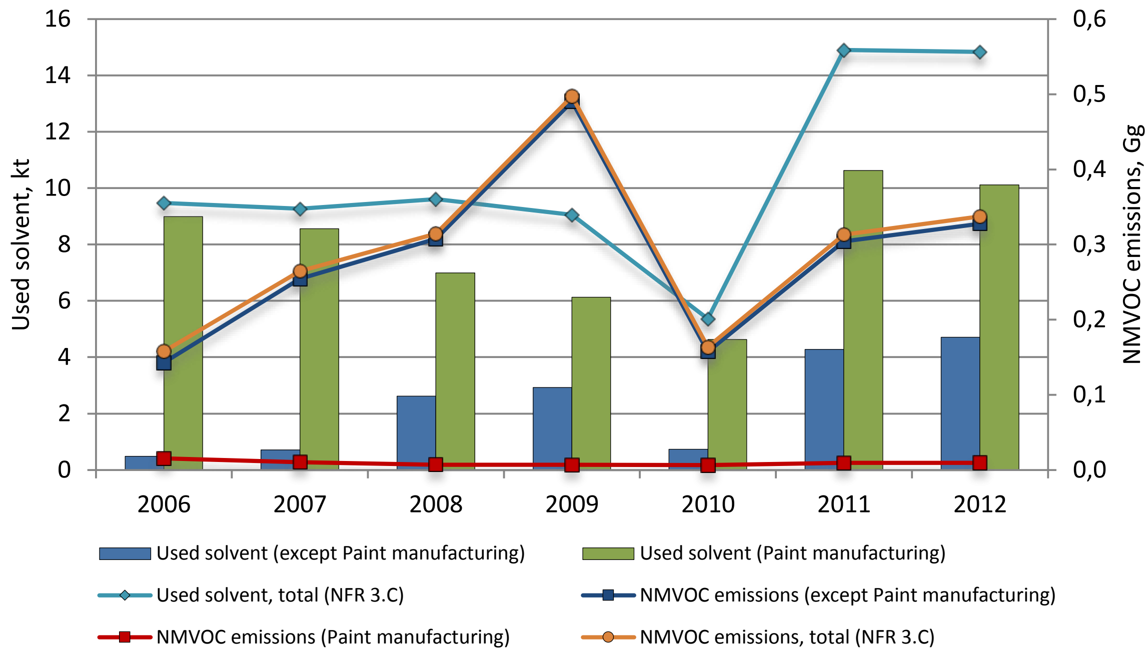


Figure 5.8 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period 2006-2012

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

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

Table 5.9 NMVOC emissions and the consumption of solvents from chemical products manufacturing or processing by SNAP codes in the period 1990-2012

SNAP code	060300		060303		060304		060305		060307	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	0.496	NA	NA	NA	NA	NA	NA	NA	NA	NA
1991	0.615	NA	NA	NA	NA	NA	NA	NA	NA	NA
1992	0.201	NA	NA	NA	NA	NA	NA	NA	NA	NA
1993	0.135	NA	NA	NA	NA	NA	NA	NA	NA	NA
1994	0.135	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	0.250	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	0.197	NA	NA	NA	NA	NA	NA	NA	NA	NA
1997	0.192	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	0.307	NA	NA	NA	NA	NA	NA	NA	NA	NA
1999	0.217	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	0.107	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	0.113	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	0.151	NA	NA	NA	NA	NA	NA	NA	NA	NA

SNAP code	060300		060303		060304		060305		060307	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
2003	0.127	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	0.184	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	0.125	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006	-	-	0.001428	NA	0.079	0.136	0.032	0.022	0.015	8.987
2007	-	-	0.000087	0.001225	0.123	0.089	0.019	0.326	0.010	8.560
2008	-	-	0.003941	0.001193	0.109	2.165	0.008	0.014	0.007	6.988
2009	-	-	0.006130	0.003646	0.043	1.680	0.006	0.021	0.007	6.126
2010	-	-	0.008150	0.005290	0.052	0.073	0.014	0.010	0.006	4.628
2011	-	-	0.012633	3.421080	0.062	0.106	0.019	0.019	0.009	10.628
2012	-	-	0.010391	3.891760	0.060	0.091	0.019	0.011	0.009	10.120

SNAP code	060308		060309		060312		060313		060314	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1998	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1999	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006	NA	NA	0.001982	0.088021	0.001727	NA	0.000040	0.001360	0.026	0.236
2007	0.00051	0.04055	0.001538	NA	0.000154	NA	0.000043	0.001460	0.111	0.248
2008	0.00065	0.05320	0.000641	NA	0.000005	NA	0.000064	0.002710	0.186	0.383
2009	0.00032	0.02616	0.000447	0.000577	0.000002	NA	0.000245	0.007518	0.434	1.187
2010	0.00032	0.02616	0.000434	0.000575	0.000001	NA	0.000297	0.014275	0.082	0.601
2011	NA	NA	0.000042	NA	0.000356	0.000250	0.000182	0.012870	0.210	0.714
2012	NA	NA	0.000014	NA	0.000350	0.000188	0.000170	0.018028	0.238	0.703

5.4.3. Source-specific QA/QC and verification

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

5.4.4. Source-specific planned improvements

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

5.5. Other (NFR 3.D)

5.5.1. Source category description

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

5.5.1.1. Printing (NFR 3.D.1)

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

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

- Heat set offset printing

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

- Publication packaging

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

- Rotogravure & Flexography

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

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

Situation in Estonia

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

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

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

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

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

5.5.1.3.1. Fat, edible and non-edible oil extraction

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

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

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

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

5.5.1.3.2. Preservation of wood

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

5.5.1.3.3. Vehicles dewaxing

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

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

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

5.5.1.3.4. Treatment of vehicles

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

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

5.5.1.3.5. Industrial application of adhesives

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

Relevant sectors are the production of adhesive tapes, composite foils, the transportation sector (passenger cars, commercial vehicles, mobile homes, rail vehicles and aircrafts), the manufacture of shoes and leather goods, and the wood material and furniture industry (EGTEI, 2003).

In 2012, NMVOC emissions from the NFR 3.D sector have decreased by 49.8% compared to the year 1990.

5.5.2. Methodological issues

5.5.2.1. Printing Industry (3.D.1)

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

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

Where:

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

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

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

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

An approach combining ink consumption with emission factor is applied.

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

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

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

5.5.2.1.1. Activity Data

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

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

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

5.5.2.1.2. Results

A number of printing facilities is permitted.

Between 2006 and 2012, activity data regarding ink use in point sources is collected in the OSIS database.

For the years 2006 to 2012, activity data for calculations are calculated as follows:

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

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

Table 5.10 NMVOC emissions and the consumption of solvents from printing industry by SNAP code in the period 1990-2012

SNAP code	060403	
Year	NMVOC, Gg	Activity data, kt
1990	0.085	0.171
1991	0.071	0.142
1992	0.058	0.117
1993	0.062	0.124
1994	0.097	0.194
1995	0.136	0.271
1996	0.132	0.264
1997	0.190	0.379
1998	0.209	0.418
1999	0.250	0.500
2000	0.263	0.525
2001	0.306	0.611
2002	0.334	0.668
2003	0.412	0.823
2004	0.583	1.165
2005	0.774	1.547
2006	0.666	1.762
2007	0.491	2.090
2008	0.773	2.330
2009	0.228	1.708
2010	0.354	2.150
2011	0.344	2.062
2012	0.467	2.406

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

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

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

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

Where:

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

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

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

The default emission factor for this source category is presented in the following table. It has been derived from an assessment of the emission factors presented in the GAINS model (IIASA, 2008). It represents a weighted average of the emission factor from this model for all the countries considered in 2000.

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

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

5.5.2.2.1. Activity Data

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

Table 5.11 NMVOC emissions from domestic solvent use (other than paint application) and the population of Estonia by SNAP code in the period 1990-2012

SNAP code	**060408**	
Year	NMVOC, Gg	Activity data, mln.inhab.
1990	4.068	1.571
1991	4.060	1.568
1992	4.027	1.555
1993	3.914	1.511
1994	3.825	1.477
1995	3.751	1.448
1996	3.691	1.425
1997	3.642	1.406
1998	3.608	1.393
1999	3.572	1.379
2000	3.554	1.372
2001	3.103	1.367
2002	2.654	1.361

SNAP code	060408	
Year	NMVOC, Gg	Activity data, mln.inhab.
2003	2.224	1.356
2004	1.783	1.351
2005	1.348	1.348
2006	1.345	1.345
2007	1.342	1.342
2008	1.341	1.341
2009	1.340	1.340
2010	1.340	1.340
2011	1.340	1.340
2012	1.340	1.340

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

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

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

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

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

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

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

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

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

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

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

5.5.2.3.3. Application of glues and adhesives (SNAP 060405)

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

Activity data

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

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

The quantity of industrially used adhesives is estimated by import, export and production data (CN code 35069100). Import and export data is available from Statistics Estonia. Production data is available from the OSIS database for the years 2006-2012. At present, there is no information available regarding adhesive production between 1990 and 1999.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2012, activity data regarding adhesives use in point sources is collected in the OSIS database (SNAP 060405).

For the years 2006-2012, activity data for calculations is calculated as following:

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

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

5.5.2.3.4. Preservation of wood (SNAP 060406)

The Estonian Forest Industries Association was questioned regarding wood preservation.

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

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

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

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

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

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

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

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

Between 1990 and 2000, treatment with bituminous materials was widespread, but there are no statistics available. Nowadays, treatment with bituminous coating is negligible, and treatment is done by special polymers, if needed.

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

The Tier 2 emission factor is used for calculations – 0.2 kg/person/year.

As the number of cars in Estonia per inhabitant was smaller than the number of cars per inhabitant in the European Union, a reduction coefficient for the emission factor is applied.

Table 5.12 Motorisation rate - cars per 1,000 inhabitants[8]

Year	Number of vehicles per 1000 inhabitants		Coefficient, %
	Estonia	EU-15	
1990	153	386	40%
1991	167	386	43%
1992	182	401	45%
1993	210	413	51%
1994	229	420	55%
1995	265	427	62%
1996	285	435	66%
1997	304	436	70%
1998	324	451	72%
1999	333	461	72%
2000	338	472	72%

It means that for example in 1995 the number of cars per inhabitant accounted for 62% of the average European Union country value and in 2000 for 72%. Information for 1990 was not found and it was taken equal with the year 1991.

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

The customized emission factors were calculated by the following example:

Year 1995: 0.2 x 62% = 0.124 kg/person/year

Year 2000: 0.2 x 72% = 0.143 kg/person/year

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

5.5.2.3.6. Vehicles dewaxing (SNAP 060409)

The Association of Estonian Automobile Sales and Maintenance Companies and Toyota Baltic plc were interviewed in 2010 regarding this activity.

It was found that at least no dewaxing operations have been carried out in at least the last five years. If required, paint protection is provided by using (polyethylene) film. Waxing is only used in very rare cases, such as special deliveries by sea transport from long distances.

In the period from 1995 to 2005, dewaxing was carried out in rare cases, i.e. special delivery directly from Japan. For these cases, it is not known if dewaxing was carried out in Finland or in Estonia. It is very difficult to obtain relevant data. Most of the dewaxing operations of imported cars are conducted in a treatment centre that is located in the port of Hanko in Finland.

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

5.5.2.3.7. Domestic use of pharmaceutical products (SNAP 060411)

Not included in this inventory due to lack of methodology and emission factor.

5.5.2.3.8. Other (SNAP 060412)

NMVOC emissions and activity data for the years 2000-2012 are gathered from OSIS and CollectER databases, and are reported by operators.

5.5.2.3.9. Use of tobacco (SNAP 060602)

The Tier 2 emission factors are used for pollutant emissions calculations.

Table 5.13 Emission factors from the EMEP/EEA emission inventory guidebook 2009 for calculating pollutant emissions from tobacco combustion

Pollutant	Emission Factor	Unit
NMVOC	4.8	g/ton tobacco
NO_x	3.5	g/ton tobacco
CO	122	g/ton tobacco
TSP	40	g/ton tobacco
PM_{10}	40	g/ton tobacco
$PM_{2.5}$	40	g/ton tobacco
PCDD/F	1.3	ng/ton tobacco
PAH-4	8.3	mg/ton tobacco
Pb	0.05	mg/ton tobacco
Cd	0.1	mg/ton tobacco
Hg	0.1	mg/ton tobacco
As	0.16	mg/ton tobacco
Cr	0.35	mg/ton tobacco
Cu	0.15	mg/ton tobacco

The quantity of tobacco combusted (smoked) in Estonia is estimated by the import and export data (CN code 2402) available from Statistics Estonia.

Data regarding import and export and production is not available for the years 1990-1994.

Tobacco products were produced in Estonia until 1996; as a result, the production amounts for the years 1990-1994 are considered equal with consumption (Table 5.14).

Table 5.14 The use of tobacco and pollutant emissions from tobacco combustion in the period 1990-2012 (except NMVOC)

Year	Use of tobacco, kt	NO_x	CO	TSP	PM_{10}	$PM_{2.5}$	PCDD/F	PAH-4
		Gg					g I-Teq	Mg
1990	3.494	0.000012	0.000426	0.000140	0.000140	0.000140	0.0000045	0.000029
1991	3.001	0.000011	0.000366	0.000120	0.000120	0.000120	0.0000039	0.000025
1992	1.493	0.000005	0.000182	0.000060	0.000060	0.000060	0.0000019	0.000012
1993	2.207	0.000008	0.000269	0.000088	0.000088	0.000088	0.0000029	0.000018
1994	1.919	0.000007	0.000234	0.000077	0.000077	0.000077	0.0000025	0.000016
1995	1.784	0.000006	0.000218	0.000071	0.000071	0.000071	0.0000023	0.000015
1996	1.686	0.000006	0.000206	0.000067	0.000067	0.000067	0.0000022	0.000014
1997	2.667	0.000009	0.000325	0.000107	0.000107	0.000107	0.0000035	0.000022
1998	1.576	0.000006	0.000192	0.000063	0.000063	0.000063	0.0000020	0.000013
1999	1.756	0.000006	0.000214	0.000070	0.000070	0.000070	0.0000023	0.000015
2000	1.630	0.000006	0.000199	0.000065	0.000065	0.000065	0.0000021	0.000014
2001	1.628	0.000006	0.000199	0.000065	0.000065	0.000065	0.0000021	0.000014
2002	1.928	0.000007	0.000235	0.000077	0.000077	0.000077	0.0000025	0.000016
2003	1.958	0.000007	0.000239	0.000078	0.000078	0.000078	0.0000025	0.000016
2004	1.948	0.000007	0.000238	0.000078	0.000078	0.000078	0.0000025	0.000016
2005	2.088	0.000007	0.000255	0.000084	0.000084	0.000084	0.0000027	0.000017
2006	2.047	0.000007	0.000250	0.000082	0.000082	0.000082	0.0000027	0.000017

Year	Use of tobacco, kt	NO_x	CO	TSP	PM_{10}	$PM_{2.5}$	PCDD/F	PAH-4
		Gg					g I-Teq	Mg
2007	2.958	0.000010	0.000361	0.000118	0.000118	0.000118	0.0000038	0.000025
2008	1.286	0.000005	0.000157	0.000051	0.000051	0.000051	0.0000017	0.000011
2009	1.987	0.000007	0.000242	0.000079	0.000079	0.000079	0.0000026	0.000016
2010	1.024	0.000004	0.000125	0.000041	0.000041	0.000041	0.0000013	0.000008
2011	1.561	0.000005	0.000190	0.000062	0.000062	0.000062	0.0000020	0.000013
2012	1.490	0.000005	0.000182	0.000060	0.000060	0.000060	0.0000019	0.000012

Year	Use of tobacco, kt	Pb	Cd	Hg	As	Cr	Cu
		Mg					
1990	3.494	0.00000017	0.00000035	0.00000035	0.00000056	0.00000122	0.00000052
1991	3.001	0.00000015	0.00000030	0.00000030	0.00000048	0.00000105	0.00000045
1992	1.493	0.00000007	0.00000015	0.00000015	0.00000024	0.00000052	0.00000022
1993	2.207	0.00000011	0.00000022	0.00000022	0.00000035	0.00000077	0.00000033
1994	1.919	0.00000010	0.00000019	0.00000019	0.00000031	0.00000067	0.00000029
1995	1.784	0.00000009	0.00000018	0.00000018	0.00000029	0.00000062	0.00000027
1996	1.686	0.00000008	0.00000017	0.00000017	0.00000027	0.00000059	0.00000025
1997	2.667	0.00000013	0.00000027	0.00000027	0.00000043	0.00000093	0.00000040
1998	1.576	0.00000008	0.00000016	0.00000016	0.00000025	0.00000055	0.00000024
1999	1.756	0.00000009	0.00000018	0.00000018	0.00000028	0.00000061	0.00000026
2000	1.630	0.00000008	0.00000016	0.00000016	0.00000026	0.00000057	0.00000024
2001	1.628	0.00000008	0.00000016	0.00000016	0.00000026	0.00000057	0.00000024
2002	1.928	0.00000010	0.00000019	0.00000019	0.00000031	0.00000067	0.00000029
2003	1.958	0.00000010	0.00000020	0.00000020	0.00000031	0.00000069	0.00000029
2004	1.948	0.00000010	0.00000019	0.00000019	0.00000031	0.00000068	0.00000029
2005	2.088	0.00000010	0.00000021	0.00000021	0.00000033	0.00000073	0.00000031
2006	2.047	0.00000010	0.00000020	0.00000020	0.00000033	0.00000072	0.00000031
2007	2.958	0.00000015	0.00000030	0.00000030	0.00000047	0.00000104	0.00000044
2008	1.286	0.00000006	0.00000013	0.00000013	0.00000021	0.00000045	0.00000019
2009	1.987	0.00000010	0.00000020	0.00000020	0.00000032	0.00000070	0.00000030
2010	1.024	0.00000005	0.00000010	0.00000010	0.00000016	0.00000036	0.00000015
2011	1.561	0.00000008	0.00000016	0.00000016	0.00000025	0.00000055	0.00000023
2012	1.490	0.00000007	0.00000015	0.00000015	0.00000024	0.00000052	0.00000022

Table 5.15 NMVOC emissions from chemical products manufacturing or processing and the activity data by SNAP codes in the period 1990-2012

SNAP code	060400		060404		060405		060406	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	0.817	NA	NA	NA	0.324	0.415	NA	NA
1991	1.014	NA	NA	NA	0.215	0.275	NA	NA
1992	0.332	NA	NA	NA	0.155	0.198	NA	NA
1993	0.224	NA	NA	NA	0.127	0.163	NA	NA
1994	0.223	NA	NA	NA	0.155	0.199	NA	NA
1995	0.412	NA	NA	NA	0.218	0.279	NA	NA
1996	0.325	NA	NA	NA	0.438	0.562	NA	NA
1997	0.316	NA	NA	NA	0.296	0.379	NA	NA
1998	0.506	NA	NA	NA	0.448	0.574	NA	NA
1999	0.357	NA	NA	NA	0.556	0.712	NA	NA
2000	-	-	NA	NA	0.907	1.162	0.00050	NA
2001	-	-	NA	NA	0.928	1.189	0.00193	NA
2002	-	-	0.0013	NA	1.385	1.776	0.00014	NA
2003	-	-	0.0017	NA	1.601	2.052	NA	NA
2004	-	-	0.0016	NA	1.609	2.063	NA	NA
2005	-	-	0.0018	NA	2.060	2.641	0.00001	NA
2006	-	-	0.0018	NA	2.291	3.365	0.00306	0.069

SNAP code	060400		060404		060405		060406	
Year	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
2007	-	-	0.0017	NA	1.751	3.968	0.01457	0.029
2008	-	-	0.0017	NA	1.578	2.516	0.00736	0.017
2009	-	-	0.0016	NA	1.205	1.944	0.01376	0.026
2010	-	-	0.0015	NA	0.561	1.238	0.01143	0.018
2011	-	-	0.0009	NA	0.699	1.477	0.01075	0.022
2012	-	-	0.0003	NA	0.865	1.733	0.01061	0.022

SNAP code	060407		060412		060602	
Year	NMVOC, Gg	Activity data, mln.inhab.	NMVOC, Gg	Activity data, kt	NMVOC, Gg	Activity data, kt
1990	0.124	1.571	NA	NA	0.000017	3.494
1991	0.136	1.568	NA	NA	0.000014	3.001
1992	0.141	1.555	NA	NA	0.000007	1.493
1993	0.154	1.511	NA	NA	0.000011	2.207
1994	0.161	1.477	NA	NA	0.000009	1.919
1995	0.180	1.448	NA	NA	0.000009	1.784
1996	0.187	1.425	NA	NA	0.000008	1.686
1997	0.195	1.406	NA	NA	0.000013	2.667
1998	0.201	1.393	NA	NA	0.000008	1.576
1999	0.199	1.379	NA	NA	0.000008	1.756
2000	0.196	1.372	0.008	NA	0.000008	1.630
2001	0.176	1.367	0.008	NA	0.000008	1.628
2002	0.157	1.361	0.030	NA	0.000009	1.928
2003	0.136	1.356	0.025	NA	0.000009	1.958
2004	0.116	1.351	0.001	NA	0.000009	1.948
2005	NO	-	0.003	NA	0.000010	2.088
2006	NO	-	0.028	0.238	0.000010	2.047
2007	NO	-	0.005	0.289	0.000014	2.958
2008	NO	-	0.020	0.353	0.000006	1.286
2009	NO	-	0.013	0.052	0.000010	1.987
2010	NO	-	0.012	0.069	0.000005	1.024
2011	NO	-	0.022	0.081	0.000008	1.561
2012	NO	-	0.034	0.137	0.000007	1.490

5.5.3. Source-specific QA/QC and verification

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

5.5.4. Source-specific planned improvements

As some activities are not included in this inventory, there is a need to conduct research to determine whether emissions from these activities are important for this inventory. Also, there is a need to review the NMVOC emissions for the years 1990-1999 and study the possibility to obtain activity data for these emissions.

6. AGRICULTURE (NFR 4)

6.1. Overview of the sector

6.1.1. Sources category description

The Estonian inventory of air pollutants from agriculture presently includes emissions from animal husbandry and the application of fertilizers as listed in Table 6.1.

Table 6.1 Reporting activities for the agriculture sector

NFR	Source	Description	Emissions reported
4.B.1.a	Cattle dairy	Includes emissions from dairy cows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.1.b	Cattle non-dairy	Includes emissions from young cattle, beef cattle and suckling cows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.3	Sheep	Includes emissions from sheep and goats	NO_x, NMVOC, NH_3
4.B.4	Goats	Emissions from this sector are allocated to 4.B.4	IE
4.B.6	Horses	Includes emissions from horses	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$
4.B.8	Swine	Includes emissions from fattening pigs and sows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.9.a	Laying hens	Includes emissions from laying hens	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.9.b	Broilers	Includes emissions from broilers	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.B.9.d	Other poultry	Includes emission from cocks, ducks, geese and turkeys	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
4.D.1.a	Synthetic N-fertilizers	Includes emissions from application of nitrogen fertilizers and field preparation	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$

The share of agriculture sources in total emissions in 2012 was: NO_x – 3.7%, NH_3 – 94.3%, NMVOC – 11.2%, PM_{10} and TSP – 4.8%. The share of other pollutants was not so significant.

The emissions of NO_x, NH_3 and NMVOC have decreased compared to 1990 by 39%, 57% and 64% and the trend of the emissions of these categories is given in Figure 6.1. The emissions from the agriculture sector are presented in Table 6.2. The decrease of air pollution is mainly the result of rapid economic changes in the 1990s.

In 2012 the emissions of NO_x, NMVOC, NH_3 and particles have increased compared to 2011 by 7%, 2.7%, 4,2% and 4% mainly due to increase in livestock and use of fertilisers during the same period.

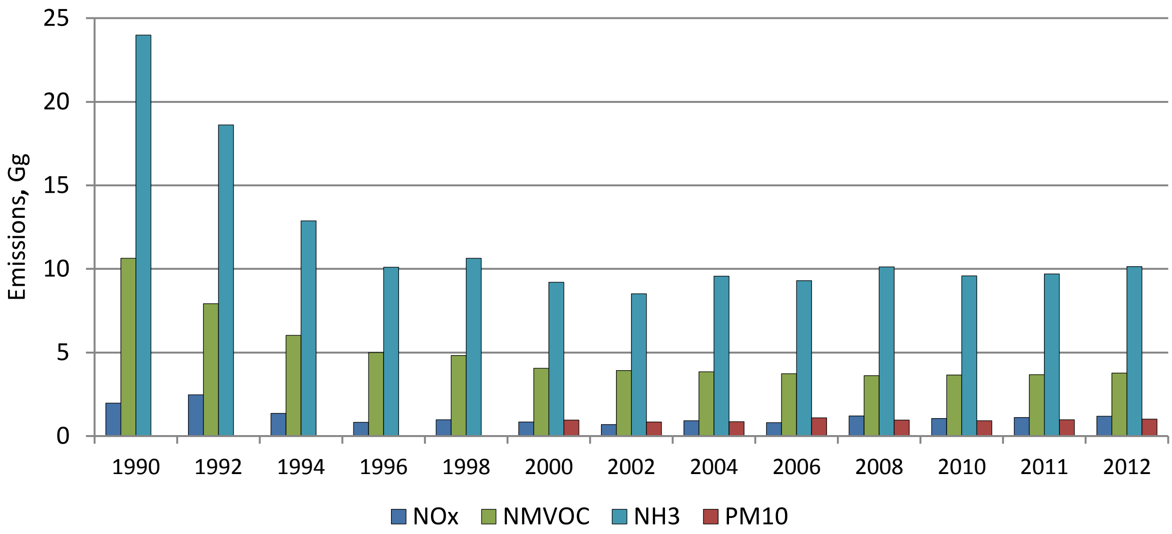


Figure 6.1 NO_x, NH_3, NMVOC and PM_{10} emissions from the agriculture sector in the period 1990-2012 (Gg)

Table 6.2 Total emissions from the agriculture sector in the period 1990-2012 (Gg)

	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}
1990	1.966	10.633	24.000	NR	NR
1991	1.612	9.647	21.271	NR	NR
1992	2.475	7.928	18.621	NR	NR
1993	1.456	6.404	13.867	NR	NR
1994	1.365	6.028	12.878	NR	NR
1995	0.966	5.401	11.146	NR	NR
1996	0.830	4.991	10.098	NR	NR
1997	0.891	4.991	10.490	NR	NR
1998	0.976	4.819	10.630	NR	NR
1999	0.836	4.143	9.146	NR	NR
2000	0.841	4.057	9.212	0.101	0.949
2001	0.727	4.107	9.212	0.096	0.804
2002	0.687	3.932	8.514	0.096	0.848
2003	0.788	3.916	9.363	0.095	0.827
2004	0.913	3.853	9.571	0.096	0.864
2005	0.778	3.789	9.138	0.101	1.050
2006	0.807	3.727	9.299	0.102	1.083
2007	0.975	3.797	9.578	0.106	1.188
2008	1.201	3.621	10.130	0.096	0.965
2009	0.992	3.605	9.365	0.092	0.890
2010	1.062	3.656	9.591	0.096	0.917
2011	1.109	3.674	9.705	0.098	0.973
2012	1.192	3.777	10.138	0.101	1.015
trend 1990-2012, %	**-39.4**	**-64.5**	**-57.7**	**-0.04**	**6.9**

The largest part of NH_3 emissions comes from manure management – 72.7%, and 27.3% is from use of synthetic fertilizers (Figure 6.2). The main polluter of PM_{10} is agricultural crop operations – 76.5% (Figure 6.3).

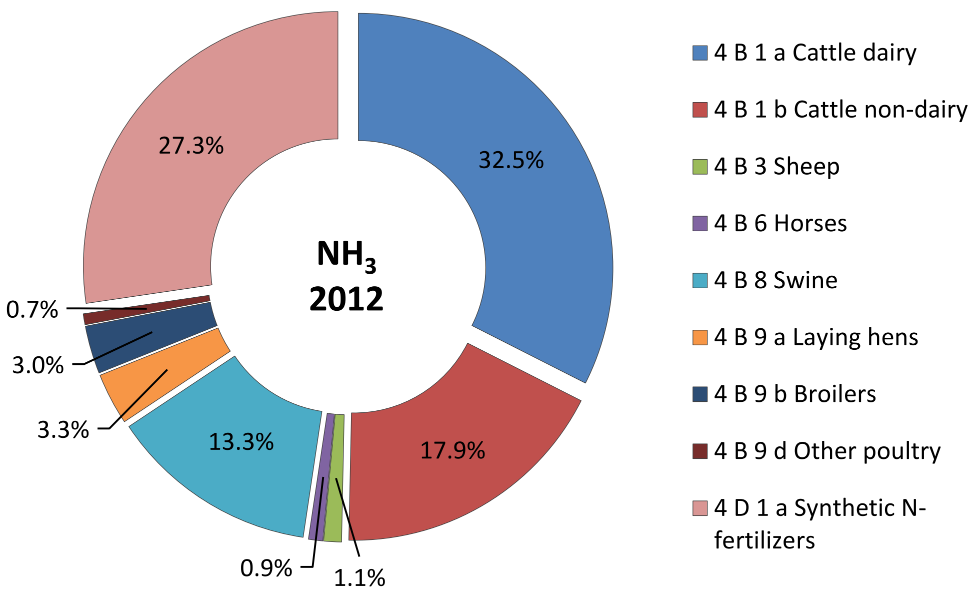


Figure 6.2 NH_3 emission distributions by the agriculture sector activities in 2012

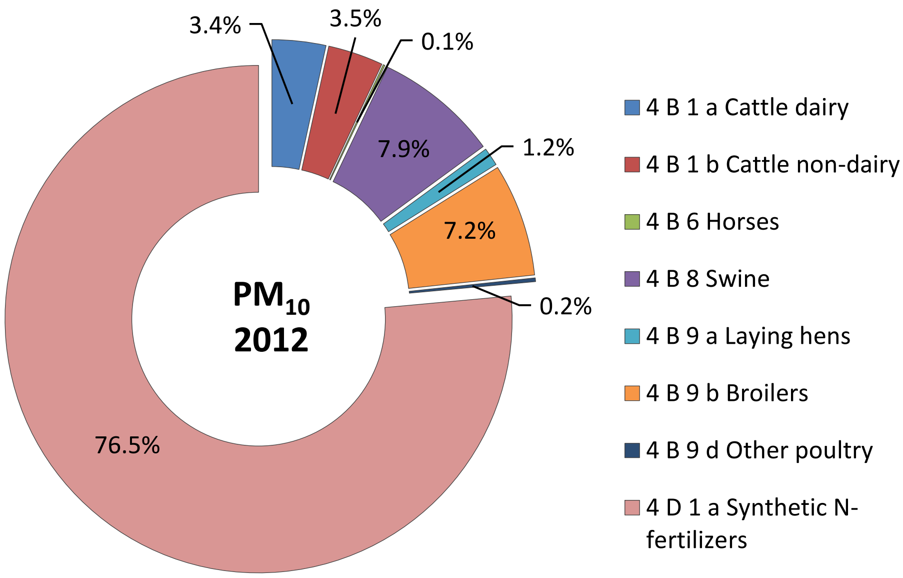


Figure 6.3 PM_{10} emissions from livestock and agricultural soils in 2012

6.2. Manure Management (NFR 4.B)

6.2.1. Source category description

Manure management is the main source of NH_3 emissions in Estonia. The share of manure management in total emissions in 2012 was 68.5%. The sector covers the management of manure from domestic livestock. Estonia reports emissions from the manure management of cattle, swine, horses, goats, sheep and poultry.

In addition to NH_3, NO_x, NMVOC, TSP, PM_{10} and $PM_{2.5}$ are generated from manure management.

All the emission time series are presented in Tables 6.3-6.7.

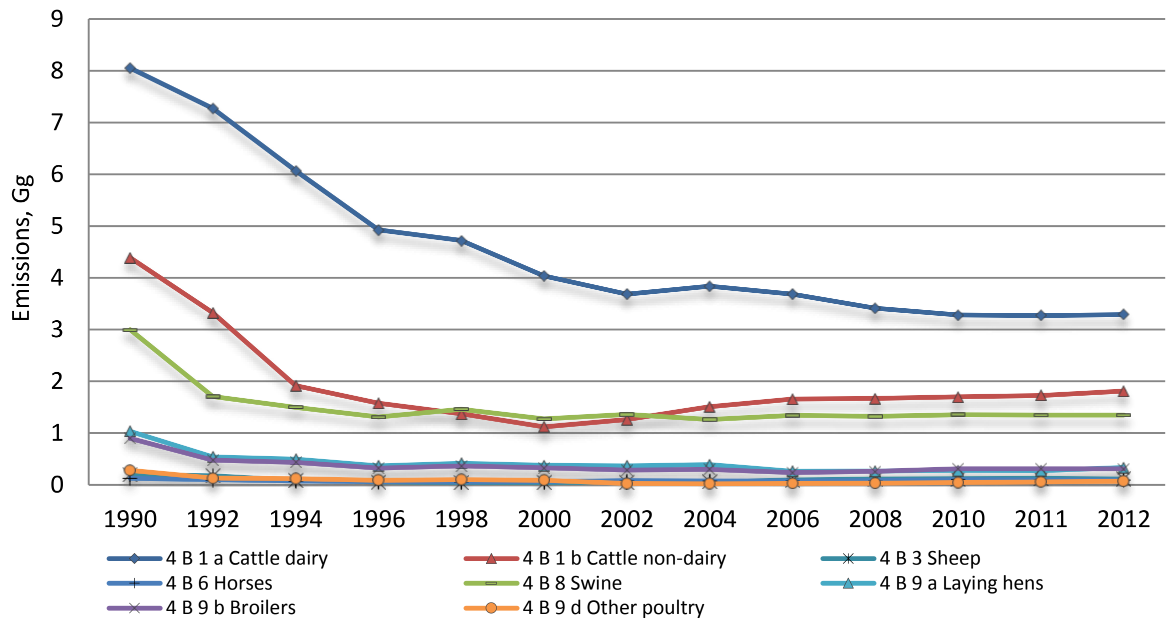


Figure 6.4 NH_3 emissions from manure management in the period 1990-2012

During the period 1990-2012, the emission of NH_3 decreased 59% (Figure 6.4). The reduction in air pollution was mainly due to the rapid economic changes in agriculture in the 1990s.

In 2012 all emissions have increased compared to 2011 by 2% due to increase in livestock (cattle dairy and non-dairy) during the same period.

Table 6.3 Total emissions of NO_x from manure management in the period 1990-2012 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	0.043	0.045	0.001	0.001	0.001	0.006	0.004	0.001
1991	0.041	0.042	0.001	0.001	0.000	0.005	0.003	0.001
1992	0.039	0.034	0.001	0.001	0.000	0.003	0.002	0.001
1993	0.035	0.022	0.000	0.001	0.000	0.003	0.002	0.001
1994	0.033	0.020	0.000	0.001	0.000	0.003	0.002	0.001
1995	0.029	0.017	0.000	0.001	0.000	0.003	0.002	0.000
1996	0.026	0.016	0.000	0.001	0.000	0.002	0.001	0.000

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1997	0.025	0.015	0.000	0.001	0.000	0.003	0.002	0.000
1998	0.022	0.014	0.000	0.001	0.000	0.003	0.002	0.000
1999	0.018	0.012	0.000	0.001	0.000	0.002	0.002	0.000
2000	0.016	0.011	0.000	0.001	0.000	0.002	0.001	0.000
2001	0.015	0.010	0.000	0.001	0.000	0.003	0.001	0.000
2002	0.013	0.009	0.000	0.001	0.000	0.002	0.001	0.000
2003	0.012	0.008	0.000	0.001	0.000	0.002	0.001	0.000
2004	0.011	0.006	0.000	0.001	0.000	0.002	0.001	0.000
2005	0.010	0.005	0.000	0.001	0.000	0.002	0.001	0.000
2006	0.009	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2007	0.008	0.004	0.000	0.001	0.000	0.003	0.001	0.000
2008	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2009	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2010	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2011	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
2012	0.008	0.004	0.000	0.001	0.000	0.002	0.001	0.000
trend 1990-2012, %	**-82.0**	**-90.2**	**-42.9**	**-29.0**	**-42.7**	**-67.5**	**-65.7**	**-74.5**

Table 6.4 Total emissions of NMVOC from manure management in the period 1990-2012(Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	3.818	3.531	0.028	1.937	0.647	0.409	0.265
1991	3.594	3.286	0.029	1.642	0.548	0.349	0.199
1992	3.446	2.673	0.025	1.107	0.338	0.215	0.123
1993	3.083	1.750	0.017	0.916	0.319	0.203	0.116
1994	2.875	1.540	0.012	0.981	0.310	0.197	0.113
1995	2.521	1.369	0.010	0.924	0.288	0.183	0.105
1996	2.334	1.268	0.008	0.921	0.230	0.146	0.084
1997	2.281	1.168	0.007	1.019	0.258	0.164	0.094
1998	2.157	1.102	0.006	1.032	0.261	0.166	0.095
1999	1.882	0.954	0.006	0.814	0.244	0.155	0.089
2000	1.782	0.901	0.006	0.899	0.234	0.149	0.085
2001	1.749	0.976	0.006	0.921	0.283	0.131	0.041
2002	1.572	1.023	0.007	0.946	0.229	0.131	0.023
2003	1.588	1.039	0.007	0.919	0.235	0.115	0.014
2004	1.584	0.986	0.008	0.877	0.242	0.135	0.019
2005	1.534	1.012	0.010	0.887	0.215	0.109	0.022
2006	1.474	1.009	0.013	0.933	0.164	0.106	0.027
2007	1.401	1.018	0.015	1.011	0.255	0.086	0.012
2008	1.365	1.018	0.016	0.909	0.165	0.117	0.030
2009	1.315	1.021	0.016	0.903	0.199	0.110	0.040
2010	1.312	1.035	0.017	0.934	0.173	0.142	0.044
2011	1.308	1.052	0.018	0.931	0.171	0.142	0.054
2012	1.317	1.104	0.016	0.925	0.208	0.140	0.067
trend 1990-2012, %	**-65.5**	**-68.7**	**-41.7**	**-52.2**	**-67.8**	**-65.7**	**-74.8**

Table 6.5 Total emissions of NH_3 from manure management in the period 1990-2012 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.3 Sheep	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
1990	8.056	4.389	0.196	0.127	2.995	1.035	0.899	0.279
1991	7.585	4.085	0.200	0.115	2.528	0.877	0.768	0.210
1992	7.273	3.323	0.174	0.098	1.707	0.541	0.474	0.130
1993	6.506	2.176	0.117	0.077	1.395	0.511	0.447	0.123
1994	6.067	1.915	0.086	0.074	1.498	0.496	0.434	0.119
1995	5.321	1.702	0.070	0.068	1.422	0.461	0.404	0.111
1996	4.925	1.577	0.055	0.062	1.309	0.368	0.322	0.088
1997	4.902	1.453	0.050	0.062	1.432	0.412	0.361	0.099
1998	4.720	1.370	0.043	0.058	1.462	0.418	0.365	0.100
1999	4.192	1.186	0.043	0.058	1.171	0.390	0.341	0.094
2000	4.037	1.121	0.045	0.062	1.273	0.375	0.328	0.090
2001	4.032	1.324	0.045	0.081	1.300	0.452	0.288	0.043
2002	3.685	1.261	0.047	0.078	1.360	0.367	0.287	0.025
2003	3.785	1.528	0.048	0.086	1.320	0.376	0.252	0.015
2004	3.838	1.506	0.057	0.075	1.262	0.388	0.298	0.020
2005	3.775	1.602	0.073	0.071	1.282	0.344	0.241	0.023
2006	3.686	1.656	0.092	0.073	1.339	0.262	0.234	0.028
2007	3.502	1.669	0.107	0.078	1.485	0.407	0.188	0.013
2008	3.414	1.669	0.115	0.078	1.322	0.264	0.258	0.032
2009	3.288	1.675	0.113	0.080	1.311	0.319	0.243	0.042
2010	3.281	1.697	0.116	0.101	1.357	0.276	0.312	0.046
2011	3.271	1.725	0.123	0.096	1.348	0.273	0.309	0.057
2012	3.291	1.811	0.114	0.092	1.347	0.333	0.309	0.070
trend 1990-2012, %	**-59.1**	**-58.7**	**-41.7**	**-27.9**	**-55.0**	**-67.8**	**-65.6**	**-74.8**

Table 6.6 Total emissions of $PM_{2.5}$ from manure management in the period 2000-2012 (Gg)

	4.B.1.a Cattle dairy	4.B.1.b Cattle non-dairy	4.B.6 Horses	4.B.8 Swine	4.B.9.a Laying hens	4.B.9.b Broilers	4.B.9.d Other poultry
2000	0.030	0.019	0.001	0.011	0.002	0.010	0.0004
2001	0.030	0.021	0.001	0.012	0.002	0.009	0.0002
2002	0.027	0.022	0.001	0.013	0.002	0.009	0.0001
2003	0.027	0.022	0.001	0.012	0.002	0.008	0.0001
2004	0.027	0.021	0.001	0.012	0.002	0.009	0.0001
2005	0.026	0.022	0.001	0.012	0.001	0.008	0.0001
2006	0.025	0.022	0.001	0.012	0.001	0.007	0.0001
2007	0.024	0.022	0.001	0.014	0.002	0.006	0.0001
2008	0.023	0.022	0.001	0.012	0.001	0.008	0.0001
2009	0.022	0.022	0.001	0.012	0.001	0.008	0.0002
2010	0.022	0.022	0.001	0.013	0.001	0.010	0.0002
2011	0.022	0.023	0.001	0.013	0.001	0.010	0.0002
2012	0.022	0.024	0.001	0.013	0.001	0.010	0.0003
trend 1990-2012, %	**-26.0**	**22.6**	**38.9**	**11.5**	**-10.4**	**-6.1**	**-20.8**

Table 6.7 Total emissions of PM_{10} from manure management in the period 2000-2021 (Gg)

	4.B.1.a Cattle dairy	**4.B.1.b Cattle non-dairy**	**4.B.6 Horses**	**4.B.8 Swine**	**4.B.9.a Laying hens**	**4.B.9.b Broilers**	**4.B.9.d Other poultry**
2000	0.047	0.029	0.001	0.072	0.013	0.078	0.003
2001	0.046	0.032	0.001	0.073	0.016	0.068	0.001
2002	0.042	0.033	0.001	0.079	0.013	0.068	0.001
2003	0.042	0.034	0.001	0.077	0.013	0.060	0.000
2004	0.042	0.032	0.001	0.073	0.014	0.070	0.001
2005	0.041	0.033	0.001	0.075	0.012	0.057	0.001
2006	0.039	0.033	0.001	0.078	0.009	0.055	0.001
2007	0.037	0.033	0.001	0.089	0.014	0.045	0.000
2008	0.036	0.033	0.001	0.078	0.009	0.061	0.001
2009	0.035	0.033	0.001	0.077	0.011	0.057	0.001
2010	0.035	0.034	0.001	0.080	0.010	0.074	0.002
2011	0.035	0.034	0.001	0.079	0.010	0.073	0.002
2012	0.035	0.036	0.001	0.080	0.012	0.073	0.002
trend 1990-2012, %	**-26.2**	**22.5**	**45.5**	**11.3**	**-11.1**	**-5.8**	**-20.8**

6.2.2. Methodological issues

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

The Tier 1 method uses readily available statistical data and default emission factors. The Tier 1 default emission factors also assume an average or typical process description.

The Tier 1 approach uses the general equation:

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

Where,

$AR_{\text{Population Size}}$ = activity rate for specific activity

EF = emission factor for this process, technology

Emissions from manure are calculated separately for each animal category and within each animal category; separately for slurry or solid manure management system depends on the animal category (Table 6.9). According to the new guidebook, there are different emission factors for solid and slurry manure type (Table 6.8). The share of cattle dairy manure management in Estonia is 50% solid and 50% slurry and based on an article by Allan Kaasik (Saasteainete kasvuhoonegaside emissioon loomakasvatusest. Kaasik, Allan 2007, Tõulooma-kasvatus, 2, 21–24).

The share of manure management from cattle non-dairy is 70% slurry and 30% solid.

There are no default emission factors for TSP in the renewed Guidebook, so the calculated TSP emission factors were the used proportion between PM_{10} and TSP in the old Guidebook (new PM_{10} EF*100% / the proportion of an old PM_{10} EF of old TSP EF).

Table 6.8 NO_x, NH_3, NMVOC and PM emission factors for manure management

NFR	NO_x slurry	NO_x solid	NMVOC	NH_3 slurry	NH_3 solid	$PM_{2.5}$	PM_{10}	TSP
	kg/capita							
Cattle dairy	0.007	0.154	13.600	39.300	28.700	0.230	0.360	0.799
Cattle non-dairy	0.002	0.094	7.400	13.400	9.200	0.160	0.240	0.533
Sheep and goats		0.005	0.200		1.400			
Horses		0.131			14.800	0.120	0.180	
Fattening pigs	0.001		3.900	6.700		0.080	0.500	1.111
Sows	0.004		13.300	15.800		0.090	0.580	1.288
Laying hens		0.003	0.300		0.480	0.002	0.017	0.038
Broilers		0.001	0.100		0.220	0.007	0.052	0.115
Other poultry		0.004	0.900		0.950	0.004	0.032	0.068

Activity data

Information regarding the numbers of livestock in agriculture is available from Statistics Estonia (www.stat.ee) for the years 1990-2012.

Table 6.9 Number of livestock (1,000 head)

	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry
1990	280.7	477.1	139.8	8.6	336.0	47.1	2,157.0	4,085.3	294.2
1991	264.3	444.0	142.8	7.8	279.5	41.5	1,827.6	3,489.2	221.5
1992	253.4	361.2	124.3	6.6	189.4	27.7	1,128.0	2,153.4	136.7
1993	226.7	236.5	83.3	5.2	148.5	25.3	1,064.6	2,032.5	129.0
1994	211.4	208.1	61.5	5.0	160.9	26.6	1,032.8	1,971.7	125.2
1995	185.4	185.0	49.8	4.6	157.1	23.4	960.7	1,834.1	116.5
1996	171.6	171.4	39.2	4.2	104.4	38.6	767.2	1,464.7	93.0
1997	167.7	157.9	35.6	4.2	107.2	45.2	858.7	1,639.2	104.1
1998	158.6	148.9	30.8	3.9	114.2	44.1	869.8	1,660.5	105.4
1999	138.4	128.9	30.9	3.9	98.8	32.2	812.4	1,550.9	98.5
2000	131.0	121.8	32.2	4.2	99.0	38.6	780.9	1,490.8	94.7
2001	128.6	131.9	32.4	5.5	99.5	40.1	941.7	1,307.7	45.5
2002	115.6	138.3	33.8	5.3	114.1	37.7	764.6	1,305.9	25.8
2003	116.8	140.4	34.3	5.8	110.7	36.6	783.4	1,146.3	15.5
2004	116.5	133.3	41.0	5.1	106.6	34.7	808.0	1,353.6	21.4
2005	112.8	136.7	52.4	4.8	110.4	34.3	716.8	1,093.5	24.5
2006	108.4	136.4	66.0	4.9	111.7	37.4	546.4	1,062.7	29.6
2007	103.0	137.5	76.4	5.3	137.4	35.7	848.6	856.7	13.5
2008	100.4	137.5	81.8	5.3	116.9	34.1	550.1	1,173.7	33.5
2009	96.7	138.0	80.4	5.4	115.2	34.1	664.8	1,103.5	43.9
2010	96.5	139.8	82.7	6.8	119.7	35.1	575.2	1,419.4	48.8
2011	96.2	142.1	88.2	6.5	117.2	35.6	568.9	1,404.4	59.6
2012	96.8	149.2	81.4	6.2	120.2	34.3	693.9	1,403.0	74.0

6.3. Agricultural Soils (NFR 4.D)

6.3.1. Source category description

Direct NH_3 emissions from fertilizers and particle emissions from grain fields are reported under NFR 4.D.1.a. The share of agricultural soils in total NH_3 emissions in 2012 was 27%.

In addition to NH_3, NO_x, NMVOC, PM_{10} and $PM_{2.5}$ are generated from this sector.

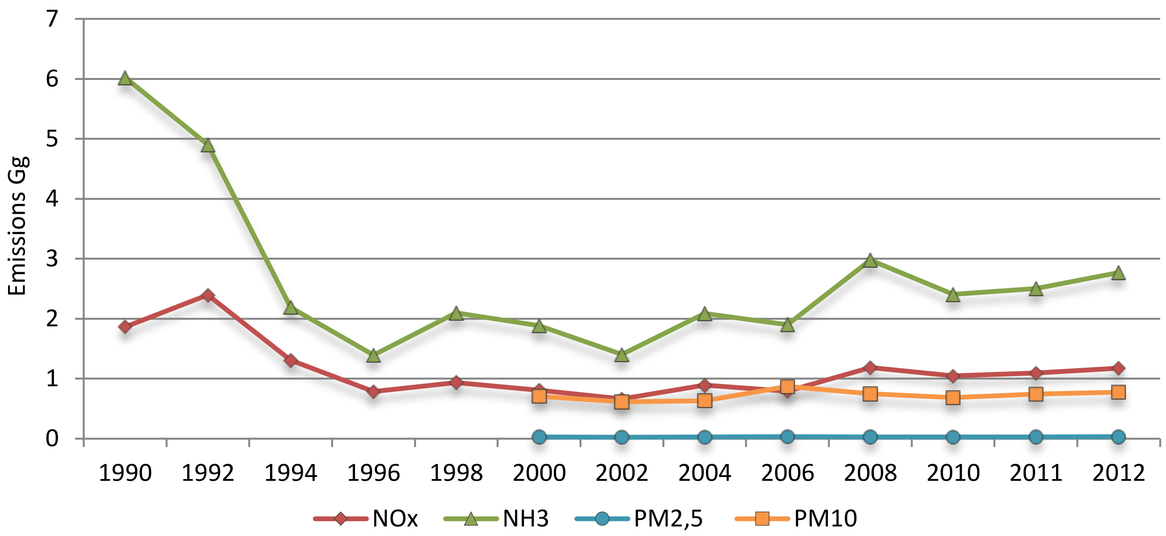


Figure 6.5 NO_x, NH_3, PM_{10} and $PM_{2.5}$ emissions from agricultural soils in the period 1990-2012

During the period 1990-2012, the emission of NH_3 decreased 37% (Figure 6.5), mainly due to changes in Estonian agriculture. All the emission time series are presented in Table 6.10.

In 2012 NO_x, NH_3 and particles emissions have increased compared to 2011 by 7%, 10% and 4.7% mainly due to increase in use of fertilisers during the same period.

Table 6.10 Total emissions from agricultural soils in the period 1990-2012 (Gg)

Year	NO_x	NH_3	$PM_{2.5}$	PM_{10}
1990	1.864	6.023	NR	NR
1991	1.517	4.902	NR	NR
1992	2.395	4.902	NR	NR
1993	1.391	2.516	NR	NR
1994	1.306	2.190	NR	NR
1995	0.913	1.588	NR	NR
1996	0.782	1.391	NR	NR
1997	0.846	1.720	NR	NR
1998	0.934	2.094	NR	NR
1999	0.800	1.671	NR	NR
2000	0.808	1.881	0.027	0.706
2001	0.697	1.647	0.022	0.567
2002	0.661	1.403	0.024	0.612

Year	NO_x	NH_3	$PM_{2.5}$	PM_{10}
2003	0.764	1.953	0.023	0.601
2004	0.891	2.086	0.024	0.631
2005	0.759	1.687	0.032	0.830
2006	0.790	1.899	0.033	0.867
2007	0.958	2.098	0.037	0.968
2008	1.184	2.978	0.029	0.745
2009	0.975	2.296	0.026	0.674
2010	1.046	2.405	0.026	0.682
2011	1.092	2.503	0.028	0.740
2012	1.174	2.770	0.030	0.776
trend 1990-2012, %	**-37.0**	**-54.0**	**9.9**	**9.9**

6.3.2. Methodological issues

Emission calculations from agricultural soils based on the Tier 1 method from the renewed Guidebook. There are no default emission factors for TSP in the Guidebook, so the PM_{10} emission factors were used. The Tier 1 method uses readily available statistical data (Table 6.11) and default emission factors (Table 6.12).

Table 6.11 NO_x, NH_3, NMVOC and PM emission factors for agricultural soils

Pollutant	Unit	Value
NO_x	kg kg-1 fertilizer-N applied	0.026
NMVOC	kg kg-1 fertilizer-N applied	5.96E-09
NH_3	kg kg-1 fertilizer-N applied	0.084
$PM_{2.5}$	g/ha	0.06
PM_{10}	g/ha	1.56
TSP	g/ha	1.56

Activity Data

Information regarding synthetic N-fertilizer use and the area covered by these crops is available from Statistics Estonia (www.stat.ee) for the years 1990-2012.

Table 6.12 Synthetic N-fertilizer use and the area covered by these crops in the period 1990-2012

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1990	71,700	789,315
1991	58,360	754,579
1992	92,099	952,103
1993	53,515	545,833
1994	50,222	517,607
1995	35,127	415,952

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1996	30,072	355,638
1997	32,545	422,690
1998	35,921	478,345
1999	30,772	421,067
2000	31,079	452,538
2001	26,793	363,504
2002	25,414	392,196
2003	29,372	384,951
2004	34,254	404,309
2005	29,184	532,319
2006	30,384	556,083
2007	36,854	620,449
2008	45,542	477,786
2009	37,519	432,051
2010	40,217	437,302
2011	41,995	474,102
2012	45,171	497,269

6.4. Source-specific QA/QC and verification

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

6.5. Sources-specific planned improvements

- For improving data quality to introduce other Tier 2 or Tier 3 methods for emissions estimating which is based on detailed activities data and emission factors.
- To provide uncertainty analysis.

7. LAND USE AND LAND-USE CHANGE (NFR 5)

7.1. Overview of the sector

The emissions are not included in the present inventory.

8. WASTE (NFR 6)

8.1. Overview of the sector

8.1.1. Sources category description

Emissions from solid waste disposal on land (landfills), waste water treatment, waste incineration and other waste sources are included in this category. Emissions from the NFR of the waste sector are based on point sources (facilities) while area sources data are included for some sectors (6.B, 6.D).

Table 8.1 Reported emissions for the waste sector (NFR 6)

NFR	Source	Description	Emissions reported
6.A	Solid waste disposal on land	Includes emissions from landfill on the base of four operators reports. Only point sources data.	NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO
6.B	Waste-water handling	Point sources data includes emissions 9 waste water treatment plants. Additionally the calculation of emissions from diffuse sources.	NO_x, NMVOC, SO_x, NH_3, CO
6.C.a	Clinical waste incineration	Only one operator is reported data about hospital waste inceneration. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, CO, HM (emissions located in NFR 6.c.b) PCDD/PCDF (expert estimation)
6.C.b	Industrial waste incineration	Includes emission from flaring in chemical industry, sluge and waste oil incineration. Data from 5 operators.	NO_x, NMVOC, SO_x, NH_3, TSP, CO, Cu, PCDD/PCDF
6.C.d	Cremation	Includes data from 2 operators	NO_x, NMVOC, SO_x, NH_3, TSP, CO
6.D	Other	Includes data from 2 point sources, one from them of compost production. Additionally the calculation of emissions from diffuse sources.	NO_x, NMVOC, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb Cd, Hg, As, Cr, Cu, PCDD/PCDF

Emissions from point sources are taken from the OSIS database and the emissions for diffuse sources are calculated from the data received from Statistics Estonia, Estonian Rescue Service and the waste management system. The emission factors given in EMEP/EEA guidebook and expert opinions are used in the additional calculations.

The share of waste sources (mainly waste from waste incineration) into total dioxins emissions in 2012 was 5.3%. The shares of other pollutants are not so significant. The emissions of dioxins decreased in 2012 compared to 2011 by 42% due to decrease of burned waste amount.

8.2. Solid waste disposal on land (NFR 6.A)

8.2.1. Sources category description

This chapter includes emissions from solid waste disposal on land. This sector, however, is only a minor source of air pollutant emissions. Small quantities of non-methane volatile organic compounds, ammonia, particulate matter and carbon monoxide may be emitted.

8.2.2. Methodological issues

All the emissions are based on operator reports (there were 4 operators in 2012). Data is available from 2000.

Table 8.2 Emissions from solid waste disposal on land in the period 2000-2012

	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg	Mg				Gg
2000	0.250	NA	NR	NR	NA	NA
2001	NA	NA	NR	NR	NA	NA
2002	NA	NA	NR	NR	NA	NA
2003	0.020	NA	NR	NR	NA	NA
2004	NA	NA	NR	NR	NA	NA
2005	0.000	NA	NA	NA	0.000	NA
2006	NA	NA	NA	NA	NA	NA
2007	NA	NA	NA	NA	NA	NA
2008	NA	NA	0.070	0.139	0.278	NA
2009	0.024	0.038	NA	NA	0.011	0.024
2010	NA	0.025	NA	NA	0.058	NA
2011	NA	0.025	NA	0.242	0.774	NA
2012	NA	0.025	0.283	0.283	0.857	NA

8.2.3. Source-specific QA/QC and verification

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

8.2.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Emission calculations from landfills by using data from the waste management system.

8.3. Waste water handling (NFR 6.B)

8.3.1. Sources category description

This chapter covers emissions from waste water handling. In general, emissions of NO_x, NMVOC, SO_x, NH_3 and CO occur from waste water treatment plants, but are largely insignificant in terms of total national emissions.

8.3.2. Methodological issues

Emissions from waste water handling are based on data from facilities (there were 6 operators in 2012).

In addition to the facility data, NMVOC emissions are based on the Tier 1 method, whereby emissions are calculated using a default emission factor (NMVOC 15 mg/m^3 waste water). In this calculation, data from Statistics Estonia were used. Data are available from 1994.

Table 8.3 Emissions from waste water handling in the period 1994-2012

	NO_x	NMVOC	SO_x	NH_3	CO
	Mg	Gg	Mg		Gg
1994	NA	0.029	NA	NA	NA
1995	NA	0.028	NA	NA	NA
1996	NA	0.025	NA	NA	NA
1997	NA	0.025	NA	NA	NA
1998	NA	0.025	NA	NA	NA
1999	NA	0.023	NA	NA	NA
2000	NA	0.022	NA	NA	NA
2001	NA	0.023	NA	NA	NA
2002	NA	0.021	NA	NA	NA
2003	NA	0.024	NA	NA	NA
2004	NA	0.027	NA	NA	NA
2005	NA	0.024	NA	NA	NA
2006	NA	0.024	NA	NA	NA
2007	NA	0.028	NA	NA	NA
2008	1.234	0.025	0.124	0.979	0.001
2009	0.444	0.022	0.124	1.074	0.006
2010	0.441	0.029	0.126	0.426	NA
2011	0.444	0.029	0.124	0.229	NA
2012	0.441	0.025	0.125	0.318	NA

8.3.3. Source-specific QA/QC and verification

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

8.3.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Emission calculations from waste water treatment by using data from the waste management system. Also, specify data for latrines.

8.4. Waste incineration (NFR 6.C)

8.4.1. Sources category description

This sector includes the volume reduction, by combustion. In Estonia, the following waste treatments take place: cremation, clinical and industrial waste incineration.

8.4.2. Methodological issues

Emissions from the waste incineration sector are based on data from facilities (there were 8 operators in 2012). Emissions are calculated by operators on the basis of measurements, and the combined method (measurements plus calculations) is also used.

In addition to the facility data, PCDD/PCDF emissions from clinical and industrial waste incineration are calculated. In these calculations, data from the waste data management system were used.

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

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

Table 8.4 Emissions from waste incineration in the period 1990-2012

	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Gg				Mg			Gg
1990	NA	NA	NA	NA	NR	NR	NA	NA
1991	NA	NA	NA	NA	NR	NR	NA	NA
1992	NA	NA	NA	NA	NR	NR	NA	NA
1993	NA	NA	NA	NA	NR	NR	NA	NA
1994	NA	NA	NA	NA	NR	NR	NA	NA
1995	NA	NA	NA	NA	NR	NR	NA	NA
1996	NA	NA	NA	NA	NR	NR	NA	NA
1997	NA	NA	NA	NA	NR	NR	NA	NA
1998	NA	NA	NA	NA	NR	NR	NA	NA
1999	NA	NA	NA	NA	NR	NR	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA
2003	NA	NA	0.010	NA	NA	NA	4.000	0.020
2004	NA	0.010	0.050	NA	NA	NA	NA	NA
2005	NA	0.010	0.020	NA	NA	NA	NA	NA
2006	NA	NA	NA	NA	NA	NA	NA	NA
2007	NA	NA	0.010	NA	NA	NA	NA	NA
2008	0.007	0.0004	0.005	NA	NA	NA	0.098	0.003
2009	0.016	0.011	0.017	0.002	NA	NA	0.149	0.013
2010	0.016	0.015	0.010	0.002	NA	NA	0.212	0.015
2011	0.014	0.038	0.010	0.002	0.324	0.402	0.637	0.015
2012	0.012	0.001	0.049	0.0003	NA	NA	0.247	0.006

	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/F	PAHs	PCBs
	kg	g		kg		Mg	kg		g I-Teq	kg	
1990	NA	NA	NA	NA	NA	NA	NA	NA	0.470	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA	NA	0.470	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA	NA	0.460	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA	NA	0.450	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA	NA	0.440	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA	NA	0.430	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA	NA	0.430	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA	NA	0.620	NA	NA
1998	NA	NA	NA	NA	NA	NA	NA	NA	0.560	NA	NA
1999	NA	NA	NA	NA	NA	NA	NA	NA	0.290	NA	NA
2000	NA	NA	NA	NA	NA	NA	NA	NA	0.400	NA	NA
2001	NA	NA	NA	NA	NA	NA	NA	NA	0.360	NA	NA
2002	NA	NA	NA	NA	NA	NA	NA	NA	0.620	NA	NA
2003	NA	NA	NA	NA	NA	NA	NA	NA	0.483	NA	0.001
2004	0.240	NA	NA	NA	NA	NA	NA	NA	0.660	NA	NA
2005	0.270	NA	NA	NA	NA	NA	NA	NA	0.640	NA	NA
2006	0.210	NA	NA	NA	NA	NA	NA	NA	0.050	NA	NA
2007	NA	NA	NA	NA	NA	NA	NA	NA	0.300	NA	NA
2008	NA	NA	NA	NA	NA	0.000	NA	NA	0.455	NA	NA
2009	NA	NA	NA	NA	NA	0.024	NA	NA	0.582	NA	NA
2010	NA	NA	NA	NA	NA	0.009	NA	NA	0.321	NA	NA
2011	0.048	0.200	0.100	0.029	0.010	0.009	0.019	0.029	0.361	0.085	NA
2012	NA	NA	NA	NA	NA	0.007	NA	NA	0.208	NA	NA

8.4.3. Source-specific QA/QC and verification

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

8.4.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations, if necessary.

8.5. Other waste (NFR 6.D)

8.5.1. Sources category description

This chapter covers emissions from other waste, which includes data from facilities (there were 10 operators in 2012) and from the following activities: compost production, slurry spreading, car fires, detached and undetached house fires, apartment and industrial building fires.

8.5.2. Methodological issues

Emissions from the other waste sector are based on date from facilities and additional calculations.

In addition to the facility data, emissions of ammonia, particulate matter, heavy metals and dioxins are calculated according to the Tier 2 method giving default emission factors. In this calculation, data from Statistics Estonia and the Estonian Rescue Service were used.

Table 8.5 Emissions from other waste in the period 1990-2012

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	Mg	Gg	Mg	Gg				Mg
1990	NA	NA	NA	0.002	NR	NR	NA	NA
1991	NA	NA	NA	0.002	NR	NR	NA	NA
1992	NA	NA	NA	0.002	NR	NR	NA	NA
1993	NA	NA	NA	0.002	NR	NR	NA	NA
1994	NA	NA	NA	0.002	NR	NR	NA	NA
1995	NA	NA	NA	0.002	NR	NR	NA	NA
1996	NA	NA	NA	0.008	NR	NR	NA	NA
1997	NA	NA	NA	0.016	NR	NR	NA	NA
1998	NA	NA	NA	0.002	NR	NR	0.001	NA
1999	NA	NA	NA	0.003	NR	NR	0.001	NA
2000	NA	NA	NA	0.006	0.001	0.001	0.001	NA
2001	NA	NA	NA	0.009	0.001	0.001	0.001	NA
2002	NA	NA	NA	0.024	0.001	0.001	0.001	NA
2003	NA	NA	NA	0.072	0.001	0.001	0.001	NA
2004	NA	NA	NA	0.097	0.001	0.001	0.001	NA
2005	NA	NA	NA	0.115	0.001	0.001	0.001	NA
2006	NA	NA	NA	0.161	0.001	0.001	0.001	NA
2007	NA	NA	NA	0.187	0.001	0.001	0.001	NA
2008	NA	0.005	NA	0.165	0.001	0.001	0.001	NA
2009	NA	0.004	NA	0.159	0.001	0.001	0.001	NA
2010	0.475	0.005	NA	0.188	0.001	0.001	0.001	0.475
2011	1.329	0.006	0.068	0.130	0.001	0.001	0.001	1.444
2012	3.489	0.007	0.276	0.037	0.0001	0.0001	0.0001	3.727

	Pb	Cd	Hg	As	Cr	Cu	PCDD/F
	kg						g I-Teq
1990	NA	NA	NA	NA	NA	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA
1998	0.001	0.001	0.001	0.002	0.002	0.004	0.002
1999	0.001	0.001	0.001	0.002	0.002	0.004	0.002
2000	0.001	0.001	0.001	0.002	0.002	0.004	0.002
2001	0.001	0.001	0.001	0.002	0.002	0.004	0.002
2002	0.001	0.001	0.001	0.002	0.002	0.004	0.002
2003	0.001	0.001	0.001	0.002	0.002	0.004	0.002
2004	NA	0.001	0.001	0.002	0.001	0.003	0.002
2005	NA	0.001	0.001	0.002	0.002	0.004	0.002
2006	NA	0.001	0.001	0.002	0.002	0.004	0.002
2007	NA	0.001	0.001	0.001	0.001	0.003	0.002
2008	NA	0.001	0.001	0.001	0.001	0.003	0.001
2009	NA	0.001	0.001	0.001	0.001	0.003	0.001
2010	NA	0.001	0.001	0.001	0.001	0.002	0.001
2011	NA	0.001	0.001	0.001	0.001	0.002	0.001
2012	0.700	0.257	0.416	0.409	0.390	0.924	0.001

8.5.3. Source-specific QA/QC and verification

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

8.5.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations if necessary.

9. RECALCULATIONS AND IMPROVEMENTS

The latest recalculations in the emission inventory were done for the time period from 1990 to 2011. The reason for the recalculations is specified in the Summary.

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

The following changes have been carried out in comparison with last year's report.

9.1. Energy sector (NFR 1)

9.1.1. Stationary combustion in energy sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2013 and 2014 are made by using exact calculation numbers.

1.A.1.a Public electricity and heat production

All pollutants emissions have been recalculated for the 2011. Recalculation concern using corrected activity data (additionally calculated emission from the peat briquette).

Table 9.1 The differences in Public electricity and heat production emissions for the year 2011 between 2013 and 2014 submissions (Gg)

	Unit	Old	Recalc.	Difference, %
NO_x	Gg	14.740	14.745	0.03
NMVOC	Gg	0.401	0.405	0.80
SO_x	Gg	66.242	66.246	0.01
$PM_{2.5}$	Gg	11.712	11.716	0.04
PM_{10}	Gg	25.082	25.091	0.03
TSP	Gg	29.227	29.253	0.09
CO	Gg	4.708	4.740	0.69
Pb	Mg	36.126	36.130	0.01
Cd	Mg	0.611	0.611	0.03
Hg	Mg	0.609	0.609	0.01
As	Mg	10.796	10.798	0.02
Cr	Mg	9.642	9.643	0.01
Cu	Mg	2.425	2.426	0.04
Ni	Mg	6.088	6.094	0.10
Zn	Mg	49.393	49.396	0.01
PCDD/ PCDF	g	3.106	3.106	0.00
benzo(a) pyrene	Mg	0.645	0.646	0.16
benzo(b) fluoranthene	Mg	0.857	0.859	0.16
benzo(k) fluoranthene	Mg	0.327	0.327	0.16
indeno (1.2.3-cd)	Mg	0.321	0.321	0.16

	Unit	Old	Recalc.	Difference, %
pyrene				
PAHs. total	Mg	2.150	2.153	0.16

9.1.2. Transport sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2013 and 2014 are made by using exact calculation numbers.

1.A.3.b Road transport

All the NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Cr, Cu, Ni, Zn, Diox, PAHs emissions are recalculated for the period 2002-2011.

Recalculations concern using corrected fuel consumption data by Statistics Estonia and small correction in average annual mileage driven.

The differences in road transport emissions between the submissions for 2013 and 2014 are presented in Table 9.2.

Table 9.2 The differences in road transport emissions between the 2013 and 2014 submissions (%)

	NOx	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
2002	-0.046	-0.006	-0.030	-0.001	-0.051	-0.054	-0.045	-0.003
2003	-0.037	-0.005	-0.029	-0.001	-0.038	-0.043	-0.034	-0.002
2004	-0.037	-0.006	-0.029	0.000	-0.032	-0.043	-0.029	-0.003
2005	-0.008	-0.001	-0.005	0.000	-0.007	-0.011	-0.006	-0.001
2006	-0.232	-0.041	-0.182	-0.004	-0.212	-0.203	-0.185	-0.020
2007	-0.136	-0.026	-0.109	-0.002	-0.123	-0.123	-0.105	-0.012
2008	-0.101	-0.021	-0.075	-0.001	-0.092	-0.096	-0.076	-0.010
2009	-0.010	-0.002	0.000	0.000	-0.009	-0.022	-0.007	-0.001
2010	-0.118	-0.027	-0.031	-0.001	-0.109	-0.109	-0.087	-0.012
2011	-3.561	-0.502	-3.417	-0.167	-3.548	-3.539	-3.548	-0.446

	Pb	Cd	Cr	Cu	Ni	Se	Zn	PCDD/F	PAHs
2002	-0.001	-0.029	-0.030	-0.028	-0.021	0.000	-0.025	-0.005	-0.029
2003	-0.002	-0.015	-0.021	-0.020	-0.017	0.000	-0.017	-0.003	-0.021
2004	-0.002	-0.015	-0.020	-0.018	-0.016	0.000	-0.018	-0.003	-0.020
2005	0.000	0.000	-0.004	-0.004	-0.005	0.000	-0.003	-0.001	-0.005
2006	-0.018	-0.105	-0.118	-0.111	-0.101	-0.103	-0.099	-0.019	-0.097
2007	-0.010	-0.074	-0.066	-0.060	-0.054	-0.049	-0.056	-0.011	-0.051
2008	-0.006	-0.038	-0.045	-0.041	-0.041	-0.050	-0.039	-0.007	-0.036
2009	-0.001	0.000	-0.004	-0.004	-0.010	0.000	-0.005	-0.001	-0.005
2010	-0.020	-0.041	-0.044	-0.043	-0.039	-0.054	-0.039	-0.007	-0.037
2011	-1.734	-3.065	-3.511	-3.412	-3.197	-3.242	-3.132	-0.574	-4.785

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

All the emissions have been recalculated for the year 2011. Recalculations concern using corrected fuel consumption data.

The differences in agricultural sector emissions between the 2013 and 2014 submissions are presented in Table 9.3.

Table 9.3 The differences in agricultural machinery emissions for the year 2011 between the 2013 and 2014 submissions (%)

	Unit	Old	Recalc.	Difference, %
NO_x	Gg	2.138	2.696	26.113
NMVOC	Gg	0.205	0.259	26.112
SO_x	Gg	0.003	0.035	915.549
NH_3	Gg	0.000	0.001	26.113
$PM_{2.5}$	Gg	0.106	0.134	26.113
PM_{10}	Gg	0.106	0.134	26.113
TSP	Gg	0.106	0.134	26.113
CO	Gg	0.668	0.842	26.103
Pb	Mg	0.002	0.002	0.000
Cd	Mg	0.001	0.001	26.113
Cr	Mg	0.003	0.004	26.113
Cu	Mg	0.104	0.131	26.113
Ni	Mg	0.004	0.005	26.113
Se	Mg	0.001	0.001	26.113
Zn	Mg	0.061	0.077	26.113
benzo(a)pyrene	Mg	0.002	0.002	26.113
benzo(b)fluoranthene	Mg	0.003	0.004	26.113
Total POPs	Mg	0.005	0.006	26.113

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

All the NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10} and TSP emissions have been recalculated for the period 2005-2011.

Explanations for recalculations in the international maritime sector: corrected the number of vessels and average gross tonnage of vessels by Statistics Estonia, also corrected some minor calculation mistakes which were made in previous years.

The differences in international maritime navigation sector emissions between the 2013 and 2014 submissions are presented in Table 9.4.

Table 9.4 The differences in international maritime emissions between the 2013 and 2014 submissions (%)

	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP
2005	2.402	-12.341	0.000	-9.391	-7.901	-7.901
2006	0.959	-7.669	0.000	-4.955	-4.175	-4.175
2007	0.746	-6.102	0.000	-3.636	-3.044	-3.044
2008	0.833	-5.048	-0.554	-2.835	-2.298	-2.298
2009	1.077	-6.391	-0.461	-3.584	-2.913	-2.913
2010	0.537	-7.423	0.000	-4.317	-3.586	-3.586
2011	0.613	-8.506	0.000	-5.146	-4.312	-4.312

9.2. Solvent and Other Product Use (NFR 3)

There has been made some recalculations of NMVOC emissions for the period 1990-1999 due to the emission factor corrections in NFR 3.A.1 sector and in NFR 3.D.3 sector for the year 2011 due to the corrections in activity data.

Table 9.5 The differences in solvent sector NMVOC emissions between the 2013 and 2014 submissions

Year		3.A.1	3.D.3	Total NMVOC
1990	Old	0.671		9.443
	Recalculation	0.690		9.462
	Difference, %	**2.84**		**0.20**
1991	Old	0.730		10.040
	Recalculation	0.751		10.061
	Difference, %	**2.84**		**0.21**
1992	Old	0.968		7.747
	Recalculation	0.995		7.774
	Difference, %	**2.84**		**0.36**
1993	Old	0.989		7.292
	Recalculation	1.018		7.320
	Difference, %	**2.84**		**0.39**
1994	Old	1.794		8.075
	Recalculation	1.845		8.126
	Difference, %	**2.84**		**0.63**
1995	Old	2.153		9.291
	Recalculation	2.214		9.353
	Difference, %	**2.84**		**0.66**
1996	Old	2.740		9.848
	Recalculation	2.818		9.926
	Difference, %	**2.84**		**0.79**
1997	Old	3.108		10.064
	Recalculation	3.196		10.153
	Difference, %	**2.84**		**0.88**
1998	Old	3.031		10.792
	Recalculation	3.118		10.879
	Difference, %	**2.84**		**0.80**
1999	Old	3.063		10.409
	Recalculation	3.150		10.496
	Difference, %	**2.84**		**0.84**
2011	Old		0.732	6.343
	Recalculation		0.734	6.344
	Difference, %		**0.16**	**0.02**

9.3. Agriculture sector (NFR 4)

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2013 and 2014 are made by using exact calculation numbers.

4.B.9.b Broilers

NH_3, PM_{10}, TSP emissions have been recalculated for the year 2011. Recalculations concern using corrected activity data.

The differences in agricultural sector emissions between the 2013 and 2014 submissions are presented in Table 9.6.

Table 9.6 The differences in agricultural sector emissions between the 2013 and 2014 submissions

	Old, Gg	Recalc., Gg	Difference, %
NH_3	0.312	0.309	-1.019
PM_{10}	0.074	0.073	-1.068
TSP	0.164	0.162	-1.057

9.4. Waste sector (NFR 6)

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2013 and 2014 are made by using exact calculation numbers.

6.D Other waste(s)

NH_3 emissions have been recalculated for the period 1990-2011.

Explanations for recalculations in the waste sector:

- Correction of activity data (amount of compost production from waste).

The differences in waste sector NH_3 emissions between the 2013 and 2014 submissions are presented in Table 9.7.

Table 9.7 The differences in waste sector NH_3 emissions between the 2013 and 2014 submissions

	NH_3		
	Old, Gg	**Recalc., Gg**	**Difference, %**
1990	0.002	0.002	-5.079
1991	0.002	0.002	-5.111
1992	0.002	0.002	-5.130
1993	0.002	0.002	-5.131
1994	0.002	0.002	-5.170
1995	0.002	0.002	-5.024
1996	0.008	0.001	-80.939
1997	0.016	0.003	-82.832
1998	0.002	0.001	-68.451
1999	0.003	0.002	-40.684
2000	0.006	0.005	-28.863
2001	0.009	0.004	-49.731
2002	0.024	0.004	-83.469
2003	0.071	0.016	-77.396
2004	0.097	0.018	-81.136
2005	0.115	0.025	-78.076
2006	0.161	0.028	-82.797
2007	0.187	0.045	-76.208
2008	0.165	0.050	-69.702
2009	0.159	0.056	-65.149
2010	0.188	0.052	-72.140
2011	0.130	0.038	-70.946

10. PROJECTION

Estonian emission projections for substances regulated by the LRTAP Gothenburg Protocol and additionally PM_{10} were compiled in early 2012. In some cases these projections exceed the emission reduction commitments agreed with the Gothenburg Protocol because final agreements were made after compilation of the projections. The projections will be updated and latest obligations of Estonia will be taken into account during 2014.

Table 10.1 National emission ceilings for 2010 and emission projections for 2015 and 2020

Pollutant	National emissions ceiling for 2010 (Gg)	Emission projections for 2015 (Gg)	Emission projections for 2020 (Gg)
SO_2	100	51.78	51.97
NO_x	60	32.70	31.84
NMVOC	49	39.53	40.71
NH_3	29	9.69	9.95
PM_{10}	NA	21.22	21.25
$PM_{2.5}$	NA	18.34	18.62

ANNEX I

Key sources categories level assessment

Table 1 Key source categories for NO_x emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**11.9599**	**37.0%**
1 A 3 b iii Road transport:, Heavy duty vehicles	**5.4704**	**53.9%**
1 A 3 b i Road transport: Passenger cars	**3.1945**	**63.7%**
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	**2.5930**	**71.7%**
1 A 2 f i Stationary combustion in manufacturing industries and construction	**1.6117**	**76.7%**
1 A 3 c Railways	**1.5720**	**81.6%**
1 A 4 b i Residential: Stationary plants	1.4994	86.2%
4 D 1 a Synthetic N-fertilizers	1.1744	89.8%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.8854	92.6%
1 A 3 b ii Road transport: Light duty vehicles	0.6993	94.7%
1 A 4 a i Commercial / institutional: Stationary	0.3548	95.8%
1 A 1 c Manufacture of solid fuels and other energy industries	0.2421	96.6%
1 A 4 a ii Commercial / institutional: Mobile	0.2025	97.2%
1 A 3 d ii National navigation (Shipping)	0.1536	97.7%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.1503	98.1%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1318	98.5%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1169	98.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0848	99.2%
1 A 3 a i (i) International aviation (LTO)	0.0807	99.4%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0628	99.6%
2 B 1 Ammonia production	0.0243	99.7%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0151	99.7%
2 C 1 Iron and steel production	0.0137	99.8%
6 C b Industrial waste incineration (d)	0.0114	99.8%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0080	99.8%
2 A 7 a Quarrying and mining of minerals other than coal	0.0078	99.9%
4 B 1 a Cattle dairy	0.0078	99.9%
1 A 1 b Petroleum refining	0.0078	99.9%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0055	99.9%
4 B 1 b Cattle non-dairy	0.0044	99.9%
6 D Other waste(e)	0.0035	99.9%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0034	100.0%
1 B 2 a iv Refining / storage	0.0032	100.0%
4 B 9 a Laying hens	0.0021	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0020	100.0%
4 B 9 b Broilers	0.0014	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0012	100.0%
4 B 6 Horses	0.0008	100.0%
2 C 5 e Other metal production	0.0006	100.0%
6 B Waste-water handling	0.0004	100.0%
6 C d Cremation	0.0004	100.0%
1 B 2 c Venting and flaring	0.0004	100.0%
4 B 3 Sheep	0.0004	100.0%
4 B 8 Swine	0.0003	100.0%
4 B 9 d Other poultry	0.0003	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0002	100.0%

NFR code	2012 (Gg)	Cumulative Total
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0001	100.0%
2 D 2 Food and drink	0.0000	100.0%
2 D 3 Wood processing	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
2 B 5 a Other chemical industry	0.0000	100.0%

Table 2 Key source categories for NMVOC emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**16.2782**	**48.3%**
1 A 3 b i Road transport: Passenger cars	**1.6149**	**53.0%**
3 A 1 Decorative coating application	**1.4443**	**57.3%**
1 B 2 a v Distribution of oil products	**1.3647**	**61.4%**
3 D 2 Domestic solvent use including fungicides	**1.3397**	**65.3%**
4 B 1 a Cattle dairy	**1.3165**	**69.2%**
4 B 1 b Cattle non-dairy	**1.1041**	**72.5%**
3 B 1 Degreasing	**1.0272**	**75.6%**
3 A 2 Industrial coating application	**0.9930**	**78.5%**
4 B 8 Swine	**0.9250**	**81.3%**
3 D 3 Other product use	0.9104	84.0%
2 D 2 Food and drink	0.7400	86.1%
1 A 4 b ii Residential: Household and gardening (mobile)	0.4962	87.6%
3 D 1 Printing	0.4670	89.0%
1 B 2 a iv Refining / storage	0.4388	90.3%
1 A 1 a Public electricity and heat production	0.4239	91.6%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.4025	92.8%
3 C Chemical products	0.3372	93.8%
1 A 3 b v Road transport: Gasoline evaporation	0.2609	94.5%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.2491	95.3%
4 B 9 a Laying hens	0.2082	95.9%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.2076	96.5%
1 A 4 a ii Commercial / institutional: Mobile	0.1489	96.9%
4 B 9 b Broilers	0.1403	97.4%
1 A 3 c Railways	0.1395	97.8%
1 A 3 b ii Road transport: Light duty vehicles	0.0923	98.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0914	98.3%
4 B 9 d Other poultry	0.0666	98.5%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0655	98.7%
2 B 5 b Storage, handling and transport of chemical products	0.0561	98.9%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0535	99.0%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0434	99.2%
1 A 4 a i Commercial / institutional: Stationary	0.0415	99.3%
1 A 3 d ii National navigation (Shipping)	0.0298	99.4%
6 B Waste-water handling	0.0255	99.4%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0198	99.5%
1 B 2 b Natural gas	0.0186	99.6%
2 A 6 Road paving with asphalt	0.0181	99.6%
2 D 1 Pulp and paper	0.0170	99.7%
2 B 5 a Other chemical industry	0.0167	99.7%
4 B 3 Sheep	0.0163	99.8%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0140	99.8%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0112	99.8%
1 A 3 a i (i) International aviation (LTO)	0.0107	99.9%

NFR code	2012 (Gg)	Cumulative Total
2 D 3 Wood processing	0.0099	99.9%
3 B 2 Dry cleaning	0.0081	99.9%
6 D Other waste(e)	0.0068	99.9%
2 C 1 Iron and steel production	0.0064	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0041	100.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0038	100.0%
1 B 2 c Venting and flaring	0.0023	100.0%
2 C 5 e Other metal production	0.0008	100.0%
6 C d Cremation	0.0006	100.0%
2 B 1 Ammonia production	0.0006	100.0%
6 C b Industrial waste incineration (d)	0.0006	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0006	100.0%
1 A 1 b Petroleum refining	0.0005	100.0%
2 F Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	0.0003	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0002	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0001	100.0%
2 C 3 Aluminium production	0.0000	100.0%
4 D 1 a Synthetic N-fertilizers	0.0000	100.0%

Table 3 Key source categories for SO_x emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 1 a Public electricity and heat production	**33.5069**	**82.6%**
1 A 2 f i Stationary combustion in manufacturing industries and construction	4.8743	94.6%
1 A 1 c Manufacture of solid fuels and other energy industries	1.1557	97.4%
1 A 4 b i Residential: Stationary plants	0.4377	98.5%
1 A 4 a i Commercial / institutional: Stationary	0.1460	98.9%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1281	99.2%
1 A 3 c Railways	0.0600	99.3%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0535	99.5%
6 C b Industrial waste incineration (d)	0.0497	99.6%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0371	99.7%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0350	99.8%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0224	99.8%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0209	99.9%
1 B 2 a iv Refining / storage	0.0170	99.9%
1 A 3 d ii National navigation (Shipping)	0.0080	99.9%
1 A 3 a i (i) International aviation (LTO)	0.0072	100.0%
1 A 3 b i Road transport: Passenger cars	0.0055	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0038	100.0%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0030	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0030	100.0%
1 A 3 b ii Road transport: Light duty vehicles	0.0009	100.0%
2 A 7 a Quarrying and mining of minerals other than coal	0.0009	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0009	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0006	100.0%
1 B 2 c Venting and flaring	0.0004	100.0%
6 D Other waste(e)	0.0003	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0003	100.0%
6 C d Cremation	0.0001	100.0%
6 B Waste-water handling	0.0001	100.0%

NFR code	2012 (Gg)	Cumulative Total
2 C 5 e Other metal production	0.0001	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0001	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0001	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0000	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0000	100.0%
2 B 5 a Other chemical industry	0.0000	100.0%
2 D 2 Food and drink	0.0000	100.0%
2 D 3 Wood processing	0.0000	100.0%
2 C 5 b Lead production	0.0000	100.0%

Table 4 Key source categories for NH_3 emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
4 B 1 a Cattle dairy	**3.2912**	**30.6%**
4 D 1 a Synthetic N-fertilizers	**2.7702**	**56.4%**
4 B 1 b Cattle non-dairy	**1.8113**	**73.2%**
4 B 8 Swine	**1.3473**	**85.7%**
4 B 9 a Laying hens	0.3331	88.8%
4 B 9 b Broilers	0.3087	91.7%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.2115	93.7%
1 A 3 b i Road transport: Passenger cars	0.1864	95.4%
4 B 3 Sheep	0.1140	96.5%
4 B 6 Horses	0.0918	97.3%
2 C 5 e Other metal production	0.0719	98.0%
4 B 9 d Other poultry	0.0703	98.6%
1 A 4 b i Residential: Stationary plants	0.0659	99.2%
6 D Other waste(e)	0.0370	99.6%
2 B 5 a Other chemical industry	0.0147	99.7%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0081	99.8%
2 B 5 b Storage, handling and transport of chemical products	0.0065	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0046	99.9%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0031	99.9%
3 C Chemical products	0.0031	100.0%
2 B 1 Ammonia production	0.0018	100.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0006	100.0%
6 B Waste-water handling	0.0003	100.0%
6 C b Industrial waste incineration (d)	0.0003	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0002	100.0%
1 A 3 c Railways	0.0002	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0001	100.0%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0001	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0001	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0001	100.0%
1 B 2 a iv Refining / storage	0.0000	100.0%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0000	100.0%
1 A 3 d ii National navigation (Shipping)	0.0000	100.0%
6 A Solid waste disposal on land	0.0000	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
6 C d Cremation	0.0000	100.0%
2 D 3 Wood processing	0.0000	100.0%
1 A 1 a Public electricity and heat production	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%

NFR code	2012 (Gg)	Cumulative Total
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0000	100.0%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0000	100.0%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0000	100.0%
1 A 4 a i Commercial / institutional: Stationary	0.0000	100.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0000	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%

Table 5 Key source categories for $PM_{2.5}$ emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**11.6240**	**68.0%**
1 A 1 a Public electricity and heat production	**2.6377**	**83.5%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	1.0609	89.7%
1 A 4 a i Commercial / institutional: Stationary	0.2441	91.1%
1 A 1 c Manufacture of solid fuels and other energy industries	0.2175	92.4%
1 A 3 b i Road transport: Passenger cars	0.1571	93.3%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1286	94.1%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1247	94.8%
1 B 2 a iv Refining / storage	0.1057	95.4%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.1027	96.0%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.0938	96.6%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0563	96.9%
1 A 3 b vii Road transport: Automobile road abrasion	0.0525	97.2%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0498	97.5%
3 D 3 Other product use	0.0469	97.8%
1 A 3 b ii Road transport: Light duty vehicles	0.0469	98.1%
1 A 3 c Railways	0.0411	98.3%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0338	98.5%
4 D 1 a Synthetic N-fertilizers	0.0298	98.7%
2 A 7 a Quarrying and mining of minerals other than coal	0.0257	98.8%
2 D 3 Wood processing	0.0256	99.0%
4 B 1 b Cattle non-dairy	0.0239	99.1%
4 B 1 a Cattle dairy	0.0223	99.2%
1 A 3 d ii National navigation (Shipping)	0.0184	99.3%
1 A 4 a ii Commercial / institutional: Mobile	0.0148	99.4%
4 B 8 Swine	0.0127	99.5%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0103	99.6%
4 B 9 b Broilers	0.0098	99.6%
2 C 1 Iron and steel production	0.0091	99.7%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0085	99.7%
2 D 1 Pulp and paper	0.0075	99.8%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0058	99.8%
2 A 7 b Construction and demolition	0.0057	99.8%
2 D 2 Food and drink	0.0046	99.9%
2 B 5 a Other chemical industry	0.0036	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0030	99.9%
2 A 3 Limestone and dolomite use	0.0028	99.9%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0022	99.9%
2 C 3 Aluminium production	0.0019	99.9%
2 A 1 Cement production	0.0015	100.0%

NFR code	2012 (Gg)	Cumulative Total
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0015	100.0%
4 B 9 a Laying hens	0.0014	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0008	100.0%
4 B 6 Horses	0.0007	100.0%
2 C 5 e Other metal production	0.0007	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0006	100.0%
1 A 3 a i (i) International aviation (LTO)	0.0004	100.0%
2 B 5 b Storage, handling and transport of chemical products	0.0004	100.0%
4 B 9 d Other poultry	0.0003	100.0%
6 A Solid waste disposal on land	0.0003	100.0%
1 B 2 c Venting and flaring	0.0003	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0002	100.0%
6 D Other waste(e)	0.0001	100.0%
2 A 6 Road paving with asphalt	0.0001	100.0%
2 A 2 Lime production	0.0000	100.0%
2 C 5 b Lead production	0.0000	100.0%
3 A 2 Industrial coating application	0.0000	100.0%
2 C 5 d Zinc production	0.0000	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0000	100.0%
2 C 5 a Copper production	0.0000	100.0%
3 B 1 Degreasing	0.0000	100.0%
2 A 7 d Other Mineral products	0.0000	100.0%

Table 6 Key source categories for PM_{10} emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**11.6240**	**55.4%**
1 A 1 a Public electricity and heat production	**4.8453**	**78.5%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**1.1436**	**84.0%**
4 D 1 a Synthetic N-fertilizers	0.7757	87.7%
1 A 1 c Manufacture of solid fuels and other energy industries	0.4586	89.9%
1 A 4 a i Commercial / institutional: Stationary	0.2817	91.2%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.1750	92.0%
1 A 3 b i Road transport: Passenger cars	0.1571	92.8%
1 B 2 a iv Refining / storage	0.1310	93.4%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1305	94.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1286	94.6%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.1027	95.1%
1 A 3 b vii Road transport: Automobile road abrasion	0.0963	95.6%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.0837	96.0%
4 B 8 Swine	0.0800	96.4%
2 D 3 Wood processing	0.0773	96.7%
4 B 9 b Broilers	0.0730	97.1%
2 A 7 b Construction and demolition	0.0574	97.4%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0563	97.6%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0552	97.9%
3 D 3 Other product use	0.0469	98.1%
1 A 3 b ii Road transport: Light duty vehicles	0.0469	98.3%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0445	98.6%
1 A 3 c Railways	0.0432	98.8%
4 B 1 b Cattle non-dairy	0.0358	98.9%
4 B 1 a Cattle dairy	0.0348	99.1%

NFR code	2012 (Gg)	Cumulative Total
2 A 7 a Quarrying and mining of minerals other than coal	0.0263	99.2%
2 D 1 Pulp and paper	0.0226	99.3%
1 A 3 d ii National navigation (Shipping)	0.0184	99.4%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0162	99.5%
1 A 4 a ii Commercial / institutional: Mobile	0.0148	99.6%
2 D 2 Food and drink	0.0137	99.6%
4 B 9 a Laying hens	0.0118	99.7%
2 B 5 a Other chemical industry	0.0108	99.7%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0103	99.8%
2 C 1 Iron and steel production	0.0101	99.8%
2 A 3 Limestone and dolomite use	0.0082	99.9%
2 A 1 Cement production	0.0045	99.9%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0041	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0032	99.9%
2 C 3 Aluminium production	0.0025	99.9%
4 B 9 d Other poultry	0.0024	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0015	100.0%
2 B 5 b Storage, handling and transport of chemical products	0.0011	100.0%
4 B 6 Horses	0.0011	100.0%
2 C 5 e Other metal production	0.0009	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0008	100.0%
2 A 6 Road paving with asphalt	0.0008	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0008	100.0%
1 A 3 a i (i) International aviation (LTO)	0.0004	100.0%
1 B 2 c Venting and flaring	0.0003	100.0%
6 A Solid waste disposal on land	0.0003	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0002	100.0%
2 A 2 Lime production	0.0002	100.0%
6 D Other waste(e)	0.0001	100.0%
2 C 5 b Lead production	0.0000	100.0%
2 C 5 d Zinc production	0.0000	100.0%
3 A 2 Industrial coating application	0.0000	100.0%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0000	100.0%
2 C 5 a Copper production	0.0000	100.0%
3 B 1 Degreasing	0.0000	100.0%
2 A 7 d Other Mineral products	0.0000	100.0%
2 B 1 Ammonia production	0.0000	100.0%

Table 7 Key source categories for TSP emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**13.2830**	**49.2%**
1 A 1 a Public electricity and heat production	**7.2435**	**76.1%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	**1.5167**	**81.7%**
4 D 1 a Synthetic N-fertilizers	0.7757	84.6%
1 A 1 c Manufacture of solid fuels and other energy industries	0.6155	86.9%
1 A 4 a i Commercial / institutional: Stationary	0.4285	88.5%
2 A 7 a Quarrying and mining of minerals other than coal	0.2339	89.3%
2 D 3 Wood processing	0.2331	90.2%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.2279	91.0%
1 A 3 b vii Road transport: Automobile road abrasion	0.1930	91.8%
4 B 8 Swine	0.1777	92.4%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.1708	93.1%
4 B 9 b Broilers	0.1620	93.7%

NFR code	2012 (Gg)	Cumulative Total
1 B 2 a iv Refining / storage	0.1578	94.2%
1 A 3 b i Road transport: Passenger cars	0.1571	94.8%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1357	95.3%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1286	95.8%
2 A 7 b Construction and demolition	0.1145	96.2%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1041	96.6%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.1027	97.0%
4 B 1 b Cattle non-dairy	0.0795	97.3%
4 B 1 a Cattle dairy	0.0774	97.6%
2 D 1 Pulp and paper	0.0685	97.8%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0663	98.1%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0563	98.3%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0546	98.5%
3 D 3 Other product use	0.0475	98.7%
1 A 3 b ii Road transport: Light duty vehicles	0.0469	98.8%
1 A 3 c Railways	0.0456	99.0%
2 D 2 Food and drink	0.0415	99.2%
2 B 5 a Other chemical industry	0.0328	99.3%
2 C 1 Iron and steel production	0.0278	99.4%
4 B 9 a Laying hens	0.0262	99.5%
2 A 3 Limestone and dolomite use	0.0253	99.6%
3 A 2 Industrial coating application	0.0210	99.6%
1 A 3 d ii National navigation (Shipping)	0.0184	99.7%
1 A 4 a ii Commercial / institutional: Mobile	0.0148	99.8%
2 A 1 Cement production	0.0138	99.8%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0103	99.9%
4 B 9 d Other poultry	0.0051	99.9%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0047	99.9%
2 C 3 Aluminium production	0.0041	99.9%
2 A 6 Road paving with asphalt	0.0039	99.9%
2 B 5 b Storage, handling and transport of chemical products	0.0035	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0032	100.0%
3 C Chemical products	0.0030	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0024	100.0%
2 C 5 e Other metal production	0.0014	100.0%
4 B 6 Horses	0.0011	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0010	100.0%
6 A Solid waste disposal on land	0.0009	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0008	100.0%
2 A 2 Lime production	0.0005	100.0%
1 A 3 a i (i) International aviation (LTO)	0.0004	100.0%
1 B 2 c Venting and flaring	0.0004	100.0%
3 B 1 Degreasing	0.0003	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0003	100.0%
6 C b Industrial waste incineration (d)	0.0002	100.0%
6 D Other waste(e)	0.0001	100.0%
3 D 1 Printing	0.0001	100.0%
2 C 5 b Lead production	0.0001	100.0%
2 C 5 d Zinc production	0.0001	100.0%
6 C d Cremation	0.0001	100.0%
2 A 7 d Other Mineral products	0.0000	100.0%
2 C 5 a Copper production	0.0000	100.0%

Table 8 Key source categories for CO emissions for 2012, level assessment

NFR code	2012 (Gg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**101.7784**	**62.7%**
1 A 1 c Manufacture of solid fuels and other energy industries	**24.8731**	**78.0%**
1 A 3 b i Road transport: Passenger cars	**14.7979**	**87.1%**
1 A 1 a Public electricity and heat production	5.1241	90.3%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	4.9203	93.3%
1 A 4 b ii Residential: Household and gardening (mobile)	2.6715	95.0%
1 B 2 a iv Refining / storage	1.8590	96.1%
1 A 3 b iii Road transport:, Heavy duty vehicles	1.3150	96.9%
1 A 3 b ii Road transport: Light duty vehicles	0.8964	97.5%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.8095	98.0%
1 A 4 a i Commercial / institutional: Stationary	0.6617	98.4%
1 A 4 a ii Commercial / institutional: Mobile	0.3941	98.6%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.3291	98.8%
1 A 3 c Railways	0.3210	99.0%
2 B 5 a Other chemical industry	0.3049	99.2%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.2903	99.4%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1665	99.5%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1655	99.6%
1 B 1 a Fugitive emission from solid fuels: Coal mining and handling	0.1505	99.7%
1 A 3 a i (i) International aviation (LTO)	0.1246	99.7%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.1118	99.8%
1 A 3 d ii National navigation (Shipping)	0.0792	99.9%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0695	99.9%
1 A 3 a ii (i) Civil aviation (Domestic, LTO)	0.0536	99.9%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0325	100.0%
2 G Other production, consumption, storage, transportation or handling of bulk products	0.0147	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0088	100.0%
1 A 1 b Petroleum refining	0.0076	100.0%
2 C 1 Iron and steel production	0.0076	100.0%
2 A 7 a Quarrying and mining of minerals other than coal	0.0069	100.0%
6 C b Industrial waste incineration (d)	0.0055	100.0%
6 D Other waste(e)	0.0037	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0034	100.0%
3 C Chemical products	0.0019	100.0%
2 C 5 e Other metal production	0.0014	100.0%
1 B 1 b Fugitive emission from solid fuels: Solid fuel transformation	0.0008	100.0%
1 B 2 c Venting and flaring	0.0004	100.0%
2 B 1 Ammonia production	0.0002	100.0%
3 D 3 Other product use	0.0002	100.0%
2 D 2 Food and drink	0.0000	100.0%
6 C d Cremation	0.0000	100.0%

Table 9 Key source categories for Pb emissions for 2012, level assessment

NFR code	2012 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**31.8209**	**94.8%**
1 A 4 b i Residential: Stationary plants	0.6927	96.8%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.3552	97.9%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.2395	98.6%
1 A 3 b i Road transport: Passenger cars	0.2086	99.2%

NFR code	2012 (Mg)	Cumulative Total
1 A 4 a i Commercial / institutional: Stationary	0.0909	99.5%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0594	99.7%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0277	99.7%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0226	99.8%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0192	99.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0095	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0088	99.9%
2 C 5 b Lead production	0.0080	99.9%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0056	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0050	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0027	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0019	100.0%
2 C 5 e Other metal production	0.0010	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0008	100.0%
6 D Other waste(e)	0.0007	100.0%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0006	100.0%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0005	100.0%
2 C 1 Iron and steel production	0.0005	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0002	100.0%
3 D 3 Other product use	0.0002	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0001	100.0%
3 B 1 Degreasing	0.0001	100.0%
1 B 2 a iv Refining / storage	0.0001	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 3 c Railways	0.0000	100.0%

Table 10 Key source categories for Cd emissions for 2012, level assessment

NFR code	2012 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0.5324**	**92.2%**
1 A 4 b i Residential: Stationary plants	0.0171	95.1%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0139	97.5%
1 A 3 b i Road transport: Passenger cars	0.0041	98.2%
1 A 4 a i Commercial / institutional: Stationary	0.0028	98.7%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0019	99.0%
1 A 3 b vi Road transport: Automobile tyre and brake wear	0.0011	99.2%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0007	99.4%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0006	99.5%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0006	99.6%
1 A 3 b ii Road transport: Light duty vehicles	0.0006	99.7%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0006	99.8%
1 A 3 c Railways	0.0003	99.8%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0003	99.9%
6 D Other waste(e)	0.0003	99.9%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0002	99.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0002	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0001	100.0%
1 A 3 d ii National navigation (Shipping)	0.0000	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0000	100.0%

NFR code	2012 (Mg)	Cumulative Total
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0000	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%
1 B 2 a iv Refining / storage	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0000	100.0%

Table 11 Key source categories for Hg emissions for 2012, level assessment

NFR code	2012 (Mg)	Cumulative Total
1 A 1 a Public electricity and heat production	**0.5315**	**95.9%**
1 A 4 b i Residential: Stationary plants	0.0183	99.2%
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0027	99.7%
1 A 4 a i Commercial / institutional: Stationary	0.0006	99.8%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0005	99.8%
6 D Other waste(e)	0.0004	99.9%
1 A 2 e Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0003	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
1 A 2 d Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0001	100.0%
1 A 2 a Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0000	100.0%
1 B 2 c Venting and flaring	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
1 B 2 a iv Refining / storage	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 2 b Stationary Combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%
1 A 2 c Stationary combustion in manufacturing industries and construction: Chemicals	0.0000	100.0%

Table 12 Key source categories for PCB emissions for 2012, level assessment

NFR code	2012 (Mg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**6.2000**	**64.6%**
1 A 1 a Public electricity and heat production	**2.4874**	**90.6%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.7531	98.4%
1 A 4 a i Commercial / institutional: Stationary	0.1236	99.7%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0145	99.8%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0138	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0007	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
1 A 3 c Railways	0.0000	100.0%

Table 13 Key source categories for PCDD/PCDF emissions for 2012, level assessment

NFR code	2012 (g I-Teq)	Cumulative Total
1 A 1 a Public electricity and heat production	**1.6989**	**42.9%**
1 A 4 b i Residential: Stationary plants	**1.6700**	**85.0%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.2158	90.4%
6 C b Industrial waste incineration (d)	0.1404	94.0%

NFR code	2012 (g I-Teq)	Cumulative Total
1 A 3 b i Road transport: Passenger cars	0.1200	97.0%
6 C a Clinical waste incineration (d)	0.0680	98.7%
1 A 4 a i Commercial / institutional: Stationary	0.0222	99.3%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0113	99.6%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0085	99.8%
1 A 3 b ii Road transport: Light duty vehicles	0.0044	99.9%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0020	99.9%
6 D Other waste(e)	0.0010	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0008	100.0%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0002	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%
3 D 3 Other product use	0.0000	100.0%
1 A 3 c Railways	0.0000	100.0%

Table 14 Key source categories for PAHs emissions for 2012, level assessment

NFR code	2012 (Mg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**11.7307**	**78.4%**
1 A 1 a Public electricity and heat production	**2.2965**	**93.8%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.7633	98.9%
1 A 4 a i Commercial / institutional: Stationary	0.0958	99.5%
1 A 3 b i Road transport: Passenger cars	0.0262	99.7%
1 A 3 b iii Road transport:, Heavy duty vehicles	0.0144	99.8%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0088	99.8%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0060	99.9%
1 A 4 c ii Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0059	99.9%
1 A 3 b ii Road transport: Light duty vehicles	0.0053	100.0%
1 A 3 c Railways	0.0037	100.0%
1 A 2 f ii Mobile Combustion in manufacturing industries and construction	0.0022	100.0%
1 A 4 a ii Commercial / institutional: Mobile	0.0005	100.0%
1 A 3 d ii National navigation (Shipping)	0.0003	100.0%
1 A 4 b ii Residential: Household and gardening (mobile)	0.0003	100.0%
1 A 3 b iv Road transport: Mopeds & motorcycles	0.0001	100.0%
3 D 3 Other product use	0.0000	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

Table 15 Key source categories for HCB emissions for 2012, level assessment

NFR code	2012 (Mg)	Cumulative Total
1 A 4 b i Residential: Stationary plants	**0.1000**	**54.1%**
1 A 1 a Public electricity and heat production	**0.0594**	**86.3%**
1 A 2 f i Stationary combustion in manufacturing industries and construction: Other	0.0222	98.3%
1 A 4 a i Commercial / institutional: Stationary	0.0027	99.7%
1 A 4 c i Agriculture/Forestry/Fishing: Stationary	0.0002	99.8%
1A 4 c iii Agriculture/Forestry/Fishing: National fishing	0.0002	99.9%
1 A 1 c Manufacture of solid fuels and other energy industries	0.0001	100.0%
1 A 1 b Petroleum refining	0.0000	100.0%

ANNEX II

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ANNEX III

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