REPUBLIC OF ESTONIA
ENVIRONMENT AGENCY

ESTONIAN INFORMATIVE INVENTORY REPORT 1990-2013

Submitted under the Convention on Long-Range Transboundary Air Pollution

Tallinn 2015

Data sheet

Title: Estonian Informative Inventory Report 1990-2013

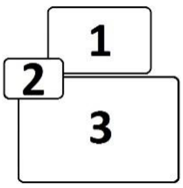
Date: March 13th 2015

Authors: Natalija Kohv, Helen Heintalu, Elo Mandel, Ardi Link, Maria Oravas

Editor: Ardi Link

Contact: Elo Mandel
Estonian Environment Agency
Mustamäe tee 33, 10616 Tallinn, Estonia
E-mail: Elo.Mandel@envir.ee

Cover photos:



1. Tallinn medieval Old Town (source: www.traveloutthere.com);
2. Tallinn city centre (photo by Raul Mee);
3. Kakerdaja Fen (photo by Kalev Vask) - *It is one of the largest fens in Kõrvemaa. It covers an area of approximately 1000 hectares. The most unique feature of this picturesque fen is that it has two levels of different height. Thousands of water birds stop on the fen in spring and autumn. Lake Kakerdaja can be found right in the middle of the fen.*

TABLE OF CONTENTS

ABBREVIATIONS

CAS	Chemical Abstracts Service, pollutants nomenclature
CEIP	Centre on Emission Inventories and Projections
CEPMEIP	Co-ordinated European Programme on Particulate Matter Emission Inventories, Projections and Guidance
CLRTAP	Convention on Long Range Transboundary Air Pollution
CN	Combined Nomenclature
CollectER	Point and area sources database
COPERT 4	Road transport database
CORINAIR	CORe INventory AIR emissions programme
GNFR	Gridding NFR (aggregated NFR categories)
EB	Energy Balance
EEA	European Environment Agency
EEB	Estonian Environmental Board
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
ESTEA	Estonian Environment Agency
EU	European Union
GAINS	Greenhouse Gas and Air Pollution Interactions and Synergies model
GHG	Greenhouse gases
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 (ESTEA)
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
B(a)p	Benzo(a)pyrene
B(b)f	Benzo(b)fluoranthene
B(k)f	Benzo(k)fluoranthene
Cd	Cadmium
CFC	Chlorofluorocarbon
Cr	Chromium
Cu	Copper
CO	Carbon monoxide
HCB	Hexachlorobenzene
HCl	Hydrochloric acid
HFCs	Hydrofluorocarbons

Hg	Mercury
HM	Heavy metals
I(1,2,3-cd)p	Indeno(1,2,3-cd)pyrene
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

kt Kilotonne, 10^3 tonne

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

t Tonne

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.

Forest in the evening light (photo by Kristjan Klementi)

EXCUTIVE SUMMARY

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 to provide an Informative Inventory Report. The emissions data of all pollutants for the period 1990-2013 together with projections were submitted on 12th February 2015. 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 made for the time period from 1990 to 2012. The reasons for the recalculations are specified in Table 0.1 below:

Table 0.1 The status of recalculations in the 2015 submission

NFR14 code	NFR name	Recalculation reasons	Pollutant	Recalculation period
1A2gviii	Stationary combustion in manufacturing industries and construction	Additionally calculated emission from the cement production	B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs, HCB	1990-2012
1A3di(i)	International maritime navigation	Correction of gross tonnage of vessels	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP,	2005-2012
		Correction of fuel consumption	CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, HCB, PCB	2012
1A4bi	Residential: Stationary	Correction of emission factor	Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs, HCB, PCB	1990-2012
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2010-2012
1B2aiv	Fugitive emissions oil: Refining / storage	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2001, 2008-2012
2A1	Cement production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2003-2006, 2008-2012
2A2	Lime production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2008-2012
2A5a	Quarrying and mining of minerals other than coal	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2009-2012
2A6	Other mineral products	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2000, 2002-2006, 2008-2009, 2012
2B1	Ammonia production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2008, 2011

NFR14 code	NFR name	Recalculation reasons	Pollutant	Recalculation period
2B10a	Chemical industry: Other	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2000-2005, 2007-2009, 2012
2B10b	Storage, handling and transport of chemical products	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2008-2009, 2012
2C1	Iron and steel production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2007-2012
2C3	Aluminium production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2009-2012
2C5	Lead production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2009-2012
2C6	Zinc production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2009-2012
2C7a	Copper production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2009-2012
2C7c	Other metal production	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2000-2012
2D3a	Domestic solvent use including fungicides	New emission factor in EMEP/EEA Guidebook 2013	NMVOC	2000-2012
			Hg	1990-2012
2D3b	Road paving with asphalt	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2000-2012
			TSP	1990-2012
2D3d	Coating applications	Corrections in statistical data from Eurostat and in point sources data from OSIS database	NMVOC	2002-2012
		Corrections in point sources data from OSIS database	TSP	2012
2D3e	Degreasing	Corrections in statistical data from Eurostat and Statistics Estonia	NMVOC	2000-2012
		Corrections in point sources data from OSIS database	TSP	2010, 2012
			Pb	2011
2D3h	Printing	Corrections in statistical data from Eurostat (2002-2012). Previously the statistical data used for calculations were taken under CN 3215; now the data are taken only under CN 3215.11 and 3215.19	NMVOC	1990-2012
2D3i	Other solvent use	New emission factor in EMEP/EEA Guidebook 2013 for the application of glues and adhesives. Corrections in statistical data from Eurostat and Statistics Estonia. Corrections in point sources data from OSIS database	NMVOC	2000-2012

NFR14 code	NFR name	Recalculation reasons	Pollutant	Recalculation period
2G	Other product use	New emission factors in EMEP/EEA Guidebook 2013 for tobacco combustion and use of fireworks	NO_x, NMVOC, SO_x, NH_3, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
2H1	Pulp and paper industry	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2000-2012
2H2	Food and beverages industry	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2000, 2002-2006, 2009-2010
2I	Wood processing	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2011
2L	Other production, consumption, storage, transportation or handling of bulk products	New emission factor in EMEP/EEA Guidebook 2013	$PM_{2.5}$, PM_{10}	2010-2011
3B2	Manure management - Sheep	Corrections of activity data	NO_x, NMVOC, NH_3, TSP	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
3B4gi	Manure management - Laying hens	Corrections of activity data	NO_x, NMVOC, NH_3, TSP	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
3B4gii	Manure management - Broilers	Corrections of activity data	NO_x, NMVOC, NH_3, TSP	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
3B4giv	Manure management - Other poultry	Corrections of activity data	NO_x, NMVOC, NH_3, TSP	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
3B4h	Manure management - Other animals	Additionally estimated, new inventory source	NO_x, NMVOC, NH_3, TSP	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
3Da1	Inorganic N-fertilizers	Corrections in statistical data from Statistics Estonia	NO_x, NMVOC	1990-2012
5B1	Biological treatment of waste - Composting	New emission factor in EMEP/EEA Guidebook 2013	NH_3	1992-2012
5C2	Open burning of waste	Additionally estimated, new inventory source	NO_x, NMVOC, SO_x, TSP, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/F, B(a)p, B(b)f, B(k)f, Total PAHs, HCB, PCB	1990-2012
			$PM_{2.5}$, PM_{10}	2000-2012
5E	Other waste	New emission factor in EMEP/EEA Guidebook 2013. Additionally calculated, corrections for heavy metals	TSP, Pb, Cd, Hg, As, Cr, Cu, PCDD/F	1998-2012
			$PM_{2.5}$, PM_{10}	2000-2012

Detailed sector by sector explanations concerning the recalculations are presented in Chapter 8.

The differences in total emissions between the 2014 and 2015 submissions are presented in Table 0.2.

Table 0.2 Difference between the 2014 and 2015 submissions (%)

Year	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP	Pb	Cd
1990	0.03	0.62	0.00	4.14	0.10	NR	NR	0.64	0.27	2.34
1991	0.03	0.59	0.01	3.77	0.09	NR	NR	0.59	0.29	2.28
1992	-1.95	1.08	0.01	5.31	0.08	NR	NR	0.74	0.58	3.08
1993	-1.50	0.74	0.01	3.90	0.12	NR	NR	0.57	0.63	4.29
1994	-1.44	0.36	0.01	2.96	0.09	NR	NR	0.60	0.64	3.78
1995	-1.02	0.19	0.02	3.06	0.07	NR	NR	0.69	0.97	11.43
1996	-0.77	0.17	0.02	3.59	0.06	NR	NR	0.70	1.35	24.79
1997	-0.69	0.02	0.02	2.30	0.08	NR	NR	0.95	2.16	26.00
1998	-0.68	0.17	0.02	3.08	0.07	NR	NR	1.41	2.61	21.52
1999	-0.70	-0.06	0.02	2.35	0.07	NR	NR	1.37	2.84	22.39
2000	-0.53	-0.42	0.02	1.79	0.06	2.22	1.71	1.63	2.92	37.92
2001	-0.42	0.35	0.02	4.58	0.06	1.95	1.71	1.49	1.93	36.08
2002	-0.50	0.44	0.02	5.85	0.07	2.45	2.21	2.35	2.28	35.65
2003	-0.33	0.44	0.02	6.58	0.08	2.27	2.27	2.46	2.32	33.89
2004	-0.59	0.09	0.01	6.22	0.08	2.32	2.49	2.50	1.27	33.62
2005	-0.61	-0.34	0.01	4.32	0.09	2.55	2.69	3.74	1.71	31.66
2006	-0.53	-0.40	0.01	5.36	0.08	3.84	3.35	5.33	2.05	32.66
2007	-0.76	-0.43	0.01	2.45	0.12	2.34	2.30	4.44	1.53	32.53
2008	-0.70	0.10	0.01	5.06	0.05	2.45	2.96	3.99	1.23	35.44
2009	-0.84	0.02	0.01	5.20	0.08	1.34	2.04	4.05	0.72	48.21
2010	-0.79	1.14	0.01	5.12	0.04	0.95	1.55	2.80	0.77	34.44
2011	-0.85	1.14	0.01	6.06	0.07	0.32	0.82	0.86	0.91	31.32
2012	-0.95	1.21	0.01	5.38	0.06	0.76	2.13	1.57	1.18	37.27

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs total	HCB	PCB
1990	2.98	0.04	0.51	-0.44	-0.13	1.51	51.74	-21.45	205.06	-17.52
1991	2.22	0.10	0.43	-0.37	-1.48	1.55	57.81	-21.45	190.36	-16.21
1992	3.25	0.12	0.61	-0.47	-0.44	1.88	27.65	-30.31	204.90	-22.81
1993	5.17	0.15	0.90	-0.28	-0.21	2.74	22.35	-30.17	229.03	-16.66
1994	5.48	0.17	1.01	-0.39	-0.27	2.71	7.42	-41.02	140.33	-35.60
1995	5.86	0.13	3.05	-0.86	-0.39	9.40	23.60	-30.08	164.87	-55.15
1996	5.18	0.15	3.42	-0.96	-1.09	11.58	29.80	-29.88	150.89	-54.81
1997	6.04	0.20	3.83	-0.35	-1.07	12.42	31.94	-29.41	157.89	-58.20
1998	7.23	0.18	3.27	0.24	-1.21	10.76	86.45	-28.51	137.67	-51.82
1999	8.44	0.21	3.38	0.77	-2.21	11.05	109.13	-26.49	143.23	-53.74
2000	8.05	0.20	3.19	0.17	-2.62	11.99	100.40	-29.13	124.13	-62.95
2001	5.87	0.11	3.25	0.36	-1.50	11.66	85.05	-31.89	110.54	-56.35
2002	6.59	0.14	3.37	0.40	-2.30	12.05	82.82	-33.52	112.57	-57.48
2003	5.62	0.12	3.10	0.59	-0.40	10.63	61.85	-36.36	92.59	-53.65
2004	4.08	0.04	3.16	1.34	-1.21	10.64	60.66	-37.29	66.86	-59.76
2005	4.02	0.15	2.85	2.90	-1.12	9.94	67.45	-37.23	70.98	-58.09
2006	3.74	0.15	2.99	3.64	-1.44	10.76	77.09	-40.04	87.07	-62.28

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs total	HCB	PCB
2007	3.16	0.04	3.15	3.89	-0.99	11.14	31.93	-47.67	111.13	-77.33
2008	2.82	0.01	3.66	2.20	-1.56	12.87	26.02	-48.29	97.60	-69.29
2009	3.60	0.01	4.80	0.50	-1.66	16.60	21.49	-49.48	51.35	-68.38
2010	1.91	-0.03	3.50	1.61	-0.99	12.26	12.46	-48.45	46.31	-61.77
2011	2.36	0.01	3.08	2.02	-1.14	10.89	12.69	-49.67	52.80	-63.11
2012	2.44	-0.01	2.59	5.28	-1.16	13.03	14.03	-51.71	50.69	-63.75

In comparison to last year, submission recalculations were made for all pollutants (different pollutants number for different sectors, tables 0.1 and 0.2). The detailed descriptions are presented in the chapters on Energy, Industry, Agriculture and Waste).

The main changes occurred in the emissions of heavy metals and POPs due to the use of national emission factors for POPs and new EMEP/EEA Guidebook emission factors for heavy metals for residential combustion. The main reason for the ammonia emission change is a correction of the activity data in the agriculture sector.

The sharp increase in emission factors of some heavy metals for the sector on the use of fireworks and the calculation of emissions for new sources of the burning of waste also influenced the change in emissions

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 the NEC report there are insignificant distinctions in SO_2, NMVOC, NO_x and ammonia emissions (adjustment was made within the frame of CLRTAP report), which will be modified in the final NEC report in December 2015.

In this section, a comparison with UNFCCC report is presented (last GHG inventory submission 17.10.2014). 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 the bottom to the top and contains data of the point sources (about 1,950, not only LPS) and diffuse sources. Different tools are used for data collection: the national web interface point sources database OSIS and 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. The AP database uses data given by enterprises (measurements and calculations). Emission calculations from the point sources are based on national emission factors. For emission calculations from diffuse sources, EMEP/EEA Guidebook emission factors are used, but it should be noted that some of the emission factors are different in the EMEP/EEA Guidebook from those in the IPCC Good Practice Guidance.

Estonia recognises 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 on streamlining the AP and GHG emission reporting requirements.

Table 0.3 Differences in national total emissions (kt) between CLRTAP and UNFCCC reports

Year	NO_x			NMVOC			SO_x			CO		
	CLRTAP	UNFCC	%	CLRTAP	UNFCC	%	CLRTAP	UNFCC	%	CLRTAP	UNFCC	%
1990	73.64	77.20	**-4.61**	70.61	53.80	**31.24**	273.62	184.26	**48.50**	226.81	189.98	**19.39**
1991	67.94	72.16	**-5.84**	67.26	51.63	**30.29**	251.30	179.67	**39.87**	226.19	186.48	**21.29**
1992	42.85	45.94	**-6.72**	45.52	34.83	**30.68**	191.68	106.22	**80.45**	127.21	101.49	**25.34**
1993	38.92	39.36	**-1.12**	37.51	32.59	**15.08**	155.91	66.45	**134.63**	123.76	106.25	**16.47**
1994	41.46	43.62	**-4.96**	41.22	37.56	**9.75**	150.25	71.98	**108.74**	149.67	133.67	**11.97**
1995	38.78	41.34	**-6.20**	49.99	42.69	**17.10**	116.12	75.83	**53.14**	197.06	165.38	**19.15**
1996	42.13	43.98	**-4.20**	52.54	44.14	**19.03**	125.16	85.46	**46.46**	219.44	185.34	**18.40**
1997	40.95	43.51	**-5.89**	54.44	46.14	**17.99**	116.23	82.47	**40.93**	228.91	202.66	**12.96**
1998	38.08	39.73	**-4.16**	46.28	40.11	**15.41**	104.33	74.16	**40.69**	181.28	160.71	**12.80**
1999	36.53	38.87	**-6.01**	45.63	39.81	**14.62**	97.62	72.81	**34.08**	190.41	171.88	**10.78**
2000	37.45	37.74	**-0.77**	45.00	37.64	**19.55**	96.98	80.61	**20.31**	182.73	166.36	**9.84**
2001	39.91	39.48	**1.10**	45.07	37.57	**19.96**	90.70	82.59	**9.83**	188.58	173.18	**8.89**
2002	40.85	38.50	**6.11**	44.41	36.44	**21.85**	87.00	79.36	**9.63**	181.87	161.69	**12.48**
2003	41.62	38.16	**9.08**	43.26	37.03	**16.83**	100.26	80.55	**24.46**	174.41	157.05	**11.05**
2004	38.94	36.65	**6.26**	43.19	36.35	**18.83**	88.25	84.68	**4.22**	171.35	151.66	**12.98**
2005	36.41	34.37	**5.94**	40.00	33.98	**17.71**	76.29	81.54	**-6.44**	157.84	139.37	**13.25**
2006	35.19	33.01	**6.61**	38.18	33.95	**12.46**	69.95	79.66	**-12.19**	143.92	133.79	**7.58**
2007	38.33	36.30	**5.58**	38.38	36.80	**4.28**	87.98	85.58	**2.80**	162.90	149.07	**9.28**
2008	35.53	32.92	**7.94**	36.98	33.58	**10.14**	69.38	77.10	**-10.01**	166.84	145.50	**14.67**
2009	29.99	28.12	**6.67**	35.46	30.15	**17.62**	54.83	64.16	**-14.53**	168.39	146.17	**15.20**
2010	36.44	33.65	**8.30**	35.41	31.09	**13.91**	83.22	75.10	**10.81**	172.09	152.00	**13.22**
2011	35.56	33.39	**6.50**	33.51	30.83	**8.68**	72.73	71.99	**1.02**	148.03	136.75	**8.25**
2012	32.06	31.82	**0.75**	34.14	31.11	**9.75**	40.59	69.96	**-41.99**	162.47	140.48	**15.65**
2013	29.72	NA	NE	32.93	NA	NE	36.50	NA	NE	157.92	NA	NE

Table 0.4 Differences in national total emissions (kt) between CLRTAP and NECD reports

Year	NO_x			NMVOC			SO_x			NH_3		
	CLRTAP	NEC	%	CLRTAP	NEC	%	CLRTAP	NEC	%	CLRTAP	NEC	%
1990	73.64	73.62	**0.03**	70.61	70.21	**0.57**	273.62	273.61	**0.00**	25.61	24.61	**4.07**
1991	67.94	67.93	**0.03**	67.26	66.89	**0.57**	251.30	251.29	**0.01**	22.60	21.80	**3.70**
1992	42.85	43.71	**-1.96**	45.52	45.04	**1.07**	191.68	191.66	**0.01**	20.12	19.11	**5.27**
1993	38.92	39.51	**-1.51**	37.51	37.24	**0.72**	155.91	155.90	**0.01**	14.58	14.04	**3.81**
1994	41.46	42.07	**-1.45**	41.22	41.08	**0.35**	150.25	150.23	**0.01**	13.55	13.17	**2.88**
1995	38.78	39.18	**-1.03**	49.99	49.90	**0.19**	116.12	116.11	**0.02**	11.84	11.50	**2.97**
1996	42.13	42.46	**-0.78**	52.54	52.47	**0.14**	125.16	125.14	**0.02**	10.75	10.39	**3.50**
1997	40.95	41.24	**-0.71**	54.44	54.43	**0.02**	116.23	116.21	**0.02**	10.99	10.76	**2.18**
1998	38.08	38.34	**-0.69**	46.28	46.22	**0.14**	104.33	104.31	**0.02**	11.17	10.85	**3.00**
1999	36.53	36.79	**-0.71**	45.63	45.64	**-0.02**	97.62	97.61	**0.02**	9.63	9.42	**2.26**
2000	37.45	37.66	**-0.54**	45.00	45.03	**-0.08**	96.98	96.96	**0.02**	9.68	9.52	**1.70**
2001	39.91	40.08	**-0.42**	45.07	44.96	**0.24**	90.70	90.69	**0.02**	9.99	9.57	**4.49**
2002	40.85	41.06	**-0.51**	44.41	44.20	**0.47**	87.00	86.99	**0.02**	9.36	8.86	**5.73**
2003	41.62	41.76	**-0.34**	43.26	42.96	**0.71**	100.26	100.24	**0.02**	10.36	9.73	**6.47**
2004	38.94	39.18	**-0.60**	43.19	42.88	**0.73**	88.25	88.25	**0.01**	10.63	10.01	**6.12**
2005	36.41	36.64	**-0.62**	40.00	39.73	**0.68**	76.29	76.28	**0.01**	10.11	9.70	**4.20**
2006	35.19	35.39	**-0.54**	38.18	37.88	**0.80**	69.95	69.94	**0.01**	10.37	9.85	**5.25**
2007	38.33	38.63	**-0.78**	38.38	38.23	**0.38**	87.98	87.97	**0.01**	10.42	10.18	**2.29**

Year	NO_x			NMVOC			SO_x			NH_3		
	CLRTAP	NEC	%	CLRTAP	NEC	%	CLRTAP	NEC	%	CLRTAP	NEC	%
2008	35.53	35.79	**-0.71**	36.98	36.69	**0.81**	69.38	69.38	**0.01**	11.33	10.79	**4.99**
2009	29.99	30.25	**-0.85**	35.46	35.18	**0.79**	54.83	54.83	**0.01**	10.41	9.91	**5.09**
2010	36.44	36.74	**-0.80**	35.41	35.12	**0.82**	83.22	83.22	**0.01**	10.64	10.13	**5.07**
2011	35.56	35.87	**-0.86**	33.51	33.14	**1.12**	72.73	72.73	**0.01**	10.91	10.29	**5.98**
2012	32.06	32.37	**-0.96**	34.14	33.82	**0.96**	40.59	40.58	**0.01**	11.33	10.76	**5.31**
2013	29.72	30.08	**-1.19**	32.93	32.64	**0.89**	36.50	36.49	**0.03**	11.30	10.99	**2.85**

The inventory improvements made during 2014:

- Recalculation of POPs (by using the national methodology) and heavy metals (by using the new EMEP/EEA Guidebook 2013 emission factors) for the residential combustion sector;
- Recalculation of $PM_{2.5}$, PM_{10} and other pollutants for the industrial processes & product use and waste sectors;
- Recalculation in the agriculture sector due to correction of activity data.

New inventory pollution sources:

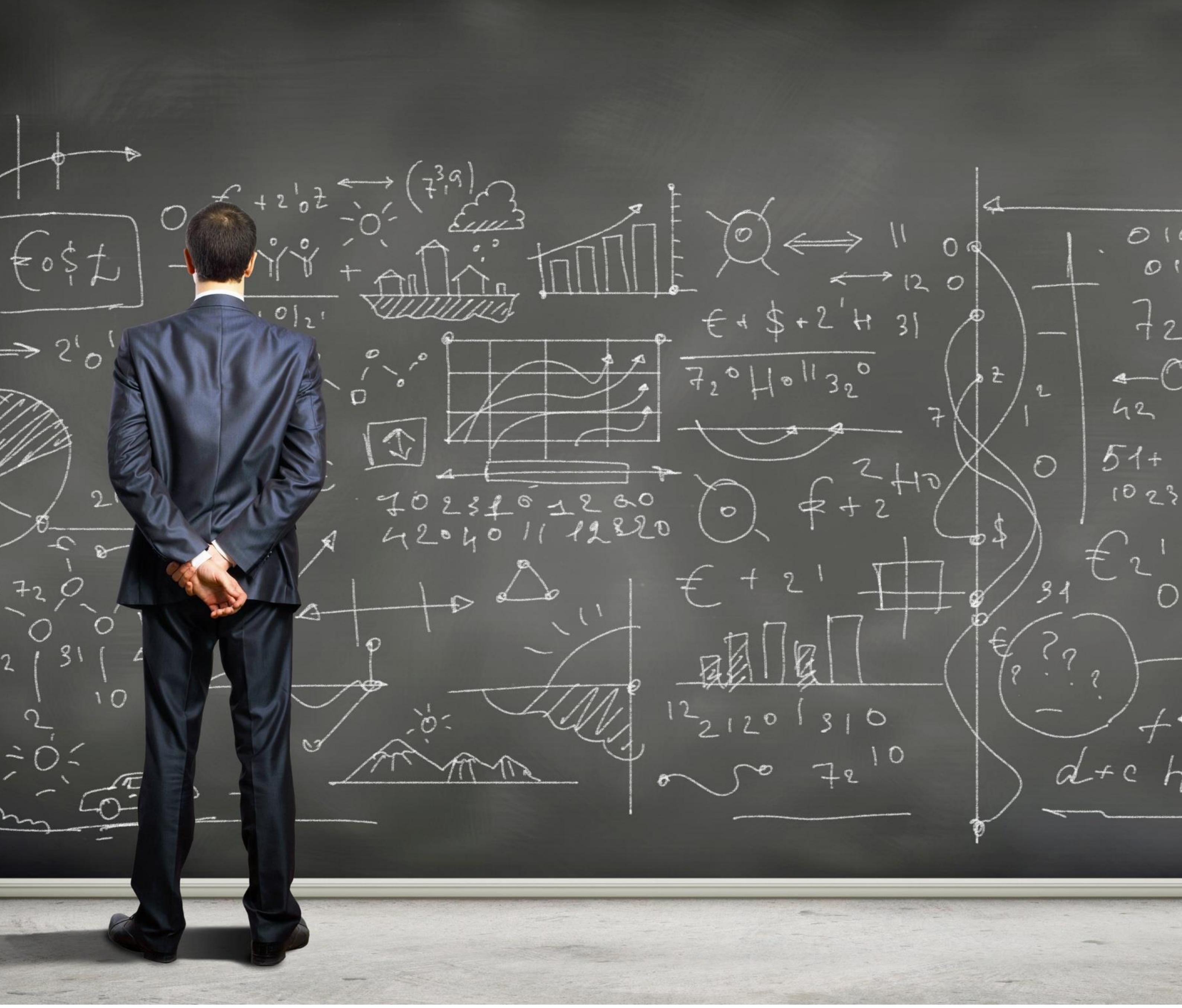
- 3B4h Manure management - Other animals;
- 5C2 Open burning of waste.

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

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

Priorities for future inventory improvement:

- Check the POPs emissions from waste incineration;
- Provide uncertainty analysis for all key sources;
- Check the activities data and emission factors in energy industries. The main problem appears to be a discrepancy in the data regarding fuel consumption between statistical energy balance and the reports of the enterprises;
- Use the Tier 2 or Tier 3 methods for the estimation of emissions from agriculture.



Source: www.galleryhip.com

1. INTRODUCTION

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 2015. The report contains information on Estonian emission inventories from 1990 to 2013. The inventories detail the anthropogenic emissions of the 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, $PM_{2.5}$ and NMVOCs are reported for the years 2020, 2025 and 2030.

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 the national Informative Inventory Reports (IIR) 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 2020 for 2013) 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 2013.

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

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

The ESTEA performs the final data quality control and assurance procedure before its submission. In preparation for the inventory and in compiling basic data, ESTEA 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 are 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 is presented 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, the database contained data about 600 enterprises; however, by 2013 the number had increased to 2,020.

The point sources information system contains data 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 related to accidental releases where such information is available (deliberate, accidental, routine and non-routine). Data are presented on each source of pollution and on the facility as a whole. Emission data are 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). The operator shall indicate the method of emission calculation.

Emissions for some air pollutants (POPs, in some case PM_{10} and $PM_{2.5}$) not included in the reporting requirements under the environmental permits are additionally calculated by the Ambient Air Department and used in the 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, the final verification at the ESTEA is carried out and the data are then ready for use in various reports (Figure 1.2).

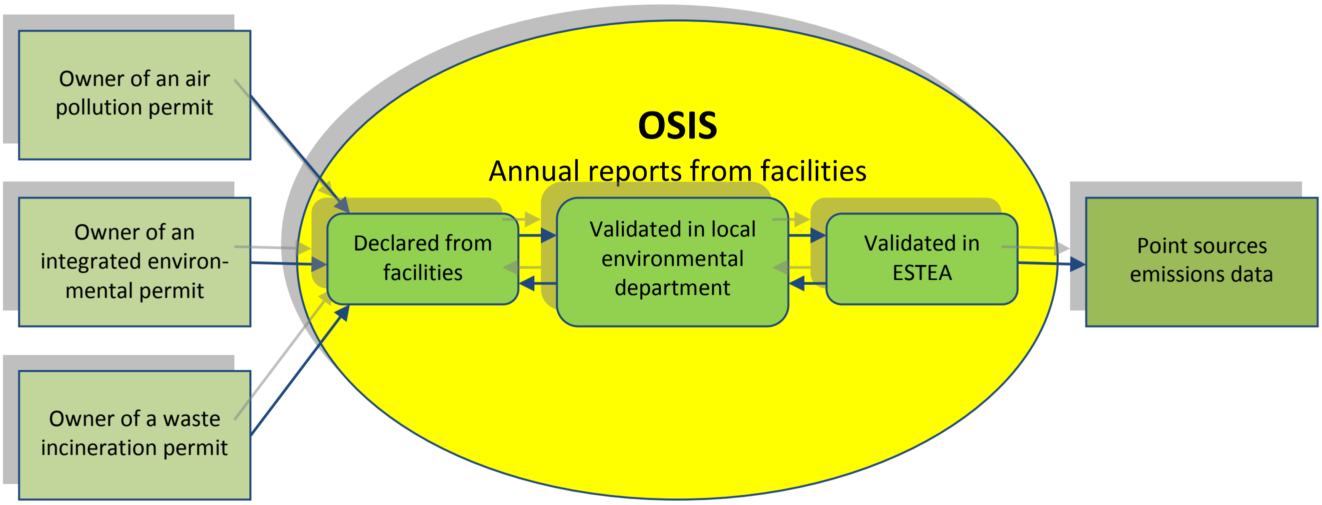


Figure 1.2 Validation of Estonian point sources data

The pollutant emissions from all diffuse sources have been calculated by ESTEA. The main diffuse sources are combustion in the 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 the solvent use sector calculated by ESTEA are used in reporting to the UNFCCC Secretariat and the EU CO_2 Monitoring Mechanism.

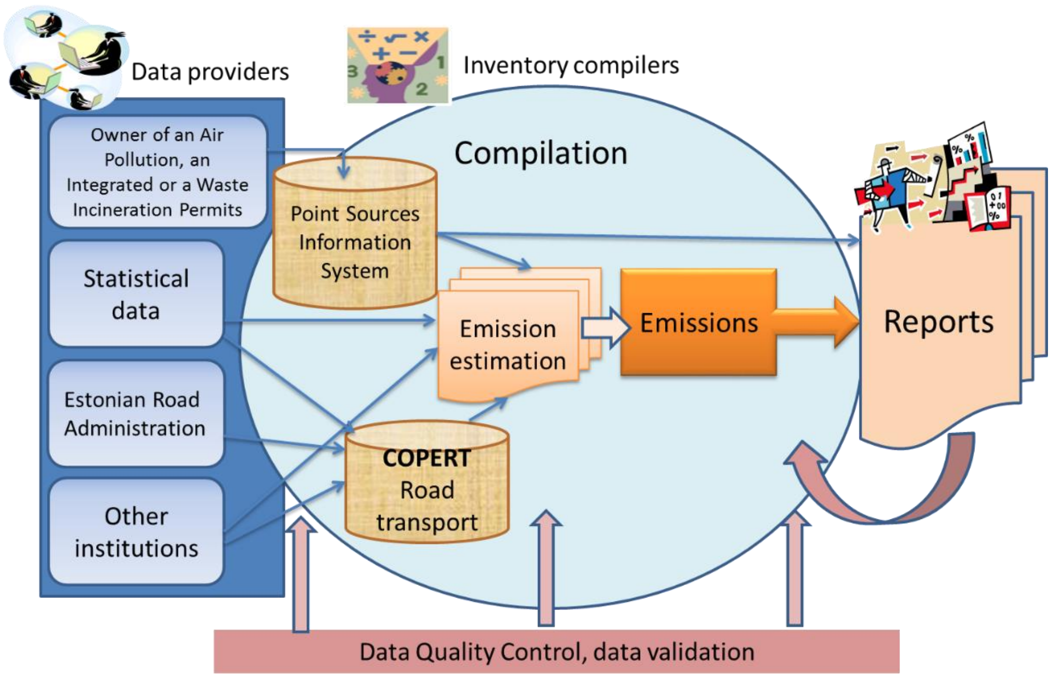


Figure 1.3 Air pollution inventory structure

1.4. Methods and data sources

The data reported by the operators and the 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 ESTEA 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, the COPERT 4 methodology and emission factors are used. 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). ESTEA has obtained vehicle data (passenger cars, light and duty vehicles, buses, motorcycles) and annual mileage per vehicle from the Estonian Road Administration. Meteorological data are 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 the EMEP/EEA Guidebook 2013.

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 2013, 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 (1A1a) and road transport (1A3biii) 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 (1A4bi) is also a main source of NMVOC (47.8%). Additionally, road transport (1A3bi) decorative coating application (2D3d), domestic solvent use (2D3a), manure management (dairy cattle, non-dairy cattle and swine) and road transport (1A3bi) constitute key sources.

According to level assessment SO_2 emissions for 2013 from the energy sector are responsible for 82.5% of SO_2 emissions in 2013. 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 (dairy cattle, swine and non-dairy cattle) and the use of mineral fertilises (3D1a), which are the main sources of pollution regarding ammonia.

The combustion in residential plants (1A4bi) is a key source for TSP, PM_{10}, $PM_{2.5}$ and BC. The influence of public electricity and heat productions (1A1a) is also significant for them.

According to level assessment, 62.3% of CO emissions come from residential combustion plants (1A4bi). In addition, road transport (1A3bi) and the oil-shale industry (1A1c) are the main polluters of CO. Combustion in the residential sector is also a key source for HCB.

The energy (1A1a) sector is the main source of heavy metals and PCB. In addition, road transport (1A3bvi) is a key polluter for Cu and combustion in residential plants (1A4bi) is a key polluter for Cd 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	1A1a	1A3biii	1A3bi	1A4cii	1A4bi	1A2f	1A3c			
	34.9%	16.7%	10.3%	7.6%	4.9%	4.7%	4.6%			83.8%
NMVOC	1A4bi	2D3d	2D3a	1A3bi	3B1a	3B1b	1B2av	2D3e	3B3	
	47.8%	7.8%	4.8%	4.1%	4.0%	3.7%	3.6%	3.0%	2.8%	81.7%
SO_x	1A1a									
	82.5%									82.5%
NH_3	3B1a	3Da1	3B1b	3B3						
	29.4%	25.0%	17.6%	11.7%						83.8%
$PM_{2.5}$	1A4bi	1A1a								
	57.4%	23.7%								81.0%
PM_{10}	1A4bi	1A1a	1A2gviii							
	44.3%	33.0%	6.4%							83.8%
TSP	1A4bi	1A1a	1A2gviii							
	44.1%	32.9%	6.0%							83.0%
BC	1A4bi	1A1a	1A2gviii	1A3bi						
	42.2%	21.6%	15.7%	4.6%						84.0%
CO	1A4bi	1A1c	1A3bi							
	62.3%	15.8%	7.9%							86.1%
Pb	1A1a									
	94.3%									94.3%
Cd	1A1a	1A4bi								
	73.4%	21.3%								94.7%

Pollutant	Key sources categories (sorted from high to low from left to right)									Total (%)
Hg	1A1a									
	94.7%									94.7%
As	1A1a									
	99.3%									99.3%
Cr	1A1a									
	93.4%									93.4%
Cu	1A1a	1A3bvi								
	49.8%	38.0%								87.8%
Ni	1A1a									
	96.3%									96.3%
Zn	1A1a									
	81.5%									81.5%
PCDD/PCDF	1A4bi	1A1a	5E	1A2gviii						
	31.9%	23.2%	21.9%	7.5%						84.5%
B(a)p	1A4bi	1A1a								
	47.0%	36.3%								83.3%
B(b)f	1A1a	1A4bi								
	42.6%	39.5%								82.1%
B(k)f	1A4bi	1A1a								
	51.7%	32.1%								83.9%
I(1,2,3-cd)p	1A4bi	1A1a								
	66.3%	23.2%								89.5%
PAH total 1-4	1A4bi	1A1a								
	49.8%	34.6%								84.4%
HCB	1A4bi	1A2gviii	1A1a							
	42.3%	27.4%	27.3%							97.0%
PCB	1A1a	1A2gviii								
	68.3%	22.5%								90.8%

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 used 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):**
  The Estonian inventory was reviewed under the stage 3 review in 2011 summer by the EMEP emission centre CEIP acting as the review secretariat. The results are available at CEIP home page (http://www.ceip.at/review-process/centralised-review-stage-3/).
- **Data collection:**
  Data collection includes both point sources emissions and diffuse sources activity. Prior to using activity data, common statistical quality checking related to the assessment of trends is carried out.
  ESTEA uses only point sources data which are checked and validated by local environmental departments.

- **Data manipulation**
  Common statistical quality checking is carried out.
- **Inventory compilation**
  Before submitting data to CEIP/EEA NFR, formats have to be 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)

NFR14 code	Substance(s)	Reason for not estimated
1A2a	NH_3	Will be calculated for next year's submission
1A2b	NH_3	Will be calculated for next year's submission
1A2c	NH_3	Will be calculated for next year's submission
1A2d	NH_3	Will be calculated for next year's submission
1A2gviii	NH_3	Will be calculated for next year's submission
1A3bi	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)).
1A3bii	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)).
1A3biii	Hg, As, HCB, PCBs	Emissions occur, but have not been estimated due to lack of

NFR14 code	Substance(s)	Reason for not estimated
		emission factors in methodology (Copert 4 version 9.0 generates and fills NFR table (including notation keys NE)).
1A3biv	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)).
1A3bv	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)).
1A3bvi	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)).
1A3bvii	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)).
1A4ai	NH_3	Will be calculated for next year's submission
1A4ci	NH_3	Will be calculated for next year's submission
1A4ciii	NH_3, PAHs	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
1B1a	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
3F	All	Will be calculated for next year's submission
5B1	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5C1bv	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5C2	NH_3, Se, I(1,2,3-cd)p	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5D1	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5D2	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5D3	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
5E	BC	Emission have not been estimated due to lack of emission factor in EMEP/EEA Guidebook 2013
1A3di(i)	NH_3	No emission factor in new GB

Table 1.3 Sources included elsewhere (IE)

NFR14 code	Substance(s)	Included in NFR code
1A2a	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2b	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2c	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2d	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2e	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii
1A2f	PCDD/PCDF, PAHs, HCB, PCBs	1A2gviii

NFR14 code	Substance(s)	Included in NFR code
1A3bvi	BC	1A2bi-1A2biv
1A5a	All	1A4ai
1A5b	All	1A4aii
2A1	All, partially TSP, PM_{10}, $PM_{2.5}$	1A2f, 1A2gviii
2A2	All, partially TSP, PM_{10}, $PM_{2.5}$	1A2f, 1A2gviii
2A3	$PM_{2.5}$, PM_{10}, TSP	1A2f
3B4d	NO_x, NMVOC, NH_3	3B2
3B4giii	NO_x, NMVOC, NH_3	3B4giv
3Da2a	NH_3	3B1a, 3B1b,3B2, 3B3
5C1a	All	1A1a
5C1biii	NO_x, NMVOC, SO_2, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn	5C1bi

Source: www.mitramark.com

2. POLLUTANTS EMISSION TRENDS

Pollutants emission trends

Estonia has been reporting data regarding the 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: 1990-2013
- PM_{10} and $PM_{2.5}$: 2000-2013
- BC: 2013
- All heavy metals: 1990-2013
- POPs: 1999-2013

Table 2.1 Main pollutant emissions in the period 1990-2013 (kt)

Year	NO_x	NMVOC	SO_2	NH_3	CO	$PM_{2.5}$	PM_{10}	TSP
1990	73.641	70.608	273.622	25.609	226.814	NR	NR	279.110
1991	67.944	67.264	251.303	22.603	226.189	NR	NR	278.834
1992	42.852	45.520	191.677	20.117	127.207	NR	NR	250.533
1993	38.917	37.507	155.909	14.579	123.756	NR	NR	197.523
1994	41.458	41.224	150.251	13.553	149.670	NR	NR	175.928
1995	38.778	49.991	116.125	11.840	197.059	NR	NR	135.191
1996	42.132	52.545	125.158	10.752	219.444	NR	NR	124.394
1997	40.947	54.441	116.226	10.991	228.912	NR	NR	101.168
1998	38.076	46.284	104.334	11.172	181.277	NR	NR	89.765
1999	36.530	45.632	97.625	9.632	190.406	NR	NR	88.357
2000	37.450	44.997	96.979	9.679	182.726	21.710	37.992	75.997
2001	39.913	45.067	90.702	9.995	188.580	22.647	37.942	74.142
2002	40.850	44.407	87.004	9.362	181.867	23.316	34.103	53.742
2003	41.620	43.261	100.256	10.360	174.410	21.325	30.656	49.811
2004	38.944	43.194	88.253	10.626	171.351	22.592	30.920	47.065
2005	36.411	39.999	76.290	10.106	157.838	20.419	27.595	38.609
2006	35.194	38.185	69.946	10.366	143.925	15.811	21.099	29.394
2007	38.330	38.376	87.978	10.418	162.903	20.781	29.684	37.551
2008	35.534	36.984	69.382	11.332	166.839	20.485	26.142	32.907
2009	29.993	35.456	54.833	10.415	168.390	18.834	23.746	29.549
2010	36.445	35.413	83.220	10.639	172.089	23.521	32.322	38.631
2011	35.563	33.507	72.731	10.910	148.035	26.561	42.130	49.785
2012	32.060	34.140	40.585	11.333	162.467	17.212	21.420	27.397
2013	29.721	32.931	36.500	11.303	157.924	19.594	25.369	29.832
trend 1990-2013, %	**-59.6**	**-53.4**	**-86.7**	**-55.9**	**-30.4**	**-9.7**	**-33.2**	**-89.3**

2.1. Sulphur dioxide

During the period of 1990-2013, the emissions of sulphur dioxide had decreased by about 86.7%, 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 182 PJ in 2013) (Figure 2.1 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 reasons for the decrease in emissions are given below.

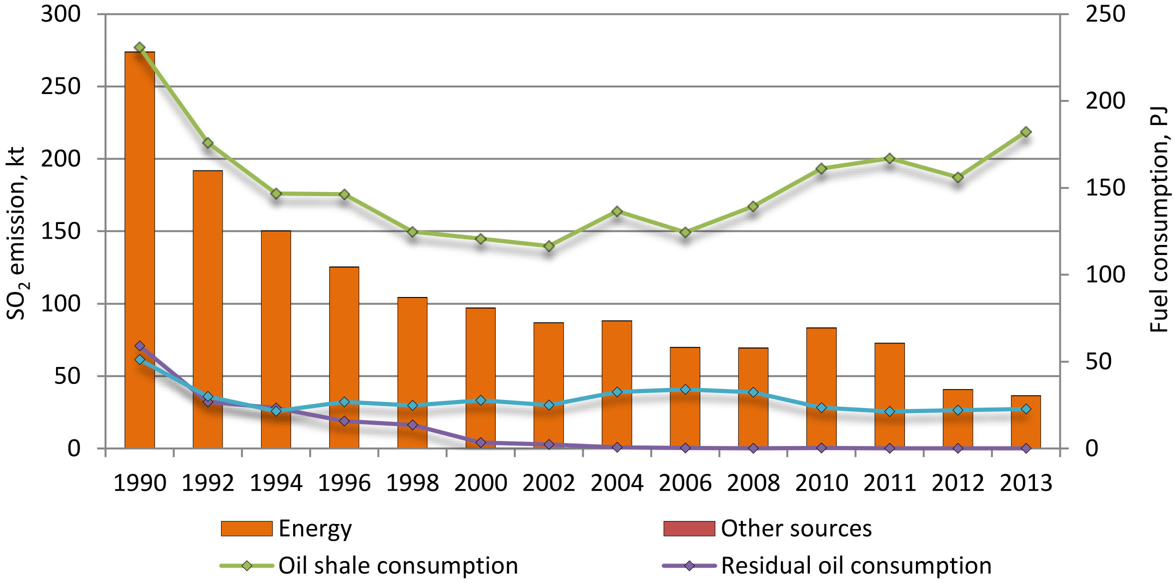


Figure 2.1 SO_2 emissions in the period 1990-2013

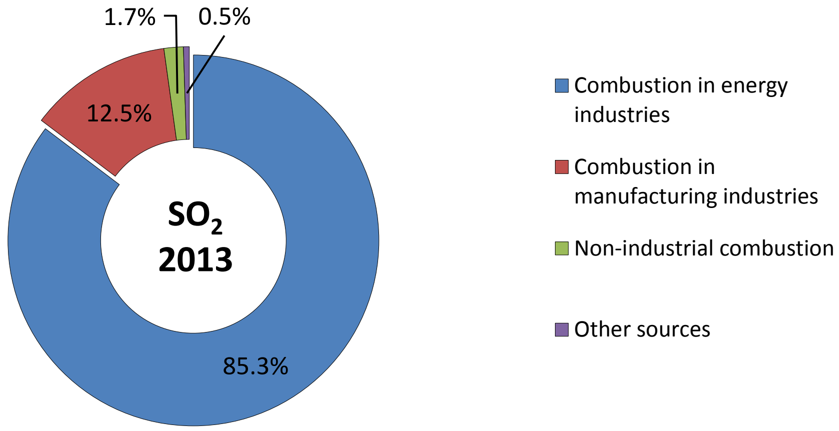


Figure 2.2 SO_2 emissions by sources of pollution in 2013

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. Unique sulphur scrubbers designed in the course of five years of research and development were installed in the Narva power plants (PP) on four energy production units of the Eesti power plant in 2012. The semi-dry NID (Novel Integrated Desulphurisation) technology, which uses the fly ash in the gas itself, does not require any additional compounds to bind the SO_2.[1] With regard to the energy units which have not 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 the flame temperature and thus improves conditions for sulphur capture with limestone included in oil shale. All these solutions mean that these filter equipped units will meet the tighter limits on sulphur emissions in flue gases that will come into effect from 2016. Measures are also being taken to reduce nitrogen emissions, which will enable units to work at full capacity after 2016, without limits. These scrubbers will also reduce the solid particle content of flue gases[2].

In 2012, SO_2 emissions from the oil shale power plants did not exceed 25 thousand tonnes.

In 2013, SO_2 emissions had decreased about 10% compared to 2012 as a result of the application of desulphurisation technology, despite an increase in the production of the electric power during the same period.

The energy sector (NFR 1.A.1.a-c) is responsible for about 85.3% of total emissions (2013, figure 2.2). The share of SO_2 emissions from the two large oil shale plants - Narva PP (Eesti and Balti) – accounts for approximately 56.9% of total emissions. The main reason for the drop in emissions since 2004 is the launch of two new boilers at the Narva PP. The boilers, which are based on circulating fluidized-bed (CFB) technology, have reduced SO_2 emissions to virtually zero. Emissions have also been considerably reduced by shutting down the old blocks.

2.2. Nitrogen oxides

Emissions of nitrogen oxides have decreased by 59.6% compared to 1990 (Figure 2.3). 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 to the reduction of NO_x emissions. The energy industry and road transport sector are the main sources of nitrogen oxide emissions – 36% and 29% respectively. The share of other mobile sources was 17% in 2013 (Figure 2.4).

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

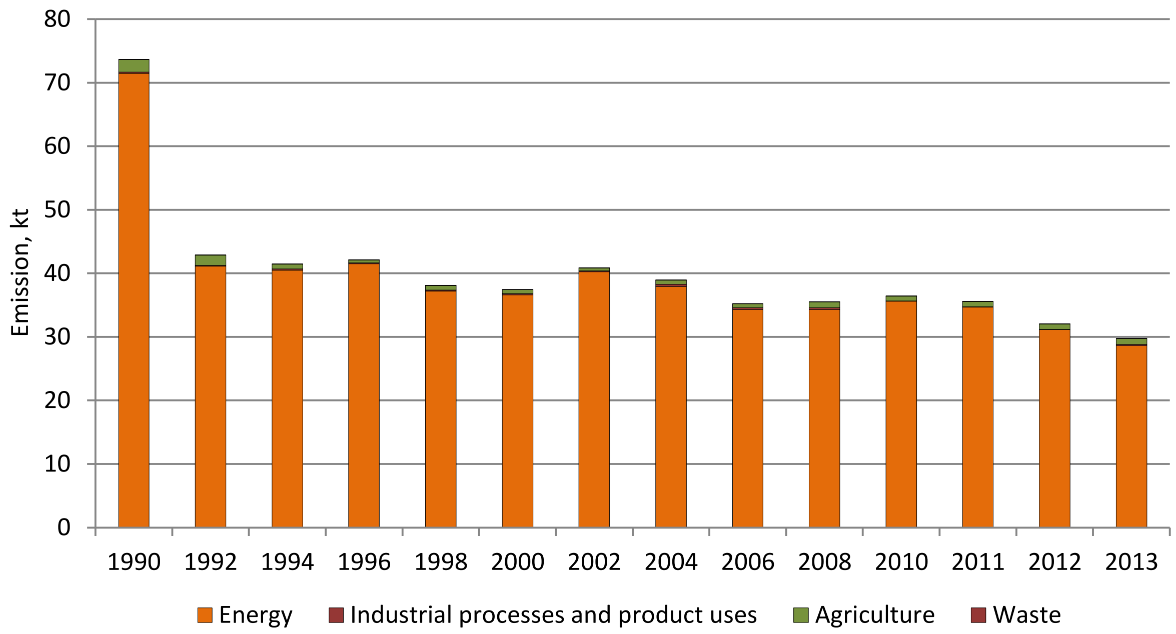


Figure 2.3 NO_x emissions in the period 1990-2013

In 2013, NO_x emissions decreased approximately 7% compared to 2012 mainly due to the reduction in mobile sources emission for the same period. Also, the introduction of clearing devices at oil shale power plants played a role.

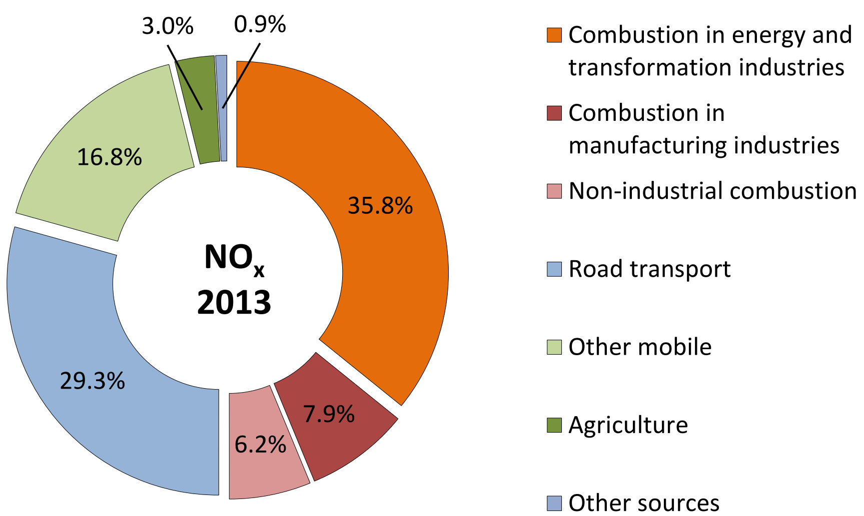


Figure 2.4 NO_x emissions by sources of pollution in 2013

2.3. Non-methane volatile compounds

In 2013, NMVOC emissions decreased 3.5% compared to 2012 mainly due to a decrease in biomass consumption in residential combustion plants. The decrease in emissions for the same period was observed in the road transport and liquid fuel distribution sectors (Figure 2.5).

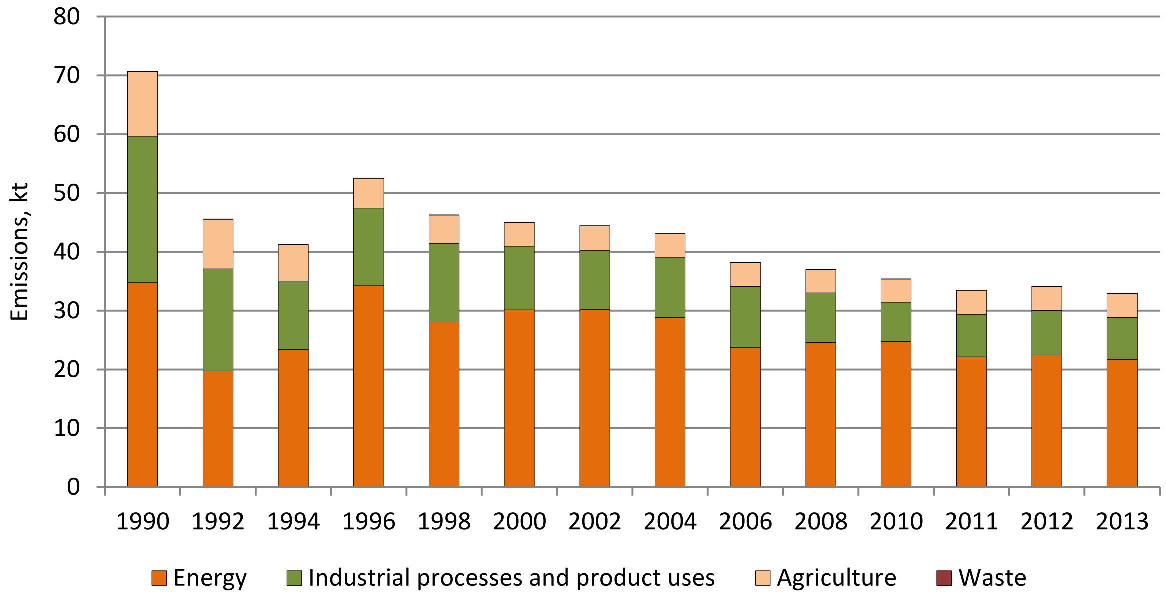


Figure 2.5 Emissions of non-methane volatile organic compounds in the period 1990-2013

The total emissions of non-methane volatile organic compounds decreased by 53.4% between the years 1990 and 2013. In 1990, the main polluters of NMVOC were industrial processes and product uses (35%) and road transport (25%), while in 2013 the dominant source was non-industrial combustion (48%). The share of industrial processes and product uses sector decreased to 22% (Figure 2.6). The primary reason for this change was a decline in the use of motor fuel in the transport sector and an increase in the consumption of diesel compared to petrol. Secondly, during the period 1990-2013, 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).

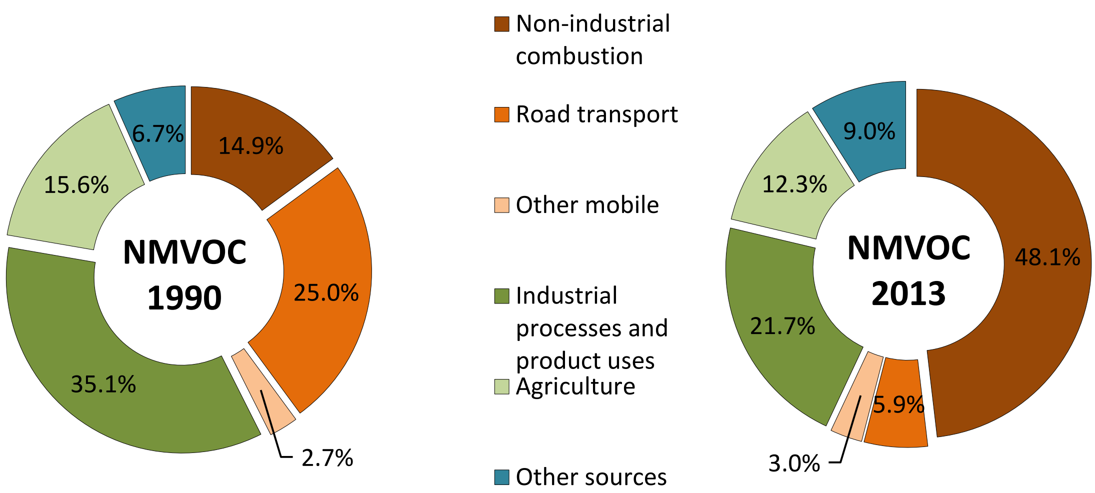


Figure 2.6 NMVOC emissions by sources of pollution in 1990 and 2013

2.4. Ammonia

Total NH_3 emissions decreased by 55.9% between the years 1990 to 2013 due to a reduction in the number of animals and use of fertilisers (Figure 2.7). Livestock manure management and mineral fertiliser use are the main sources of pollution regarding ammonia (about 93.6%). The energy sector is responsible for the 3.8% of total emission, from which road transport makes up 1.5% and fugitive emissions from solid fuels (oil shale open cast mining, mainly explosive works) account for approximately 1.7%. The ammonia emissions from road transport have increased in recent years due to a growth in new car usage. The total share industry and waste management account for approximately 2.6% of total ammonia emissions (Figure 2.8).

In 2013 the emissions of NH_3 decreased compared to 2012 by 0.6% mainly due to decrease in livestock (especially poultry and swine) during the same period.

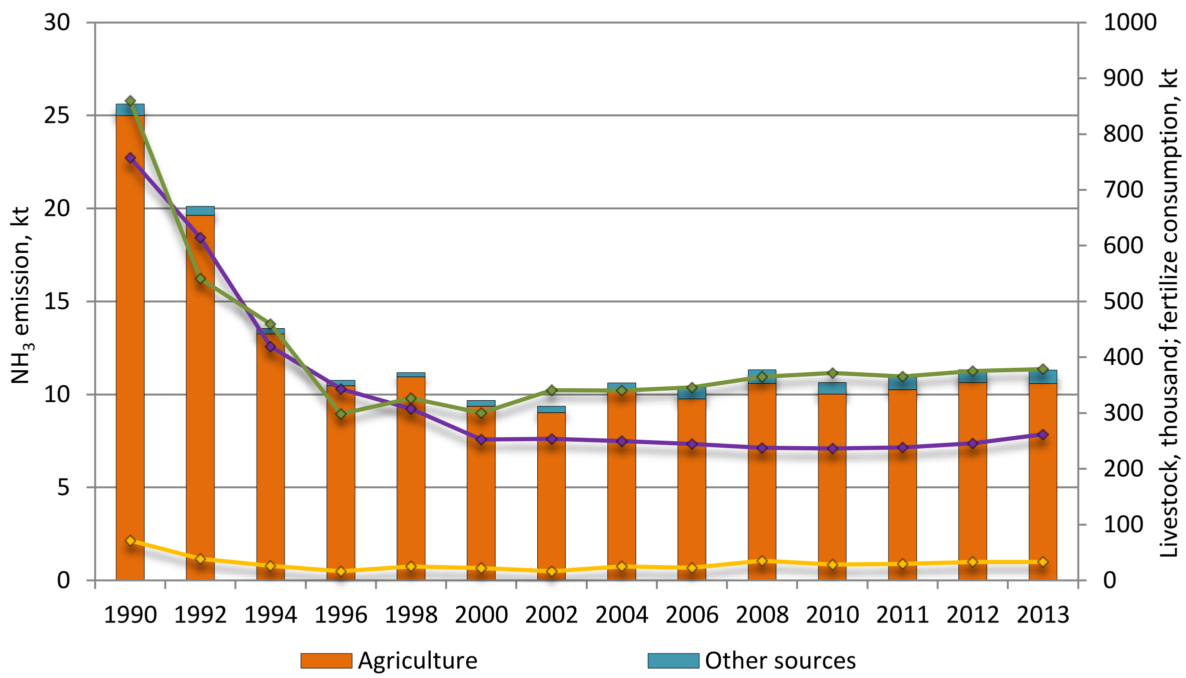


Figure 2.7 Emissions of ammonia in the period 1990-2013

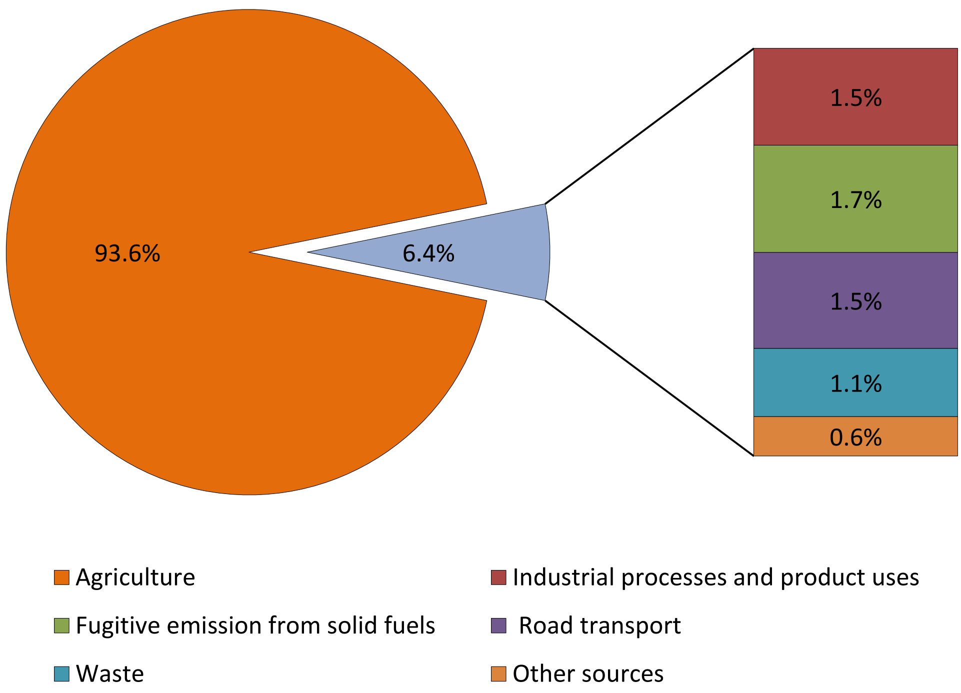


Figure 2.8 Ammonia emissions by sources of pollution in 2013

2.5. Carbon monoxide

In the period 1990-2013, the emissions of carbon monoxide decreased by 30.4%. 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 a growth in the burning of wood in the household sector (Figure 2.9).

In 1990, the main polluters of carbon monoxide were road transport (54%), while in 2013 the dominant source was non-industrial combustion (63%) (Figure 2.10). 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. 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 CO emission factor for these fuels is much higher for the domestic stoves and higher than for other fuels combustion). The share of the energy sector increased at the same period from 8% to 22%, mainly due to an increase in shale oil production in Eesti Energia Õlitööstus AS (Eesti Energia Oil Industry) plant.

In 2013, the biggest polluters of CO were combustion in the non-industrial sector (about 63%, from which a large part is wood combustion in the domestic sector), combustion in the energy industry (20%, mainly from shale oil production industry – 79%) and road transport – 11% (Figure 2.10).

In 2013, carbon monoxide emissions decreased 2.8% compared to 2012 mainly due to a reduction in motor fuel and wood combustion in the energy sector.

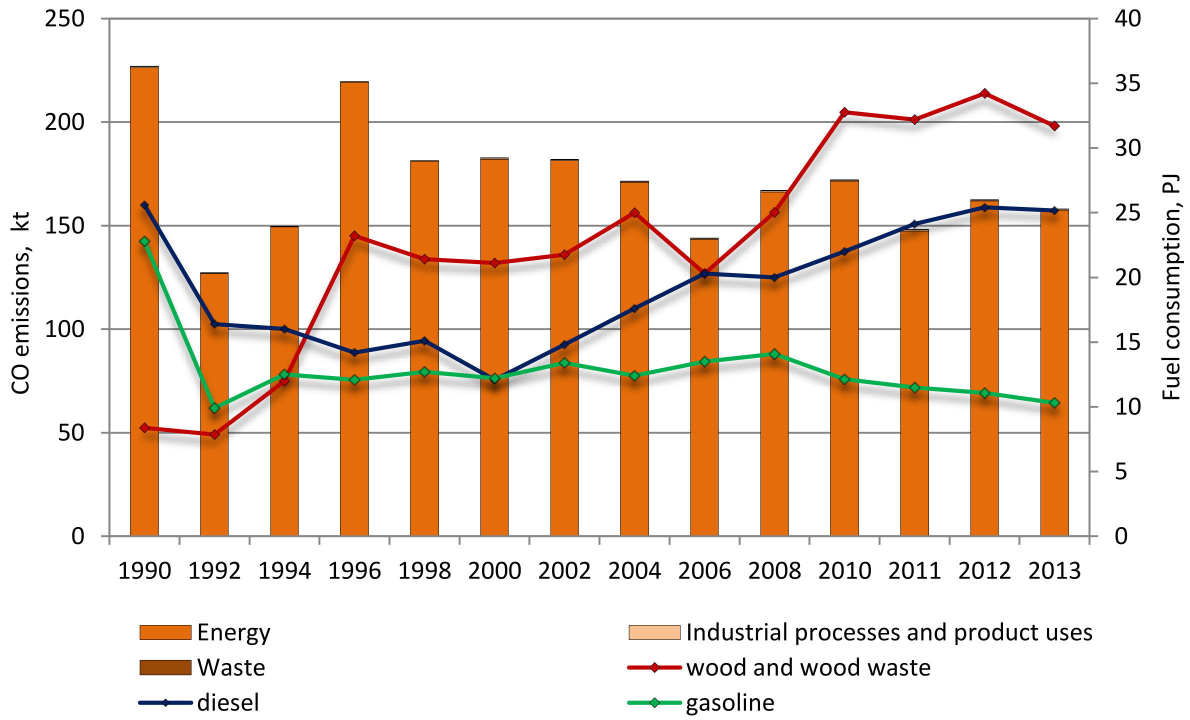


Figure 2.9 Emissions of carbon monoxide in the period 1990-2013

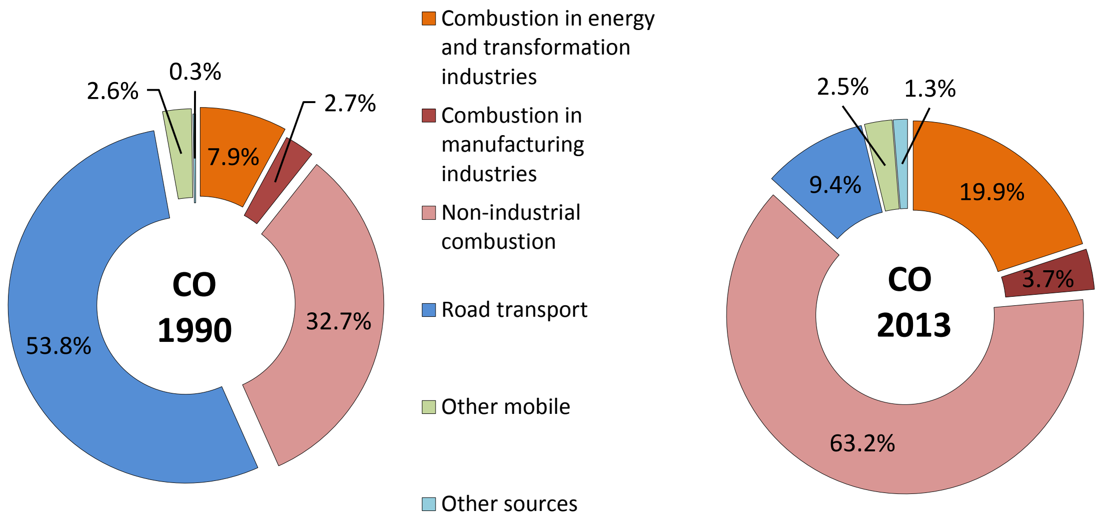


Figure 2.10 CO emissions by sources of pollution in 1990 and 2013

2.6. Particulates

The main source of particulate is the energy sector – 90.4%. The emissions of TSP by sectors of pollution are shown in Figure 2.12.

In 1990-2013, TSP emissions dropped significantly – by 89.3% (Figure 2.11). 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 insignificant growth of TSP emissions in 2013 compared to 2012 (8.9%) was mainly due to the increase in electricity production Eesti Energia Narva Elektrijaamad AS.

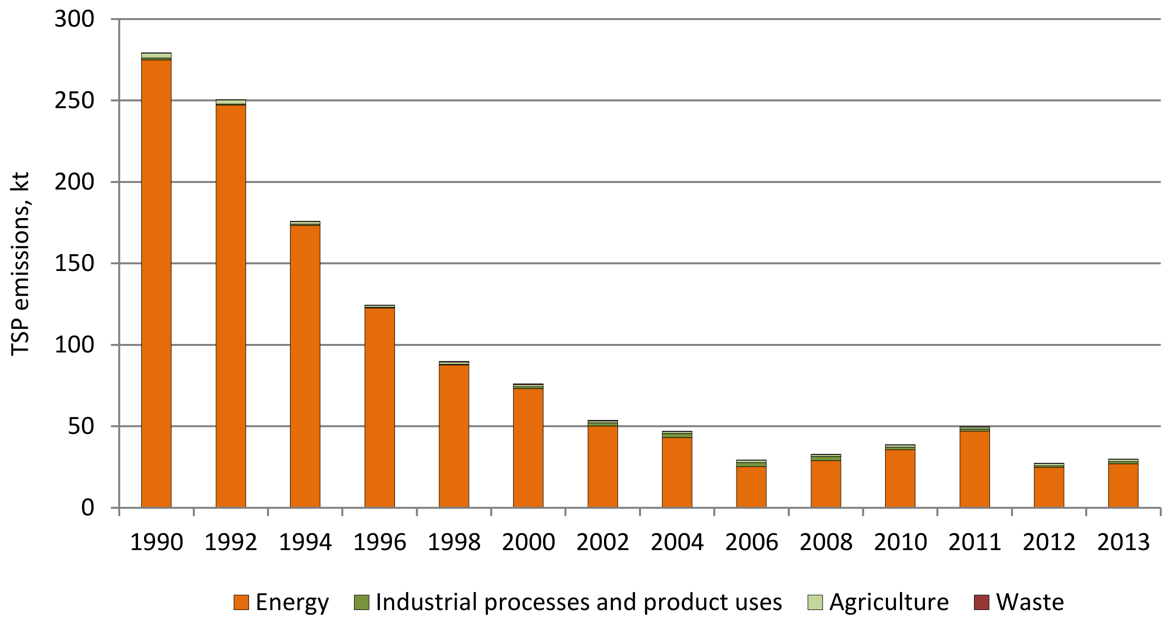


Figure 2.11 TSP emissions in the period 1990-2013

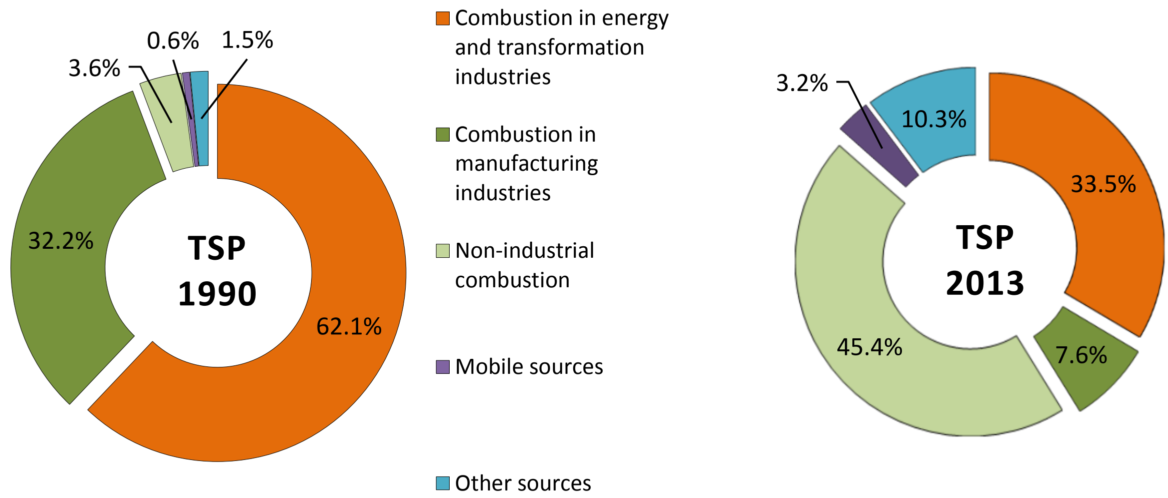


Figure 2.12 TSP emissions by sources of pollution in 1990 and 2013

In 1990, the main polluters of TSP were the energy industry (62%) and combustion in manufacturing industries (32%). In 2013 the dominant source was non-industrial combustion (45%), while the share of the energy sector had decreased by 28% and the share of industrial combustion had decreased by 24% compared to 1990 (Figure 2.11). The main reasons for such changes are the following: an increase in the share of wood combustion in the domestic sector (high emission factor of particulates); modernisation of cleaning equipment at the cement plant and a decrease in electricity production in one of the oil shale power plants. Other sources contribute to 10%, of the total emissions from which approximately 43% is agriculture.

The emissions of fine particulates PM_{10} and $PM_{2.5}$ are shown in Figure 2.13.

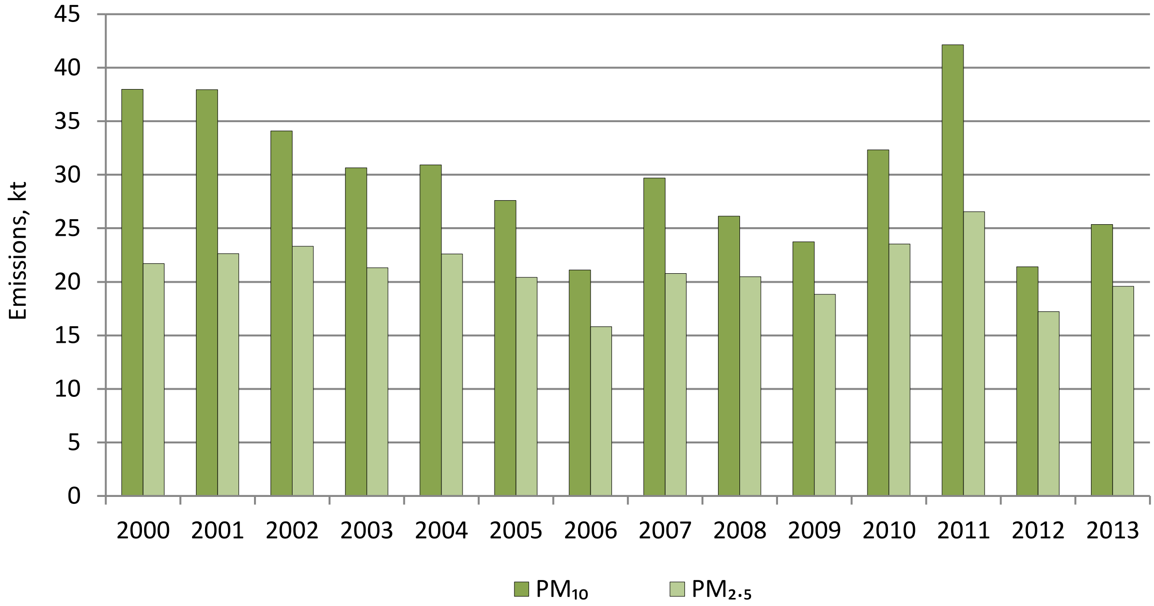


Figure 2.13 PM_{10} and $PM_{2.5}$ emissions in the period 2000-2013

In the period 2000-2013, the emissions of PM_{10} and $PM_{2.5}$ decreased by 33.2% and 9.7% respectively; this mainly resulted from the decrease in electricity production.

The growth of PM_{10} and $PM_{2.5}$ emissions in 2013 compared to 2012 (18.4% and 13.8% respectively) was mainly due to the increase in electricity production Eesti Energia Narva Elektrijaamad AS.

The primary sources of fine particulates (PM_{10}) emission in 2013 were non-industrial combustion (47%) and combustion in energy and transformation industries (34%, mainly oil shale combustion) (Figure 2.14). The distribution of $PM_{2.5}$ emissions by sources of pollution is also visible in Figure 2.14.

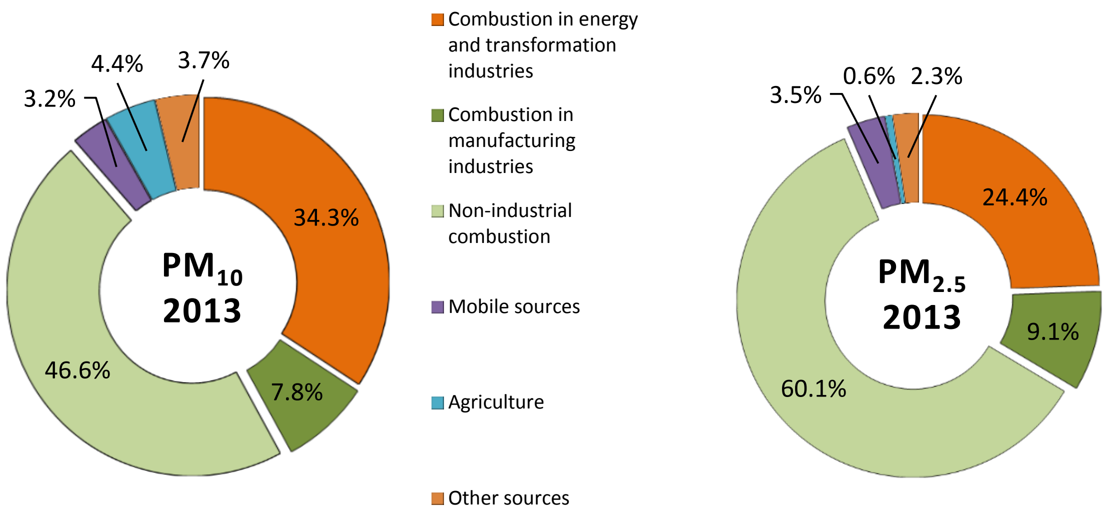


Figure 2.14 PM_{10} and $PM_{2.5}$ emission by activities in 2013

BC emissions

Emission of black carbon for all activities was calculated in this submission only for 2013. The new EMEP/EEA Guidebook 2013 methodology was applied when making the calculations. Emissions for 2000-2012 will be calculated next year.

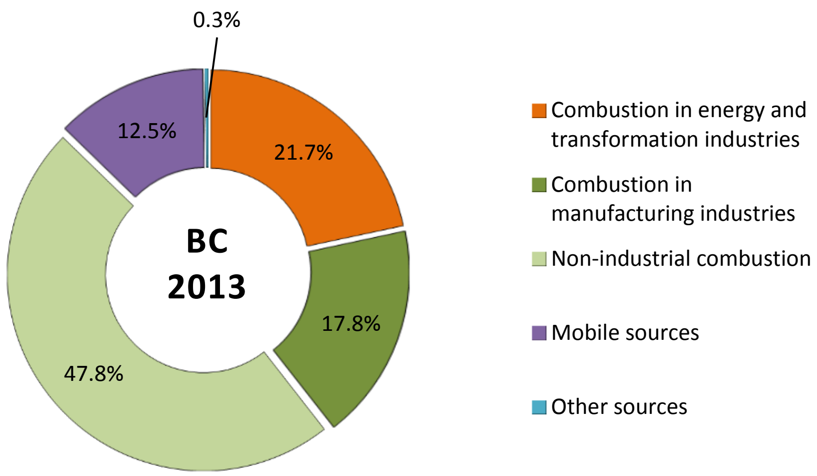


Figure 2.15 Black carbon emission by activities in 2013

The primary sources of black carbon emission in 2013 were non-industrial combustion (47.8%), combustion in energy and transformation industries (21.7%, mainly oil shale combustion) and combustion in manufacturing industry (17.8%) (Figure 2.15). Under other sources mainly Industrial processes.

2.7. Heavy metals

In 1990-2013 emissions of heavy metals dropped significantly as can be seen in Table 2.2 and Figure 2.16.

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 80.9% due to the modernisation of cleaning equipment at both the Narva Power Plants and Kunda Nordic Cement and due to the decrease in energy production. A further reason is the discontinued use of leaded petrol in Estonia since 2000. (Figure 2.18)

Table 2.2 Heavy metal emissions in the period 1990-2013 (kt)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	206.003	4.505	1.154	18.867	18.395	10.059	27.325	106.843
1991	188.693	4.297	1.044	16.467	16.025	9.326	25.543	97.860
1992	124.688	3.089	0.857	14.048	13.798	6.658	16.953	79.791
1993	103.094	2.312	0.674	10.856	10.471	5.436	14.313	62.413
1994	123.334	2.975	0.676	10.698	10.324	5.934	12.835	65.582
1995	86.266	2.180	0.635	10.083	9.956	5.042	10.460	63.989
1996	66.746	1.306	0.632	10.376	10.225	4.593	10.824	62.498
1997	47.443	1.345	0.637	10.221	9.968	4.589	9.718	62.503
1998	40.115	1.223	0.568	9.166	8.905	4.184	8.764	55.719
1999	40.133	1.158	0.542	8.728	8.502	4.059	7.481	53.550
2000	36.944	0.774	0.546	8.607	8.354	3.724	6.447	49.898
2001	37.024	0.745	0.529	8.399	8.231	4.011	6.397	49.617
2002	36.351	0.771	0.533	8.372	8.351	4.172	6.163	49.124
2003	38.451	0.841	0.613	10.122	9.820	4.503	6.768	58.014
2004	36.770	0.786	0.562	9.794	9.385	4.549	6.650	57.765
2005	35.624	0.762	0.541	9.234	9.093	4.606	6.430	53.496
2006	32.127	0.729	0.539	8.603	8.464	4.517	5.749	49.056
2007	40.487	0.901	0.671	11.085	10.790	5.231	6.724	62.156
2008	35.361	0.829	0.589	9.416	9.329	4.737	5.902	55.385
2009	28.448	0.709	0.459	7.610	7.543	4.025	4.829	46.522
2010	39.030	0.897	0.644	10.971	10.594	4.965	6.587	62.732
2011	38.483	0.859	0.646	10.889	10.418	4.894	6.415	60.716
2012	33.978	0.793	0.568	9.605	9.178	4.714	5.637	55.045
2013	39.453	0.966	0.678	11.244	10.583	5.003	6.496	62.558
trend 1990-2013, %	**-80.85**	**-78.56**	**-41.26**	**-40.40**	**-42.47**	**-50.26**	**-76.23**	**-41.45**

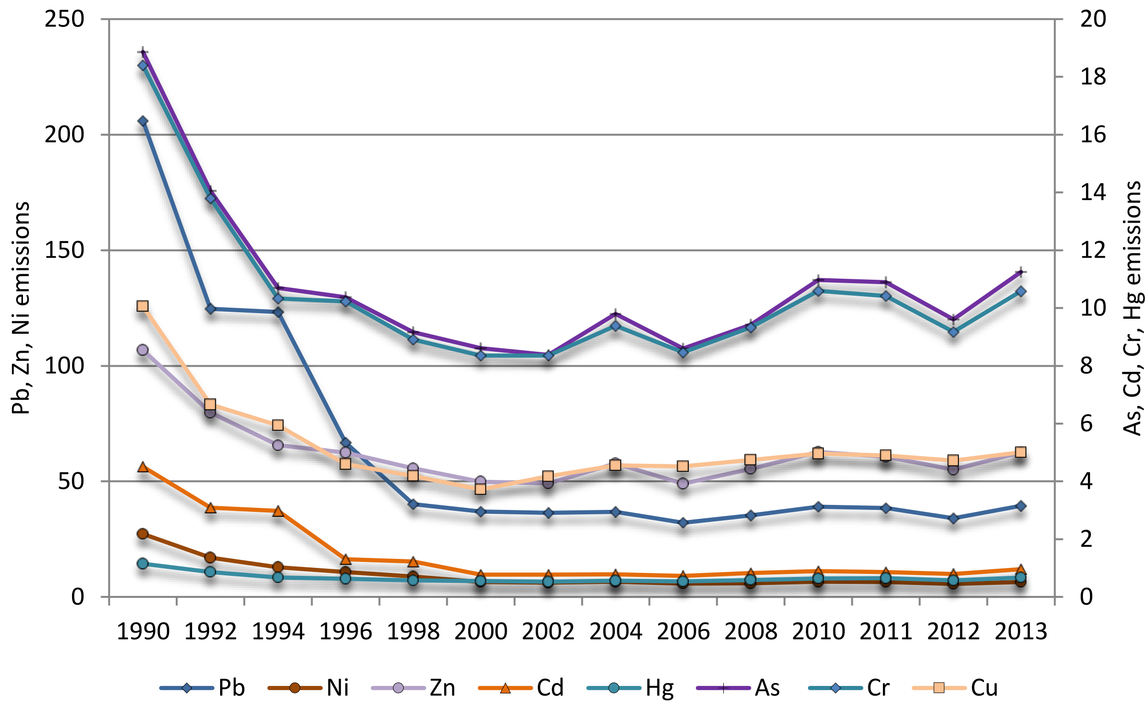


Figure 2.16 Heavy metals emissions in the period 1990-2013 (t)

The emissions of lead by sources of pollution in 1990 and 2013 are shown in Figure 2.17. The distribution of emissions by sector has considerably changed over the last 20 years. While in 1990 the main sources of lead pollution were almost equally transport, energy and industrial combustion (mainly cement manufacturing), in 2013 the main source of pollution was the energy industry (mainly oil shale power plants).

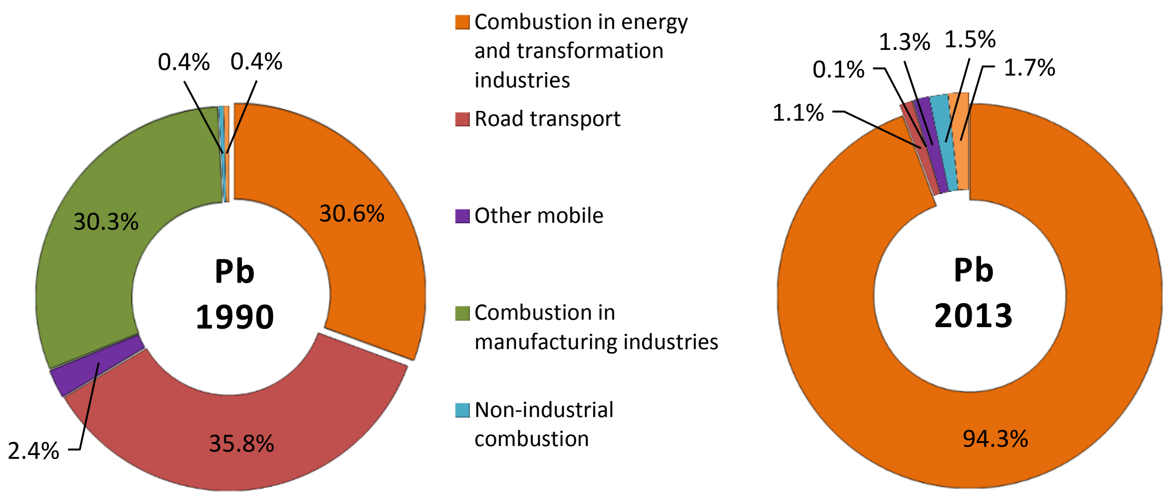


Figure 2.17 Lead emission by sources of pollution in 1990 and 2013

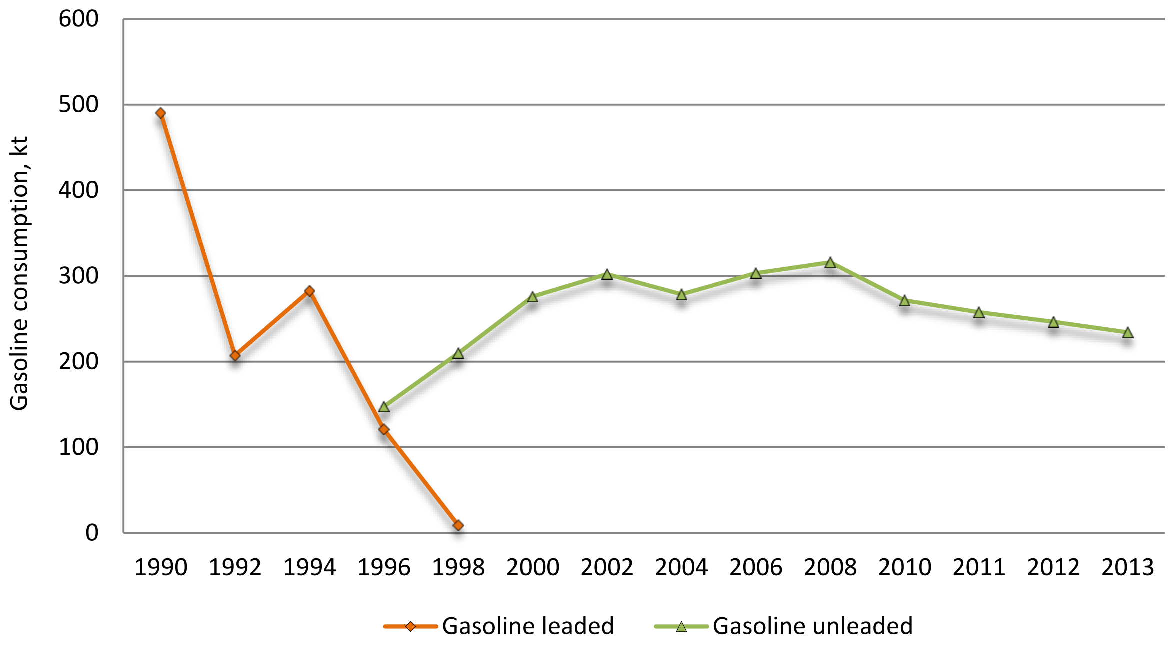


Figure 2.18 Gasoline consumption in 1990-2013

2.8. Persistent organic pollutants

The emissions of POPs are shown in Table 2.3 and Figure 2.19.

Table 2.3 POPs emission in the period 1990-2013

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs, total	HCB	PCB
	g I-Teq	t					kg	
1990	8.598	2.741	3.141	1.730	1.972	9.584	0.183	8.375
1991	8.542	2.675	3.152	1.670	1.832	9.328	0.174	8.539
1992	5.483	1.715	1.908	1.061	1.222	5.907	0.153	5.609
1993	4.349	1.431	1.545	0.909	1.093	4.977	0.132	8.808
1994	4.116	1.443	1.521	0.918	1.167	5.048	0.168	5.149
1995	5.597	2.854	2.806	1.839	2.626	10.125	0.318	4.122
1996	6.397	3.308	3.300	2.148	3.064	11.819	0.351	4.724
1997	6.375	3.302	3.288	2.143	3.073	11.806	0.361	4.316
1998	7.109	2.685	2.723	1.726	2.430	9.564	0.309	4.349
1999	7.224	2.666	2.760	1.703	2.374	9.504	0.292	3.772
2000	6.812	2.498	2.559	1.587	2.254	8.899	0.291	2.619
2001	6.550	2.388	2.509	1.517	2.108	8.521	0.295	4.196
2002	6.871	2.382	2.491	1.516	2.106	8.495	0.276	4.001
2003	6.676	2.371	2.495	1.483	2.072	8.420	0.280	4.754
2004	6.122	2.474	2.658	1.525	2.039	8.695	0.308	3.709
2005	5.649	2.262	2.490	1.367	1.783	7.902	0.257	3.723
2006	4.909	2.258	2.099	1.193	1.480	7.029	0.225	3.043
2007	6.477	1.930	2.005	1.242	1.744	6.921	0.275	1.804
2008	6.532	2.050	2.131	1.279	1.803	7.263	0.290	2.800
2009	5.912	2.158	2.269	1.331	1.857	7.614	0.262	3.056

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	PAHs, total	HCB	PCB
	g I-Teq	t					kg	
2010	6.217	2.407	2.620	1.445	1.956	8.427	0.301	4.173
2011	6.118	2.048	2.255	1.228	1.637	7.169	0.271	3.616
2012	4.520	2.061	2.267	1.244	1.652	7.224	0.278	3.477
2013	3.457	2.109	2.227	1.288	1.594	7.219	0.283	3.937
trend 1990-2013, %	**-59.79**	**-23.04**	**-29.08**	**-25.55**	**-19.16**	**-24.68**	**54.38**	**-52.99**

In the period 1990-2013 dioxin, PAHs total and PCB emissions decreased by approximately 59.8%, 24.7% and 53% respectively. Only HCB emissions increased for the same period by 54.4%, but decreased from 1995 to 2013 by 11%. In this year's submission, all POPs emissions were recalculated for the Residential Stationary sector (the reasons and a detailed description are presented in the chapter on Energy).

The main source of PCB emission is oil shale combustion, which directly depends on the amount of burned fuel. The main sources of dioxin emission are the residential sector (33%, mainly wood combustion), the waste sector (32%), the energy sector (23%, includes also waste combustion as fuel) and combustion in the manufacturing industry (8%, includes also waste combustion as fuel, mainly in the cement manufacturing industry) (Figure 2.20).

The main contributor to the total PAHs and HCB emissions is the residential sector (52% and 42% respectively) (Figures 2.21 and 2.22), which is followed in second place by the energy sector. Currently, national POPs emission factors are being developed for the energy sector.

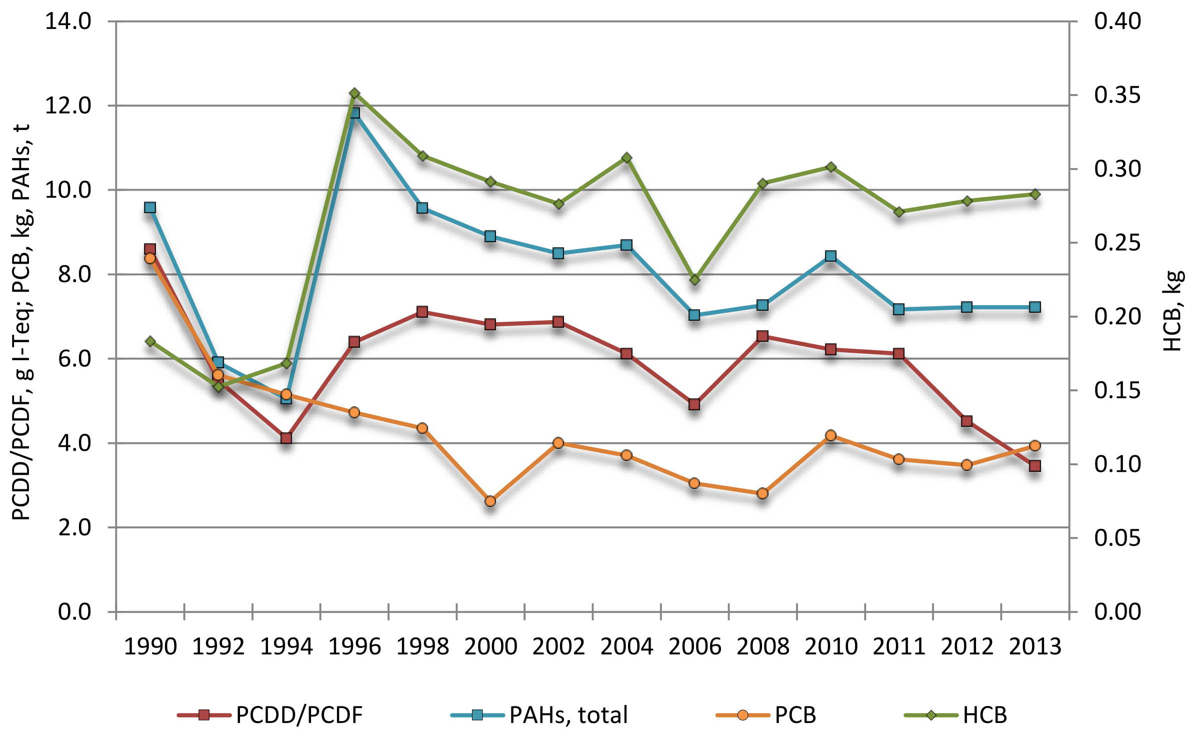


Figure 2.19 POPs emissions in the period 1990-2013

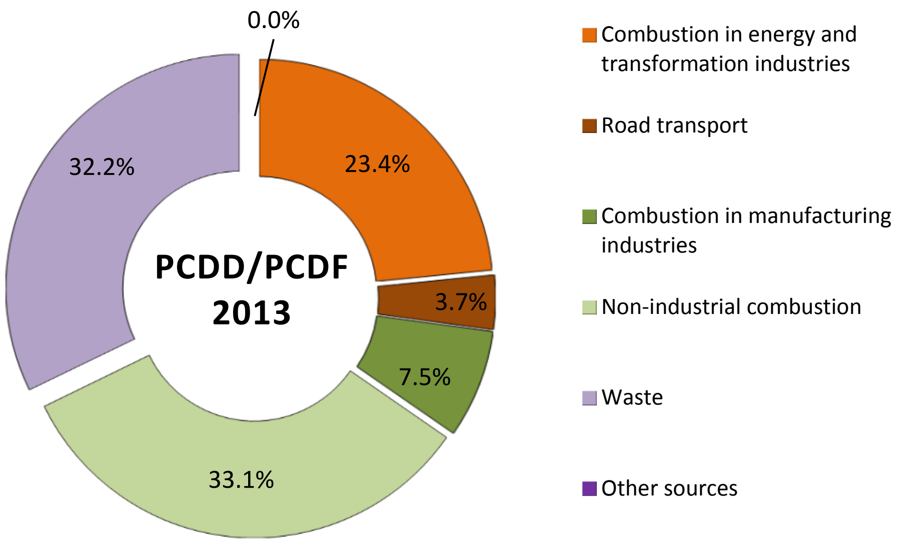


Figure 2.20 Dioxin (PCDD/PCDF) emissions by activities in 2013

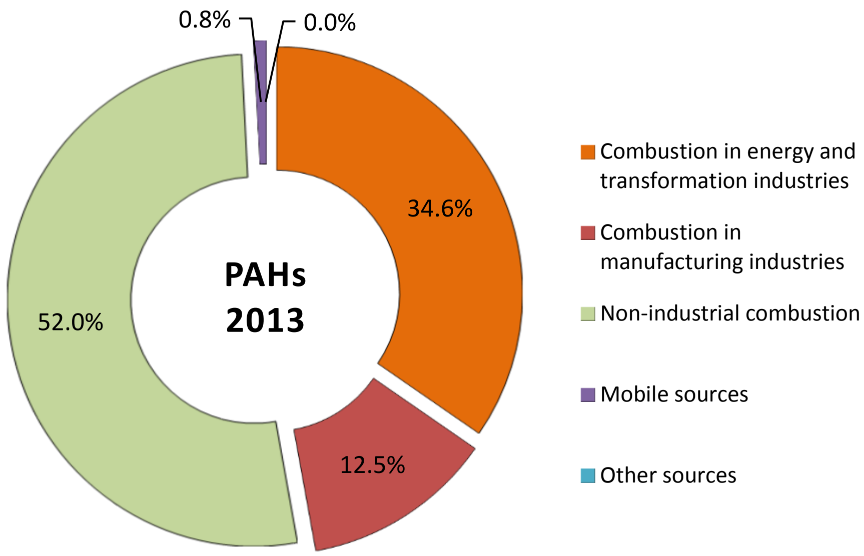


Figure 2.21 PAHs emissions by activities in 2013

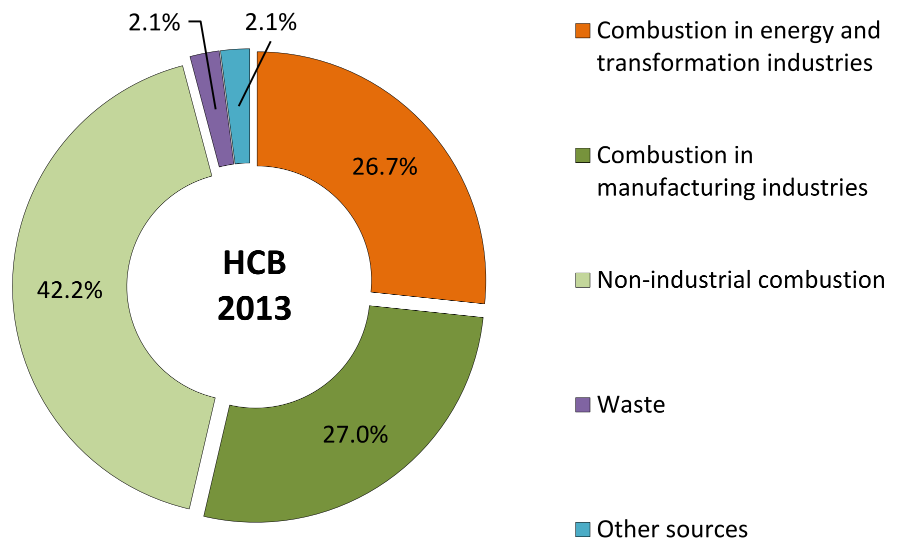
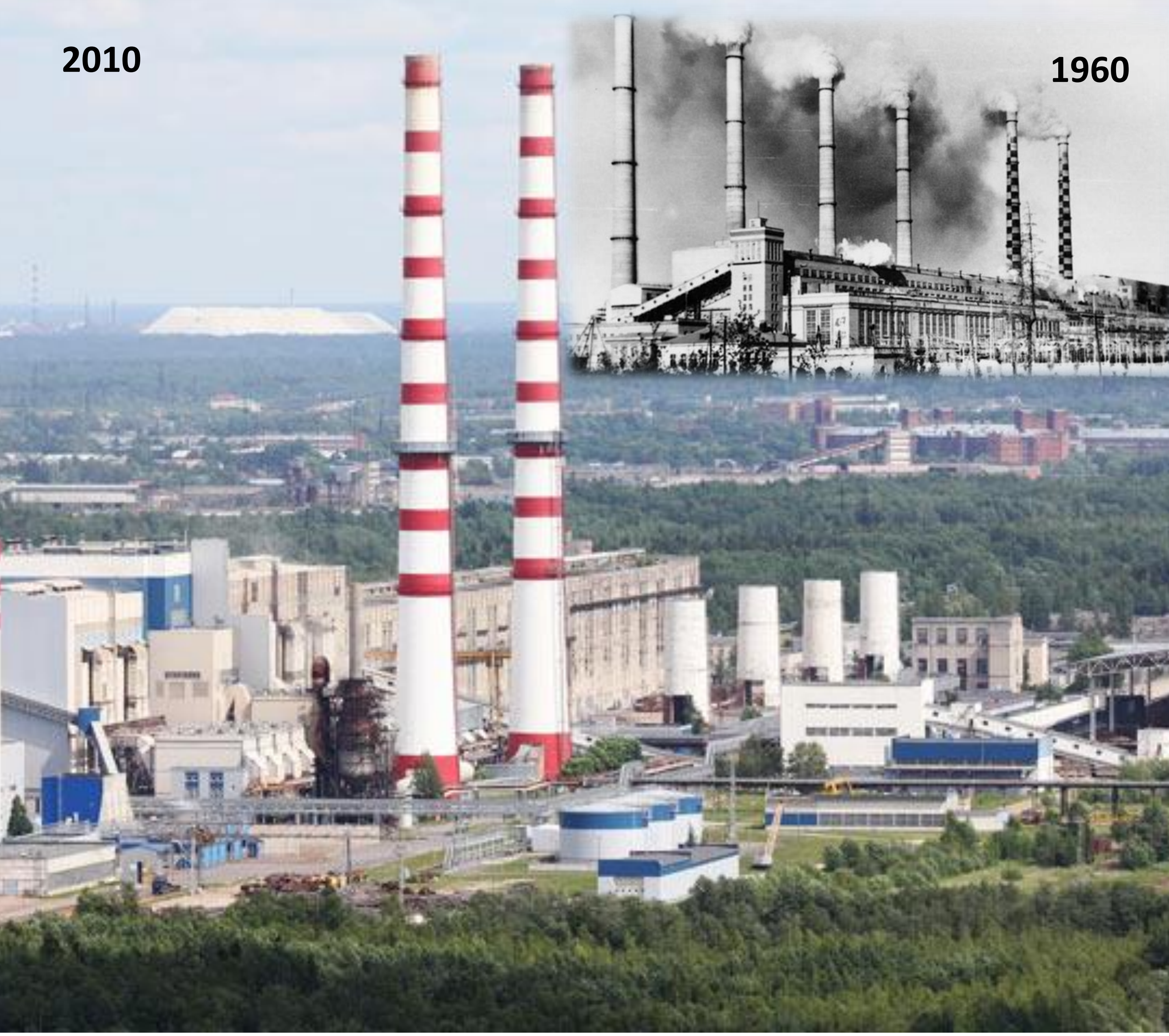


Figure 2.22 HCB emission by activities in 2013



Balti power plant in 1960 and in 2010 (Source: www.energia.ee)

3. ENERGY SECTOR (NFR 1)

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 2013, the energy sector contributed 99.9% of total SO_2 emissions, 96.2% of total NO_x emissions, 90.4% of TSP emissions, 65.8% of total NMVOC emissions, 99.7% of total CO emissions and 98.3% of Pb emissions (Figure 3.5, 3.6 and Table 3.1). During the period 1990-2013, the emissions of sulphur dioxide from the energy sector decreased by approximately 86.7% and the emissions of nitrogen oxides by about 60% resulting from a decline in energy production (oil shale consumption as a main fuel in Estonia fell from 231 PJ in 1990 to 182 PJ in 2013) (Figures 3.1 and 3.2).

There was a decrease in SO_2 and NO_x emissions of 10% and 8% respectively in 2013 compared to 2012.This was due to 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. With regard to the energy units which are not 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 the flame temperature and therefore improves conditions for sulphur captured with limestone included in oil shale.

The TSP, PM_{10} and $PM_{2.5}$ emissions increased in 2013 compared to 2012 by 9%, 19% and 13% respectively, which was mainly due to the increase in electricity production in Eesti Energia Narva Elektrijaamad AS, which was also the reason for the growth in heavy metals and POPs emissions in this period. (Table 3.1).

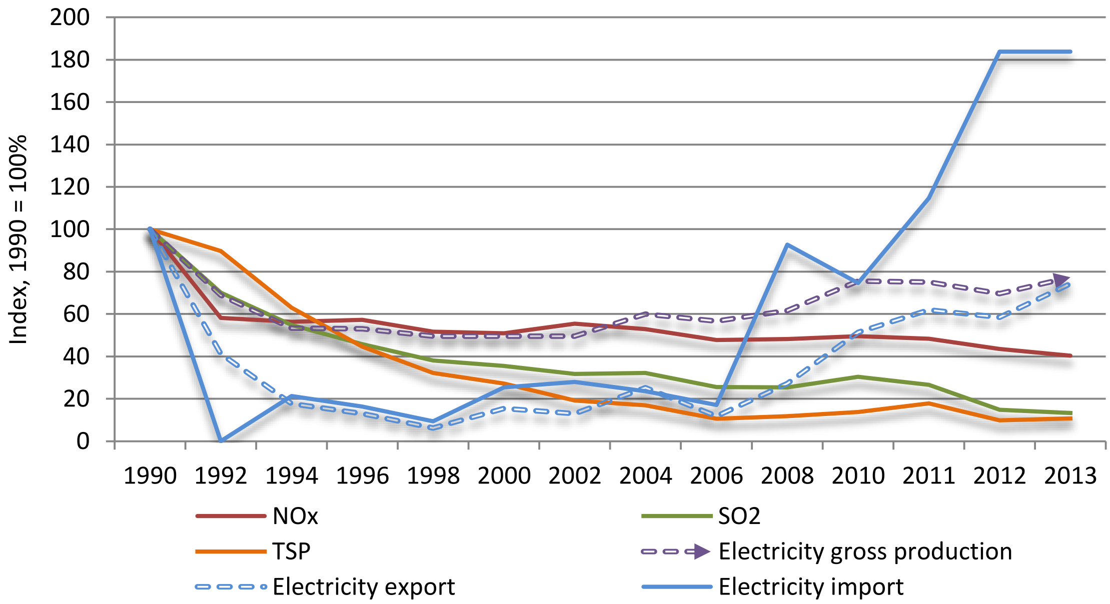


Figure 3.1 Pollutants emissions, electricity production and export in 1990-2013

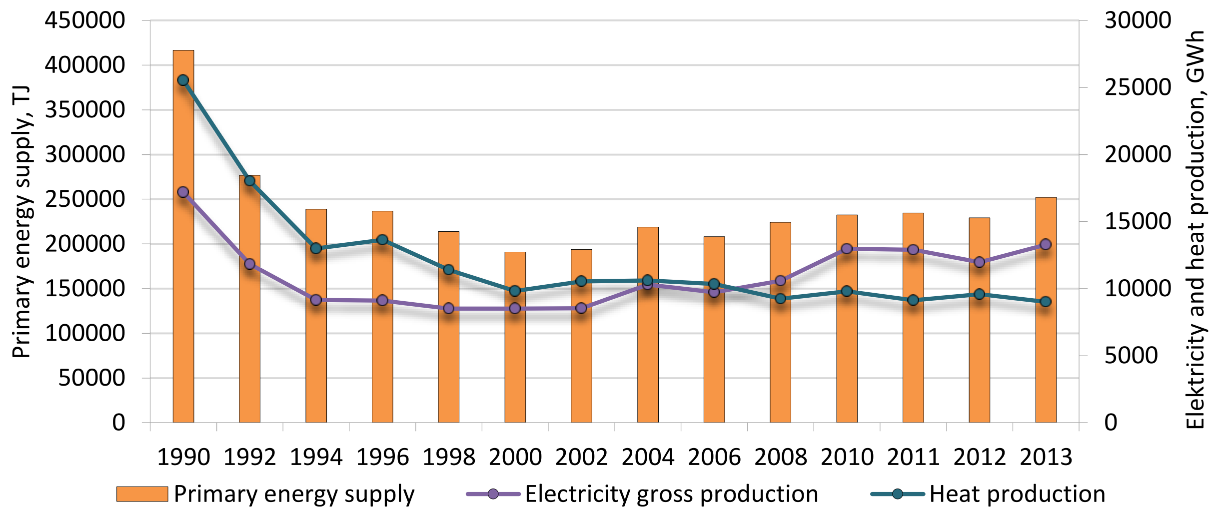


Figure 3.2 Total energy supply, electricity and heat production in the period of 1990-2013

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 2013, the share of domestic fuels – oil shale, wood and peat – accounted for approximately 82% (from which oil shale is about 82%) of the primary energy supply. Imported fuels (natural gas, fuel oils, coal and motor fuels) made up 15% (Figure 3.3). Renewables formed 13.4% of the gross inland consumption in 2013, 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 2013, the production of wind and hydro energy increased by 16.6% compared to 2012. 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 it accounted for 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 2013, 52% of the primary energy was used for the production of electricity and 15% for heat generation.

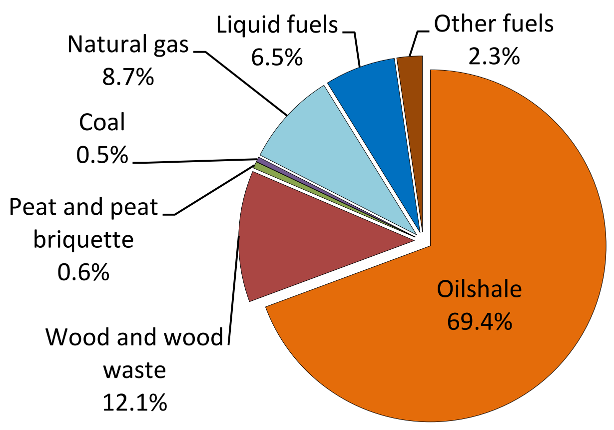


Figure 3.3 Structure of primary energy supply in Estonia in 2013

Domestic fuels have a large share in Estonia's total energy resources; and in the balance of primary energy they are mainly based on oil shale. In 2013, 20.5 million tonnes of oil shale were produced, which is 9% more than in 2012. The majority of oil shale is consumed in power plants as a raw material for shale oil. The demand for shale oil in Estonia and in external markets increased the production of shale oil by about 5%. Nearly 86% of the production was exported – 15% more than in 2012. More than one third (34%) of this amount was exported to the Netherlands, followed by Belgium and Denmark. The production of peat fuels increased significantly in 2013 – by 58%. Compared to 2012, peat briquettes production also increased by 7.5%.

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 fluidised bed (CFB). Renovation of the 8th unit in the Eesti PP was completed 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 fluidised bed. The new units save more than 20% in fuel. The pollution level is several times lower than that stipulated in EU environmental regulations.

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

Table 3.1 Pollutant emissions from the energy sector in the period 1990-2013

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	kt								t	
1990	71.46	34.76	273.61	0.06	NR	NR	274.85	226.24	205.21	4.46
1991	66.21	33.27	251.29	0.05	NR	NR	275.74	225.69	187.89	4.25
1992	41.14	19.73	191.66	0.04	NR	NR	247.22	126.80	123.78	3.05
1993	38.00	19.10	155.90	0.04	NR	NR	195.41	123.60	102.31	2.27
1994	40.51	23.38	150.23	0.06	NR	NR	173.44	149.50	122.34	2.93
1995	38.14	30.74	116.11	0.10	NR	NR	133.01	196.93	85.16	2.13
1996	41.48	34.32	125.14	0.12	NR	NR	122.59	219.32	65.55	1.26
1997	40.19	36.12	116.21	0.13	NR	NR	99.39	228.72	46.16	1.29
1998	37.22	28.08	104.31	0.11	NR	NR	87.75	181.14	38.89	1.17
1999	35.76	29.54	97.61	0.12	NR	NR	86.38	190.28	38.87	1.11
2000	36.61	30.14	96.92	0.17	20.96	35.97	73.09	182.08	35.69	0.72
2001	39.01	31.29	90.61	0.20	21.92	35.98	71.11	187.95	36.12	0.71
2002	40.24	30.21	86.83	0.22	22.40	31.84	50.16	181.44	35.37	0.73
2003	40.81	28.71	100.08	0.22	20.50	28.44	46.20	173.96	37.41	0.80
2004	37.90	28.83	88.06	0.29	21.68	28.44	43.05	170.86	35.89	0.76
2005	35.67	25.65	76.13	0.31	19.52	25.03	34.61	157.34	34.61	0.73
2006	34.30	23.74	69.82	0.35	14.91	18.46	25.18	143.42	31.12	0.70

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	kt								t	
2007	37.40	24.86	87.94	0.41	19.93	27.01	33.21	162.24	39.69	0.87
2008	34.28	24.58	69.35	0.42	19.60	23.59	28.89	166.26	34.73	0.81
2009	29.18	24.52	54.78	0.39	18.20	21.71	26.41	167.79	28.02	0.68
2010	35.62	24.73	83.17	0.40	22.96	30.41	35.67	171.54	38.50	0.88
2011	34.68	22.12	72.69	0.45	26.09	40.32	47.02	147.49	37.94	0.84
2012	31.11	22.49	40.53	0.47	16.77	19.63	24.74	162.02	33.37	0.77
2013	28.60	21.68	36.45	0.43	19.04	23.39	26.96	157.41	38.79	0.94
trend 1990-2013, %	**-60.0**	**-37.6**	**-86.7**	**626.2**	**-9.2**	**-35.0**	**-90.2**	**-30.4**	**-81.1**	**-78.8**

Year	Hg	As	Cr	Cu	Ni	Zn	PAH (4 total)	PCDD/ PCDF	HCB	PCB
	t							g I-Teq	kg	
1990	1.11	18.84	18.39	10.03	27.32	106.84	9.58	7.82	0.17	8.33
1991	1.00	16.44	16.02	9.30	25.54	97.85	9.33	7.77	0.16	8.50
1992	0.82	14.02	13.80	6.64	16.95	79.78	5.91	4.68	0.14	5.56
1993	0.64	10.83	10.47	5.42	14.31	62.40	4.98	3.60	0.12	8.77
1994	0.63	10.67	10.32	5.91	12.83	65.57	5.05	3.30	0.15	5.10
1995	0.59	10.05	9.95	5.02	10.46	63.97	10.12	4.75	0.30	4.07
1996	0.59	10.35	10.22	4.57	10.82	62.48	11.82	5.51	0.33	4.66
1997	0.59	10.19	9.96	4.54	9.71	62.48	11.81	5.28	0.34	4.25
1998	0.52	9.13	8.90	4.13	8.76	55.69	9.56	4.00	0.29	4.29
1999	0.50	8.70	8.50	3.99	7.48	53.51	9.50	4.38	0.27	3.71
2000	0.50	8.58	8.34	3.67	6.44	49.85	8.90	3.94	0.27	2.56
2001	0.49	8.38	8.21	3.96	6.38	49.56	8.52	3.84	0.28	4.15
2002	0.49	8.35	8.31	4.09	6.12	48.95	8.49	3.81	0.26	3.95
2003	0.57	10.09	9.80	4.42	6.75	57.85	8.42	3.99	0.26	4.70
2004	0.53	9.78	9.38	4.45	6.64	57.71	8.69	3.65	0.30	3.68
2005	0.51	9.21	9.02	4.42	6.39	53.39	7.90	3.11	0.25	3.70
2006	0.51	8.58	8.40	4.31	5.72	48.94	7.03	2.93	0.22	3.02
2007	0.64	11.06	10.72	4.98	6.69	62.01	6.92	4.47	0.27	1.78
2008	0.57	9.40	9.25	4.58	5.85	55.30	7.26	4.53	0.28	2.78
2009	0.44	7.60	7.50	3.93	4.82	46.48	7.61	3.91	0.26	3.04
2010	0.62	10.96	10.51	4.81	6.57	62.66	8.43	4.78	0.30	4.16
2011	0.63	10.88	10.32	4.73	6.39	60.64	7.17	4.72	0.27	3.60
2012	0.55	9.59	9.16	4.52	5.62	54.94	7.22	3.28	0.27	3.46
2013	0.66	11.23	10.56	4.79	6.48	62.44	7.22	2.34	0.28	3.92
trend 1990-2013, %	**-41.0**	**-40.4**	**-42.6**	**-52.2**	**-76.3**	**-41.6**	**-24.7**	**-70.0**	**64.9**	**-53.0**

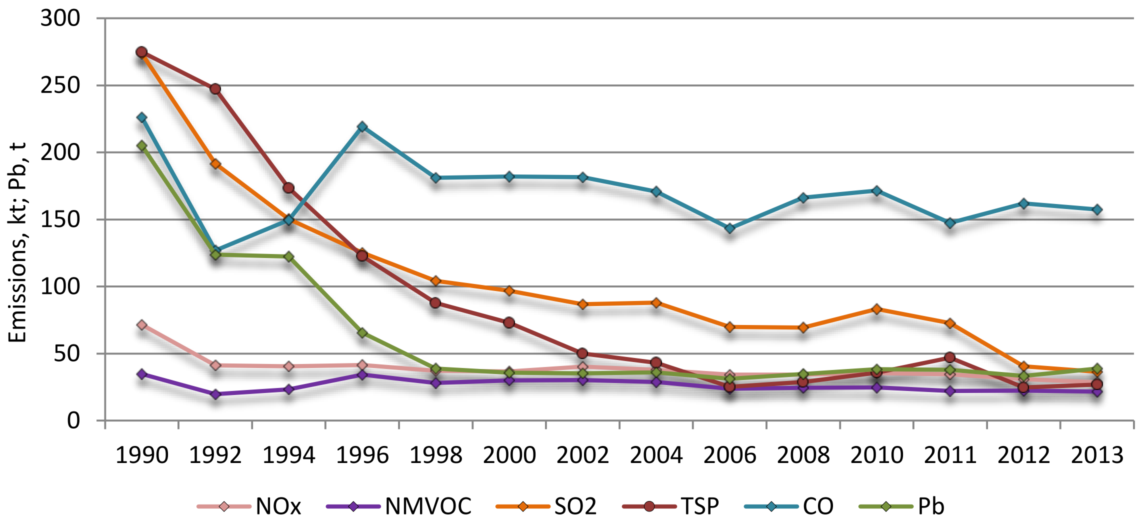


Figure 3.4 Pollutant emissions from the energy industry in the period 1990-2013

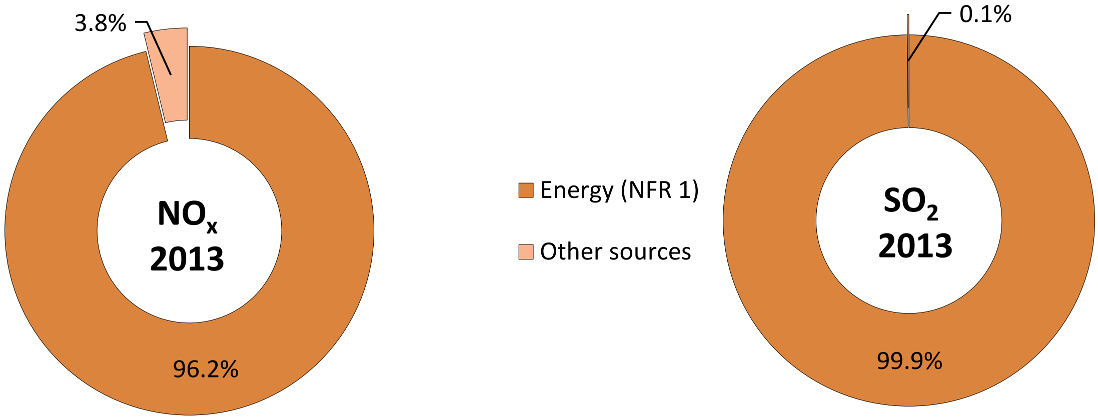


Figure 3.5 Share of NMVOC and TSP emissions from the energy sector in total emissions in 2013

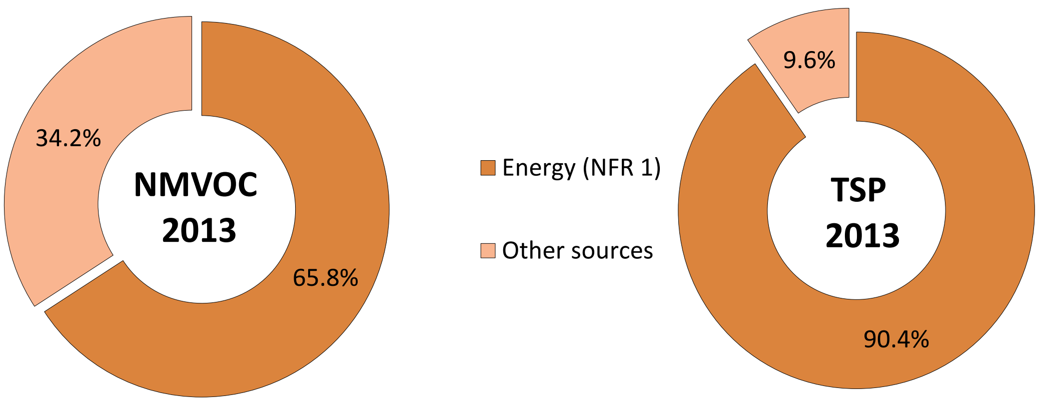


Figure 3.6 Share of NO_x emissions from the energy sector as a percentage of total emissions in 2013

3.2. Stationary fuel combustion

3.2.1. Sources category description

Table 3.2 Stationary fuel combustion activities

NFR	Source	Description	Emissions reported
1A1	**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}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	b. Petroleum refining	Includes emissions from process furnaces in the oil shale industry. Only two point sources data.	NMVOC, NO_x, CO, PCDD/ PCDF
	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}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1A2	**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}, $PM_{2.5}$, BC, 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}, $PM_{2.5}$, BC, 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}, $PM_{2.5}$, BC, CO, Pb, As, Cr, Cu, Zn
	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}, $PM_{2.5}$, BC, 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}, $PM_{2.5}$, BC, CO, HM
	f. Non-metallic minerals	Includes emissions from all boilers in the manufacturing industry, other processes with contact: cement, lime, glass, bricks and other productions. (SNAP 0301, 030311-030320). Data of point and diffuse sources.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	gviii. Other	Includes emissions from all boilers in the manufacturing industry, other processes with contact: (SNAP 030204-030205; 030326) Data of point and diffuse sources.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1A4	**Non-industrial combustion plants**		
	ai Commercial / institutional: Stationary	Includes emissions from boilers or other equipment in the commercial sector. Data of point and diffuse	NO_x, SO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB

NFR	Source	Description	Emissions reported
		sources.	
	bi 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}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
	ci 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}, $PM_{2.5}$, BC, CO, HM, PCDD/ PCDF, PAHs, HCB, PCB
1A5a	**Other stationary (including military)**		IE, reported under 1A4ai

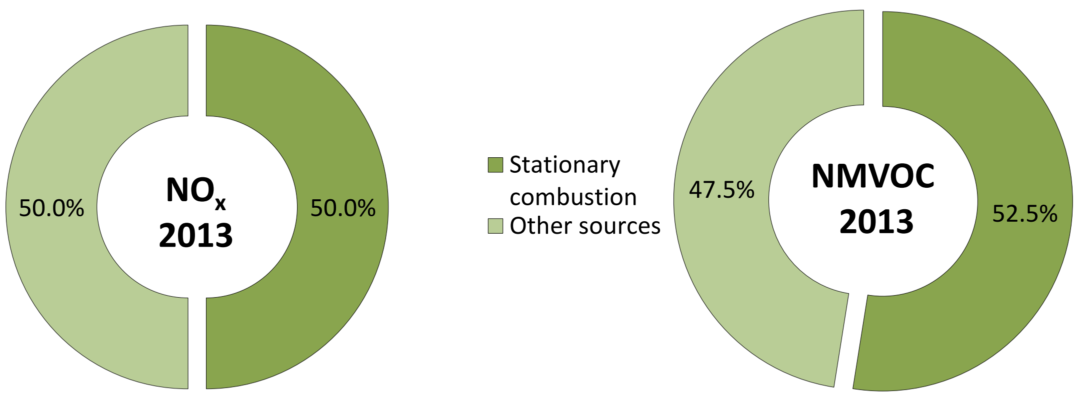


Figure 3.7 NO_x and NMVOC emissions from stationary fuel combustion and other sources in 2013

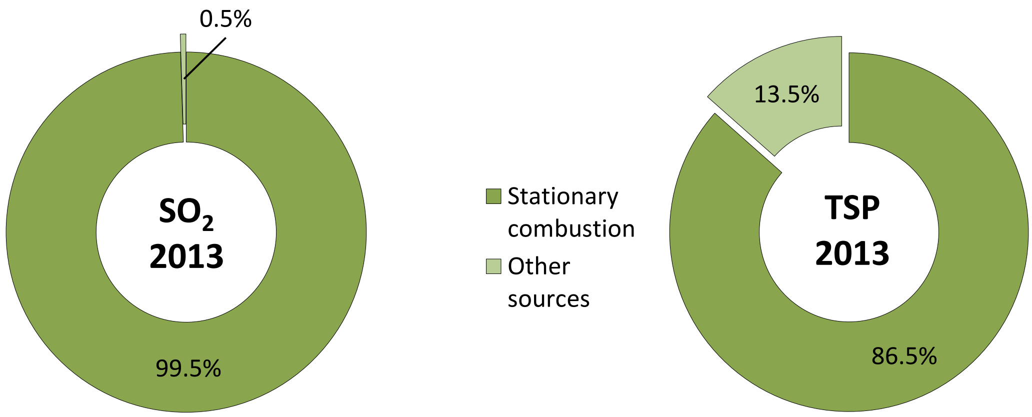


Figure 3.8 SO_2 and TSP emissions from stationary fuel combustion and other sources in 2013

Table 3.3 Pollutant emissions from stationary fuel combustion in the period 1990-2013

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO	Pb	Cd
	kt								t	
1990	33.43	12.77	266.71	0.04	NR	NR	273.13	98.26	126.48	4.44
1991	30.51	12.35	244.67	0.03	NR	NR	274.09	98.52	118.20	4.24
1992	21.51	9.85	187.72	0.03	NR	NR	246.27	73.93	89.46	3.04
1993	16.75	8.32	151.61	0.03	NR	NR	194.25	63.99	67.22	2.27
1994	18.08	10.43	146.16	0.04	NR	NR	172.35	78.31	79.32	2.92
1995	18.28	18.47	112.46	0.07	NR	NR	132.00	130.35	60.38	2.13
1996	19.89	21.56	121.27	0.08	NR	NR	121.58	150.26	43.84	1.25
1997	18.30	21.22	112.32	0.08	NR	NR	98.33	146.13	36.31	1.28
1998	16.94	16.68	100.33	0.06	NR	NR	86.73	118.71	32.82	1.17
1999	16.12	16.05	94.09	0.06	NR	NR	85.43	113.19	31.32	1.10
2000	17.14	15.31	93.77	0.06	20.06	34.94	71.88	113.67	30.67	0.72
2001	18.15	15.28	89.70	0.06	21.11	35.01	69.91	115.21	30.13	0.70
2002	17.55	15.96	85.72	0.07	21.42	30.67	48.78	118.55	29.82	0.72
2003	20.00	16.39	99.37	0.06	19.57	27.31	44.84	121.29	35.14	0.79
2004	18.26	16.84	87.45	0.06	20.69	27.28	41.69	125.56	33.78	0.75
2005	16.22	14.89	75.75	0.05	18.58	23.89	33.25	114.84	32.47	0.72
2006	14.70	13.88	69.48	0.05	13.96	17.29	23.76	102.59	29.65	0.69
2007	18.17	17.04	87.62	0.06	18.97	25.84	31.80	124.11	38.14	0.86
2008	16.61	17.94	69.07	0.07	18.70	22.48	27.53	133.55	33.14	0.80
2009	13.95	18.27	54.62	0.07	17.44	20.72	25.16	138.28	26.62	0.68
2010	19.05	18.86	83.03	0.07	22.16	29.35	34.32	144.78	37.98	0.87
2011	19.39	16.44	72.48	0.06	25.34	39.30	45.69	124.08	37.46	0.83
2012	16.02	17.25	40.38	0.07	16.00	18.59	23.40	137.89	32.88	0.76
2013	14.86	17.29	36.32	0.07	18.34	22.49	25.82	137.04	38.34	0.94
trend 1990-2013, %	**-55.6**	**35.4**	**-86.4**	**67.0**	**-8.6**	**-35.6**	**-90.5**	**39.5**	**-69.7**	**-78.9**

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAH (4 total)	HCB	PCB
	t						g I-Teq	t	kg	
1990	1.11	18.84	18.26	7.28	27.27	104.24	7.60	9.49	0.17	8.31
1991	1.00	16.44	15.91	6.81	25.49	95.48	7.54	9.24	0.16	8.47
1992	0.82	14.02	13.73	5.27	16.92	78.54	4.58	5.86	0.14	5.55
1993	0.64	10.83	10.40	3.93	14.28	61.05	3.50	4.93	0.12	8.76
1994	0.63	10.67	10.24	4.28	12.81	63.98	3.16	5.00	0.15	5.09
1995	0.59	10.05	9.88	3.59	10.44	62.51	4.62	10.08	0.30	4.06
1996	0.59	10.35	10.14	3.03	10.80	60.92	5.37	11.77	0.33	4.65
1997	0.59	10.19	9.88	2.93	9.69	60.81	5.13	11.76	0.34	4.25
1998	0.52	9.13	8.83	2.65	8.74	54.22	3.89	9.52	0.29	4.29
1999	0.50	8.70	8.42	2.50	7.46	51.98	4.25	9.47	0.27	3.71
2000	0.50	8.58	8.26	2.14	6.42	48.30	3.81	8.86	0.27	2.56
2001	0.49	8.37	8.11	2.12	6.36	47.68	3.67	8.48	0.28	4.15
2002	0.49	8.35	8.21	2.09	6.09	46.97	3.66	8.44	0.26	3.95
2003	0.57	10.09	9.71	2.49	6.72	55.92	3.84	8.37	0.26	4.70
2004	0.53	9.78	9.28	2.48	6.61	55.74	3.50	8.65	0.30	3.68
2005	0.51	9.21	8.91	2.41	6.36	51.34	2.96	7.85	0.25	3.70

Year	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAH (4 total)	HCB	PCB
	t						g I-Teq	t	kg	
2006	0.51	8.58	8.29	2.15	5.68	46.74	2.77	6.97	0.22	3.02
2007	0.64	11.06	10.60	2.70	6.66	59.69	4.31	6.86	0.27	1.78
2008	0.57	9.40	9.13	2.34	5.81	53.03	4.36	7.21	0.28	2.78
2009	0.44	7.60	7.39	1.92	4.78	44.44	3.75	7.56	0.26	3.04
2010	0.62	10.96	10.40	2.67	6.53	60.52	4.63	8.37	0.30	4.16
2011	0.63	10.88	10.21	2.61	6.36	58.52	4.58	7.11	0.26	3.60
2012	0.55	9.59	9.05	2.31	5.59	52.74	3.14	7.17	0.27	3.46
2013	0.66	11.23	10.45	2.65	6.45	60.29	2.22	7.16	0.28	3.92
1990-2013, %	**-40.9**	**-40.4**	**-42.8**	**-63.6**	**-76.4**	**-42.2**	**-70.8**	**-24.6**	**64.9**	**-52.8**

Energy related activities (without transport) are the most significant contributors to SO_2 emissions – 99.5% in 2013. The share of mobile sources of the 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 fluidised 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 the total SO_2 emissions. The share of oil shale power plants contributing to the total SO_2 emission has decreased by 21% compared to 2011.

The Narva PP is 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.

(*Photo on the left by Lembit Michelson: Eesti power plant*)

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 instalment of the equipment (nitrogen oxides scrubbers) to reduce NO_x emissions of the Eesti PP was commenced. (Eesti Energia)

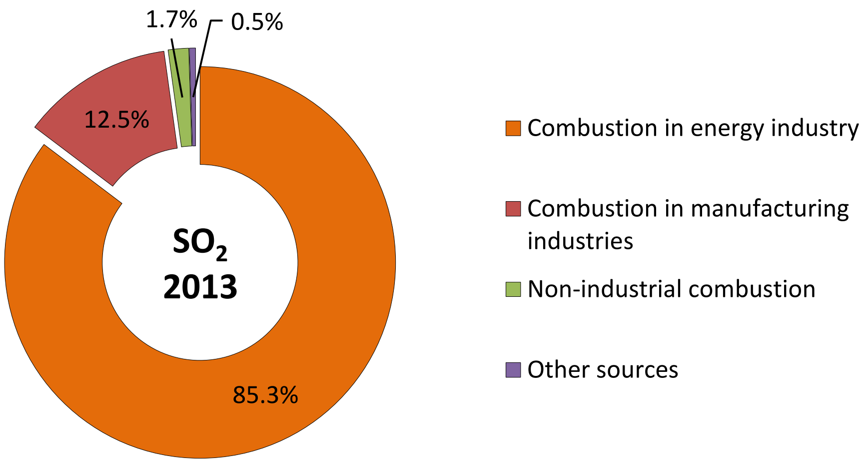


Figure 3.9 SO_2 emissions by sources of pollution in 2013

Non-industrial combustion is responsible for about 92% of the total NMVOC emissions in stationary combustion, for approximately 73% of CO and 52% of TSP emissions (Figures 3.10, 3.11, 3.13, 3.14). Combustion in energy and transformation industries is responsible for 86% of SO_2 and for the 23% of CO emissions in stationary combustion (thus the main part of carbon monoxide is emitted from Narva shale oil production plant, which increased during the last year as a result of growing shale oil production) (Figures 3.10, 3.12, 3.14).

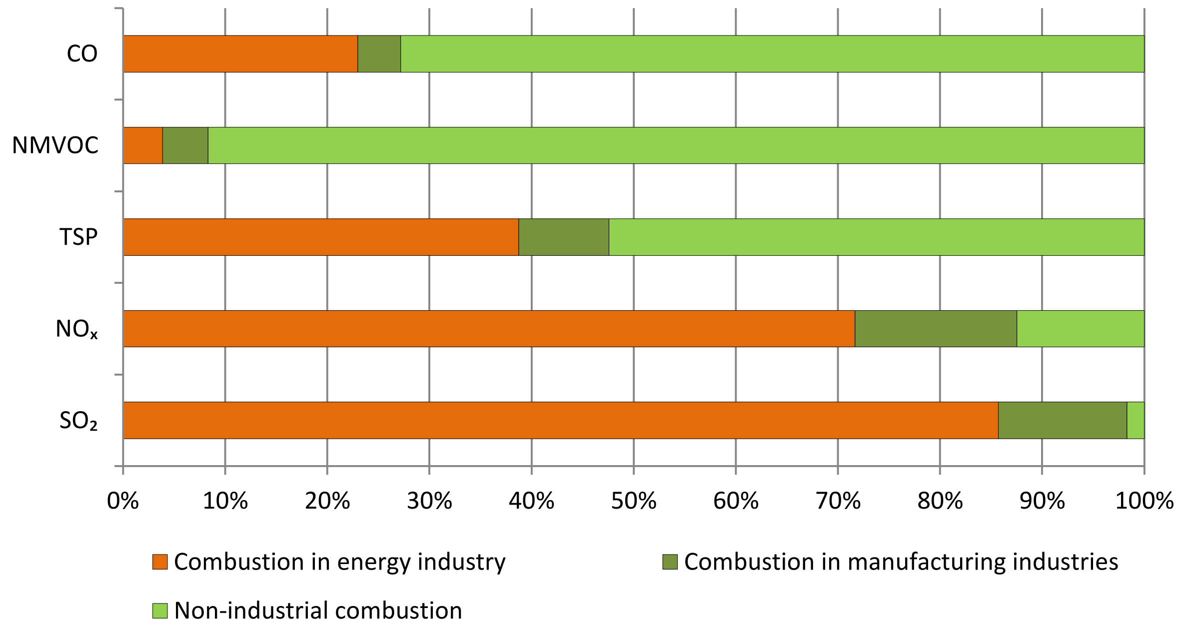


Figure 3.10 Distribution of pollutants emissions by sector in stationary combustion in 2013

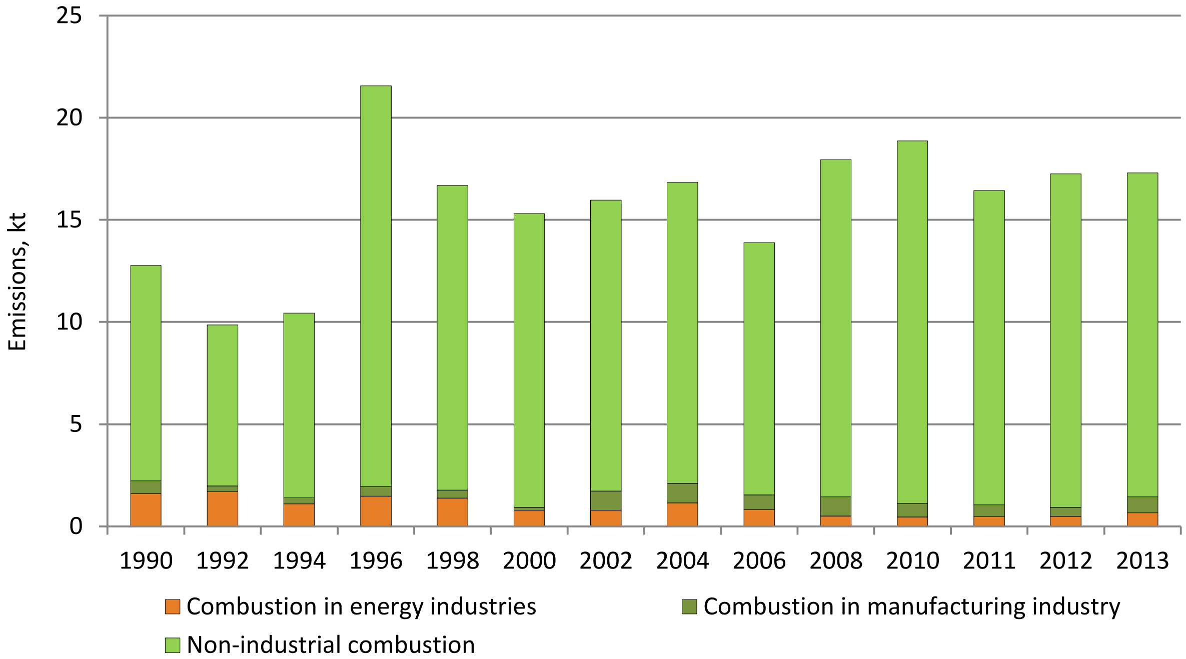


Figure 3.11 Distribution of NMVOC emissions by sector in stationary combustion in the period 1990-2013

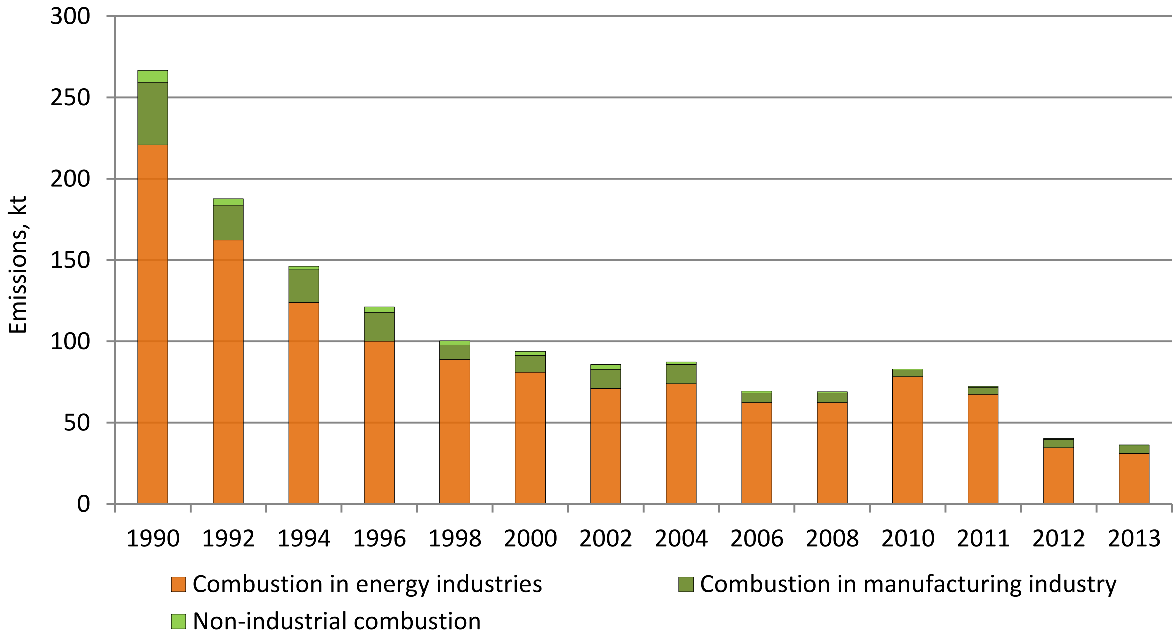


Figure 3.12 Distribution of SO_2 emissions by sector in stationary combustion in the period 1990-2013

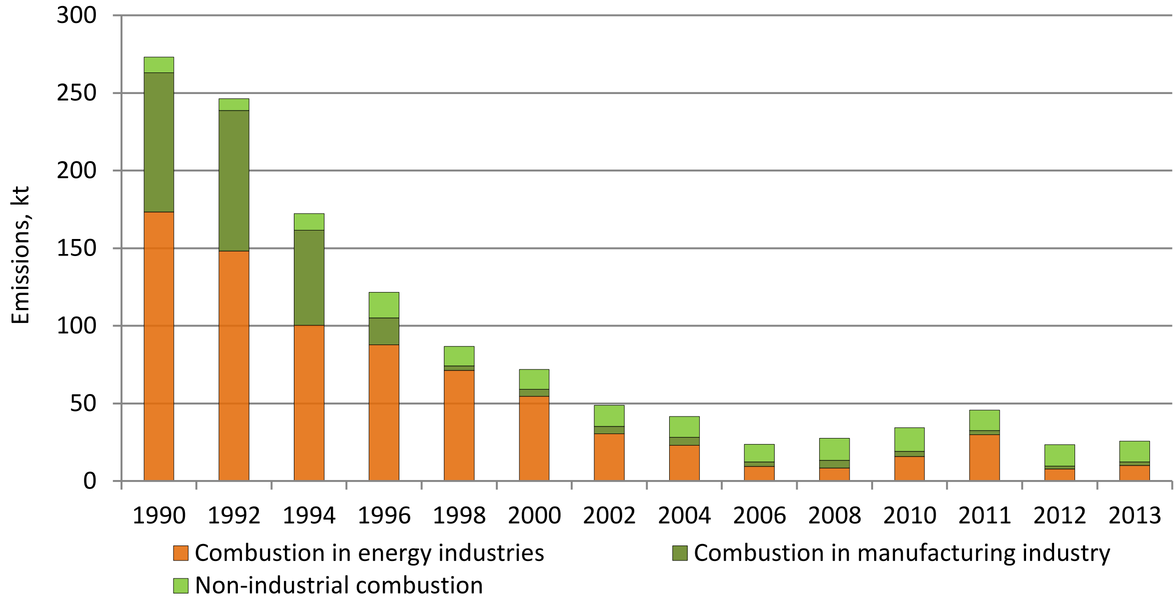


Figure 3.13 Distribution of TSP emissions by sector in stationary combustion in the period 1990-2013

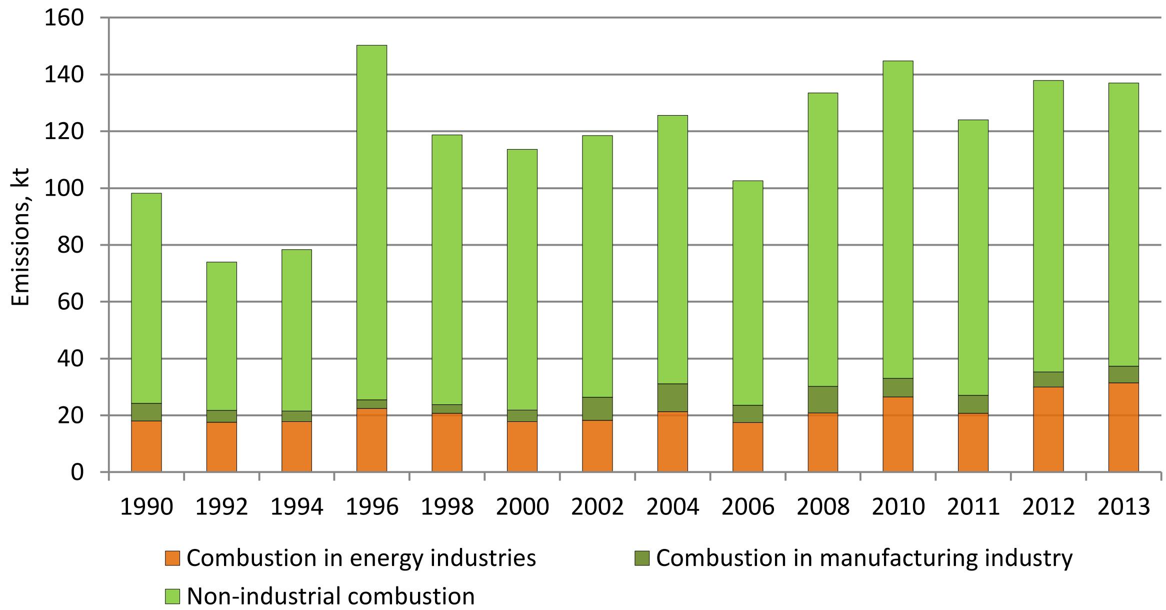


Figure 3.14 Distribution of CO emissions by sector in stationary combustion in the period 1990-2013

3.2.2. Methodological issues

NFR 1A1a: Public electricity and heat production, **NFR 1A2f** Stationary combustion in manufacturing industries and construction: Non-metallic minerals, **NFR 1A2gviii** Stationary combustion in manufacturing industries and construction: Other, and **NFR 1A4ai**, **ci** 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 1A1b: Petroleum refining:only two facilities reported emissions from process furnaces in the shale oil industry**.** Emissions are calculated on the basis of measurements, or the combined method (measurements plus calculations) is used.

NFR 1A1c: 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 a 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) (*Photo on the left by Matti Kämärä: Petroter technology in VKG Oil plant*). 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 (*Photo on the left: Enefit technology; source: www.enefit.com*). This plant, the only one of its kind in the world, uses the efficient Enefit-140 (*in the left on the photo*) 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. The 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, more reliable and more efficient. This new generation of technology has been developed jointly by Eesti Energia and the international engineering company Outotec. Having produced its first oil in December 2012, the new Enefit-280 (*in the right on the photo*) plant will gradually increase it operations to reach the designed parameters. Eesti Energia is planning to expand its oil business and build a hydrogen processing complex by 2016, creating a business capable of producing liquid fuels of higher quality than the current shale oil that will meet all the legal requirements for use as motor fuel.

NFR 1A2a: 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 1A2b: 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 1A2c: 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 1A2d: 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 1A2e: 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 1A2f: Non-metallic minerals include emissions from all boilers and other processes with contact in the non-metallic minerals industry: cement, lime, glass, bricks and other productions (SNAP 0301, 030311-030326). Data are only from point 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 are calculated on the basis of national emission factors and POPs on the basis of the EMEP/EEA Guidebook. For cement production the HCB and PAHs emissions are for the first time calculated on the basis of measurements.

NFR 1A2gviii: Others include emissions from all boilers in the other manufacturing industry (excluding NFR 1A2a-e, 1A2f), other processes with contact: other productions (SNAP 0301, 030326). Data are from 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 factors and POPs on the basis of the EMEP/EEA Guidebook.

NFR 1A4ai–ci: Commercial/institutional: Stationary and Agriculture/Forestry/Fishing: Stationary includes pollutant emissions from combustion processes in this sector. Data are from 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 factors and POPs on the basis of the EMEP/EEA Guidebook.

NFR 1A4bi: 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 have been summarised 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 the Energy Balance contains 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. In order to determine 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 Carbon 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
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 the formula:

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

where

B – fuel consumption;
S^r – sulphur content in fuel;
ŋ – 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 the technology (high, medium or low).

The national methodology is co-ordinated by the Ministry of the Environment, and at present the national methodology for boilers is being updated. Therefore, it was decided not to use this year new EMEP/EEA Guidebook 2013 for NFR 1A1, 1A2, 1A4ai and 1A4ci sectors. Most probably, the national methodology will be used next year.

This year, emissions for the residual stationary combustion sector were recalculated for the persistent organic pollutants and heavy metals. The calculation of POPs emissions was achieved by the use of national factors for wood burning defined within the project "The Geneva Convention on Long Range Transboundary Air Pollution on Persistent Organic Pollutants Protocol compliance". Within the project, measurements for various types of the burning installations (stoves, single household boilers, open fireplaces) were carried out and average values were defined. Measurements were also made for conventional and advanced stoves and boilers. Emission factors are shown in Table 3.12. For the calculation of heavy metals, emissions from wood combustion and POPs and HM from other fuels were used as emission factors for the new EMEP/EEA Guidebook 2013 and are presented in the Tables 3.10 and 3.11.

Calculations of emissions of POPs from the burning of waste in stoves were also made in addition. Emission factors were also defined within the project "Tööstuslikest allikatest ja koduahjudest eralduvate välisõhu saasteainete heitkoguste inventuuri metoodikate täiendamine" (Table 3.13). Data on the amount of the burned waste were obtained on the basis of the Estonian Statistic questionnaire. Emissions are included in sector 1A4bi.

The NGO, Estonian Chimney Court, believes that in addition to paper and paperboard packaging, diapers, sanitary napkins, various plastic packaging, shoes, clothes, and other residues are burned in domestic stoves. Thanks to growing awareness and new technology, waste burning in households shows a downward trend. People should be motivated not to burn waste as heaters used in such a way will wear faster and maintenance and repair are expensive.

It is estimated that approximately 45% of private households may burn waste (Table 3.15). It might be considered that growing awareness and continuous notification concerning the quantities of waste incinerated will assist in its downward trend.

The emission factors for the main substances will be defined and emissions are calculated according to the next period of the reporting.

Table 3.9 Main pollutant emission factors for NFR 1A4bi

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
BC	% of $PM_{2.5}$	6.4	10	5.4	8.5

Table 3.10 HM and POPs emission factor for NFR 1A4bi (EMEP/EEA Guidebook 2013)

Pollutant	Unit	Solid fuels (not biomass)				Liquid fuels		Natural gas	
		Fireplaces, saunas, outdoor heaters	Conventional stoves	Advanced stoves	Small boilers (<=50 kW_{th})	Stoves	Small boilers (<=50 kW_{th})	Fireplaces, saunas, outdoor heaters	Small boilers (<=50 kW_{th})
Pb	mg/GJ	100	100	100	200	0.012	0.012	0.0015	0.0015
Cd	mg/GJ	0.5	1	1	3	0.001	0.001	0.00025	0.00025
Hg	mg/GJ	3	5	5	6	0.12	0.12	0.1	0.1
As	mg/GJ	1.5	1.5	1.5	5	0.002	0.002	0.12	0.12
Cr	mg/GJ	10	10	10	15	0.2	0.2	0.00076	0.00076
Cu	mg/GJ	20	20	15	30	0.13	0.13	0.000076	0.000076
Ni	mg/GJ	10	10	10	20	0.005	0.005	0.00051	0.00051
Se	mg/GJ	1	2	2	2	0.002	0.002	0.011	0.011
Zn	mg/GJ	200	200	200	300	0.42	0.42	0.0015	0.0015
PCB	µg/GJ	170	170	170	170				
PCDD/F	ng/GJ	500	1000	500	500	10	1.8	1.5	1.5
B(a)p	mg/GJ	100	250	150	270	80	80	0.00056	0.00056
B(b)f	mg/GJ	170	400	180	250	40	40	0.00084	0.00084
B(k)f	mg/GJ	100	150	100	100	70	70	0.00084	0.00084
I(1,2,3-cd)p	mg/GJ	80	120	80	90	160	160	0.00084	0.00084
HCB	µg/GJ	0.62	0.62	0.62	0.62				

Table 3.11 HM and PCB emission factor for wood combustion for NFR 1A4bi (EMEP/EEA Guidebook 2013)

Pollutant	Unit	Biomass				
		Fireplaces, saunas, outdoor heaters	Conventional stoves	Small boilers (<=50 kW_{th})	Advanced stoves and boilers	Pellet stoves and boilers
Pb	mg/GJ	27	27	27	27	27
Cd	mg/GJ	13	13	13	13	13
Hg	mg/GJ	0.56	0.56	0.56	0.56	0.56
As	mg/GJ	0.19	0.19	0.19	0.19	0.19
Cr	mg/GJ	23	23	23	23	23
Cu	mg/GJ	6	6	6	6	6
Ni	mg/GJ	2	2	2	2	2
Se	mg/GJ	0,5	0,5	0,5	0,5	0,5
Zn	mg/GJ	512	512	512	512	512
PCB	µg/GJ	0.060	0.060	0.060	0.007	0.01

Table 3.12 POPs national emission factors for NFR 1A4bi

Pollutant	Unit	Biomass				
		Conventional stoves, fireplaces	Advanced stoves	Conventional small boilers (<=35 kW_{th})	Advanced small boilers (<=35 kW_{th})	Wood briquette stoves and boilers
PCDD/PCDF	ng/GJ	161.9	2.8	15.025	0.4696	6.7
B(a)p	mg/GJ	37.9	1.185	489.008	0.037	2.942
B(b)f	mg/GJ	28.5	0.891	433.051	0.028	2.212
B(k)f	mg/GJ	18.2	0.569	358.864	0.018	1.413
I(1,2,3-cd)p	mg/GJ	28.1	0.878	591.640	0.027	2.181
HCB	µg/GJ	17.104	2.741	8.333	0.261	8.537

Table 3.13 National POPs emission factors for the waste combustion in stoves

Pollutant	Unit	Emission factor
PCDD/PCDF	µg/GJ	0.013
B(a)p	µg/GJ	1015.223
B(b)f	µg/GJ	1250.731
B(k)f	µg/GJ	490.350
I(1,2,3-cd)p	µg/GJ	642.662
HCB	µg/GJ	8.955

Activity data

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

Table 3.14 Fuel consumption in stationary fuel combustion in the period 1990-2013 (PJ)

Year	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

Year	Liquid fuels	Solid fuels	Biomass	Gas
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
2013	5.08	174.52	31.64	18.58

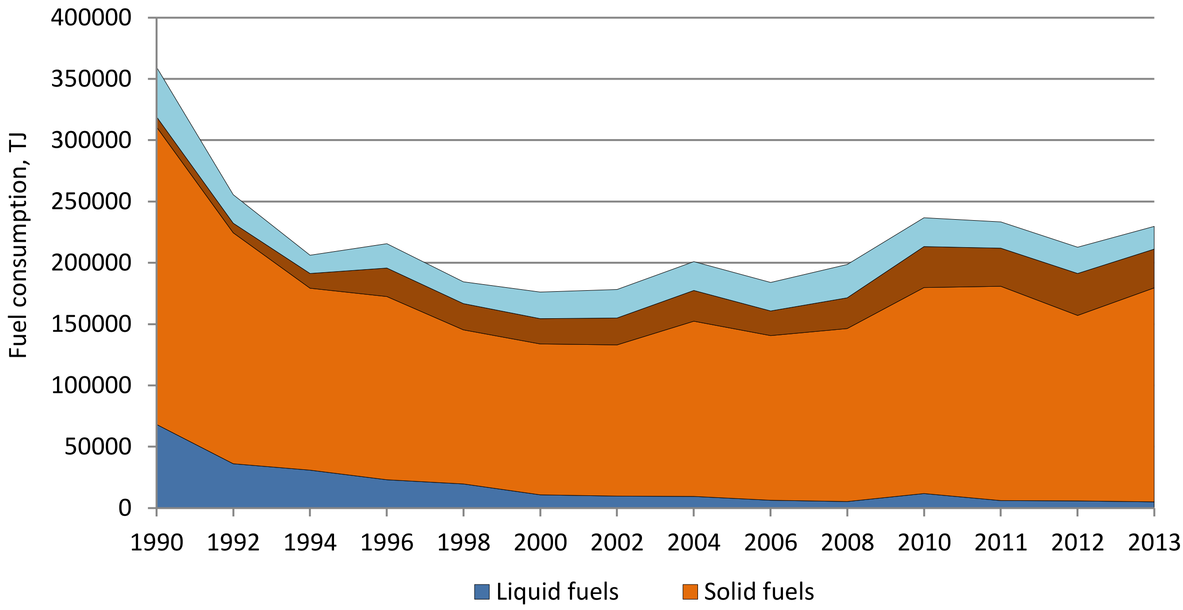


Figure 3.15 Fuel consumption by stationary combustion in the period of 1990-2013

Table 3.15 Amount of the waste incinerated in domestic stoves (tonnes)

Year	Amount of waste
1990	16757.7887
1991	18337.3905
1992	19785.1716
1993	20779.7546
1994	21824.9387
1995	22886.0485
1996	23105.1928
1997	23366.9625
1998	23716.4735

Year	Amount of waste
1999	24042.9748
2000	24996.0177
2001	23891.4338
2002	22793.7887
2003	21796.0366
2004	20760.9282
2005	19764.6890
2006	20547.8283
2007	21005.8103
2008	21200.3391
2009	21104.0397
2010	20701.4702
2011	20980.5529
2012	21270.6344
2013	21501.9304

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, and 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 are then summarised 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 whether heat is sold or is used for its own needs.

Not many improvements were made in this reporting year.

3.2.4. Sources-specific planned improvements

- Improve the QA/QC procedure.
- Recalculate main pollutants emissions from NFR 1A4bi residential combustion sector according to updated national emission factors.
- Recalculate pollutants emissions from NFR 1A1, 1A2, 1A4ai and 1A4ci combustion sectors according to the updated national emission factors in the EMEP/EEA Guidebook 2013.
- Provide uncertainty analysis.

3.3. Transport

3.3.1. Overview of the sector

Table 3.16 Transport sector reporting activities

NFR	Source	Description	Method	Emissions
1A2gii	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, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1A3ai-ii(i)	International and domestic aviation LTO (civil)	Activities include all use of aircraft (jets, turboprop powered and piston engine aircraft, helicopters) consisting passengers and freight transport.	Tier 2	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP, BC, CO
1A3ai-ii(ii)	International and domestic aviation cruise (civil)	Activities include all use of aircraft consisting passengers and freight transport.	Tier 1	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP, BC, CO
1A3bi-iv	Road transport	Road transport includes use of vehicles with combustion engines: passengers cars, light duty vehicles, heavy duty trucks, buses and motorcycles	Tier 3	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, 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
1A3bv	Road transport: Gasoline evaporation	Gasoline evaporation from automobiles	Tier 3	NMVOC
1A3bvi	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,
1A3bvii	Road transport: Automobile road abrasion	PM emissions from road abrasion	Tier 1	$PM_{2.5}$, PM_{10}, TSP
1A3c	Railways	Railway transport operated by steam and diesel locomotives	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, 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
1A3dii	National navigation (Shipping)	Merchant ships, passenger ships, technical ships, pleasure and tour ships	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs

NFR	Source	Description	Method	Emissions
		and other inland vessels.		
1A4aii	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, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1A4bii	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, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	Land based mobile off-road vehicles and other machinery used in agriculture/forestry sector (agricultural tractors, harvesters, combines etc.).	Tier 1	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Cr, Cu, Ni, Se, Zn, B(a)p, B(b)f, Total PAHs
1A4ciii	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, BC, 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, PCBs
1A3di(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, BC, 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, PCBs

Table 3.16 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 3.16). The share of mobile sources in total national emissions in 2013 was the following: NO_x – 46.1%, NMVOC – 8.8% and CO – 12%. 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 63.9%, 85.1% and 85.1% respectively. The trend of the emissions of these categories is given in Figure 3.17, Tables 3.17-3.19.

Some recalculations were made for the international maritime navigation sector. The main reasons for recalculations were following: correction of gross tonnage of ships and fuel consumption. Recalculations led to a change in total emissions. A detailed overview is given in each transport subsector and Chapter 8.

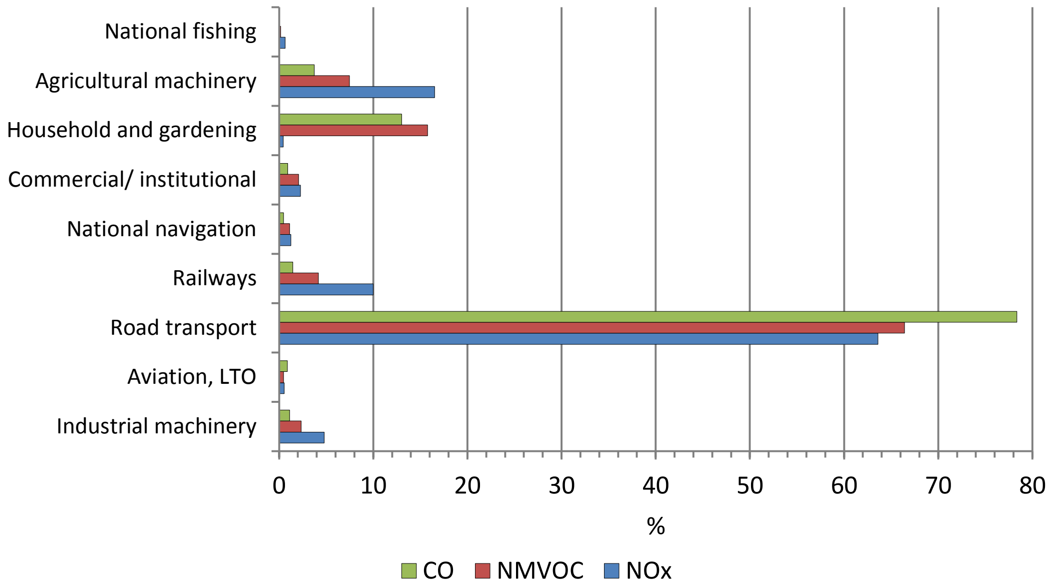


Figure 3.16 NO_x, NMVOC and CO emission shares in the transport sectors

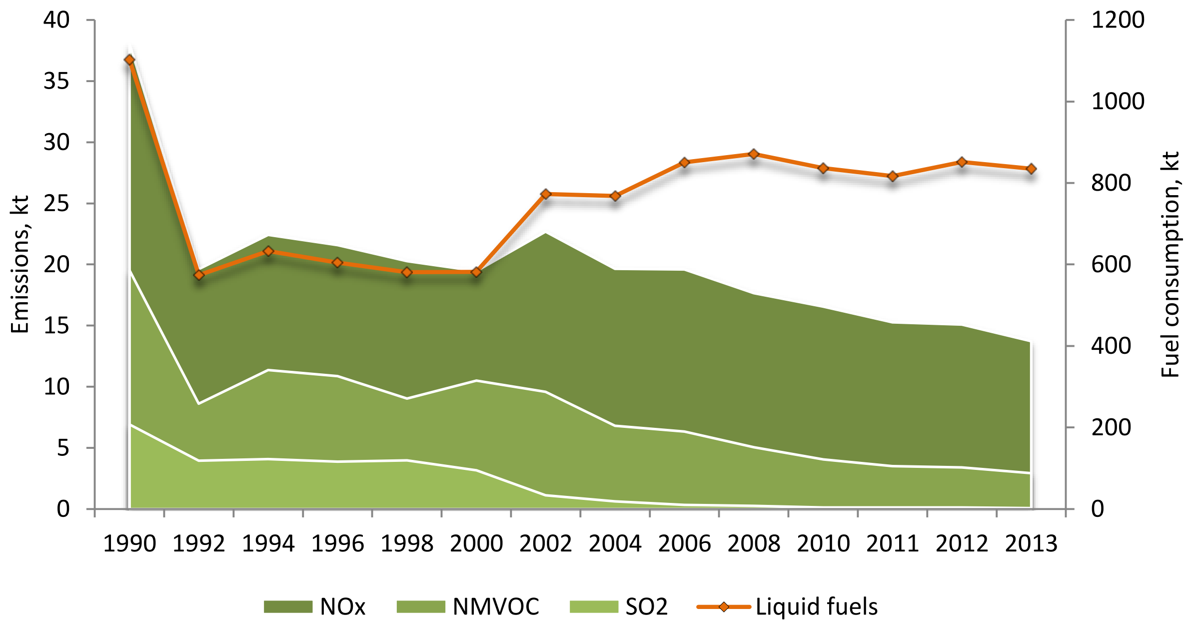


Figure 3.17 NO_x, NMVOC and CO emissions from the transport sector

Table 3.17 Total emissions from the transport sector in the period 1990-2013 (kt)

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	38.030	19.517	6.899	0.019	NR	NR	1.721	NR	127.979
1991	35.699	18.683	6.620	0.018	NR	NR	1.653	NR	127.167
1992	19.630	8.603	3.942	0.009	NR	NR	0.955	NR	52.872
1993	21.254	9.502	4.287	0.013	NR	NR	1.158	NR	59.606
1994	22.429	11.363	4.075	0.024	NR	NR	1.093	NR	71.187
1995	19.860	10.638	3.647	0.030	NR	NR	1.013	NR	66.579
1996	21.588	10.854	3.869	0.040	NR	NR	1.014	NR	69.060
1997	21.892	12.184	3.885	0.051	NR	NR	1.058	NR	82.587
1998	20.281	9.023	3.985	0.048	NR	NR	1.024	NR	62.426
1999	19.642	10.751	3.515	0.063	NR	NR	0.946	NR	77.089
2000	19.460	10.498	3.149	0.112	0.895	0.985	1.098	NR	68.210
2001	20.853	10.810	0.908	0.141	0.781	0.890	1.025	NR	72.556
2002	22.677	9.594	1.109	0.147	0.970	1.083	1.222	NR	62.623
2003	20.797	7.925	0.711	0.161	0.923	1.032	1.162	NR	52.323
2004	19.640	6.808	0.614	0.224	0.975	1.087	1.221	NR	45.037
2005	19.444	6.471	0.382	0.214	0.931	1.047	1.179	NR	42.328
2006	19.593	6.342	0.335	0.241	0.935	1.059	1.201	NR	40.583
2007	19.217	5.901	0.309	0.256	0.950	1.080	1.229	NR	37.914
2008	17.649	5.045	0.262	0.254	0.882	1.010	1.161	NR	32.434
2009	15.193	4.564	0.139	0.228	0.731	0.847	0.981	NR	29.335
2010	16.538	4.050	0.128	0.215	0.772	0.894	1.040	NR	26.567
2011	15.258	3.496	0.134	0.208	0.710	0.832	0.978	NR	22.592
2012	15.074	3.410	0.112	0.195	0.727	0.854	1.006	NR	22.115
2013	13.715	2.914	0.081	0.171	0.681	0.805	0.951	0.331	19.020
trend 1990-2013, %	**-63.9**	**-85.1**	**-98.8**	**793.0**	**-23.9**	**-18.3**	**-44.8**	**NA**	**-85.1**

Table 3.18 Total emissions of heavy metals from the transport sector in the period 1990-2013

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg		t				
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

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg		t				
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
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
2013	0.445	0.009	0.033	0.044	0.127	3.277	0.072	0.010	1.551
trend 1990-2013, %	**-99.4**	**-24.1**	**-96.5**	**-90.7**	**-2.6**	**19.0**	**43.7**	**73.7**	**-40.1**

Table 3.19 Total emissions of POPs from the transport sector in the period 1990-2013

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCB
	g I-Teq	t					g	
1990	0.226	0.022	0.040	0.017	0.012	0.091	0.074	0.020
1991	0.223	0.022	0.039	0.015	0.012	0.088	0.089	0.024
1992	0.096	0.012	0.022	0.008	0.005	0.047	0.030	0.008
1993	0.104	0.013	0.023	0.009	0.006	0.051	0.033	0.009
1994	0.142	0.012	0.021	0.010	0.008	0.050	0.034	0.009
1995	0.128	0.009	0.017	0.010	0.007	0.042	0.024	0.007
1996	0.148	0.010	0.019	0.010	0.008	0.047	0.037	0.010
1997	0.152	0.009	0.018	0.010	0.007	0.045	0.023	0.006
1998	0.111	0.008	0.016	0.010	0.006	0.040	0.009	0.002
1999	0.132	0.007	0.014	0.009	0.006	0.037	0.002	0.001
2000	0.137	0.007	0.014	0.009	0.006	0.037	0.004	0.001
2001	0.167	0.008	0.017	0.011	0.008	0.043	0.005	0.001
2002	0.156	0.011	0.020	0.012	0.008	0.050	0.001	0.000
2003	0.151	0.010	0.019	0.011	0.007	0.048	0.535	2,539
2004	0.149	0.011	0.019	0.012	0.008	0.049	0.377	1,791
2005	0.152	0.011	0.019	0.012	0.008	0.050	0.336	1,595
2006	0.160	0.012	0.021	0.013	0.009	0.055	0.170	0,809
2007	0.168	0.013	0.022	0.013	0.009	0.057	0.168	0,798
2008	0.169	0.012	0.021	0.013	0.009	0.055	0.348	1,655
2009	0.153	0.011	0.019	0.012	0.008	0.050	0.453	2,152

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCB
	g I-Teq	t					g	
2010	0.148	0.013	0.021	0.013	0.009	0.056	0.274	1,302
2011	0.143	0.012	0.021	0.013	0.009	0.055	0.143	0,679
2012	0.137	0.013	0.022	0.014	0.010	0.059	0.153	0,726
2013	0.129	0.013	0.021	0.014	0.010	0.057	0.088	0,042
trend 1990-2013, %	**-43.0**	**-39.9**	**-47. 6**	**-18.3**	**-19.781**	**-36.6**	**19.5**	**-97.9**

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.

(*Photo on the left by Eero Vabamägi: Estonian Air's Embraer 170 and CRJ900 Next Gen aircrafts*)

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 0.25%, 0.04% and 0.10% respectively in the transport sector in 2013. Other pollutants have an even smaller share.

Aviation emissions reflect the level of overall aviation activity. The growth of air travel during the past decades has been noticeable. During the period 1990-2013, the emission of NO_x, NMVOC and CO from the LTO phase increased by 44.3%, 12% and 37.1% respectively (Figures 3.18-20, Table 3.20), which is mainly due to changes in fuel consumption and the number of landing and take-off operations. This is roughly in line with the trends in the number of air passengers and amount of freight transported over the same period (Figure 3.21). Figures 3.18-20 illustrate the importance of the international aviation sector which contributes to the majority of emissions from the aviation sector.

The emissions of NO_x, NMVOC and CO decreased in 2013 compared to 2012 by 9.2%, 8.9% and 7.7% respectively, due to a decrease in fuel consumption (12.3%) and the number of landing and take-off operations (19.4%).

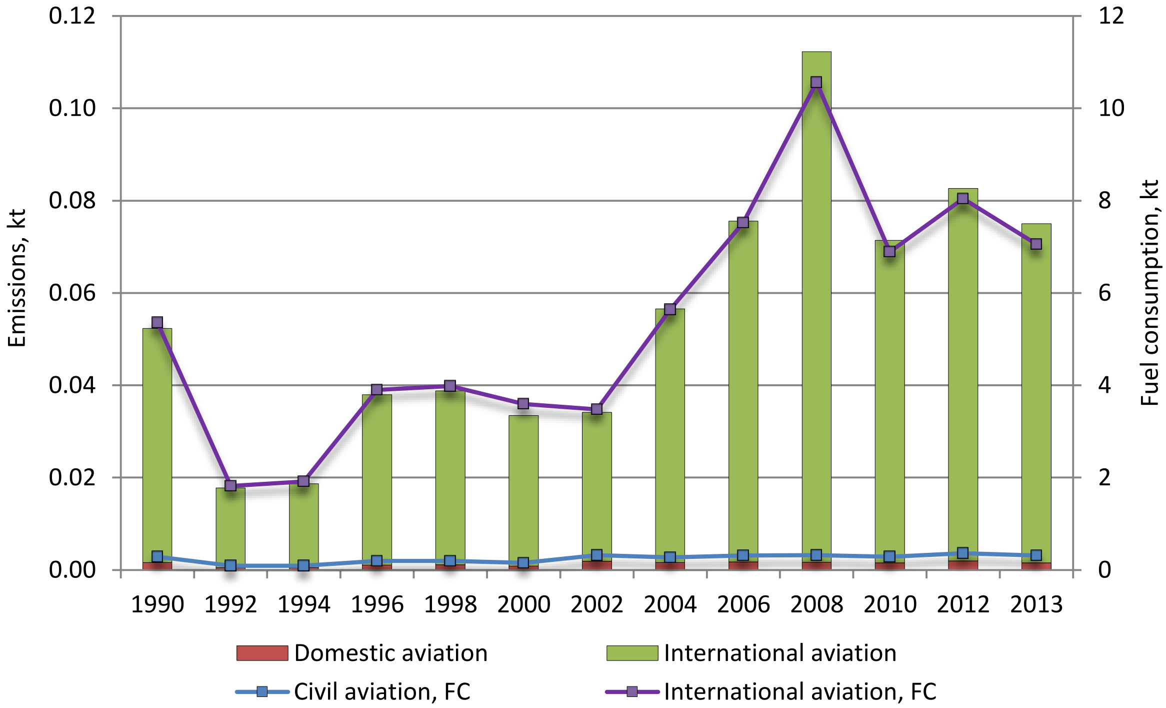


Figure 3.18 NO_x emissions from the LTO-cycle

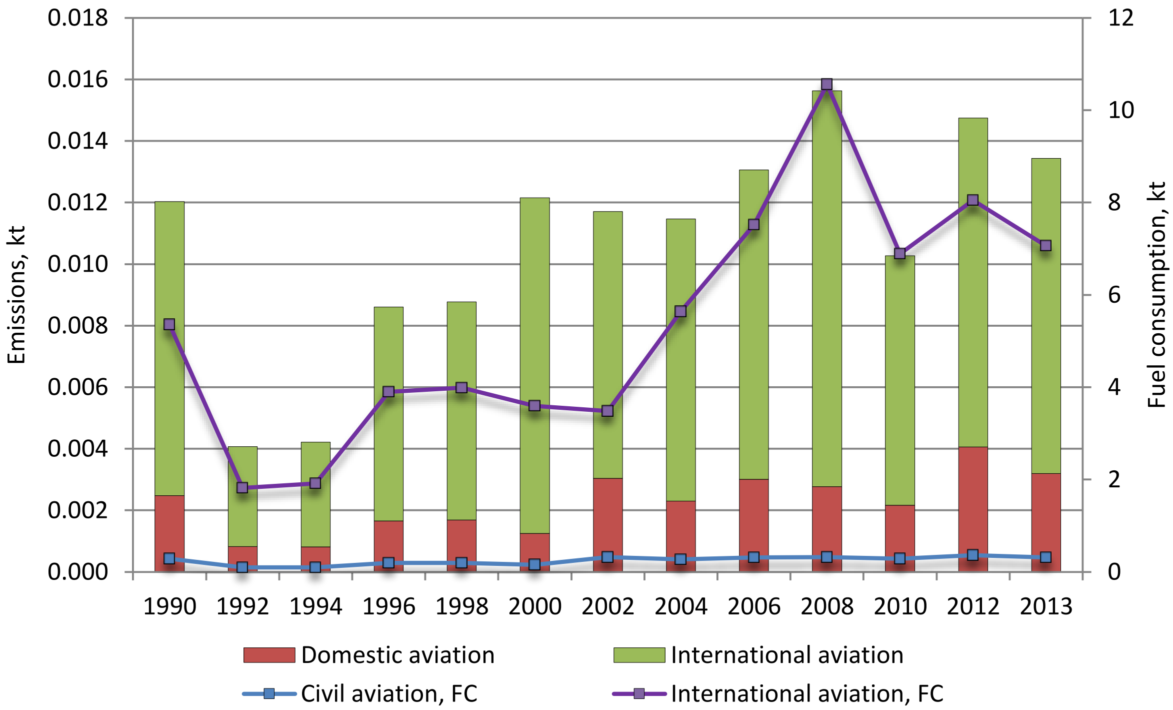


Figure 3.19 NMVOC emissions from the LTO-cycle

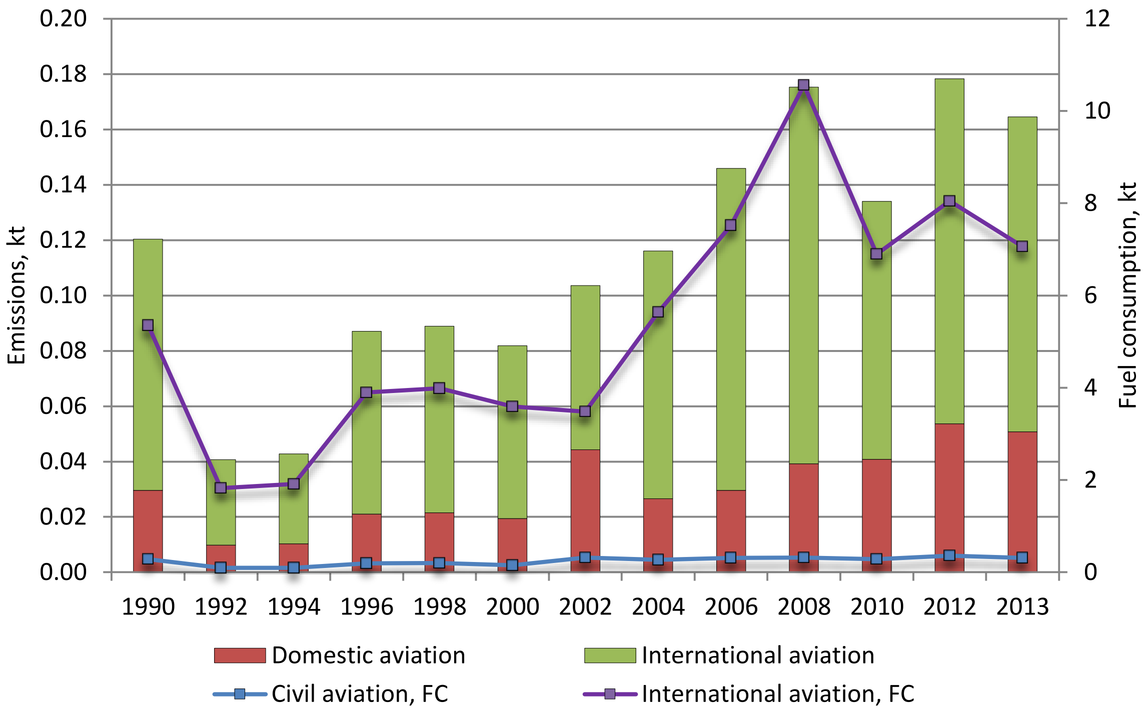


Figure 3.20 CO emissions from the LTO-cycle

Table 3.20 Emissions from the LTO-cycle in aviation sector in the period 1990-2013

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
	kt				t				kt
1990	0.052	0.012	0.006	NA	NR	NR	0.392	NR	0.120
1991	0.052	0.012	0.006	NA	NR	NR	0.392	NR	0.120
1992	0.018	0.004	0.002	NA	NR	NR	0.133	NR	0.041
1993	0.019	0.004	0.002	NA	NR	NR	0.141	NR	0.043
1994	0.019	0.004	0.002	NA	NR	NR	0.139	NR	0.043
1995	0.030	0.007	0.003	NA	NR	NR	0.221	NR	0.068
1996	0.038	0.009	0.004	NA	NR	NR	0.283	NR	0.087
1997	0.036	0.008	0.004	NA	NR	NR	0.265	NR	0.082
1998	0.039	0.009	0.004	NA	NR	NR	0.289	NR	0.089
1999	0.037	0.008	0.004	NA	NR	NR	0.275	NR	0.084
2000	0.033	0.012	0.004	NA	0.314	0.314	0.314	NR	0.082
2001	0.033	0.010	0.004	NA	0.282	0.282	0.282	NR	0.078
2002	0.034	0.012	0.004	NA	0.272	0.272	0.272	NR	0.104
2003	0.042	0.010	0.004	NA	0.330	0.330	0.330	NR	0.103
2004	0.057	0.011	0.006	NA	0.441	0.441	0.441	NR	0.116
2005	0.078	0.015	0.008	NA	0.652	0.652	0.652	NR	0.155
2006	0.076	0.013	0.008	NA	0.642	0.642	0.642	NR	0.146
2007	0.090	0.013	0.009	NA	0.780	0.780	0.780	NR	0.156
2008	0.112	0.016	0.010	NA	0.941	0.941	0.941	NR	0.175
2009	0.075	0.010	0.007	NA	0.603	0.603	0.603	NR	0.129
2010	0.071	0.010	0.007	NA	0.558	0.558	0.558	NR	0.134
2011	0.087	0.013	0.008	NA	0.638	0.638	0.638	NR	0.165
2012	0.083	0.015	0.008	NA	0.465	0.465	0.465	NR	0.178
2013	0.075	0.013	0.007	NA	0.463	0.463	0.463	0.221	0.165
trend 1990-2013, %	**44.3**	**12.0**	**14.1**	**NA**	**47.4**	**47.4**	**18.1**	**45.4**	**37.1**

Table 3.21 Emissions from the cruise phase in the aviation sector in the period 1990-2013 (kt)

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	0.385	0.015	0.030	NA	NR	NR	0.006	NR	0.035
1991	0.385	0.015	0.030	NA	NR	NR	0.006	NR	0.035
1992	0.128	0.005	0.010	NA	NR	NR	0.002	NR	0.012
1993	0.206	0.008	0.016	NA	NR	NR	0.003	NR	0.019
1994	0.165	0.006	0.013	NA	NR	NR	0.003	NR	0.015
1995	0.190	0.007	0.015	NA	NR	NR	0.003	NR	0.017
1996	0.153	0.006	0.012	NA	NR	NR	0.002	NR	0.014
1997	0.237	0.009	0.019	NA	NR	NR	0.004	NR	0.021
1998	0.147	0.006	0.012	NA	NR	NR	0.002	NR	0.013
1999	0.230	0.009	0.018	NA	NR	NR	0.004	NR	0.021
2000	0.224	0.009	0.018	NA	0.004	0.004	0.004	NR	0.020
2001	0.158	0.006	0.012	NA	0.002	0.002	0.002	NR	0.014
2002	0.187	0.007	0.015	NA	0.003	0.003	0.003	NR	0.017
2003	0.177	0.007	0.014	NA	0.003	0.003	0.003	NR	0.016
2004	0.298	0.011	0.023	NA	0.005	0.005	0.005	NR	0.027
2005	0.501	0.020	0.039	NA	0.008	0.008	0.008	NR	0.043
2006	0.301	0.012	0.024	NA	0.005	0.005	0.005	NR	0.026
2007	0.511	0.020	0.040	NA	0.008	0.008	0.008	NR	0.044
2008	0.216	0.008	0.017	NA	0.003	0.003	0.003	NR	0.019
2009	0.321	0.012	0.025	NA	0.005	0.005	0.005	NR	0.028
2010	0.376	0.015	0.029	NA	0.006	0.006	0.006	NR	0.033
2011	0.320	0.012	0.025	NA	0.005	0.005	0.005	NR	0.028
2012	0.369	0.014	0.029	NA	0.006	0.006	0.006	NR	0.032
2013	0.269	0.010	0.021	NA	0.004	0.004	0.004	0.002	0.023
trend 1990-2013, %	**-30.1**	**-30.1**	**-29.9**	**NA**	**5.2**	**5.2**	**-29.9**	**19.4**	**-33.7**

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 Guidebook 2013).

For the LTO phase, the 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 3.22) 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 3.24). Fuel-based cruise emission factors are taken from the EMEP/EEA Guidebook 2013 as a single set for an average aircraft (Table 3.23). Finally, when given the fuel related cruise emission factors, total domestic and international energy use and emissions can be calculated. All the calculations are made by using the following equations:

LTO Emissions = Number of LTOs * Emission Factor LTO

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

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

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

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

The methodology requires information on the number of LTOs grouped by representative aircraft types (Table 3.22). This kind of detailed knowledge is hard to obtain (individual aircraft with their specific engines), and therefore data are an aggregated level for practical reasons (Figure 3.22). Assumptions are made if some data are missing 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 EMEP/EEA Guidebook 2013 (IPCC, FOCA, ICAO engine database etc.).

A complete emission calculation (LTO and cruise emissions for domestic and international flights) was carried out by EEIC between 1992 and 2011. Extrapolations were made for 1990 and 1991.

Table 3.22 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

	NO_x	NMVOC	SO_2	$PM_{2.5}$	CO	Fuel consumption
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, <1000sph/engine	0.3	0.58	0.07	0	2.97	70
turboprop, 1000-2000 sph/engine	1.51	0	0.2	0	2.24	200
turboprop, >2000sph/engine	1.82	0.26	0.2	0	2.33	200
Piston engine[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
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

**BC fractions of PM (f-BC) for piston engine aircraft = 0.15, for other aircraft 0.48 (EMEP/EEA Guidebook 2013)*

Table 3.23 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

**BC fractions of PM (f-BC) for piston engine aircraft = 0.15, for other aircraft 0.48 (EMEP/EEA Guidebook 2013)*

Table 3.24 Fuel consumption in the aviation sector (kt)

Year	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
2013	0.313	0.072	7.060	20.966	28.411

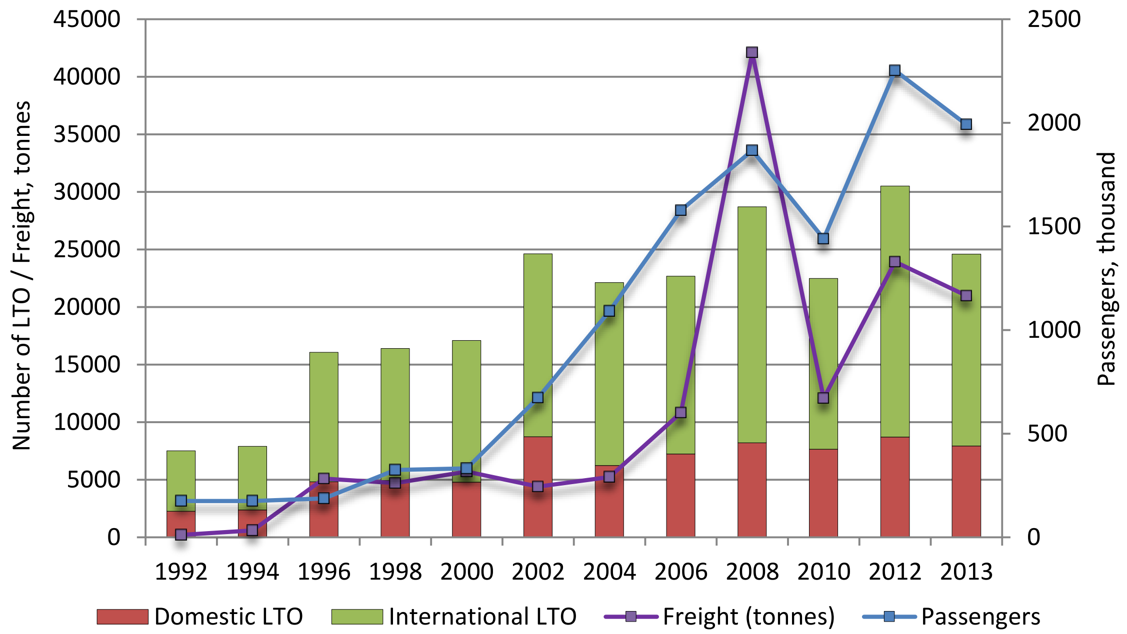


Figure 3.21 The number of LTO-cycles, passengers carried and freight transported

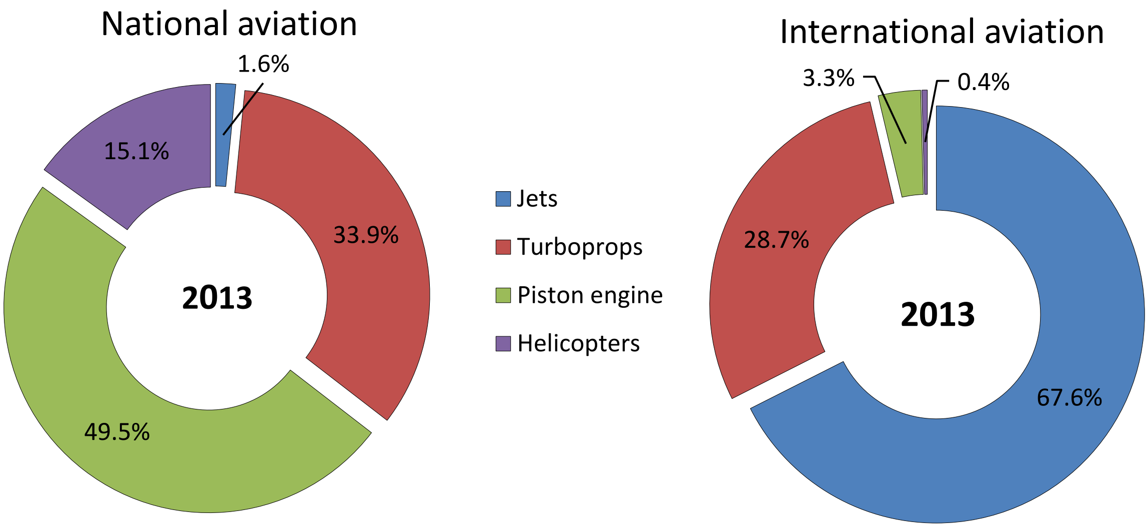


Figure 3.22 The share of different aircraft types in domestic and international civil aviation

3.3.2.3. Source-specific QA/QC and verification

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

3.3.2.4. Source-specific planned improvements

The aviation sector is no key category and contributes to only a marginal share of total emissions. Therefore, there are currently no improvements planned for this sector.

3.3.3. Road transport (1A3bi-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 the 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, such as off-roads (agricultural and industrial machinery, etc.).

(*Photo taken from www.tallinn.ee: Ülemiste intersection – one of the busiest in Tallinn*)

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 29.3%, 5.9% and 9.4% respectively in 2013. Emissions from the main pollutants and particulate matter decreased significantly throughout the time series with the exception of NH_3. The decrease in emissions was mainly caused by the stricter emission standards for road vehicles. The lead emissions from road transport have decreased by approximately 99.4% since 1990 (Figure 3.27). The reduction in emissions is connected with the prohibition on leaded gasoline in 2000. The share of road transport in total Pb emissions was 1.1% in 2013. The reduction in sulphur content in fuels has resulted in a substantial decrease in 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, the sulphur content in fuel was gradually reduced even more. Currently, all road transport fuels are sulphur free (sulphur content is less than 10 ppm). Therefore, SO_x emissions decreased by 99.7% between 1990 and 2013.

The total emissions from road transport decreased in 2013 compared to 2012. Although there was an increase in the number of vehicles (4.2%), during that time the average annual mileage and fuel consumption slightly decreased by 1.2% and 0.7% respectively. Therefore, there was no big change in emissions due to the number of new vehicles 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 3.25-27.

Fuel consumption has changed over the decades in the road transport sector. In the 1990s, gasoline consumption dominated, but from 2003 we can see a continuous growth in diesel consumption in road transport (Figure 3.28). 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 65.5% and 89% respectively between 1990 and 2013. Diesel engines, which are the main power source in heavy-duty trucks and buses, hold a rapidly increasing share in passenger cars as well.

Therefore, the reasons for emission reductions were a 52% decrease in gasoline consumption during the period 1990-2013 and an increasing number of new cars 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 used for road transport accounted for 0.03% in 2005 and increased to 0.7% in 2013 (Table 3.33).

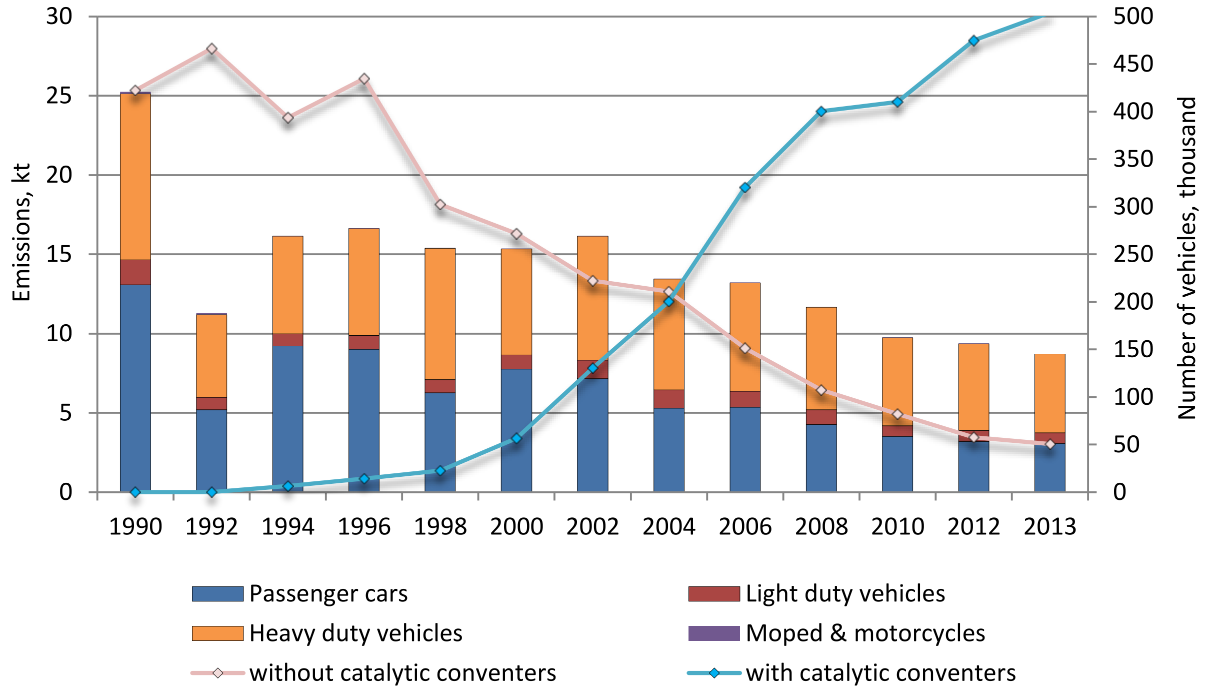


Figure 3.23 NO_x emissions from road transport

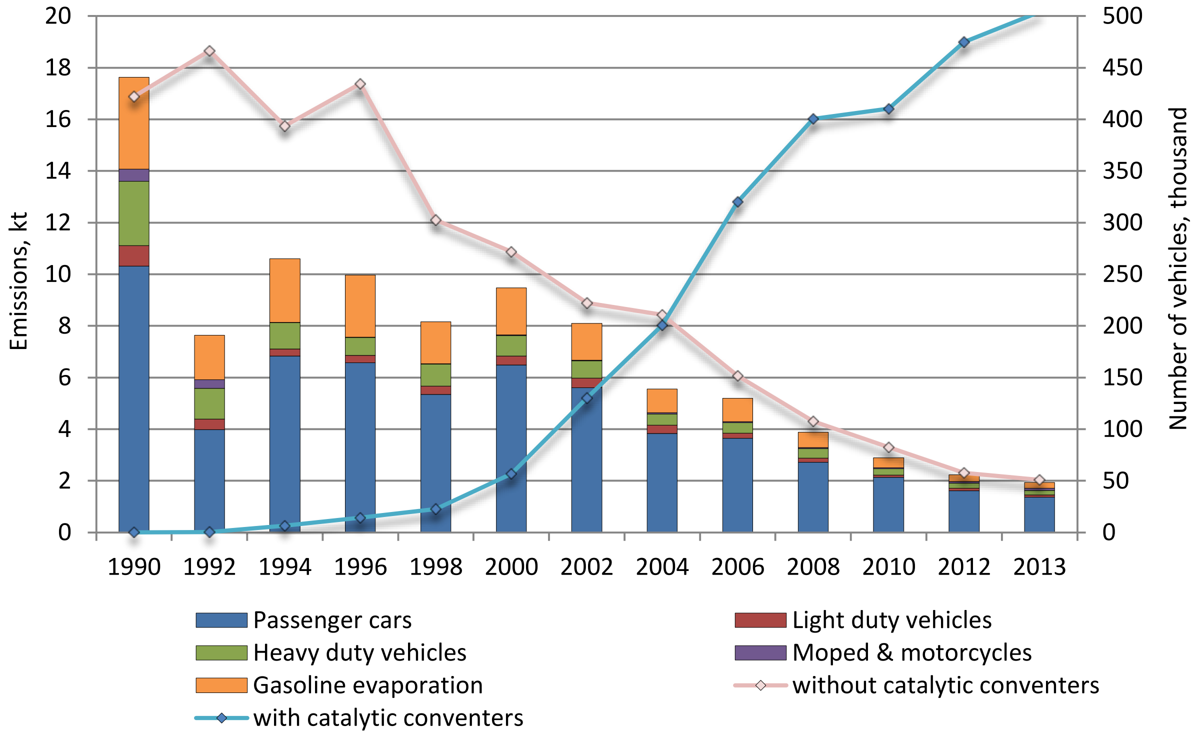


Figure 3.24 NMVOC emissions from road transport

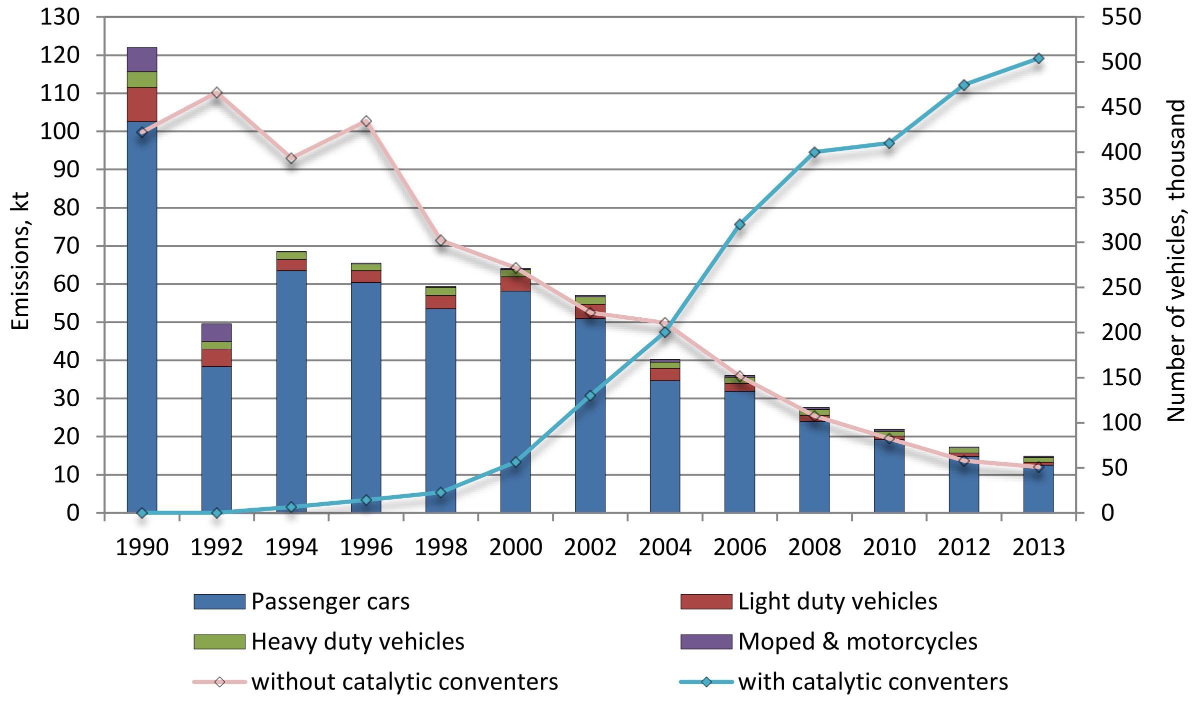


Figure 3.25 CO emissions from road transport

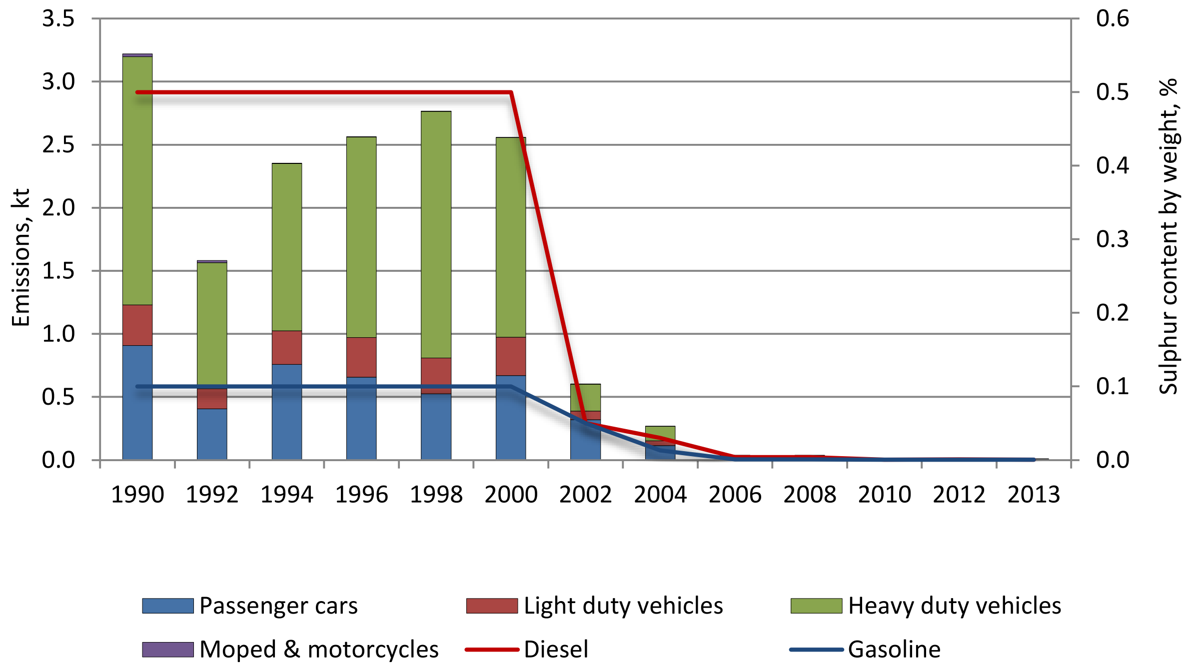


Figure 3.26 SO_2 emissions from road transport

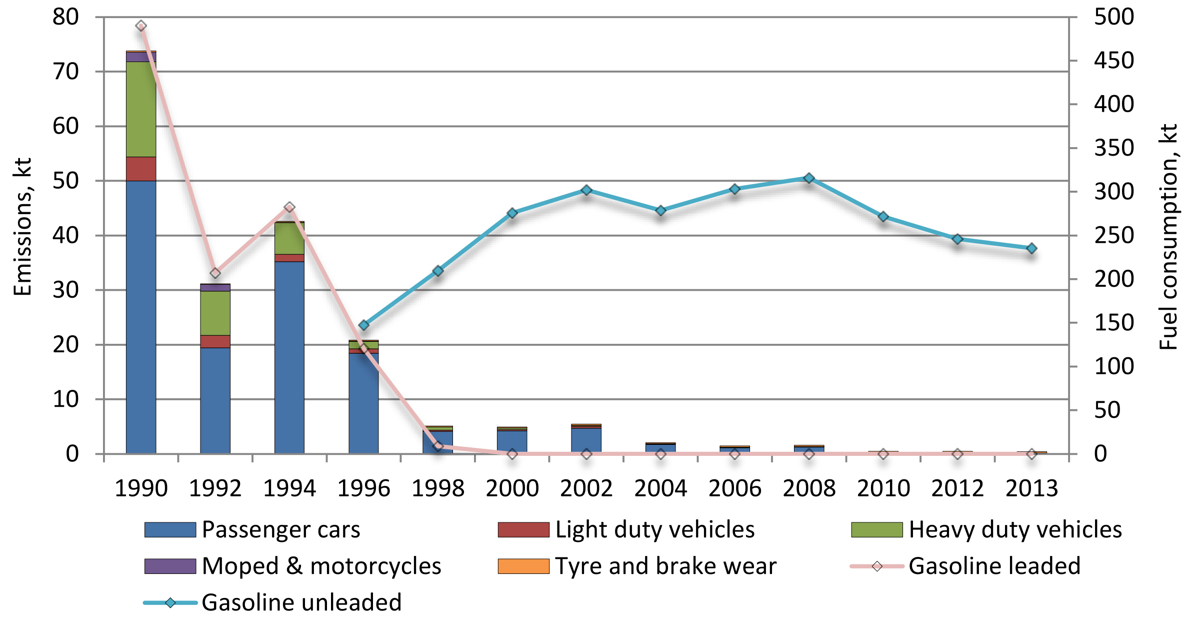


Figure 3.27 Pb emissions from road transport

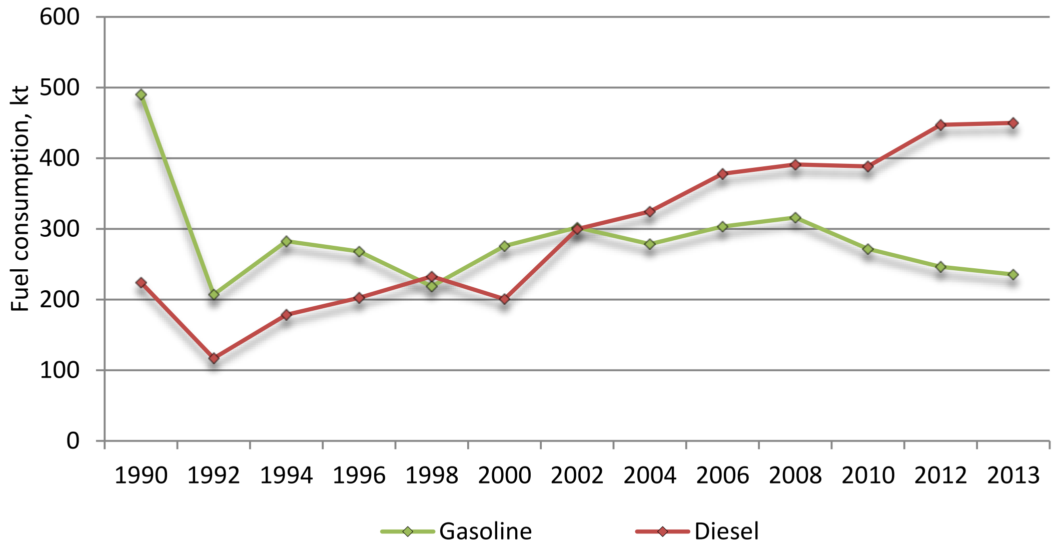


Figure 3.28 Gasoline and diesel consumption in the road transport sector

Table 3.25 Emissions from road transport in the period 1990-2013, (kt)

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	25.250	17.631	3.220	0.016	NR	NR	1.018	NR	122.056
1991	22.949	16.782	2.930	0.015	NR	NR	0.942	NR	121.144
1992	11.294	7.633	1.583	0.007	NR	NR	0.509	NR	49.562
1993	12.446	8.118	1.859	0.011	NR	NR	0.608	NR	55.237
1994	16.147	10.599	2.350	0.022	NR	NR	0.759	NR	68.550
1995	15.786	9.725	2.598	0.029	NR	NR	0.812	NR	63.319
1996	16.632	9.970	2.561	0.039	NR	NR	0.759	NR	65.492
1997	17.350	11.321	2.700	0.050	NR	NR	0.825	NR	79.040
1998	15.387	8.155	2.765	0.047	NR	NR	0.790	NR	59.370
1999	15.632	9.857	2.587	0.062	NR	NR	0.767	NR	73.653

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
2000	15.350	9.468	2.558	0.111	0.713	0.800	0.910	NR	64.102
2001	16.780	9.653	0.581	0.140	0.587	0.694	0.826	NR	67.794
2002	16.150	8.102	0.602	0.146	0.657	0.767	0.901	NR	57.005
2003	13.905	6.502	0.293	0.160	0.603	0.708	0.835	NR	46.869
2004	13.453	5.555	0.267	0.223	0.683	0.792	0.923	NR	40.176
2005	13.283	5.380	0.063	0.213	0.646	0.758	0.888	NR	37.946
2006	13.212	5.194	0.036	0.240	0.626	0.746	0.885	NR	35.965
2007	12.858	4.715	0.037	0.255	0.617	0.744	0.890	NR	33.096
2008	11.672	3.882	0.036	0.253	0.554	0.680	0.829	NR	27.628
2009	9.534	3.313	0.012	0.227	0.464	0.576	0.707	NR	24.406
2010	9.745	2.894	0.006	0.214	0.459	0.577	0.719	NR	21.922
2011	9.417	2.408	0.008	0.207	0.437	0.557	0.699	NR	18.125
2012	9.372	2.229	0.009	0.194	0.454	0.579	0.728	NR	17.338
2013	8.721	1.936	0.008	0.170	0.438	0.560	0.705	0.216	14.902
trend 1990-2013, %	**-65.5**	**-89.0**	**-99.7**	**938.1**	**-38.5**	**-29.9**	**-30.8**	**-35.2**	**-87.8**

Table 3.26 Emissions of heavy metals from road transport in the period 1990-2013, (t)

Year	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
2013	0.424	0.008	NE	NE	0.104	1.920	0.021	0.002	2.022
trend 1990-2013, %	**-99.4**	**-10.5**	**NE**	**NE**	**-6.7**	**-10.8**	**-11.7**	**-5.2**	**-8.7**

Table 3.27 Total emissions of POPs from road transport in the period 1990-2013

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCB
	g I-Teq	t						
1990	0.202	0.006	0.015	0.013	0.009	0.043	NE	NE
1991	0.194	0.005	0.013	0.010	0.009	0.037	NE	NE
1992	0.086	0.003	0.007	0.006	0.004	0.020	NE	NE
1993	0.093	0.003	0.008	0.007	0.005	0.022	NE	NE
1994	0.130	0.004	0.010	0.008	0.006	0.027	NE	NE
1995	0.120	0.004	0.009	0.007	0.006	0.027	NE	NE
1996	0.136	0.004	0.009	0.007	0.006	0.027	NE	NE
1997	0.144	0.004	0.010	0.008	0.007	0.029	NE	NE
1998	0.108	0.003	0.009	0.008	0.005	0.026	NE	NE
1999	0.132	0.004	0.009	0.008	0.006	0.027	NE	NE
2000	0.136	0.004	0.009	0.008	0.006	0.026	NE	NE
2001	0.166	0.005	0.011	0.009	0.007	0.032	NE	NE
2002	0.156	0.005	0.012	0.010	0.007	0.034	NE	NE
2003	0.150	0.006	0.011	0.010	0.007	0.033	NE	NE
2004	0.149	0.006	0.012	0.010	0.007	0.035	NE	NE
2005	0.151	0.007	0.012	0.010	0.008	0.037	NE	NE
2006	0.160	0.007	0.013	0.011	0.009	0.040	NE	NE
2007	0.168	0.008	0.014	0.012	0.009	0.043	NE	NE
2008	0.168	0.008	0.013	0.012	0.009	0.042	NE	NE
2009	0.152	0.007	0.012	0.011	0.008	0.038	NE	NE
2010	0.147	0.008	0.013	0.012	0.008	0.041	NE	NE
2011	0.142	0.008	0.013	0.012	0.009	0.042	NE	NE
2012	0.137	0.009	0.015	0.013	0.009	0.046	NE	NE
2013	0.129	0.009	0.015	0.013	0.009	0.046	NE	NE
trend 1990-2013, %	**-36.3**	**63.3**	**-4.8**	**3.2**	**-0.2**	**7.4**	**NE**	**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 3.31) and the number of vehicles (Table 3.32), which is supplied by the Estonian Road Administration. These improved statistics are available from 2001 and data for the years 1990-2000 are extrapolated. Meteorological data are obtained from the Estonian Weather Service 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 stabilised (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 3.33) by emission factors (Table 3.28-30). 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 3.28 Sulphur content of fuel (by weight), %

Fuel	1990	2001	2003	2004	2005	2006	2007	2009	2010	2011	2012	2013
Gasoline	0.1	0.05	0.015	0.013	0.005	0.001	0.0008	0.0008	0.00051	0.00055	0.00065	0.0006
Diesel	0.5	0.05	0.035	0.030	0.005	0.004	0.0040	0.0010	0.00048	0.00062	0.00071	0.00061

- **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 3.29 Lead content in gasoline (g/l)

Fuel	1990	2003	2006	2010
Leaded gasoline	0.15	-	-	-
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 into 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 3.30 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	0.0212	0.0300	0.0088	0.0001	1.7380

Table 3.31 Average annual mileage in the road transport sector (million km per year)

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

Year	Passenger cars	Light duty vehicles	Heavy duty vehicles	Motorcycles	Total
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
2013	6,730.7	849.5	961.1	44.0	8,585.3

Table 3.32 Number of vehicles in the road transport sector (thousand)

Year	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
2013	462.2	41.5	28.1	23.1	554.9

Table 3.33 Fuel consumption in the road transport sector (kt)

Year	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
2013	230.50	450.07	4.75	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 (NFR 1A3bi-iv).

Automobile tyre and brake wear calculations are based on the Tier 2 method and using the COPERT model (EMEP/EEA 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 2013.

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/EEA Guidebook 2013).

3.3.3.3. Source-specific QA/QC and verification

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

3.3.3.4. Source-specific planned improvements

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

3.3.4. Railways (NFR 1A3c)

3.3.4.1. Source category description

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

(*Photo on the left: Estonian Railways' GE C36-7 diesel-electric locomotive #1504; source: www.bahnbilder.de*)

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 10%, 4.2% and 1.5% respectively, in the transport sector in 2013.

The emissions of NO_x, NMVOC and CO in 2013 have decreased compared to 1990 by 43.7%, 45.9% and 53.7% respectively. The trend of all the emissions is given in Tables 3.34-3.36.

Emissions from rail originate primarily from the combustion of diesel and light fuel oil by locomotives. Since emissions from railway sector are calculated by 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 in trend and therefore all the emissions are directly influenced by freight rail activity.

Fuel consumption decreased 12.9% in 2013 compared to 2012 and therefore all the emissions have decreased also by the same percentage.

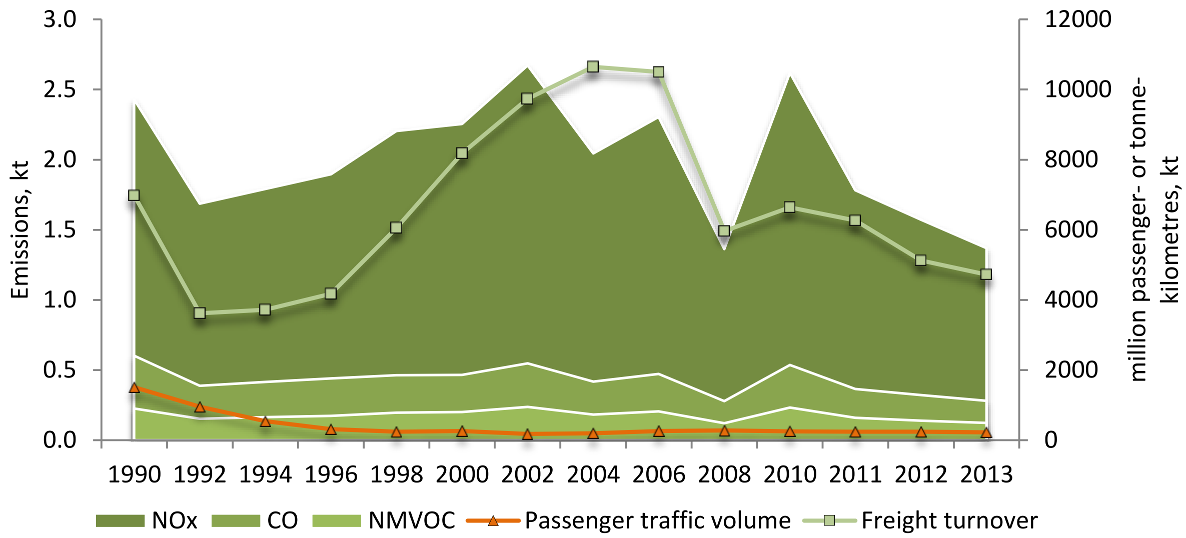


Figure 3.29 NO_x, NMVOC and CO emissions from the railway sector

Table 3.34 Emissions from railway transport in the period 1990-2013 (kt)

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	2.431	0.224	0.567	0.000	NR	NR	0.085	0.000	0.603
1991	2.278	0.213	0.559	0.000	NR	NR	0.083	0.000	0.593
1992	1.685	0.153	0.364	0.000	NR	NR	0.055	0.000	0.388
1993	1.791	0.163	0.388	0.000	NR	NR	0.058	0.000	0.413
1994	1.791	0.163	0.390	0.000	NR	NR	0.059	0.000	0.415
1995	1.736	0.157	0.365	0.000	NR	NR	0.055	0.000	0.389
1996	1.897	0.173	0.413	0.000	NR	NR	0.062	0.000	0.440
1997	1.736	0.157	0.363	0.000	NR	NR	0.055	0.000	0.388
1998	2.203	0.197	0.433	0.000	NR	NR	0.066	0.000	0.462
1999	2.411	0.214	0.463	0.000	NR	NR	0.070	0.000	0.495
2000	2.254	0.200	0.177	0.000	0.060	0.063	0.066	0.000	0.466
2001	2.097	0.187	0.167	0.000	0.056	0.059	0.062	0.000	0.435
2002	2.673	0.237	0.199	0.000	0.070	0.074	0.078	0.000	0.547
2003	2.358	0.209	0.170	0.000	0.062	0.065	0.068	0.000	0.482
2004	2.044	0.181	0.153	0.000	0.053	0.056	0.059	0.000	0.417
2005	2.201	0.195	0.168	0.000	0.058	0.060	0.064	0.000	0.449
2006	2.306	0.205	0.168	0.000	0.060	0.063	0.067	0.000	0.471
2007	1.939	0.172	0.121	0.000	0.051	0.053	0.056	0.000	0.396
2008	1.362	0.121	0.050	0.000	0.036	0.037	0.040	0.000	0.278
2009	1.834	0.163	0.050	0.000	0.048	0.050	0.053	0.000	0.375
2010	2.620	0.233	0.070	0.000	0.069	0.072	0.076	0.000	0.535
2011	1.782	0.158	0.068	0.000	0.047	0.049	0.052	0.000	0.364
2012	1.572	0.140	0.060	0.000	0.041	0.043	0.046	0.000	0.321
2013	1.368	0.121	0.052	0.000	0.036	0.038	0.040	0.023	0.279
trend 1990-2013, %	**-43.7**	**-45.9**	**-90.8**	**-43.2**	**-39.9**	**-39.9**	**-53.1**	**NA**	**-53.7**

Table 3.35 Emissions of heavy metals from railway transport in the period 1990-2013

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t	kg			t			kg	t
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
2013	0.000	0.261	0.000	0.000	0.001	0.044	0.002	0.261	0.026
trend 1990-2013, %	**-100.0**	**-61.3**	**-100.0**	**-100.**	**-66.6**	**-44.7**	**-61.7**	**-61.3**	**-62.6**

Table 3.36 Emissions of POPs from railway transport in the period 1990-2013

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCB
	g I-Teq	t					g	kg
1990	0.024	0.007	0.009	0.004	0.003	0.023	0.074	0.020
1991	0.029	0.008	0.011	0.005	0.003	0.026	0.089	0.024
1992	0.010	0.003	0.004	0.002	0.001	0.011	0.030	0.008
1993	0.011	0.003	0.005	0.002	0.001	0.012	0.033	0.009
1994	0.011	0.004	0.005	0.002	0.001	0.012	0.034	0.009
1995	0.008	0.003	0.004	0.002	0.001	0.010	0.024	0.007
1996	0.012	0.004	0.005	0.003	0.001	0.013	0.037	0.010
1997	0.008	0.003	0.004	0.002	0.001	0.009	0.023	0.006

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCB
	g I-Teq	t					g	kg
1998	0.003	0.002	0.003	0.002	0.001	0.007	0.009	0.002
1999	0.001	0.002	0.002	0.002	0.000	0.006	0.002	0.001
2000	0.001	0.002	0.003	0.002	0.000	0.006	0.004	0.001
2001	0.002	0.002	0.002	0.002	0.000	0.006	0.005	0.001
2002	0.000	0.002	0.003	0.002	0.000	0.006	0.001	0.000
2003	0.000	0.001	0.002	0.002	0.000	0.006	0.000	0.000
2004	0.000	0.001	0.002	0.001	0.000	0.005	0.000	0.000
2005	0.000	0.001	0.002	0.001	0.000	0.005	0.000	0.000
2006	0.000	0.001	0.002	0.002	0.000	0.005	0.000	0.000
2007	0.000	0.001	0.002	0.001	0.000	0.005	0.000	0.000
2008	0.000	0.001	0.001	0.001	0.000	0.003	0.000	0.000
2009	0.000	0.001	0.002	0.001	0.000	0.004	0.000	0.000
2010	0.000	0.002	0.003	0.002	0.000	0.006	0.000	0.000
2011	0.000	0.001	0.002	0.001	0.000	0.004	0.000	0.000
2012	0.000	0.001	0.002	0.001	0.000	0.004	0.000	0.000
2013	0.000	0.001	0.001	0.001	0.000	0.003	0.000	0.000
trend 1990-2013, %	**-100.0**	**-88.5**	**-85.9**	**-79.6**	**-91.9**	**-86.2**	**-100.0**	**-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 3.41) by respective emission factors. Default emission factors for the main pollutants and heavy metals are taken from EMEP/EEA Guidebook 2013 and are presented in Tables 3.37-3.39.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.41) by emission factors (Table 3.40). 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 3.37 Emission factors for railway transport

Fuel	Unit	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	f-BC	CO
Light fuel oil/ Diesel	kg/t	52.4	4.65	equation	0.007	1.37	1.44	1.52	6.4	10.7
Coal	g/GJ	173	88.8	900	-	108	117	124	6.4	931

Table 3.38 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	17.5	13.5	13	1.8	200

Table 3.39 Emission factors for POPs

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

Table 3.40 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%	0.030%	0.005%	0.004%	0.004%	0.001%	0.1%

Table 3.41 Fuel consumption in the railway sector

Year	Coal	Diesel	Light fuel oil
	TJ	kt	
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

Year	Coal	Diesel	Light fuel oil
	TJ	kt	
2004	0	1	38
2005	0	0	42
2006	0	2	42
2007	0	7	30
2008	0	1	25
2009	0	10	25
2010	0	15	35
2011	0	34	0
2012	0	30	0
2013	0	26	0.116

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 (NFR 1A3dii)

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.

(*Photo on the left by Madis Press: Riverboat Pegasus on the river Emajõgi*)

National navigation in Estonia is also a small emission source in the transport sector. The share of navigation transport in total transport emissions in 2013 was: NO_x – 1.2%, NMVOC – 1.1%, CO – 0.5%. Detailed emission data are provided in Tables 3.42-3.44.

Deviations of time series can be explained by changing statistical fuel consumption in the national navigation sector (Figure 3.30). Fuel consumption decreased 9.5% in 2013 compared to 2012, therefore all the emissions decreased also in same extent.

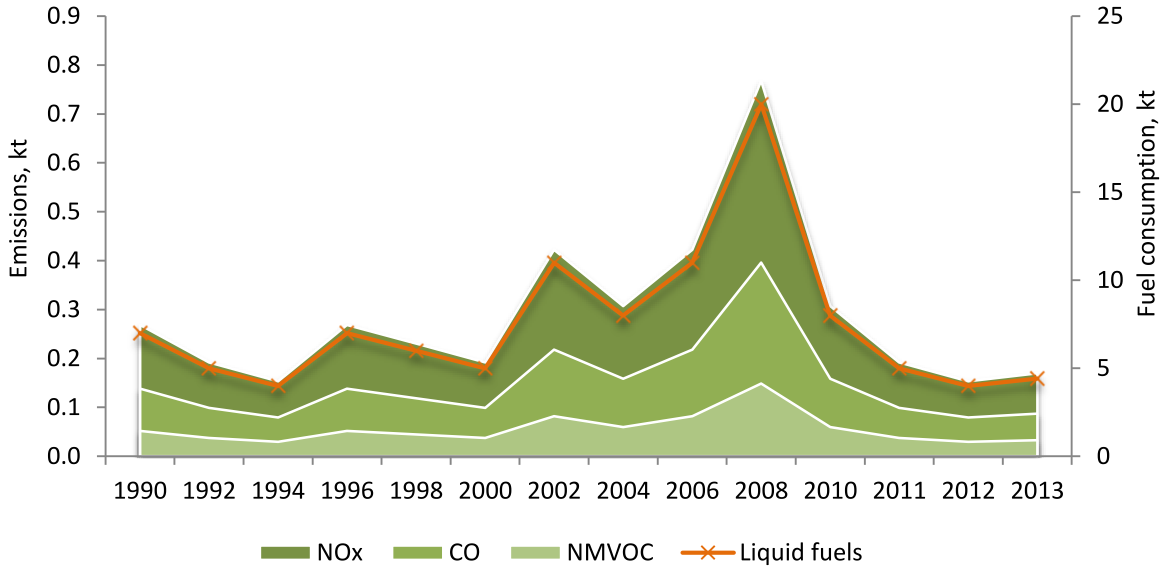


Figure 3.30 NO_x, NMVOC and CO emissions from the national navigation sector

Table 3.42 Emissions from national navigation

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
	kt			t	kt				
1990	0.269	0.052	0.070	0.049	NR	NR	0.032	0.000	0.139
1991	0.269	0.052	0.070	0.049	NR	NR	0.032	0.000	0.139
1992	0.192	0.037	0.050	0.035	NR	NR	0.023	0.000	0.099
1993	1.421	0.276	0.370	0.259	NR	NR	0.170	0.000	0.733
1994	0.154	0.030	0.040	0.028	NR	NR	0.018	0.000	0.079
1995	0.154	0.030	0.040	0.028	NR	NR	0.018	0.000	0.079
1996	0.269	0.052	0.070	0.049	NR	NR	0.032	0.000	0.139
1997	0.230	0.045	0.060	0.042	NR	NR	0.028	0.000	0.119
1998	0.230	0.045	0.060	0.042	NR	NR	0.028	0.000	0.119
1999	0.192	0.037	0.050	0.035	NR	NR	0.023	0.000	0.099
2000	0.192	0.037	0.020	0.035	0.023	0.023	0.023	0.000	0.099
2001	0.269	0.052	0.028	0.049	0.032	0.032	0.032	0.000	0.139
2002	0.422	0.082	0.044	0.077	0.051	0.051	0.051	0.000	0.218
2003	0.346	0.067	0.036	0.063	0.041	0.041	0.041	0.000	0.178
2004	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.000	0.158
2005	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.000	0.158
2006	0.422	0.082	0.044	0.077	0.051	0.051	0.051	0.000	0.218
2007	0.653	0.127	0.068	0.119	0.078	0.078	0.078	0.000	0.337
2008	0.768	0.149	0.080	0.140	0.092	0.092	0.092	0.000	0.396
2009	0.307	0.060	0.032	0.056	0.037	0.037	0.037	0.000	0.158
2010	0.307	0.060	0.016	0.056	0.037	0.037	0.037	0.000	0.158
2011	0.192	0.037	0.010	0.035	0.023	0.023	0.023	0.000	0.099

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
	kt			t	kt				
2012	0.154	0.030	0.008	0.028	0.018	0.018	0.018	0.000	0.079
2013	0.170	0.033	0.009	0.000	0.020	0.020	0.020	0.001	0.087
trend 1990-2013, %	**-36.9**	**-36.9**	**-87.4**	**-99.9**	**-11.6**	**-11.6**	**-36.9**	**NA**	**-36.9**

Table 3.43 Emissions of heavy metals from national navigation

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	kg					t	kg		t
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
2013	NA	0.044	NA	NA	0.221	0.008	0.309	0.044	0.004
trend 1990-2013, %	**NA**	**-36.9**	**NA**	**NA**	**-36.9**	**-36.9**	**-36.9**	**-36.9**	**-36.9**

Table 3.44 Emissions of POPs from national navigation

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCB
	g I-Teq	kg						
1990	NA	0.210	0.350	NA	NA	0.560	NA	NA
1991	NA	0.210	0.350	NA	NA	0.560	NA	NA
1992	NA	0.150	0.250	NA	NA	0.400	NA	NA
1993	NA	1.110	1.850	NA	NA	2.960	NA	NA
1994	NA	0.120	0.200	NA	NA	0.320	NA	NA
1995	NA	0.120	0.200	NA	NA	0.320	NA	NA
1996	NA	0.210	0.350	NA	NA	0.560	NA	NA
1997	NA	0.180	0.300	NA	NA	0.480	NA	NA
1998	NA	0.180	0.300	NA	NA	0.480	NA	NA
1999	NA	0.150	0.250	NA	NA	0.400	NA	NA
2000	NA	0.150	0.250	NA	NA	0.400	NA	NA
2001	NA	0.210	0.350	NA	NA	0.560	NA	NA
2002	NA	0.330	0.550	NA	NA	0.880	NA	NA
2003	NA	0.270	0.450	NA	NA	0.720	NA	NA
2004	NA	0.240	0.400	NA	NA	0.640	NA	NA
2005	NA	0.240	0.400	NA	NA	0.640	NA	NA
2006	NA	0.330	0.550	NA	NA	0.880	NA	NA
2007	NA	0.510	0.850	NA	NA	1.360	NA	NA
2008	NA	0.600	1.000	NA	NA	1.600	NA	NA
2009	NA	0.240	0.400	NA	NA	0.640	NA	NA
2010	NA	0.240	0.400	NA	NA	0.640	NA	NA
2011	NA	0.150	0.250	NA	NA	0.400	NA	NA
2012	NA	0.120	0.200	NA	NA	0.320	NA	NA
2013	NA	0.133	0.221	NA	NA	0.354	NA	NA
trend 1990-2013, %	**NA**	**-36.9**	**-36.9**	**NA**	**NA**	**-36.9**	**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 3.48) by respective emission factors. Default emission factors for the main pollutants are taken from EMEP/EEA Guidebook 2013 and are presented in Tables 3.45-3.46.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.48) by emission factors (Table 3.47). 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 3.45 Emission factors for national navigation transport (kg/t)

	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	f-BC	CO
Marine diesel oil/ marine gas oil	38.4	7.45	0.007	4.6	4.6	4.6	0.55	19.8

Table 3.46 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 3.47 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 3.48 Fuel consumption in the navigation sector (kt)

Year	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

Year	Light fuel oil	Diesel
2006	5	6
2007	12	5
2008	13	7
2009	2	6
2010	2	6
2011	0	5
2012	0	4
2013	0.419	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 (NFR 1A2fii), commercial machinery (NFR 1A4aii), household and gardening machinery (NFR 1A4bii), agricultural machinery (NFR 1A4cii) and national fishing (NFR 1A4ciii) sector.

(*Photo on the left: Tractor on the field; source: Shutterstock*)

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

3.3.6.1. Source category description

Other non-road machinery includes following sectors and activities:

- Industrial machinery sector (NFR 1A2fii) 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 machinery sector (NFR 1A4aii) includes different small gasoline and diesel working machinery in the residential sector.
- Household and gardening machinery sector (NFR 1A4bii) includes various machinery: trimmers, lawn mowers, chain saws snow mobiles, other vehicles and equipment.
- Agricultural machinery sector (NFR 1A4cii) includes off-road vehicles and other machinery used in agriculture/forestry (agricultural tractors, harvesters, combines, etc.).
- National fishing sector (NFR 1A4ciii) covers activities from inland, coastal and deep-sea fishing.

The total contribution to the emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide were 24.7%, 27.8% and 18.9% respectively, in the transport sector in 2013.

All the emissions have decreased in the period 1990 to 2013, but slightly increased in 2012 compared to 2011 due to small increase in fuel consumption that year. Deviations of time series can be explained by changing statistical fuel consumption in non-road machinery sector (Figures 3.31-3.33) and the share of some specific sector in total non-road machinery emissions. Detailed emission data are provided in Tables 3.49-3.51.

The most important deployment of mobile machinery is the use in agricultural and industrial sector, which are responsible for approximately 86% of total energy use, where diesel is the dominant fuel type, with 86% of energy use in 2013.

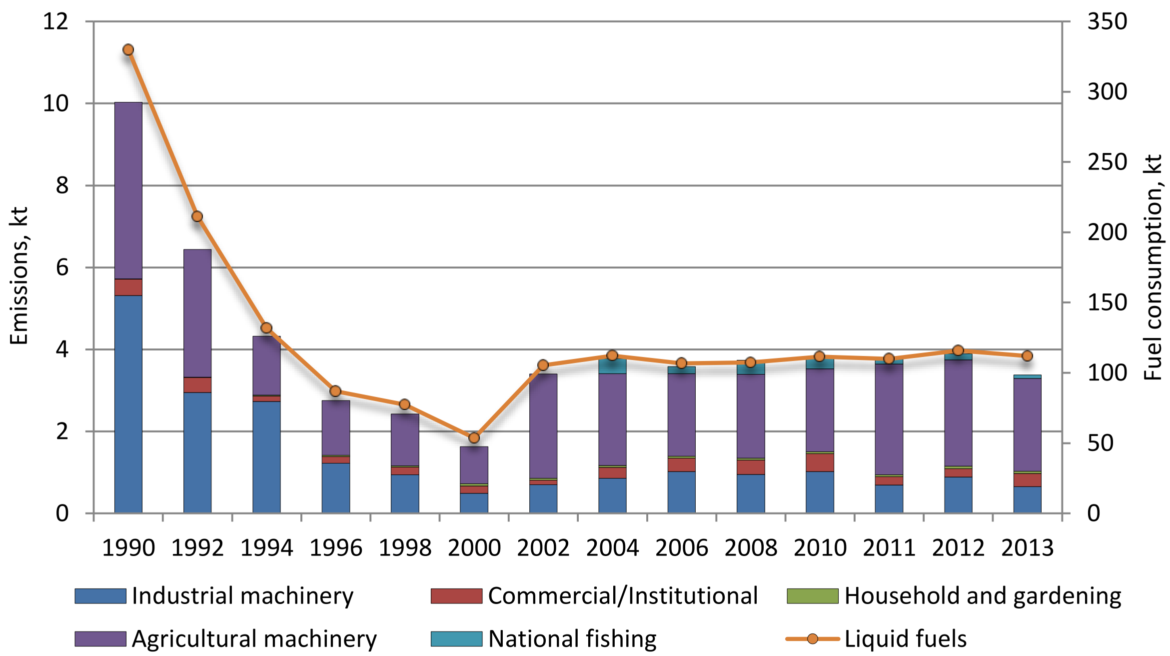


Figure 3.31 NO_x emissions from other non-road machinery

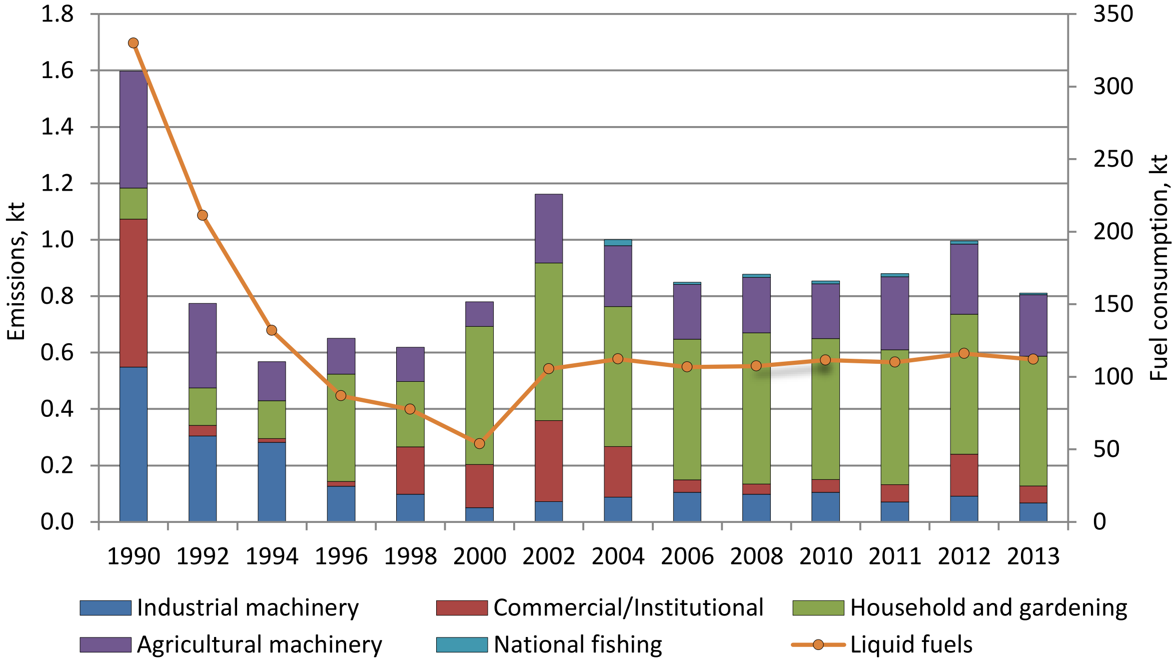


Figure 3.32 NMVOC emissions from other non-road machinery

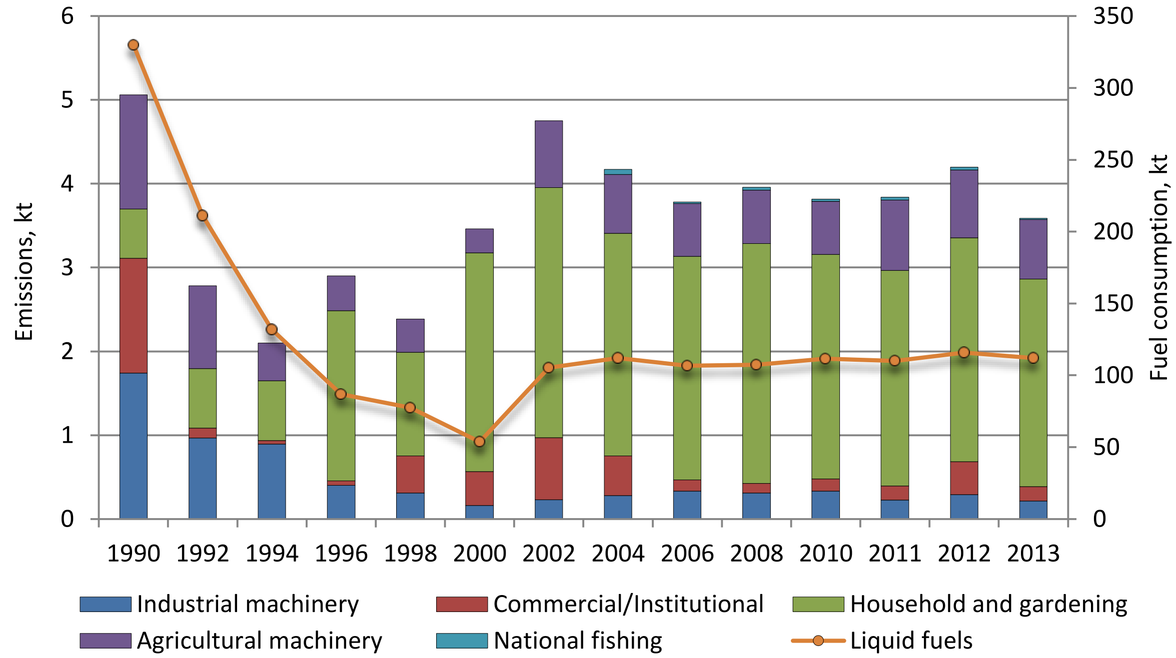


Figure 3.33 CO emissions from other non-road machinery

Table 3.49 Emissions from other non-road machinery (kt)

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	10.028	1.597	3.036	0.002	NR	NR	0.586	NR	5.061
1991	10.151	1.625	3.056	0.002	NR	NR	0.596	NR	5.171
1992	6.441	0.775	1.943	0.002	NR	NR	0.368	NR	2.783
1993	5.577	0.942	1.668	0.001	NR	NR	0.321	NR	3.180
1994	4.319	0.568	1.293	0.001	NR	NR	0.256	NR	2.100
1995	2.155	0.720	0.640	0.001	NR	NR	0.127	NR	2.724
1996	2.753	0.651	0.821	0.001	NR	NR	0.161	NR	2.902
1997	2.540	0.653	0.758	0.001	NR	NR	0.149	NR	2.959
1998	2.421	0.619	0.723	0.001	NR	NR	0.141	NR	2.385
1999	1.370	0.634	0.412	0.000	NR	NR	0.085	NR	2.758
2000	1.630	0.780	0.390	0.000	0.099	0.099	0.099	NR	3.461
2001	1.673	0.909	0.129	0.000	0.105	0.105	0.105	NR	4.110
2002	3.399	1.162	0.261	0.001	0.192	0.192	0.192	NR	4.750
2003	4.147	1.136	0.207	0.001	0.217	0.217	0.217	NR	4.692
2004	3.780	1.000	0.157	0.001	0.201	0.201	0.201	NR	4.170
2005	3.575	0.821	0.111	0.001	0.190	0.190	0.190	NR	3.619
2006	3.577	0.849	0.079	0.001	0.198	0.198	0.198	NR	3.783
2007	3.677	0.875	0.074	0.001	0.204	0.204	0.204	NR	3.929
2008	3.734	0.878	0.086	0.001	0.200	0.200	0.200	NR	3.957
2009	3.444	1.019	0.038	0.001	0.182	0.183	0.183	NR	4.268
2010	3.795	0.854	0.028	0.001	0.207	0.207	0.207	NR	3.817
2011	3.780	0.880	0.040	0.001	0.203	0.203	0.203	NR	3.839
2012	3.894	0.997	0.027	0.001	0.213	0.213	0.213	NR	4.198
2013	3.381	0.810	0.005	0.001	0.186	0.186	0.186	0.090	3.587
trend 1990-2013, %	**-66.3**	**-49.3**	**-99.8**	**-67.7**	**87.4**	**87.6**	**-68.3**	**NA**	**-29.1**

Table 3.50 Emissions of heavy metals from other non-road machinery

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg		t				
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

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Se	Zn
	t		kg		t				
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
2013	0.022	0.001	0.033	0.044	0.005	0.167	0.008	0.001	0.099
trend 1990-2013, %	**-99.6**	**-67.0**	**NA**	**NA**	**-67.0**	**-67.2**	**-62.1**	**-63.7**	**-66.9**

Table 3.51 Emissions of POPs from other non-road machinery

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCBs
	g I-Teq	t					g	
1990	0.000	0.009	0.015	NA	NA	0.024	0.000	0.000
1991	0.000	0.009	0.015	NA	NA	0.024	0.000	0.000
1992	0.000	0.006	0.010	NA	NA	0.015	0.000	0.000
1993	0.000	0.005	0.008	NA	NA	0.013	0.000	0.000
1994	0.000	0.004	0.006	NA	NA	0.010	0.000	0.000
1995	0.000	0.002	0.003	NA	NA	0.005	0.000	0.000
1996	0.000	0.003	0.004	NA	NA	0.007	0.000	0.000
1997	0.000	0.002	0.004	NA	NA	0.006	0.000	0.000
1998	0.000	0.002	0.004	NA	NA	0.006	0.000	0.000
1999	0.000	0.001	0.002	NA	NA	0.003	0.000	0.000
2000	0.000	0.002	0.003	NA	NA	0.004	0.000	0.000
2001	0.000	0.002	0.003	NA	NA	0.004	0.000	0.000
2002	0.000	0.003	0.005	NA	NA	0.008	0.000	0.000
2003	0.001	0.003	0.005	NA	NA	0.009	0.535	0.254
2004	0.001	0.003	0.005	NA	NA	0.008	0.377	0.179
2005	0.001	0.003	0.005	NA	NA	0.008	0.336	0.159
2006	0.000	0.003	0.005	NA	NA	0.008	0.170	0.081
2007	0.000	0.003	0.005	NA	NA	0.009	0.168	0.080
2008	0.001	0.003	0.005	NA	NA	0.008	0.348	0.166

Year	PCDD/F	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCBs
	g I-Teq	t					g	
2009	0.001	0.003	0.005	NA	NA	0.007	0.453	0.215
2010	0.000	0.003	0.005	NA	NA	0.008	0.274	0.130
2011	0.000	0.003	0.005	NA	NA	0.009	0.143	0.068
2012	0.000	0.003	0.006	NA	NA	0.009	0.153	0.073
2013	0.000	0.003	0.005	NA	NA	0.008	0.088	0.042
trend 1990-2013, %	**NA**	**-67.1**	**-67.6**	**NA**	**NA**	**-67.4**	**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 3.58) by respective emission factors. Default emission factors for the main pollutants and heavy metals are taken from EMEP/EEA Guidebook 2013 and are presented in Tables 3.52-3.55.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.58) by emission factors (Table 3.56). 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 industrial, commercial, household/gardening and agricultural sectors, equation (2) only for 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 3.52 Emission factors for other mobile sources

NFR	Fuel	Unit	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
1A2fii 1A4aii 1A4bii 1A4cii	Diesel	kg/t	32.792	3.385	0.008	2.086	2.086	2.086	10.722
	Gasoline: 2-stroke	kg/t	2.765	242.197	0.003	3.762	3.762	3.762	620.793
	Gasoline: 4-stroke	kg/t	7.117	17.602	0.004	0.157	0.157	0.157	770.368
1A4cii	Diesel/ Light fuel oil	kg/t	35.043	3.366	0.008	1.738	1.738	1.738	10.939
1A4ciii	Diesel/ Light fuel oil	kg/t	78.500	2.800	-	1.400	1.500	1.500	7.400
	Gasoline	kg/t	9.400	181.500	-	9.500	9.500	9.500	573.900

Table 3.53 BC emission factors for other mobile sources

NFR	Category	Fuel	f-BC
1A2f ii	Industry	Diesel	0.62
1A4c ii	Forestry	Diesel	0.65
1A4c ii	Agriculture	Diesel	0.57
1A2fii 1A4aii 1A4bii 1A4cii	All	Gasoline 2-stroke	0.05
1A2fii 1A4aii 1A4bii 1A4cii	All	Gasoline 4-stroke	0.05

Table 3.54 Emission factors for heavy metals

NFR	Fuel	Unit	Cd	Hg	As	Cu	Cr	Ni	Se	Zn
1A2fii 1A4aii 1A4bii 1A4cii	Gasoline	g/t	0.010	-	-	1.700	0.050	0.070	0.010	1.000
	Diesel/ Light fuel oil	g/t	0.010	-	-	1.700	0.050	0.070	0.010	1.000
1A4ciii	Diesel/ Light fuel oil	g/t	0.010	0.030	0.040	0.88	0.050	1.000	0.100	1.200

Table 3.55 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	
1A2fii 1A4aii 1A4bii 1A4cii	Gasoline	-	0.040	0.040	-	-	-	-
	Diesel/ Light fuel oil	-	0.030	0.050	-	-	-	-
1A4ciii	Diesel/ Light fuel oil	0.130	-	-	-	-	0.080	0.038

Table 3.56 Sulphur content of fuel (by weight)

NFR	Fuel	1990	2000	2001	2003	2004	2005	2006	2009	2010
1A2fii 1A4aii 1A4bii 1A4cii 1A4ciii	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 3.57 Lead content in fuel

NFR	Fuel	Unit	1990	2000	2004
1A2fii 1A4aii 1A4bii 1A4cii 1A4ciii	Gasoline	g/l	0.150	0.013	0.005
1A4ciii	Diesel/ Light fuel oil	g/t	0.130	0.130	0.130

Table 3.58 Total fuel consumption in other mobile sectors

Year	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
2013	95.790	11.386	4.339	111.515

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 1A4ciii sector for the period 1990-2002. These emissions are included under 1A4cii sector in this submission.

More detailed emission calculations for other non-road machinery sectors which are based on 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 (NFR 1A3di (i))

3.3.7.1. Source category description

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

(*Photo on the left: Tallinn Passenger Port*)

The emissions of nitrogen oxides, non-methane volatile compounds and carbon monoxide in 2013 have increased approximately 116.6%, 146.4% and 142.7% respectively compared to 1990. Sulphur oxide emissions decreased by 47.4% in 2012 due to stricter rules for sulphur content in fuels used by ships. However, emissions increased again in 2013 by 40.6% compared to 1990 as a result of some recalculations in fuel consumption. Detailed emissions data are provided in Tables 3.59-3.61.

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

Recalculations

NO_x, NMVOC, $PM_{2.5}$, PM_{10} and TSP emissions are recalculated for the period 2005-2012. As a result of recalculating heavy fuel oil consumption in 2012, all emissions are recalculated for that same year. An overview of the updated data is given in Chapter 8.

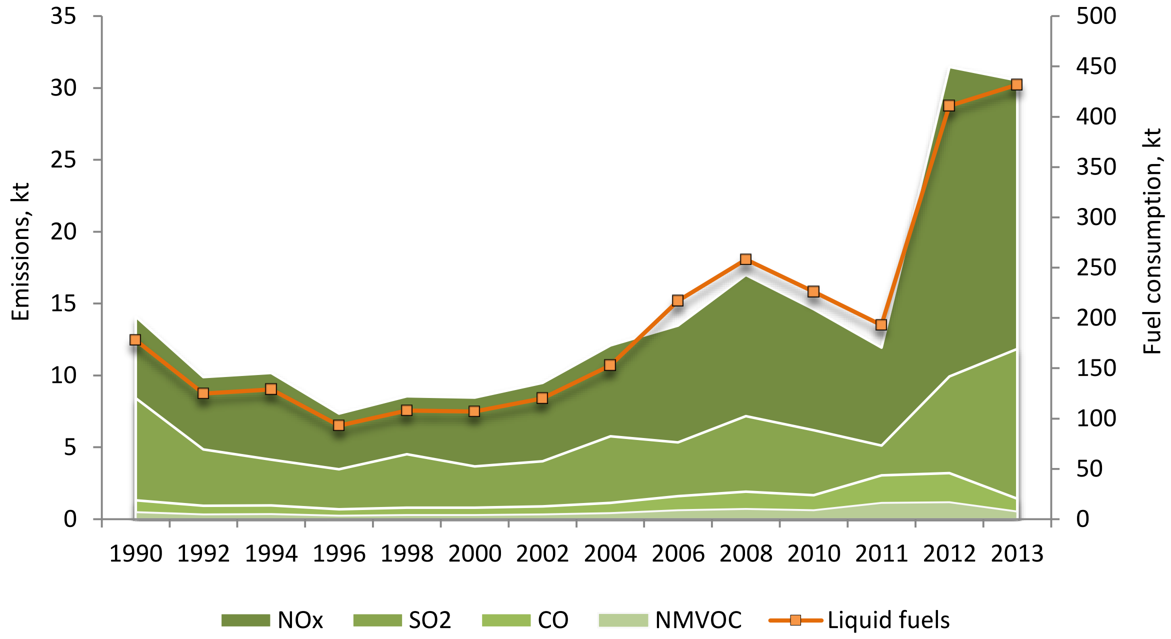


Figure 3.34 NO_x, NMVOC, SO_x and CO emissions from the international navigation sector

Table 3.59 Emissions from the international maritime navigation sector (kt)

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	14.094	0.483	8.424	NE	NR	NR	0.977	NR	1.317
1991	16.627	0.570	9.888	NE	NR	NR	1.147	NR	1.554
1992	9.878	0.342	4.858	NE	NR	NR	0.573	NR	0.925
1993	12.075	0.420	5.094	NE	NR	NR	0.610	NR	1.132
1994	10.179	0.355	4.150	NE	NR	NR	0.499	NR	0.955
1995	7.105	0.247	3.100	NE	NR	NR	0.370	NR	0.666
1996	7.347	0.255	3.482	NE	NR	NR	0.412	NR	0.688
1997	8.064	0.279	4.144	NE	NR	NR	0.487	NR	0.755
1998	8.540	0.295	4.512	NE	NR	NR	0.529	NR	0.799
1999	8.931	0.309	4.474	NE	NR	NR	0.527	NR	0.836
2000	8.452	0.293	3.678	NE	0.423	0.466	0.466	NR	0.792
2001	8.053	0.280	3.258	NE	0.382	0.421	0.421	NR	0.755
2002	9.477	0.329	4.030	NE	0.466	0.514	0.514	NR	0.888
2003	9.005	0.312	3.956	NE	0.454	0.500	0.500	NR	0.844
2004	12.093	0.418	5.762	NE	0.647	0.714	0.714	NR	1.132
2005	5.383	0.358	4.338	NE	0.451	0.399	0.399	NR	0.903

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
2006	13.481	0.613	5.340	NE	0.990	1.009	1.009	NR	1.606
2007	16.257	0.709	6.784	NE	1.249	1.294	1.294	NR	1.872
2008	16.997	0.718	7.180	NE	1.325	1.387	1.387	NR	1.909
2009	15.499	0.639	6.480	NE	1.198	1.263	1.263	NR	1.702
2010	14.600	0.631	6.192	NE	1.147	1.199	1.199	NR	1.672
2011	11.926	0.543	5.118	NE	0.950	0.979	0.979	NR	1.428
2012	31.457	1.130	9.922	NE	1.936	2.115	2.115	NR	3.041
2013	30.521	1.191	11.840	NE	2.217	2.374	2.374	0.182	3.197
trend 1990-2013, %	**116.6**	**146.4**	**40.6**	**NE**	**424.3**	**409.3**	**143.0**	**NA**	**142.7**

Table 3.60 Emissions of heavy metals from the international maritime navigation sector (t)

Year	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
2012	0.070	0.007	0.009	0.224	0.238	0.482	10.486	0.077	0.493
2013	0.076	0.008	0.009	0.268	0.284	0.525	12.584	0.086	0.518
trend 1990-2013, %	**146.9**	**150.5**	**136.0**	**158.4**	**158.2**	**147.1**	**158.9**	**150.9**	**142.7**

Table 3.61 Emissions of POPs from the international maritime navigation

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Total PAHs	HCB	PCBs
	g I-Teq	t					kg	
1990	0.074	NE	NE	NE	NE	NE	0.023	0.096
1991	0.087	NE	NE	NE	NE	NE	0.027	0.113
1992	0.044	NE	NE	NE	NE	NE	0.015	0.063
1993	0.047	NE	NE	NE	NE	NE	0.017	0.074
1994	0.039	NE	NE	NE	NE	NE	0.014	0.061
1995	0.029	NE	NE	NE	NE	NE	0.010	0.044
1996	0.032	NE	NE	NE	NE	NE	0.011	0.046
1997	0.037	NE	NE	NE	NE	NE	0.012	0.052
1998	0.041	NE	NE	NE	NE	NE	0.013	0.056
1999	0.041	NE	NE	NE	NE	NE	0.014	0.057
2000	0.036	NE	NE	NE	NE	NE	0.012	0.053
2001	0.033	NE	NE	NE	NE	NE	0.012	0.050
2002	0.040	NE	NE	NE	NE	NE	0.014	0.059
2003	0.039	NE	NE	NE	NE	NE	0.013	0.057
2004	0.055	NE	NE	NE	NE	NE	0.018	0.078
2005	0.042	NE	NE	NE	NE	NE	0.014	0.061
2006	0.087	NE	NE	NE	NE	NE	0.028	0.115
2007	0.108	NE	NE	NE	NE	NE	0.034	0.138
2008	0.114	NE	NE	NE	NE	NE	0.035	0.143
2009	0.103	NE	NE	NE	NE	NE	0.031	0.128
2010	0.099	NE	NE	NE	NE	NE	0.030	0.125
2011	0.083	NE	NE	NE	NE	NE	0.026	0.105
2012	0.164	NA	NA	NA	NA	NA	0.052	0.218
2013	0.189	NA	NA	NA	NA	NA	0.058	0.239
trend 1990-2013, %	**154.4**	**NE**	**NE**	**NE**	**NE**	**NE**	**149.3**	**147.7**

3.3.7.2. Methodological issues

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

Cruise emissions are calculated by the Tier 1, where the statistical fuel consumption (Table 3.65) is multiplied by respective emission factors (Table 3.62-3.66). Default emission factors for the main pollutants and heavy metals are taken from EMEP/EEA Guidebook 2013.

Emissions of SO_2 are dependent on fuel consumption and fuel type. SO_2 emissions are calculated by multiplying statistical fuel use (Table 3.65) by emission factors (Table 3.64). 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 3.62 Emission factors for the international maritime navigation sector, (kg/t)

	NO_x	NMVOC	$PM_{2.5}$	PM_{10}	TSP	f-BC	CO
Bunker fuel oil	79.3	2.7	5.6	6.2	6.2	0.12	7.4
Marine diesel oil	78.5	2.8	1.4	1.5	1.5	0.31	7.4

Table 3.63 Emission factors for heavy metals and PAHs

	Pb	Cd	Cu	Cr	As	Hg	Ni	Se	Zn	PCDD/F	HCB	PCB's
	g/t									TEQµg /t	mg/t	
Bunker fuel oil	0.18	0.02	1.25	0.72	0.68	0.02	32	0.21	1.2	0.47	0.14	0.57
Marine diesel oil	0.13	0.01	0.88	0.05	0.04	0.03	1	0.1	1.2	0.13	0.08	0.38

Table 3.64 Sulphur content of fuel (by weight)

	1990	2000	2006	2008
Marine diesel oil	0.5%	0.2%		0.1%
Bunker fuel oil	2.7%		1.5%	

Table 3.65 Fuel consumption in the international maritime navigation sector (kt)

	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

	Bunker fuel oil	Marine diesel oil
2005	77	45
2006	172	45
2007	222	31
2008	238	20
2009	215	15
2010	205	21
2011	169	24
2012	325	86
2013	392	40

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

There are currently no improvements planned for this sector.

3.4. Fugitive emissions (NFR 1.B)

3.4.1. Overview of the sector

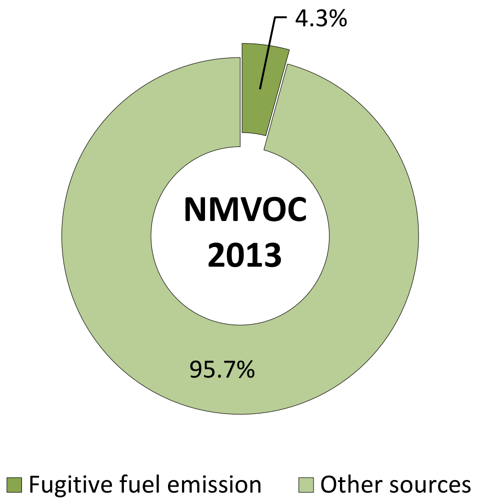
Under fugitive emissions from fuels, Estonia reports on NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, CO, NH_3, NO_x, SO_2 and HM emissions from the following activities:

(*Photo on the left: Muuga Terminal; source: www.portoftallinn.com*)

Table 3.66 Fugitive emissions activities

NFR	Source	Description	Emissions reported
1B	**Fugitive emissions from fuel**		
	1a 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
	1b 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}, $PM_{2.5}$, BC, CO, Cr
	2aiv 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
	2av Distribution of oil products	Includes emissions from liquid fuel distribution. Data of point and diffuse sources.	NMVOC
	2b Natural gas	Includes emissions from gas distribution networks. Only diffuse sources data.	NMVOC
	2c Venting and flaring	Waste gas incineration. Only two point sources data.	NO_x, SO_x, NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC, CO, Pb, Cu, Cr, Ni, Zn, PCDD/ PCDF, PAHs

NMVOC emissions from this sector contribute about 4% to total national emissions and have decreased by 40.5% up to 2013 compared to 1990 and by 19.4% compared to 2012 due to decreasing emissions from terminals (Figure 3.36 and Table 3.67). Emissions of other pollutants are very small compared to the emissions from the other sectors (Table 3.67).



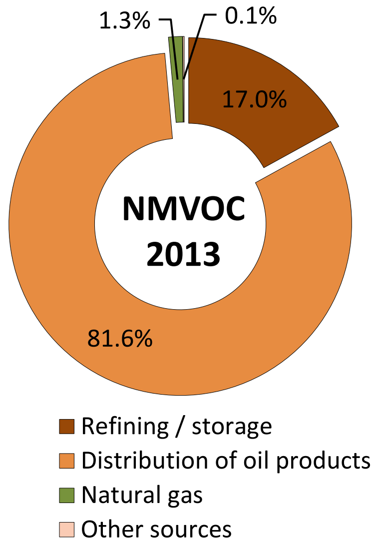


Figure 3.35 NMVOC emission distribution in 2013

Figure 3.36 NMVOC emission distribution within the fuel fugitive emission sector in 2013

Figure 3.36 shows that the distribution of oil products is a main source of NMVOC emissions in the fuel fugitive emissions sector (81.6%).

Table 3.67 Fugitive emission in the period 1990-2013 (kt)

Year	NMVOC	$PM_{2.5}$	PM_{10}	TSP	NO_x	CO	NH3	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	0.021	0.085	0.170	0.010	0.180		
2002	4.649	0.010	0.080	0.160	0.010	0.270		
2003	4.404	0.010	0.097	0.198	0.010	0.350		
2004	5.184	0.010	0.070	0.140	0.000	0.260	0.010	
2005	4.284	0.010	0.090	0.180	0.010	0.170	0.050	
2006	3.516	0.010	0.110	0.220	0.010	0.250	0.060	
2007	1.922	0.010	0.090	0.180	0.010	0.220	0.090	0.010
2008	1.593	0.014	0.102	0.202	0.017	0.276	0.102	0.013
2009	1.684	0.030	0.141	0.267	0.036	0.168	0.089	0.026
2010	1.818	0.034	0.170	0.309	0.035	0.188	0.115	0.018

Year	NMVOC	$PM_{2.5}$	PM_{10}	TSP	NO_x	CO	NH3	SO_2
2011	2.179	0.042	0.187	0.350	0.032	0.813	0.175	0.076
2012	1.824	0.051	0.182	0.329	0.019	2.011	0.212	0.038
2013	1.471	0.022	0.103	0.189	0.024	1.353	0.192	0.051
trend 1990-2013, %	**-40.5**	**116.8**	**106.1**	**71.9**	**140.0**	**576.5**	**1820.0**	**410.0**

The emission data for 1B1a Fugitive emission from solid fuels: Coal mining and handling, 1B2aiv Refining/storage and 1B2c 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 1B2av)

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.

(*Photo by Ilmar Saabas*)

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 2013. In the table below, NMVOC emissions from gasoline distribution and terminals are presented.

Table 3.68 NMVOC emissions from liquid fuel distribution in the period 1990-2013 (kt)

[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

	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**	**2013**
Gasoline distribution	0.856	0.657	0.628	0.467	0.482	0.514	0.508	0.467	0.447	0.478	0.511	0.460
Terminals	3.645	3.695	3.910	3.199	2.626	1.200	0.629	0.799	0.644	1.265	0.854	0.740

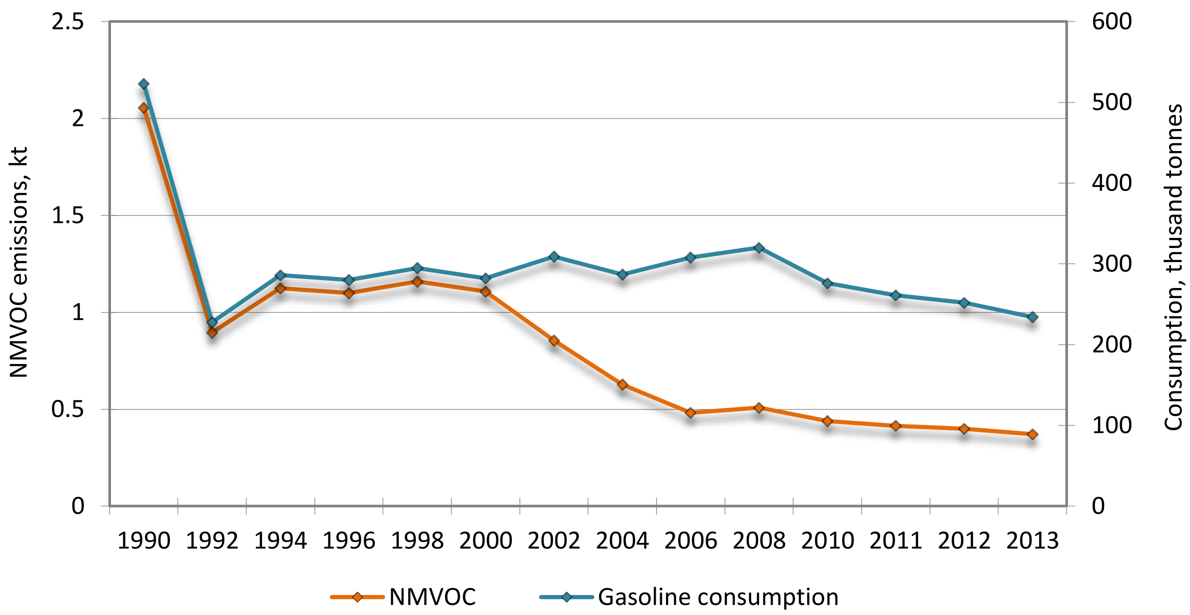


Figure 3.37 NMVOC emission and gasoline distribution in the period 1990-2013

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 92.1% from total gasoline distribution in 2013). 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 2005-2013, 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 2005-2013, the Tier 2 technology specific emission factors for Service Stations from the EMEP/EEA Guidebook 2013 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 1B2av 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 3.69.

Table 3.69 Annual average RVP of gasoline 95 in Estonia in the period 2005-2008

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

RVP for gasoline is up to 74.6 kPa.

$TVP = 74.6 \times 10^{(0.000007047x74.6+0.0132)*5+(0.0002311x74.6-0.5236)} = 27.2$ 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 3.70 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**

[4] www.emhi.ee

Activity data

Activity data on the subject of gasoline consumption is available from Statistics Estonia (Table 3.71).

Table 3.71 Consumption of motor gasoline in the period 1990-2013 (kt)

	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**	**2013**
Gasoline consumption	309	300	287	290	308	323	320	293	276	261	252	234

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.

(*Photo: Natural gas distribution; source: www.delfi.ee*)

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 3.72 NMVOC emissions from gas distribution in the period 1990-2013 (kt)

	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**	**2013**
NMVOC	0.028	0.032	0.036	0.028	0.028	0.028	0.027	0.018	0.019	0.018	0.019	0.019

[5] Eesti Gaas. Annual Report 2006

Figure 3.39 NMVOC emission from natural gas distribution in the period 1990-2013

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 Tables 3.73-74. 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 3.73 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 3.74 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	2005-2013	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 3.75 Gas consumption in the period 1990-2013 (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**	**2013**
Gas consumption	743	847	966	997	1009	1003	961	653	701	632	657	678

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.

Kunda Nordic Tsement (source: www.knc.ee)

4. INDUSTRIAL PROCESSES AND PRODUCT USE (NFR 2)

Industrial processes and product use (NFR 2)

4.1. Industrial processes – overview of the 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
2A	**Mineral Products**			
	2A1	Cement production	Includes emissions from cement production. Data reported by one operator.	TSP, PM_{10}, $PM_{2.5}$, BC
	2A2	Lime production	Includes emissions from lime production. Data reported by one operator.	TSP, PM_{10}, $PM_{2.5}$
	2A3	Glass production	Particles emissions from this sector are allocated to 1A2f.	IE
	2.A.3	Limestone and dolomite use	Includes emissions from limestone and dolomite use. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$
	2A5a	Quarrying and mining of minerals other than coal	Includes emissions from quarrying and mining of limestone and dolomite. Data reported by operators.	NO_X, SO_X, TSP, PM_{10}, $PM_{2.5}$, CO
	2A5b	Construction and demolition	Includes emissions from construction and demolition.	TSP, PM_{10}, $PM_{2.5}$
	2A5c	Storage, handling and transport of mineral products	Emissions from this sector are allocated to 2L. Data reported by operators.	IE
	2A6	Other Mineral products	Includes emissions from class production. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$
2B	**Chemical industry**			
	2B1	Ammonia production	Includes emission from ammonia production. Data reported by one operator.	NO_X, NMVOC, NH_3, SO_X, CO
	2B10a	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, BC
	2B10b	Storage, handling and transport of chemical	Includes emission from storage, handling and transport of chemical products. Data	NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$, BC

NFR	Source		Description	Emissions reported
		products	reported by operators.	
2C	**Metal Production**			
	2C1	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
	2C3	Aluminium production	Includes emission from secondary aluminium production. Data reported by operators.	NO_X, NMVOC, TSP, PM_{10}, $PM_{2.5}$, CO, BC
	2C7a	Copper production	Includes emission from secondary copper production. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$
	2C5	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
	2C6	Zinc production	Includes emission from zinc plating. Data reported by operators.	TSP, PM_{10}, $PM_{2.5}$, Zn
	2C7c	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, BC, Pb, Cr, Cu , Ni, Zn
2D	**Product use**			
	2D3b	Road paving with asphalt	Includes emissions from road paving with asphalt.	NMVOC, TSP, PM_{10}, $PM_{2.5}$, BC
2H	**Pulp, paper and food industries**			
	2H1	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
	2H2	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, BC
2I	2I	Wood processing	Includes emission from wood processing. Data reported by operators.	NO_X, NMVOC, SO_x, TSP, PM_{10}, $PM_{2.5}$
2K	2K	Consumption of POPs and heavy metals (e.g. electrical and scientific equipment)	Includes emission from consumption of POPs and heavy metals.	NMVOC, NH_3
2L	2L	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 EMEP/EEA Guidebook 2013 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).

BC emissions from industry are calculated only for the year 2013. PM_{10} and $PM_{2.5}$ emissions from the industry sector are recalculated due to the EMEP/EEA Guidebook 2013 (see Chapter 8).

The share of industry sources in total emissions in 2013 was: TSP – 4.4%, NMVOC – 2.7%, NH_3 – 1.4%, $PM_{2.5}$ – 1.3% and PM_{10} – 2.6%. 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%, 69.5% and 5.5%, respectively. The emissions of NO_x, NH_3, $PM_{2.5}$, PM_{10} and TSP increased in 2013 compared to 2012 by 76%, 36%, 51%, 36% and 22% in the result increasing production in metal- and chemical industry (mainly due to the fact that Estonia's only producer of fertiliser Nitrofert AS started working again).

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 1990-2013

Year	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO	Pb
		kt								kg
1990	0.190	15.335	NA	0.530	NR	NR	1.197	NR	0.340	NA
1991	0.100	13.894	NA	0.460	NR	NR	0.315	NR	0.300	NA
1992	0.090	9.600	NA	0.440	NR	NR	0.495	NR	0.300	NA
1993	0.050	4.405	NA	0.120	NR	NR	0.204	NR	0.010	NA
1994	0.190	3.513	NA	0.220	NR	NR	0.662	NR	0.040	NA
1995	0.070	4.377	NA	0.240	NR	NR	0.561	NR	0	NA
1996	0.150	3.191	NA	0.160	NR	NR	0.351	NR	0	NA
1997	0.150	3.142	NA	0.120	NR	NR	0.203	NR	0.010	NA
1998	0.140	2.400	NA	0.100	NR	NR	0.156	NR	0.020	NA
1999	0.190	1.457	NA	0.140	NR	NR	0.286	NR	0	NA
2000	0.200	2.080	0.040	0.120	0.265	0.560	1.195	NR	0.530	0.010
2001	0.340	1.449	0.080	0.140	0.265	0.608	1.447	NR	0.510	0.010
2002	0.130	1.513	0.160	0.110	0.419	0.846	1.913	NR	0.280	0.010
2003	0.161	1.932	0.150	0.120	0.366	0.836	1.977	NR	0.290	0
2004	0.360	1.846	0.130	0.120	0.514	1.140	2.445	NR	0.360	0
2005	0.180	1.573	0.130	0.200	0.457	1.018	2.228	NR	0.340	0
2006	0.270	1.303	0.120	0.157	0.478	1.076	2.421	NR	0.380	0.001
2007	0.250	1.072	0.020	0.138	0.410	0.996	2.434	NR	0.440	0.001
2008	0.298	0.959	0.022	0.181	0.540	1.200	2.441	NR	0.481	0.001
2009	0.058	0.881	0.025	0.083	0.285	0.758	1.637	NR	0.424	0.006
2010	0.037	0.861	0.029	0.070	0.266	0.668	1.496	NR	0.461	0.014
2011	0.062	0.919	0.022	0.093	0.163	0.495	1.195	NR	0.420	0.011
2012	0.047	0.909	0.001	0.103	0.124	0.411	1.025	NR	0.336	0.010
2013	0.200	0.892	0.000	0.162	0.257	0.652	1.320	0.006	0.381	0.011
trend 1990-2013, %	**5.50**	**-94.19**		**-69.52**	**-3.05**	**16.51**	**10.31**		**12.04**	

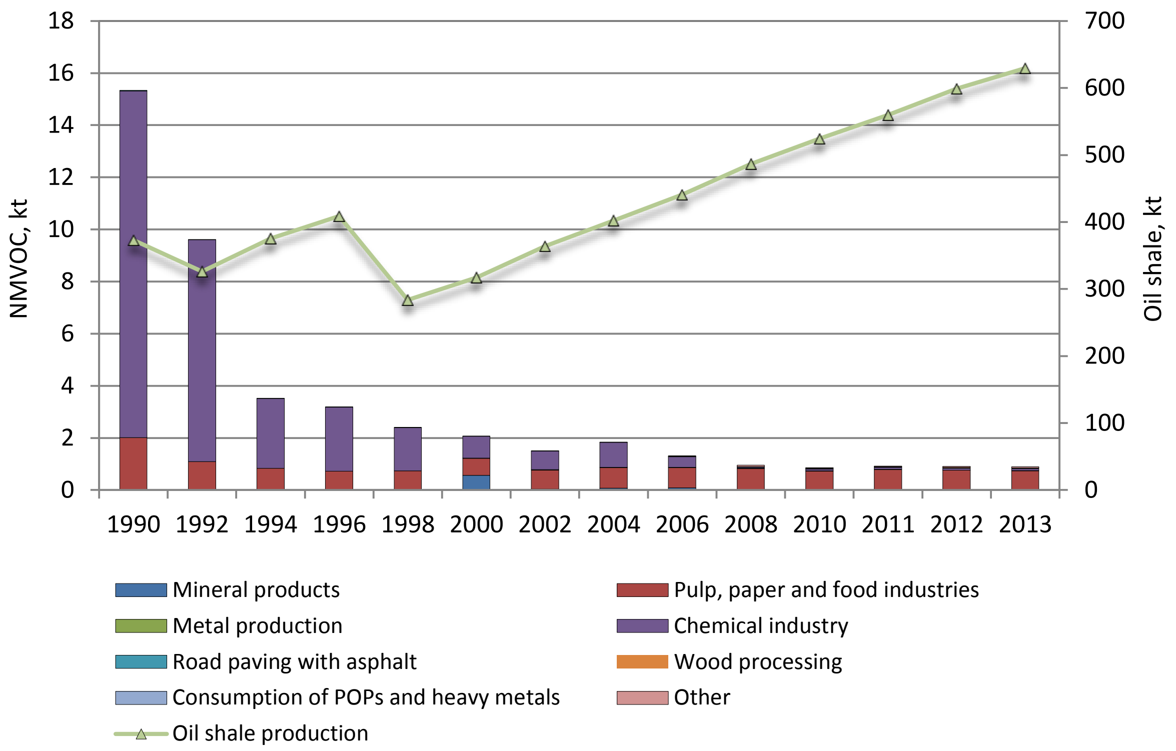


Figure 4.1 NMVOC emissions and oil shale production from the industrial sector in the period 1990-2013

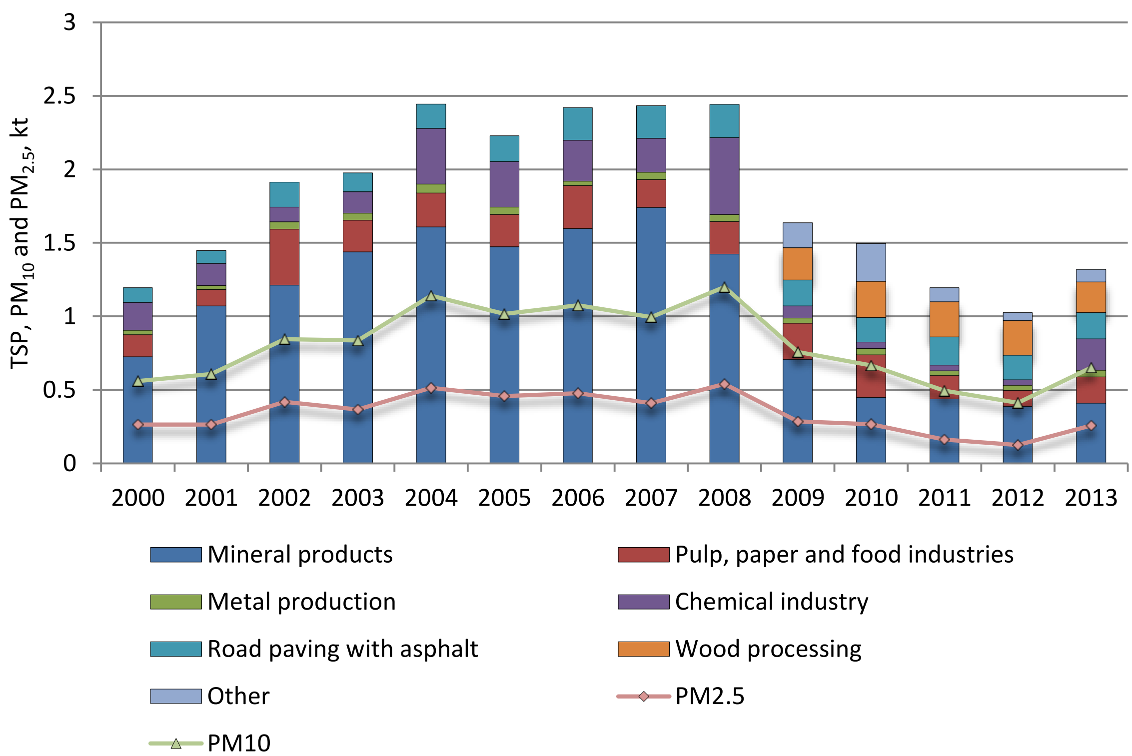


Figure 4.2 PM emissions from the industrial sector in the period 2000-2013

4.1.2. Mineral Products (NFR 2A)

4.1.2.1. 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;
- 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. This mixture is then ground into a fine powder, known as 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 modernised. The main goal was to eliminate dust pollution from clinker kilns and cement mills, which were provided with filters required for exhaust cleaning. In 1999, the company closed the local electricity and heat production plant, which had operated on natural gas. (Sustainability report 2007. Kunda Nordic Tsement AS, 2007).

(*Photo by Ilmar Saabas: Limestone excavation in Väo quarry*)

There are two facilities for lime production, one of which presents an annual 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 suitable for fertiliser and other industrial applications as well as for soil improvement.

The quarrying and mining of minerals in Estonia include 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 1990-2013 (kt)

	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	NA	NA	NA	NA	NR	NR	NA	NR	NA
1991	NA	NA	NA	NA	NR	NR	NA	NR	NA
1992	NA	NA	NA	NA	NR	NR	NA	NR	NA
1993	NA	NA	NA	NA	NR	NR	NA	NR	NA
1994	NA	NA	NA	NA	NR	NR	NA	NR	NA
1995	NA	NA	NA	NA	NR	NR	NA	NR	NA
1996	NA	NA	NA	NA	NR	NR	NA	NR	NA
1997	NA	NA	NA	NA	NR	NR	NA	NR	NA
1998	NA	NA	NA	NA	NR	NR	NA	NR	NA
1999	NA	NA	NA	NA	NR	NR	NA	NR	NA
2000	NA	0.570	NA	0.010	0.076	0.251	0.725	NR	0.040
2001	0.010	0.010	0.010	0.010	0.113	0.361	1.072	NR	0.040
2002	NA	0.040	NA	0.010	0.128	0.415	1.213	NR	NA
2003	NA	0.090	NA	0.010	0.150	0.499	1.439	NR	0.010
2004	0.010	0.070	NA	NA	0.173	0.577	1.609	NR	0.010
2005	0.010	0.080	NA	NA	0.159	0.527	1.473	NR	0.020
2006	0.010	0.080	NA	NA	0.167	0.569	1.599	NR	NA
2007	0.010	NA	NA	NA	0.172	0.601	1.741	NR	NA
2008	0.003	0.000	0.002	0.000	0.139	0.518	1.424	NR	0.003
2009	0.007	NA	0.001	NA	0.039	0.347	0.707	NR	0.006
2010	0.006	0.000	0.000	NA	0.026	0.221	0.449	NR	0.005
2011	0.010	NA	0.001	NA	0.027	0.215	0.439	NR	0.008
2012	0.008	NA	0.001	NA	0.027	0.193	0.388	NR	0.007
2013	0.008	NA	0.000	NA	0.027	0.210	0.409	0.0002	0.007

4.1.2.2. 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 1A2f, 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 implemented. Now, Kunda Nordic is obliged to carry out measurements twice a year and report on dioxin emissions. It must be noted 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

Year	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						
2013	691.4						

Table 4.5 Dioxin emission factors for the cement industry

Year	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
2013	691,400	0.004	0.037	69,600	0.07	0.0019		0.2	0.011

Emission calculations from construction and demolition (2A5b) sectors are based on the Tier 1 method from the renewed EMEP/EEA Guidebook 2013.

The Tier 1 method uses readily available statistical data and default emission factors (Table 4.6).

Table 4.6 PM emission factors for construction and demolition

NFR	Unit	PM_{10}	$PM_{2.5}$	TSP
2.A.7.b Construction and demolition	$kg/m^2/year$	0.0812	0.00812	0.162

4.1.2.3. Activity data

Information regarding constructions is available from Statistics Estonia (www.stat.ee) for the years 2000-2013 (Table 4.7). 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 4.7 Activity data for PM emission calculations from the construction sector in the period 2000-2013 (m^2 floor area)

Year	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
2013	250,402.7	607,424.0

4.1.3. Chemical industry (NFR 2B)

4.1.3.1. 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 (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 Specialities OÜ), sodium benzoate and other products. Emissions from paint and varnish production are located in the chapter on Solvent use.

(*Photo by Rauno Volmar: Nitrofert production facility*)

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

The share of NMVOC emissions from the chemical industry in the total country emissions amounted to approximately 22% in 1990, and 0.2% in 2013 (Figure 4.3). The main reason for this is the decrease in the manufacturing of chemical production at shale oil enterprises. Emissions from the chemical industry sector are presented in Table 4.8.

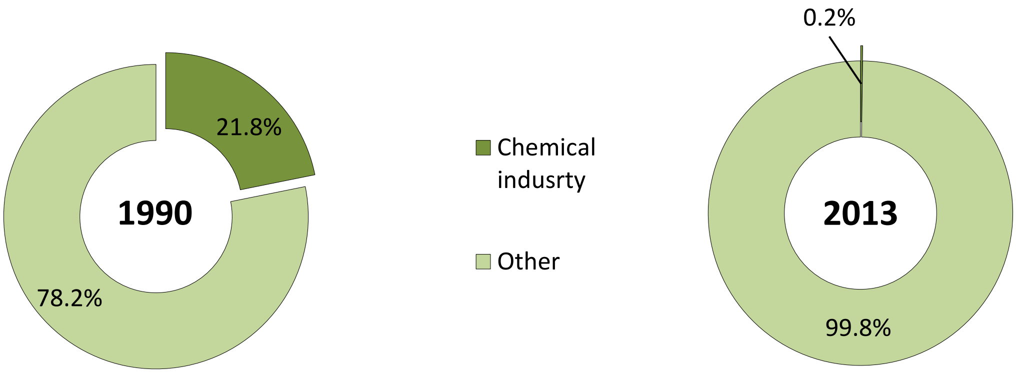


Figure 4.3 Distribution of NMVOC emissions by activities in 1990 and 2013

Table 4.8 Emissions from the chemical industry in the period 1990-2013 (kt)

Year	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	0.190	13.300	NA	0.370	NR	NR	0.940	NR	0.340
1991	0.100	12.330	NA	0.300	NR	NR	0.100	NR	0.300
1992	0.090	8.500	0	0.280	NR	NR	0.470	NR	0.300
1993	0.050	3.500	0	0.080	NR	NR	0.150	NR	0.010
1994	0.190	2.670	NA	0.140	NR	NR	0.610	NR	0.040
1995	0.070	3.530	NA	0.140	NR	NR	0.490	NR	NA
1996	0.150	2.460	NA	0.070	NR	NR	0.280	NR	NA
1997	0.150	2.390	NA	0.060	NR	NR	0.140	NR	0.010
1998	0.140	1.650	NA	0.060	NR	NR	0.080	NR	0.020
1999	0.190	0.790	NA	0.090	NR	NR	0.180	NR	NA
2000	0.190	0.840	NA	0.040	0.090	0.163	0.190	NR	0.340
2001	0.310	0.770	0.010	0.030	0.071	0.129	0.150	NR	0.320
2002	0.100	0.710	NA	0.020	0.043	0.079	0.100	NR	0.230
2003	0.130	1.065	0.010	0.030	0.067	0.122	0.146	NR	0.270
2004	0.320	0.960	0.010	0.040	0.179	0.326	0.380	NR	0.330
2005	0.160	0.720	0	0.080	0.146	0.266	0.310	NR	0.290
2006	0.230	0.410	NA	0.060	0.126	0.232	0.280	NR	0.330
2007	0.200	0.120	0	0.070	0.099	0.184	0.230	NR	0.360
2008	0.255	0.041	0.002	0.116	0.246	0.447	0.522	NR	0.398
2009	0.025	0.068	0.0003	0.009	0.026	0.052	0.082	NR	0.364
2010	NA	0.071	0.000005	0.010	0.005	0.014	0.042	NR	0.405
2011	3E-07	0.073	0.000006	0.017	0.004	0.013	0.038	NR	0.374
2012	0.024	0.073	0.000006	0.021	0.004	0.012	0.036	NR	0.305
2013	0.134	0.074	0.000005	0.066	0.092	0.171	0.213	0.003	0.327
trend 1990-2013, %		**-99.44**		**-82.26**	**3.04**	**5.27**	**-77.33**		**-3.74**

4.1.3.2. 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 4.9.

Table 4.9 Main chemicals and fuel production in the period 1990-2013 (kt)

Year	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	17	598.9	0	0	26.3
2013	121	629.6	0	0	22.0

4.1.4. Metal Production (NFR 2C)

4.1.4.1. Sources category description

The metal industry is concentrated in Tallinn and its surroundings (more than half of the work premises) and Ida-Viru County. The larger companies include AS Kohimo, AS Viljandi Metall, AS Cargotec Estonia, BLRT Grupp AS, 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).

(*Machine-building plant of BLRT Masinaehtius OÜ*; source: www.masinaehitus.ee)

Emissions from the metal industry are presented in Table 4.10.

Table 4.10 Emissions from the metal production sector in the period 1990-2013 (kt)

Year	NO_x	SO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	NA	NA	NA	0.160	NR	NR	NA	NR	NA
1991	NA	NA	0	0.160	NR	NR	NA	NR	NA
1992	NA	NA	0	0.160	NR	NR	NA	NR	NA
1993	NA	NA	NA	0.040	NR	NR	NA	NR	NA
1994	NA	NA	NA	0.080	NR	NR	NA	NR	NA
1995	NA	NA	NA	0.100	NR	NR	NA	NR	NA
1996	NA	NA	0	0.090	NR	NR	NA	NR	NA
1997	NA	NA	NA	0.060	NR	NR	NA	NR	NA
1998	NA	NA	NA	0.040	NR	NR	NA	NR	NA
1999	NA	NA	NA	0.050	NR	NR	NA	NR	NA
2000	NA	NA	0.010	0.040	0.014	0.018	0.030	NR	0.010
2001	0.010	NA	0.010	0.080	0.014	0.018	0.030	NR	0.010
2002	0.010	NA	0.020	0.060	0.023	0.030	0.050	NR	0.010
2003	0.011	NA	0.015	0.050	0.022	0.029	0.048	NR	0.010
2004	0.010	NA	0.010	0.030	0.028	0.036	0.060	NR	0.020
2005	0.010	NA	0.010	0.060	0.023	0.030	0.050	NR	0.010
2006	0.030	NA	0.010	0.080	0.014	0.018	0.030	NR	0.020
2007	0.000	NA	0.010	0.060	0.005	0.006	0.050	NR	0.020
2008	0.000	0.0002	0.008	0.033	0.002	0.002	0.048	NR	0.023
2009	0.000	0.00002	0.004	0.00006	0.001	0.001	0.035	NR	0.012
2010	0.000	0.000	0.006	0.000	0.001	0.002	0.044	NR	0.009

Year	NO_x	SO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	BC	CO
2011	0.000	0.000	0.008	0.070	0.001	0.002	0.033	NR	0.009
2012	0.001	0.000	0.007	0.072	0.001	0.001	0.034	NR	0.009
2013	0.015	0.000	0.008	0.074	0.019	0.025	0.045	0.00009	0.012

4.1.4.2. 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.

4.1.5. Road paving with asphalt (NFR 2D3b)

4.1.5.1. Sources category description

Emission calculations from road paving with asphalt (NFR 2D3b) sectors are based on the Tier 1 method from the renewed EMEP/EEA Guidebook 2013. Emissions from the road paving with asphalt are presented in Table 4.11.

(*Photo on the left: Road paving with asphalt; source: Scanpix*)

Table 4.11 Emissions from the road paving with asphalt in the period 1990-2013 (kt)

Year	NMVOC	$PM_{2.5}$	PM_{10}	TSP	BC
1990	0.027	NR	NR	0.257	NR
1991	0.023	NR	NR	0.215	NR
1992	0.003	NR	NR	0.025	NR
1993	0.006	NR	NR	0.054	NR
1994	0.006	NR	NR	0.052	NR
1995	0.008	NR	NR	0.071	NR
1996	0.008	NR	NR	0.071	NR
1997	0.007	NR	NR	0.063	NR
1998	0.008	NR	NR	0.076	NR
1999	0.011	NR	NR	0.106	NR
2000	0.011	0.001	0.013	0.100	NR

Year	NMVOC	$PM_{2.5}$	PM_{10}	TSP	BC
2001	0.009	0.001	0.011	0.085	NR
2002	0.018	0.001	0.023	0.170	NR
2003	0.014	0.001	0.017	0.130	NR
2004	0.018	0.001	0.022	0.165	NR
2005	0.019	0.001	0.023	0.175	NR
2006	0.024	0.001	0.030	0.222	NR
2007	0.024	0.001	0.030	0.223	NR
2008	0.024	0.002	0.030	0.226	NR
2009	0.016	0.001	0.023	0.176	NR
2010	0.018	0.001	0.022	0.168	NR
2011	0.020	0.001	0.026	0.192	NR
2012	0.018	0.001	0.023	0.169	NR
2013	0.019	0.001	0.024	0.177	0.001

4.1.5.2. Methodological issues

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 the batch mix and the drum mix hot mix asphalt plants. The Tier 1 method uses readily available statistical data and default emission factors (Table 4.12). For particles 99% abatement efficiencies are used.

Table 4.12 NMVOC emission factors for road paving with asphalt and PM emission factors for construction and demolition

NFR	Unit	NMVOC	PM_{10}	$PM_{2.5}$	BC	TSP
2D3b Road paving with asphalt	g/Mg asphalt	16	2000	100	5.7 % of $PM_{2.5}$	15000

4.1.5.3. Activity data

Information regarding asphalt production and laying is available from the Estonian Asphalt Pavement Association (www.asfaldiliit.ee) for the years 1990-2013 (Table 4.13). 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 4.13 Activity data for NMVOC emission calculations from asphalt production in the period 1990-2013 (tonnes)

Year	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
2013	1,183,263

4.1.6. Pulp, paper and food industries (NFR 2H)

4.1.6.1. Sources category description

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

The pulp and paper industry in Estonia has a long tradition, having been established 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 high-quality paper products for the packaging industry (Economic survey of Estonia 2008). The product range is completely 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.

(*Photo on the left by Rauno Volmar: Horizon Tselluloosi ja Paberi AS*)

The food industry is also one of the largest 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 4.14.

Table 4.14 Pollutant emissions from the pulp, paper and food industries in the period 1990-2013 (kt)

Year	NO_x	NMVOC	SO_x	$PM_{2.5}$	PM_{10}	TSP	BC	CO
1990	NA	2.008	NA	NR	NR	NA	NR	NA
1991	NA	1.541	NA	NR	NR	NA	NR	NA
1992	NA	1.097	NA	NR	NR	NA	NR	NA
1993	NA	0.899	NA	NR	NR	NA	NR	NA
1994	NA	0.837	NA	NR	NR	NA	NR	NA
1995	NA	0.839	NA	NR	NR	NA	NR	NA
1996	NA	0.723	NA	NR	NR	NA	NR	NA
1997	NA	0.745	NA	NR	NR	NA	NR	NA
1998	NA	0.742	NA	NR	NR	NA	NR	NA
1999	NA	0.656	NA	NR	NR	NA	NR	NA
2000	0.010	0.649	0.040	0.085	0.115	0.150	NR	0.140
2001	0.010	0.650	0.060	0.066	0.088	0.110	NR	0.140
2002	0.020	0.725	0.160	0.223	0.299	0.380	NR	0.040
2003	0.020	0.748	0.140	0.126	0.169	0.215	NR	0.000
2004	0.020	0.788	0.120	0.133	0.179	0.230	NR	0.000
2005	0	0.744	0.130	0.127	0.171	0.220	NR	0.020
2006	0	0.779	0.120	0.169	0.227	0.290	NR	0.000
2007	0.010	0.848	0.020	0.114	0.152	0.190	NR	0.020
2008	0.018	0.823	0.018	0.132	0.176	0.221	NR	0.028
2009	0.017	0.758	0.024	0.160	0.186	0.247	NR	0.027
2010	0.018	0.729	0.028	0.158	0.217	0.290	NR	0.028
2011	0.038	0.785	0.020	0.079	0.111	0.158	NR	0.015
2012	0.000	0.757	0.000	0.046	0.069	0.110	NR	0.000
2013	0.043	0.739	0.000	0.083	0.120	0.180	0.002	0.019

4.1.6.2. 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 EMEP/EEA Guidebook 2013 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 typically need ten years to mature. Grain whiskies typically require six years to mature. It is assumed that brandy matures in three years and that other spirits do not mature.
- Beer is considered to be typically 4% alcohol by volume and to weigh 1 tonne per m^3.
- If no better data are 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 4.15). 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) are 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 the 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 4.15 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

4.1.6.3. Activity data

Information regarding food and drink production is available from Statistics Estonia (www.stat.ee) for the years 1990-2013 (Tables 4.16-4.17).

Table 4.16 Activity data for the food industries in the period 1990-2013 (thousand tonnes)

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

Year	Bread and pastry	Flour confectionery	Meat total (slaughter weight)	Fish total	Solid cooking fats	Margarine	Concentrated feeding stuffs
2011	77.0	9.5	80.6	81.30	..	..	216.2
2012	76.7	8.1	78.4	67.80	..	..	198.8
2013	78.1	8.6	79.8	70.10	..	..	191.1

Table 4.17 Activity data for the drinks industries in the period 1990-2013 (thousand hl)

Year	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
2013	106.6	1,472.7	1.8	157.7

4.1.7. Source-specific QA/QC and verification

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

Data from operators was checked by the EEB and also by the ESTEA.

4.1.8. Sources-specific planned improvements

- Allocate the historical emission from wood and furniture industries from NFR 2A6 and NFR 2L and to include in NFR 2I Wood processing. This process demands certain efforts as corrections are necessary for carrying this out in a national point sources database.
- Provide uncertainty analysis.

4.2. Solvent and other product use – overview of the sector

4.2.1. 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 the use of fireworks under NFR 2G. Also, the heavy metals, CO, SO_x, NH_3, NO_x and POPs emissions are calculated from tobacco smoking.

(*Source: www.hdwallpapersos.com*)

In 2009-2010, the Estonian Environment Information Centre (nowadays ESTEA) outsourced an expert opinion of the estimation of NMVOC emissions from diffuse sources, including NMVOC emissions from the use of solvents and other products 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 Guidebook 2013.

This sector covers emissions from the use of solvents and other products: domestic solvent use including fungicides (NFR 2D3a), coating application (NFR 2D3d), degreasing (NFR 2D3e), dry-cleaning (NFR 2D3f), chemical products (NFR 2D3g), printing (NFR 2D3h), other solvent use (NFR 2D3i) and other product use (NFR 2G).

Air pollutants under NFR 3 in the Estonian inventory are presented in Table 4.18.

Table 4.18 Activities and emissions reported from the solvent and other product use sector in 2013

NFR	Source	Description	Method	Emissions reported
2D3a	Domestic solvent use including fungicides	NMVOC emissions from domestic solvent use	Tier 1	NMVOC
2D3d	Coating application	Includes emissions from domestic and industrial paint application	Tier 1 / Tier 3	NMVOC, TSP
2D3e	Degreasing	Includes emissions from degreasing (vapour and cold cleaning), electronic components manufacturing and other industrial cleaning	Tier 1 / Tier 3	NMVOC, PM_{10}, TSP, Pb, Cr
2D3f	Dry cleaning	Includes emissions from dry cleaning	Tier 1 / Tier 3	NMVOC
2D3g	Chemical products	Includes emissions from polyurethane, polystyrene foam and rubber processing, paints,	Tier 3	NMVOC, NH_3, TSP, Cr, Zn

NFR	Source	Description	Method	Emissions reported
		inks and glues manufacturing, textile finishing, leather tanning and other use of solvents		
2D3h	Printing	Emissions from solvents in printing houses	Tier 1 / Tier 3	NMVOC, TSP
2D3i	Other solvent use		Tier 2 / Tier 3	NMVOC, NH_3
2G	Other product use		Tier 2	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, b(a)p, b(b)f, b(k)f, I(1,2,3-cd)p

4.2.2. Quantitative overview of NMVOCs

In 2013, the solvent and other product use sector, which was the largest pollution source of NMVOC emissions in Estonia after the non-industrial combustion, accounted for 19.2% of total NMVOC emissions. The largest share was for coating application at 41.0%, with the others being domestic solvent use at 25.3%, degreasing 16.0%, printing 6.7%, other solvent use 6.4%, chemical products 4.3%, other product use 0.1% and dry cleaning 0.1% (Figure 4.4).

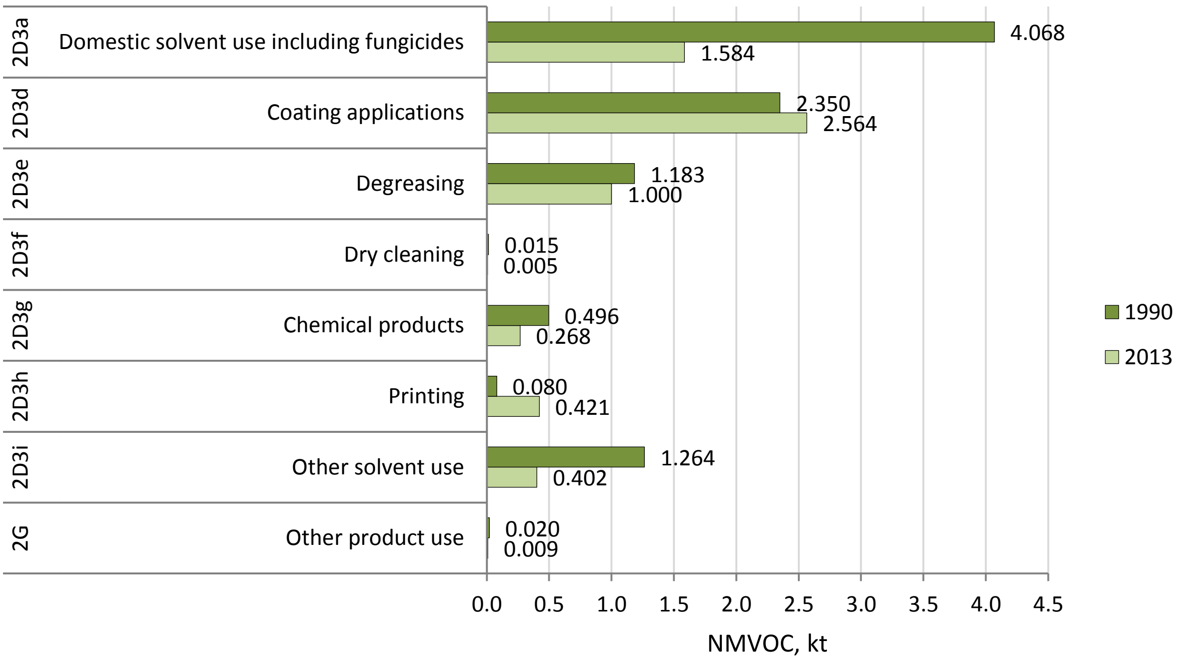


Figure 4.4 NMVOC emissions by sectors in 1990 and 2013

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 solvent sector by 34% (Figure 5.2). The trend in emissions is determined, in order of importance, by NFR categories 2D3d (Coating application) and 2D3a (Domestic solvent use). Two major categories where a decrease in NMVOC emissions has occurred in recent years include coating application (NFR 2D3d) and other solvent use (NFR 2D3i). The fluctuation of NMVOC emissions in the period 1990-2013 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 independence of the Estonian Republic and the cessation of large-scale production that was distinctive of 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, resulting in 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, which also greatly affectedthe Estonian economy. As a result, by the year 2010, NMVOC emissions fell 36% in comparison with 2006 (Figure 4.6). In 2011 there was a slight increase in NMVOC emissions by 8.9%, which means that the bottom of the emissions has been reached, and henceforward, the emissions will probably start to rise again. Nevertheless, in 2013 there was a minor decrease in NMVOC emissions by 5.4% in comparison with 2012. In 2004 and 2005, Estonia adopted directives 1999/13/EC[6] and 2004/42/EC into its legislation, but it seems that the economic growth at the time did not have a significant effect on the decrease in NMVOC emissions,which 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, which are calculated more precisely by the facilities than the emissions from the diffuse sources, represent only about 20% of total NMVOC emissions.

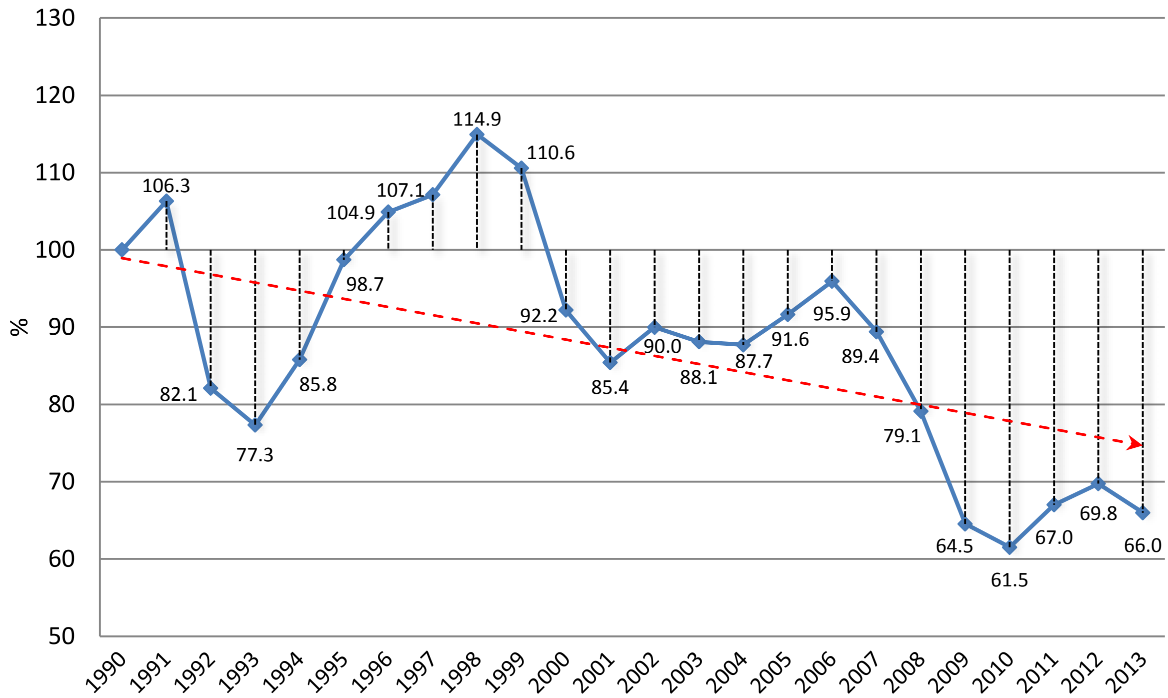


Figure 4.5 The dynamics of NMVOC emissions from the solvent and other product use sector in the period 1990-2013 (base year is 1990)

[6] In June 2013 Estonia adopted into its legislation Industrial Emissions Directive 2010/75/EU which replaced among other 6 European Commission directives also the Solvent Emissions Directive 1999/13/EC.

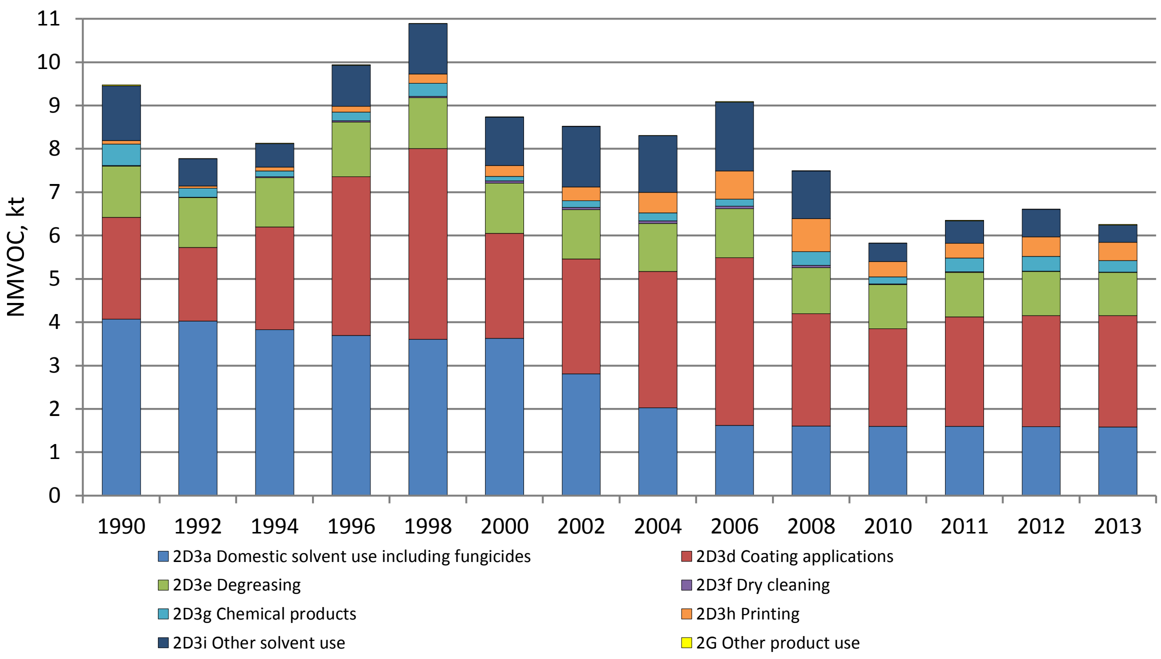


Figure 4.6 NMVOC emissions from the solvent and other product use sector in the period 1990-2013

Table 4.19 NMVOC emissions from the solvent and other product use sector in the period 1990-2013 (kt)

Sector	2D3a	2D3d	2D3e	2D3f	2D3g	2D3h	2D3i	2G
1990	4.068	2.350	1.183	0.015	0.496	0.080	1.264	0.020
1991	4.060	2.768	1.169	0.012	0.615	0.066	1.365	0.017
1992	4.027	1.700	1.149	0.011	0.201	0.054	0.628	0.009
1993	3.914	1.568	1.124	0.012	0.135	0.058	0.505	0.013
1994	3.825	2.374	1.136	0.018	0.135	0.090	0.540	0.011
1995	3.751	3.225	1.157	0.025	0.250	0.126	0.810	0.011
1996	3.691	3.668	1.258	0.030	0.197	0.134	0.949	0.010
1997	3.642	4.094	1.223	0.005	0.192	0.172	0.808	0.015
1998	3.608	4.398	1.178	0.024	0.307	0.214	1.154	0.010
1999	3.572	4.124	1.173	0.050	0.217	0.223	1.111	0.010
2000	3.629	2.418	1.159	0.050	0.107	0.249	1.115	0.009
2001	3.217	2.264	1.115	0.047	0.113	0.272	1.055	0.009
2002	2.809	2.651	1.134	0.056	0.151	0.323	1.393	0.011
2003	2.420	2.778	1.110	0.064	0.127	0.392	1.446	0.011
2004	2.022	3.150	1.103	0.064	0.184	0.474	1.303	0.011
2005	1.631	3.623	1.101	0.062	0.125	0.744	1.384	0.013
2006	1.621	3.866	1.128	0.065	0.158	0.655	1.588	0.012
2007	1.612	3.764	1.095	0.054	0.265	0.452	1.216	0.017
2008	1.606	2.588	1.067	0.051	0.314	0.765	1.097	0.007
2009	1.603	2.011	1.003	0.022	0.497	0.204	0.764	0.012
2010	1.600	2.246	1.023	0.012	0.164	0.354	0.425	0.006
2011	1.596	2.526	1.026	0.019	0.313	0.344	0.517	0.009
2012	1.590	2.564	1.016	0.008	0.337	0.456	0.630	0.009
2013	1.584	2.564	1.000	0.005	0.268	0.421	0.402	0.009
trend 1990-2013, %	**-61.1**	**9.1**	**-15.5**	**-63.2**	**-46.0**	**428.2**	**-68.2**	**-55.9**

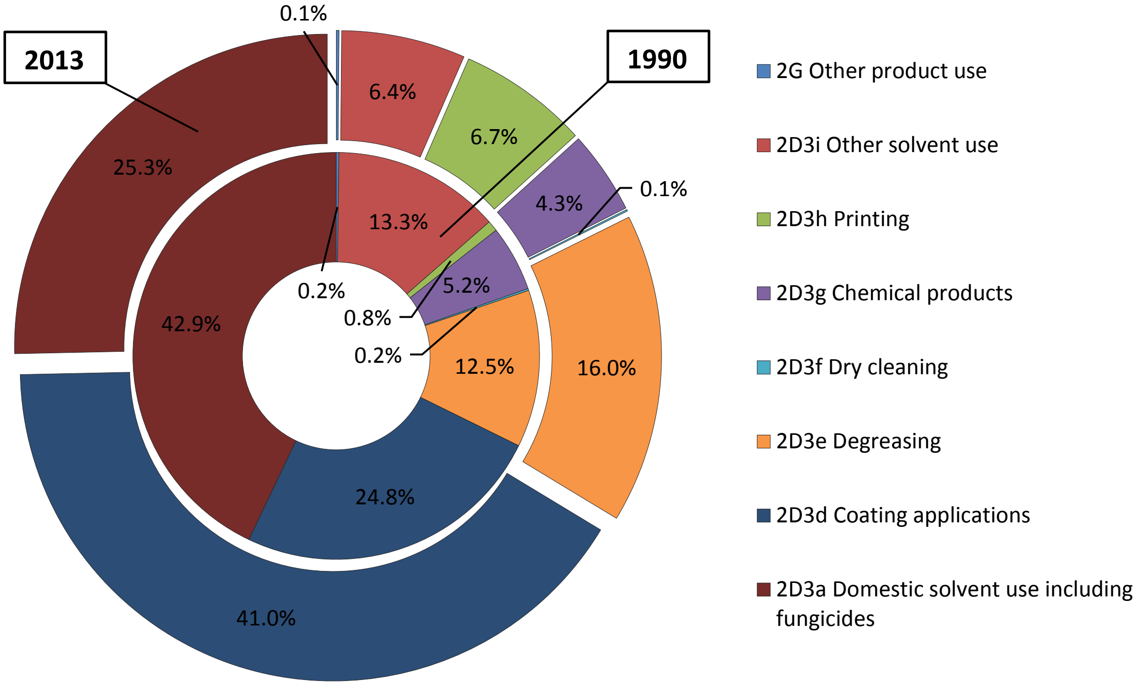


Figure 4.7 The share of NMVOC emissions in 1990 and 2013 by NFR solvent subcategory codes

4.2.3. 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 and gathered from Statistics Estonia and Eurostat using international emission factors and expert opinions. Information sources for the NMVOC inventory by different subcategories are presented in the Table 4.20 together with emission sources not included in the inventory.

Table 4.20 Information sources for the NMVOC inventory in solvent sector

PS – point sources
DS – diffuse sources

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
2D3d	Coating application: Solvents in paints	060101	Manufacture of automobiles	Reported by operators (for the years 2005-2007)	PS: facility specific
		060102	Car repairing	Expert estimate (DS); reported by operators (PS, since 2000)	DS: 600 g/kg paint applied (1990-1999); 400 g/kg paint applied (2000-2013) PS: facility specific
		060103	Construction and buildings	Statistics Estonia / Eurostat and expert estimate	DS: 217 g/kg of paint (1990-1999); 150 g/kg of paint applied (2000-2013)
		060104	Domestic use	Statistics Estonia /	

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
				Eurostat and expert estimate	
		060105	Coil coating	Reported by operators (since 2012)	PS: facility specific
		060106	Boat building	Reported by operators (since 2000)	PS: facility specific
		060107	Wood coating	Reported by operators (since 1993)	PS: facility specific
		060108	Other industrial paint application	Reported by operators (since 1990)	PS: facility specific
		060109	Other non-industrial paint application	Included in 060103 and 060104	NA
2D3e	Degreasing: Solvents in products	060200	Degreasing (vapour and cold cleaning)	Statistics Estonia / Eurostat	DS: 460 g/kg cleaning products (vapour); 0.7 kg/person/year (cold)
		060201	Metal degreasing (regarded as vapour cleaning)	Reported by operators (since 2001)	PS: facility specific
		060203	Electronic components manufacturing	Reported by operators (since 2000)	PS: facility specific
		060204	Other industrial cleaning	Reported by operators (since 2001)	PS: facility specific
2D3f	Dry cleaning: Chlorinated solvents in products	060202	Dry cleaning	Statistics Estonia / Eurostat; reported by operators (since 2002)	DS: 400 g/kg solvent use PS: facility specific
2D3g	Solvents in chemical products manufacture and processing	060300	Chemical products manufacturing or processing	Aggregated emissions for the whole SNAP 0603.., reported by operators (1990-2005)	PS: facility specific
		060301	Polyester processing	Not relevant	NA
		060302	Polyvinylchloride processing	Not relevant	NA
		060303	Polyurethane processing	Reported by operators (since 2006)	PS: facility specific
		060304	Polystyrene foam processing	Reported by operators (since 2006)	PS: facility specific
		060305	Rubber processing	Reported by operators (since 2006)	PS: facility specific
		060306	Pharmaceutical products manufacturing	Not included	NA
		060307	Paints manufacturing	Reported by operators (since 2006)	PS: facility specific
		060308	Inks manufacturing	Reported by operators (since 2007)	PS: facility specific
		060309	Glues manufacturing	Reported by operators (since 2006)	PS: facility specific
		060310	Asphalt blowing	Not occurring	NO
		060311	Adhesive,	Not included	NA

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
			magnetic tapes, films and photographs manufacturing		
		060312	Textile finishing	Reported by operators (since 2006)	PS: facility specific
		060313	Leather tanning	Reported by operators (since 2006)	PS: facility specific
		060314	Other	Reported by operators (since 2006)	PS: facility specific
2D3h	Printing ink and solvents in printing houses	060403	Printing industry	Statistics Estonia / Eurostat; reported by operators (since 2001)	DS: 500 g/kg ink; PS: facility specific
2D3a	Personal care, household cleaning agents, car care products, cosmetics and toiletries, adhesives and sealants, pharmaceutical products	060408	Domestic solvent use (other than paint application)	Statistics Estonia	DS: 2,59 kg/person/year (1990-2000); 1,2 kg/person/year (since 2005); EFs for the years 2001-2004 are interpolated
		060411	Domestic use of pharmaceutical products	Included under SNAP 060408	DS: 1.8% share of the previous emission factors
2D3i	Other solvent use	060400	Other use of solvents and related activities	Aggregated emissions for the whole SNAP 0604.., except 060405; reported by operators (1990-1999)	PS: facility specific
		060401	Glass wool enduction	Not included	NA
		060402	Mineral wool enduction	Not included	NA
		060404	Fat, edible and non edible oil extraction	Reported by operators (since 2002)	PS: facility specific
		060405	Application of glues and adhesives	Statistics Estonia / Eurostat; reported by operators (since 1990)	DS: 780 g/kg adhesives (1990-2000); 522 g/kg adhesive (since 2005); EFs for the years 2001-2004 are interpolated; PS: facility specific
		060406	Preservation of wood	Reported by operators (since 2000)	PS: facility specific
		060407	Underseal treatment and conservation of vehicles	Eurostat (1990-2004; since 2005 any occuring emissions are considered negligible)	DS: see Chapter 4.2.10.2 subparagraph 5
		060409	Vehicles dewaxing	Not included (emissions are negligible)	NA
		060412	Other (preserva-tion of seeds,…)	Reported by operators (since 2000)	PS: facility specific
2G	Other product use	060602	Use of tobacco	Statistics Estonia /	DS: 4.84 kg/Mg

NFR	Product group	SNAP	Activity where used	Activity data	NMVOC emission factors
				Eurostat	tobacco
		060603	Use of shoes	Not included	NA

Emissions, other than NMVOC, are taken from the OSIS database (reported by operators and are facility specific), except emissions from fireworks and tobacco use, where Tier 2 emission factors are taken from the EMEP/EEA Guidebook 2013.

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 collected in the annual air emissions report for the solvent use are:

- Class – solvent, varnish, adhesive, paint or other preparation that do not fall into 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 – not required since 2012) 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 (not required since 2012), NMVOC emissions in tonnes per year;
- The number of a source of pollution on a plan or map of the facility.

4.2.4. Coating Applications (NFR 2D3d)

4.2.4.1. 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, which will also be emitted. Further solvent 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 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 2013, NMVOC emissions from this sector had increased by 9.1% compared to 1990.

Coating application is divided into three major categories:

1) Decorative coating application;
2) Industrial coating application;
3) Other coating application.

Decorative coating application activity 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.

Industrial coating application describes the following sub-categories of paint application:

- manufacture of automobiles (SNAP activity 060101);
- car repairing (SNAP activity 060102);
- coil coating (SNAP activity 060105);
- boat building (SNAP activity 060106);
- wood (SNAP activity 060107) and
- other industrial paint application (SNAP activity 060108).

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

Other coating application (SNAP activity 060109 – other non-industrial paint application) 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 not covered by any of the other SNAP codes described in the "Coating applications" 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 decorative coating application because it is very complicated to distribute paint use between decorative coating and other coating application activities.

4.2.4.2. Methodological issues

The Tier 1 default emission factors have been taken from the online version of the GAINS model (IIASA, 2008[7]). A (rounded) weighted average emission factor over all the countries in the model has been derived from dividing the total NMVOC emissions by the total paint use. Data for the year 2000 have 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 the 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 Solvent Emissions Directive (1999/13/EC).

In Estonia, the directive 2004/42/EC was implemented in 2005 and came into force in 2007 (I stage) and 2010 (II stage). The Solvent Emissions Directive (1999/13/EC) was implemented and came into force in 2004 (2007 for existing installations). In 2013 Estonia implemented the Industrial Emissions Directive 2010/75/EU.

[7] IIASA (2008). Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model, www.iiasa.ac.at/rains/gains-online.html.

Decorative coating application

For the years 2000-2009, the EMEP Guidebook 2013 Tier 1 emission factor 150 g/kg paint applied is used for calculations. The general equation is:

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

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 paint applied (average 350 g/kg paint applied is used) and for water borne paints is 33 g/kg paint applied.

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. Furthermore, by 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 paint applied

Industrial coating application

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

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

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, the 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 applied, no abatement included). The emission factor 600 g/kg paint applied 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.

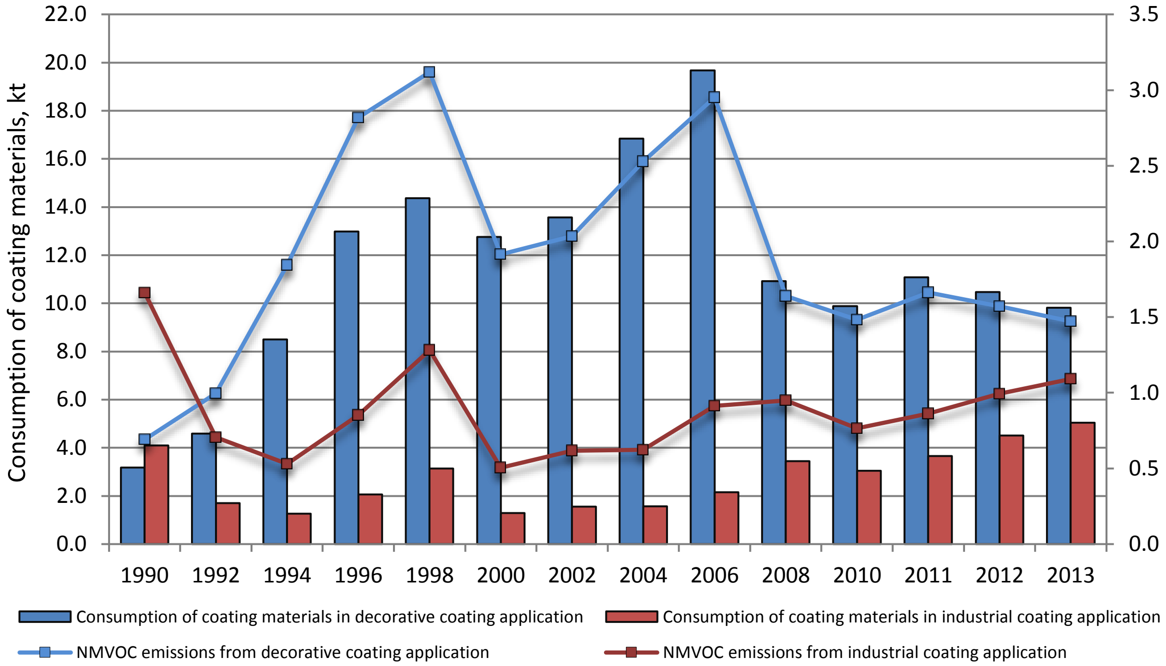


Figure 4.8 Consumption of coating materials and NMVOC emissions from decorative and industrial coating application in the period 1990-2013

The huge drop in industrial paint consumption and NMVOC emissions in 1992 (Figure 4.8) was due to the renewed independence of the Estonian Republic and the cessation of large-scale production distinctive of the Soviet Union. A huge restructuring in industry took place, and many of the large enterprises went bankrupt and were shut down because of inefficient operation.

NMVOC emissions and activity data in Figure 4.8 are based on data presented in Table 4.22 on pages 168-169.

4.2.4.3. 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 (for the years 1995-2001) and Eurostat (for the years 2002 and onward).

Data related to import and export are not available for the years 1990-1994; therefore, these amounts were calculated using the change in the current prices at that time in the 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. Also, some of the paint is used for car repairing.

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 202.8 tonnes in 2013. 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 (NMVOC: 400 g/kg paint applied). All reported emissions from point sources are estimated to be from industrial coating applications.

Data regarding paint use in point sources are available in the OSIS database for the years 2006-2013.

Decorative paint is used by construction enterprises, professional painters (SNAP 060103) and private consumers (SNAP 060104) (Table 4.21).

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

The main paint production companies, some of which have no direct sales department, were not able to answer this question.

In addition, interviews conducted at large construction stores revealed that:

1. sales division by companies and private customers depends on the marketing policy of the store,
2. a change in the division between 1995 and 2013 also depends on the marketing policy, and
3. in the years 2004-2007, an increase in 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 2001-2007, Estonia experienced extensive development and construction, during which time 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 2008-2013, 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 to have been used by professional painters and construction companies. The year 2004 is viewed as a transitional year between 2003 and 2005.

Table 4.21 NMVOC emissions and the consumption of coating materials from decorative paint application by SNAP codes in the period 1990-2013 (kt)

SNAP code	060103		060104	
Year	NMVOC	Activity data	NMVOC	Activity data
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	8.138	0.814	5.426
2003	1.332	8.880	0.888	5.920
2004	1.687	11.242	0.840	5.600
2005	2.126	14.163	0.765	5.100
2006	2.187	14.581	0.765	5.100
2007	1.982	13.211	0.765	5.100
2008	0.983	6.552	0.655	4.368
2009	0.833	5.554	0.555	3.703
2010	0.889	5.927	0.593	3.951
2011	0.998	6.651	0.665	4.434
2012	0.943	6.285	0.629	4.190
2013	0.884	5.890	0.589	3.927

Table 4.22 NMVOC emissions and consumption of coating materials from industrial paint application by SNAP codes in the period 1990-2013 (kt)

SNAP code	060100		060101		060102		060105		060106		060107		060108	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
1990	1.575	3.938	NA	NA	0.060	0.100	NA	NA	IE[1]	IE[1]	IE[1]	IE[1]	0.025	0.063
1991	1.955	4.887	NA	NA	0.063	0.104	NA	NA	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
1992	0.639	1.598	NA	NA	0.065	0.109	NA	NA	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]	IE[1]
1993	0.428	1.071	NA	NA	0.068	0.113	NA	NA	IE[1]	IE[1]	0.054	0.135	IE[1]	IE[1]
1994	0.430	1.076	NA	NA	0.071	0.118	NA	NA	IE[1]	IE[1]	0.027	0.067	0.001	0.004
1995	0.795	1.989	NA	NA	0.073	0.122	NA	NA	IE[1]	IE[1]	0.047	0.119	0.094	0.236
1996	0.626	1.565	NA	NA	0.076	0.126	NA	NA	IE[1]	IE[1]	0.037	0.093	0.112	0.280
1997	0.610	1.526	NA	NA	0.078	0.131	NA	NA	IE[1]	IE[1]	0.097	0.243	0.112	0.280
1998	0.976	2.439	NA	NA	0.081	0.135	NA	NA	IE[1]	IE[1]	0.110	0.276	0.113	0.284
1999	0.689	1.721	NA	NA	0.084	0.140	NA	NA	IE[1]	IE[1]	0.088	0.220	0.113	0.284

SNAP code	060100		060101		060102		060105		060106		060107		060108	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
2000	--	--	NA	NA	0.058	0.178	NA	NA	0.117	0.292	0.119	0.298	0.211	0.528
2001	--	--	NA	NA	0.059	0.175	NA	NA	0.116	0.290	0.218	0.544	0.054	0.136
2002	--	--	NA	NA	0.061	0.161	NA	NA	0.080	0.201	0.244	0.611	0.231	0.577
2003	--	--	NA	NA	0.063	0.164	NA	NA	0.082	0.206	0.184	0.461	0.229	0.572
2004	--	--	NA	NA	0.065	0.170	NA	NA	0.137	0.342	0.209	0.523	0.212	0.530
2005	--	--	0.002	0.004	0.066	0.169	NA	NA	0.131	0.329	0.184	0.459	0.350	0.874
2006	--	--	0.003	0.006	0.068	0.170	NA	NA	0.171	0.505	0.407	0.828	0.265	0.650
2007	--	--	0.002	0.002	0.072	0.178	NA	NA	0.357	1.126	0.439	1.191	0.147	0.659
2008	--	--	NO	NO	0.073	0.183	NA	NA	0.335	1.024	0.369	1.188	0.173	1.050
2009	--	--	NO	NO	0.075	0.187	NA	NA	0.160	0.477	0.302	1.362	0.085	0.343
2010	--	--	NO	NO	0.076	0.191	NA	NA	0.157	0.575	0.409	1.552	0.123	0.730
2011	--	--	NO	NO	0.077	0.196	NA	NA	0.135	0.470	0.463	2.056	0.188	0.938
2012	--	--	NO	NO	0.078	0.208	0.002	0.005	0.109	0.385	0.539	2.723	0.264	1.193
2013	--	--	NO	NO	0.084	0.221	0.011	0.021	0.117	0.385	0.575	3.158	0.304	1.257

NMVOC emissions presented in Table 5.5 are collected from point sources. Emissions for the period 1990-1999 are received from facilities on paper reports; 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. Since 2006 detailed emissions and activity data are reported electronically by facilities directly into the OSIS database.

4.2.4.4. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions and emission data from the OSIS database arecompared 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 arestudied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by the specialists in the Estonian Environment Agency.

4.2.4.5. 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,which 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.

4.2.5. Degreasing (NFR 2D3e)

4.2.5.1. Source category description

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 perfluoro-carbons (PFCs) (ETC/AEM-CITEPA-RISOE, 1997[8]).

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 Solvent 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 2013, NMVOC emissions from this sector had decreased by 15.5% in comparison to the year 1990.

Vapour cleaning

The most common organic solvents for vapour cleaning are:

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

The use of chlorofluorocarbons (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 TRI. Further details of the calculation of the emissions can be found in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The application of MC, PER and TRI normally requires a closed cleaning machine.

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 they generally use petroleum solvents as mineral spirits (petroleum distillates and Stoddard solvents).

---

[8] ETC/AEM-CITEPA-RIOSE (1997). Selected nomenclature for air pollution for Corinair94 inventory (SNAP 94), version 0.3 (draft).

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 the cleaning efficiency is improved by agitation. Small cold cleaning operations may be numerous in urban areas.

4.2.5.2. Methodological issues

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 2013) is considered for emission calculations.
2) Cold cleaning – emission from the rest of vapour cleaning is estimated by different emission factors by the inhabitant.

Emission factor for vapour cleaning

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

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

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.

Emission factor for cold cleaning

The emission factor used for cold cleaning is 0.7 kg/person/year, which is derived from an expert estimate made by the VTT Technical Research Centre of Finland[9].

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

4.2.5.3. 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) for the years 1995-2001 and from Eurostat for the years 2002 and onward. Data regarding import and export are 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 2013.

Cold cleaning operations

The basic activity statistics for using the Finnish emission factor are national population figures. Data regarding population by counties are available from Statistics Estonia.

4.2.5.4. 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 2013, the OSIS database received activity data regarding solvent use for degreasing in point sources.

For the years 2006-2013, activity data for calculations were calculated as follows:

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

Some companies reported emissions between 1995 and 2005, but without access to activity data. Emissions from point sources were subtracted from the total calculated NMVOC emission.

Table 4.23 NMVOC emissions and the consumption of solvents from degreasing by SNAP codes in the period 1990-2013

SNAP code	060200		060200		060201		060203		060204	
Year	NMVOC (vapour cleaning), kt	Activity data, kt	NMVOC (cold cleaning), kt	Activity data, mln.inhab.	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	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	0.388	0.981	1.401	NA	NA	0.001	0.001	NA	NA
2001	0.137	0.305	0.975	1.393	0.0007	0.0015	0.002	0.004	0.00061	0.00133
2002	0.160	0.359	0.968	1.384	0.0026	0.0057	0.002	0.005	0.00048	0.00104
2003	0.142	0.320	0.963	1.375	0.0025	0.0053	0.002	0.005	0.00057	0.00124
2004	0.141	0.319	0.956	1.366	0.0031	0.0068	0.003	0.006	0.00006	0.00013
2005	0.146	0.326	0.951	1.359	0.0003	0.0007	0.003	0.006	0.00051	0.00111
2006	0.157	0.342	0.945	1.351	0.0015	0.0028	0.018	0.056	0.00518	0.00582
2007	0.127	0.277	0.940	1.343	0.0048	0.0059	0.009	0.021	0.01300	0.01413
2008	0.085	0.184	0.937	1.338	0.0005	0.0006	0.013	0.026	0.03204	0.03824
2009	0.044	0.096	0.935	1.336	0.0059	0.0067	0.005	0.008	0.01243	0.01840
2010	0.057	0.125	0.933	1.333	0.0115	0.0119	0.005	0.008	0.01587	0.01989
2011	0.056	0.121	0.931	1.330	0.0074	0.0075	0.005	0.008	0.02707	0.02822
2012	0.040	0.086	0.928	1.325	0.0051	0.0062	0.003	0.008	0.04011	0.03620
2013	0.032	0.071	0.924	1.320	0.0047	0.0074	0.002	0.006	0.03640	0.04845

For the SNAP codes 060201, 060203 and 060204, emissions and solvent consumption are based only on the reported data from the point sources for the period 2001-2013.

4.2.5.5. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions and emission data from the OSIS database are 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 are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.5.6. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.6. Dry cleaning (NFR 2D3f)

4.2.6.1. Source category description

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

4.2.6.2. Methodological issues

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 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 into 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[10]; UBA, 1989[11]). 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.

[10] Passant N.R. (1993). Emissions of Volatile Organic Compounds from Stationary Sources in the United Kingdom: A Review of Emission Data by Process.
[11] UBA (1989). Luftreinhaltung ’89 – Tendenzen – Probleme – Lösungen. Edited by the German Federal Protection Agency (Umweltbundesamt), Erich Schmidt Verlag GmbH, Berlin 1989.

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[12]) – 40 g/kg textile treated.

Situation in Estonia

In order to understand the market situation, a descriptive interview with the representative of the main dry cleaning service provider, SOL Estonia, was carried out in 2010. SOL Estonia operates eight dry cleaning facilities in Tallinn, Pärnu, Kunda and Tartu.

Main findings for Estonia are:

- closed-circuit equipment is 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 e-mail. Questions and answers are presented in the Table 4.24.

Table 4.24 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

4.2.6.3. Activity data

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

[12] IIASA (2008). Greenhouse Gas and Air Pollution Integrations and Synergies (GAINS) model, www.iiasa.ac.at/rains/gains-online.html.

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 2006-2013.

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.

4.2.6.4. Results

Perchloroethylene might also be used in the degreasing process. It is difficult to divide the consumption of PER between dry cleaning and degreasing, which is why all PER used in Estonia is deemed to be 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 4.25 NMVOC emissions and the consumption of solvents from dry cleaning in the period 1990-2013 (kt)

SNAP code	060202	
Year	NMVOC	Activity data
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	0.152
2005	0.062	0.149
2006	0.065	0.158
2007	0.054	0.131

SNAP code	060202	
Year	NMVOC	Activity data
2008	0.051	0.124
2009	0.022	0.052
2010	0.012	0.027
2011	0.019	0.042
2012	0.008	0.017
2013	0.005	0.094

For the dry cleaning sector for the years 1990 to 2001, only statistical data are used, whereas for the period 2002 to 2013, both statistical and reported data are used.

4.2.6.5. 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 are 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 are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.6.6. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.7. Chemical Products (NFR 2D3h)

4.2.7.1. 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, the total NMVOC emissions from these activities contributed just 0.8% to the total national NMVOC emissions in 2013 and only 4.3% to the whole solvent sector.

By 2013, NMVOC emissions from the chemical products sector had decreased 46% compared to the year 1990.

4.2.7.2. 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 2006-2013 from the chemical products sector are based on emission data reported by operators in the OSIS database; hence they are divided by different SNAP codes. At present, only the total NMVOC emissions for the years 1990-2005 are known to be without any activity data. Also, for some activities within NFR 2D3h, the activity data are unknown for the period 2006-2013.

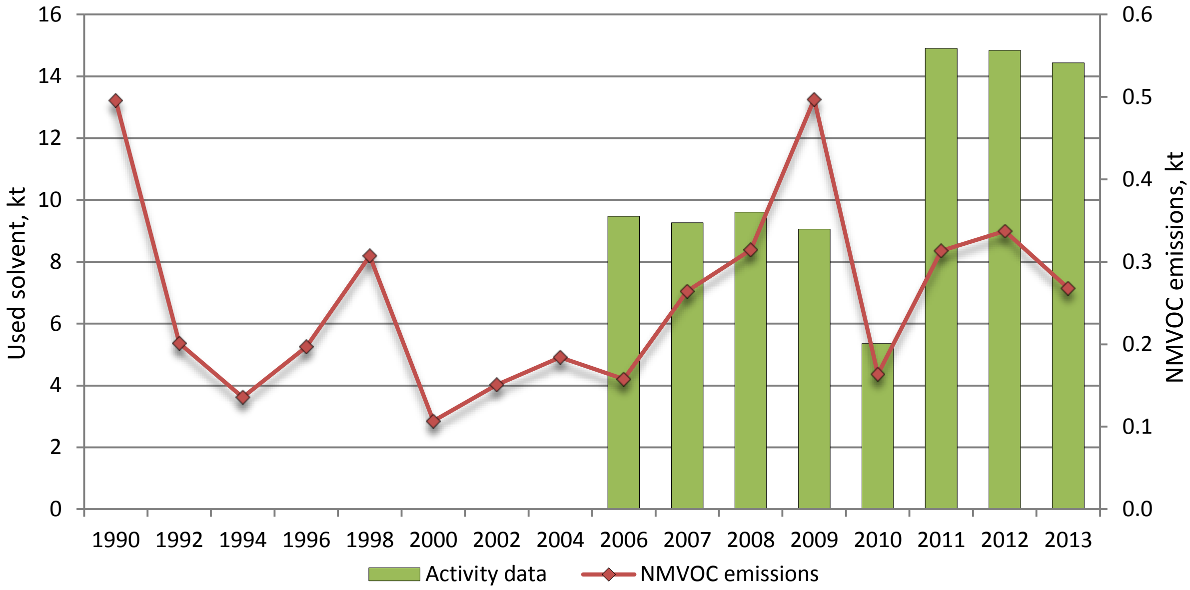


Figure 4.9 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period 1990-2013

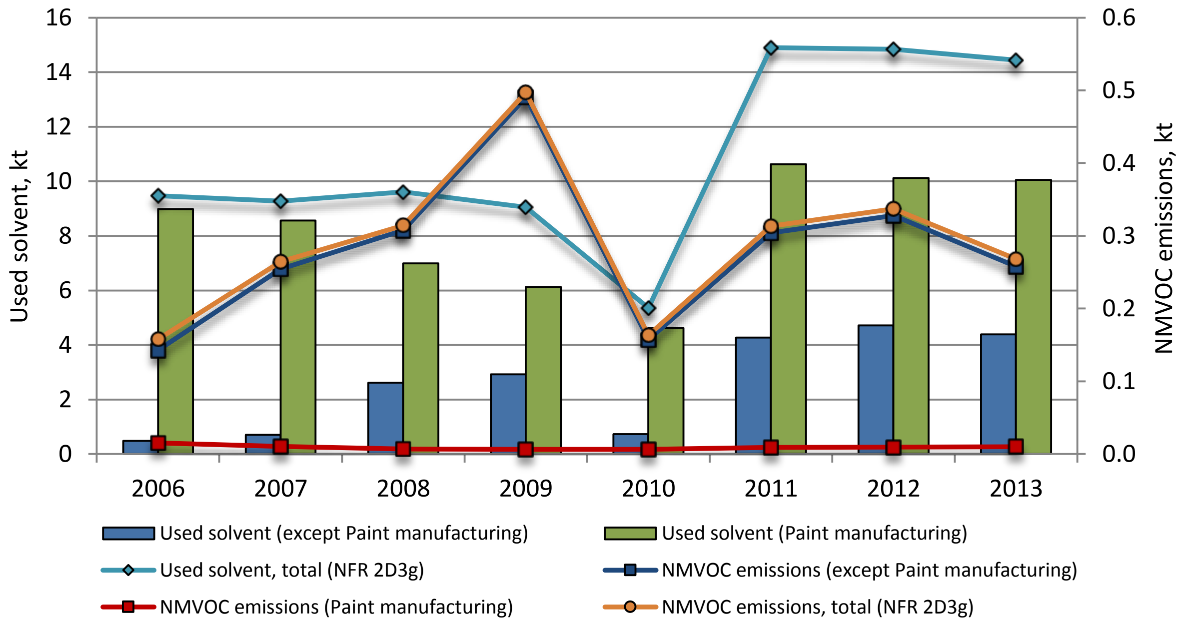


Figure 4.10 Consumption of solvents and NMVOC emissions from chemical products manufacturing or processing in the period 2006-2013

Figure 4.10 explains quite well why Figure 4.9 indicates that NMVOC emissions still grew from 2006 to 2009, although the amount of used solvent remained almost constant through that period. It is clear that the dynamics of emissions are dependent on the changes in used solvent within the sector, except the solvent used in paint manufacturing. It is because the emissions in paint manufacturing are marginal and do not affect the dynamics of the total NMVOC emissions in that sector.

NMVOC emissions for the period 1990 to 2005 came only from point sources, but without the availability of the activity data for that period.

Table 4.26 NMVOC emissions and the consumption of solvents from chemical products manufacturing or processing by SNAP codes in the period 1990-2013 (kt)

SNAP code	060300		060303		060304		060305		060307	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
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
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
2013	--	--	0.009988	3.589655	0.057	0.079	0.021	0.018	0.010	10.046

SNAP code	060308		060309		060312		060313		060314	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
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

SNAP code	060308		060309		060312		060313		060314	
Year	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data	NMVOC	Activity data
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
2013	NA	NA	0.000072	NA	0.000330	0.000135	0.000008	0.017625	0.170	0.688

4.2.7.3. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Emission data from the OSIS database is 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 are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.7.4. Source-specific planned improvements

As some activities are not included in this inventory (by the SNAP codes 060301, 060302, 060306, 060311), it is necessary to research whether the emissions from these activities are important for this inventory or whether they exist in Estonia at all. It is also necessary to review NMVOC emissions for the years 1990-2005 and to study the possibility of obtaining the activity data for these emissions.

4.2.8. Printing (NFR 2D3h)

4.2.8.1. Source category description

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 varying 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 the 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 indicates that this industry has already reduced some emissions (EGTEI, 2005[13]).

- Publication packaging

At the 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[8]).

- Rotogravure & Flexography

At the 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[8]).

The emissions of NMVOCs from printing have been significantly reduced following the introduction of the Solvent 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 tonnes/year for the heat set offset and flexography/rotogravure in packaging and 25 tonnes/year for the 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 about 100 printing facilities in Estonia. Based on their main field of activity, they 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.

(*Photo by Mari Luud; The printing machine of Kroonpress AS*)

[13] EGTEI (2005), Heatset Offset: synopsis sheet.

4.2.8.2. Methodological issues

The Tier 1 emission factor 500 g/kg ink is used for the calculations of emissions from the printing sector for diffuse sources. 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 solvent consumption data are 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 the 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[14], 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 does not change over the period.

4.2.8.3. Activity Data

The quantity of ink (CN code 3215) used in Estonia can be estimated by the import and export data from Statistics Estonia (1995-2001) and Eurostat (2002 and onward). 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 the industrial production of chemicals and chemical products in that period.

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

4.2.8.4. Results

A number of printing facilities is permitted.

Between 2006 and 2013, activity data regarding ink use in point sources were collected in the OSIS database. For the years 2006 to 2013, activity data for calculations were calculated as follows:

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

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

Table 4.27 NMVOC emissions and the consumption of solvents from the printing industry by SNAP code in the period 1990-2013 (kt)

SNAP code	060403	
Year	NMVOC	Activity data
1990	0.080	0.160
1991	0.066	0.133
1992	0.054	0.109
1993	0.058	0.116
1994	0.090	0.180
1995	0.126	0.252
1996	0.134	0.269
1997	0.172	0.345
1998	0.214	0.427
1999	0.223	0.445
2000	0.249	0.498
2001	0.272	0.545
2002	0.323	0.645
2003	0.392	0.783
2004	0.474	0.949
2005	0.744	1.488
2006	0.655	1.740
2007	0.452	2.012
2008	0.765	2.314
2009	0.204	1.660
2010	0.354	2.150
2011	0.344	2.063
2012	0.456	2.385
2013	0.421	2.225

4.2.8.5. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Emission data from the OSIS database are 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 are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Estonian Environmental Board and then by specialists from the ESTEA.

4.2.8.6. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.9. Domestic solvent use including fungicides (NFR 2D3a)

4.2.9.1. Source category description

Emissions occur due to the evaporation of NMVOCs contained in the products during their domestic use. This category does not include the use of decorative paints, which is covered under NFR 2D3d coating applications.

The products sold for public use can be divided into a number of categories:

Table 4.28 Description of the product categories used in the NFR category 2D3a

Category	Description
Cosmetics and toiletries	Products for the maintenance or improvement of personal appearance, health or hygiene.
Household (cleaning) products	Products used to maintain or improve the appearance of household durables.
Construction/DIY	Products used to improve the appearance or the structure of buildings such as adhesives and paint remover. This sector would also normally include coatings; however these fall outside the scope of this section and will be omitted.
Car care products	Products used for improving the appearance of vehicles to maintain vehicles or winter products such as antifreeze.

Pesticides such as garden herbicides and insecticides and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this sector. Domestic use of pharmaceutical products and emissions of other pollutants, such as Hg, are also included in this category.

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.

In 2013, NMVOC emissions from the NFR 2D3a sector decreased by 61.1% compared to the year 1990.

4.2.9.2. Methodological issues

The Tier 1 default 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 domestic solvent use;
$EF_{pollutant}$ = the emission factor for this pollutant.

Table 4.29 presents the EMEP/EEA Guidebook 2013 default emission factors for NFR source category 2D3a for NMVOC and Hg, for EU-15 including Iceland, Norway and Switzerland. This table also presents additional information on Tier 1 emission factors for the four main subcategories: household products, car care products, cosmetics and toiletries, DIY/buildings in addition to pharmaceutical products and other various products.

Table 4.29 Tier 1 emission factors for NFR source category 2D3a domestic solvent use including fungicides

Source category	Pollutant	Share, %	Value	Unit
Domestic solvent use including fungicides, total	**Σ NMVOC**	**100.0**	**2,700**	**g/person**
Household (cleaning) products	NMVOC	18.7	507	g/person
Car care products	NMVOC	17.2	464	g/person
Cosmetics and toiletries	NMVOC	40.2	1,088	g/person
DIY/building	NMVOC	19.3	522	g/person
Pharmaceutical products (SNAP 060411)	NMVOC	1.8	48	g/person
Various	NMVOC	2.8	76	g/person
Domestic solvent use including fungicides (fluorescent tubes)	**Hg**	**--**	**5.6**	**g/person**

An IIASA Tier 1 NMVOC emission factor for western European Union Member States (EU-15 including Iceland, Norway and Switzerland) is 1,519 ± 559 g/person. An IIASA Tier 1 NMVOC emission factor for eastern EU countries (EU-12 and 12 EECCA countries) is 703 ± 273 g/person. This suggests that an emission factor for EU-12 can be derived from Table 4.29 by multiplying with a factor 703 / 1,519 = 0.46. Total 2D3a for EU-12 and 12 EECCA countries is thus: 0.46 * (2,700 (-1,700; +3,700) = 1,200 (-780; +1,700) g/person. The derived emission factor is used to calculate NMVOC emissions from the NFR sector 2D3a for the years 2005 and onward.

NMVOC emissions for years 1990-2000 are calculated using EMEP/Corinair Emission Inventory Guidebook 2007 Tier 1 default emission factor for domestic solvent use 2,590 g/person. The emission factors for years 2001-2004 are interpolated.

4.2.9.3. Activity Data and results

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

Table 4.30 NMVOC and Hg emissions from domestic solvent use (other than paint application) and the population of Estonia in the period 1990-2013

Year	**Population, mln.inhab.**	**NMVOC emissions by domestic solvent use categories, kt**							**Hg emissions, t**
		House-hold products	Car care products	Cosmetics and toiletries	DIY/ building	Pharmaceutical products (SNAP 060411)	Various	**Total (SNAP 060408)**	
1990	1.571	0.762	0.698	1.636	0.785	0.072	0.114	**4.068**	0.008795
1991	1.568	0.761	0.697	1.633	0.784	0.072	0.114	**4.060**	0.008779
1992	1.555	0.755	0.691	1.620	0.777	0.071	0.113	**4.027**	0.008707
1993	1.511	0.734	0.671	1.574	0.755	0.069	0.110	**3.914**	0.008463
1994	1.477	0.717	0.656	1.539	0.738	0.068	0.107	**3.825**	0.008271
1995	1.448	0.703	0.643	1.509	0.724	0.067	0.105	**3.751**	0.008109
1996	1.425	0.692	0.633	1.485	0.712	0.066	0.104	**3.691**	0.007981
1997	1.406	0.683	0.625	1.465	0.703	0.065	0.102	**3.642**	0.007874
1998	1.393	0.676	0.619	1.451	0.696	0.064	0.101	**3.608**	0.007801
1999	1.379	0.670	0.613	1.437	0.689	0.063	0.100	**3.572**	0.007724
2000	1.401	0.680	0.623	1.460	0.700	0.064	0.102	**3.629**	0.007847
2001	1.393	0.603	0.552	1.294	0.621	0.057	0.090	**3.217**	0.007799
2002	1.384	0.526	0.482	1.130	0.542	0.050	0.079	**2.809**	0.007748
2003	1.375	0.454	0.415	0.974	0.467	0.043	0.068	**2.420**	0.007701
2004	1.366	0.379	0.347	0.813	0.390	0.036	0.057	**2.022**	0.007651
2005	1.359	0.306	0.280	0.656	0.315	0.029	0.046	**1.631**	0.007610
2006	1.351	0.304	0.278	0.652	0.313	0.029	0.046	**1.621**	0.007564
2007	1.343	0.302	0.276	0.648	0.311	0.029	0.045	**1.612**	0.007520
2008	1.338	0.301	0.276	0.646	0.310	0.029	0.045	**1.606**	0.007495
2009	1.336	0.300	0.275	0.645	0.309	0.028	0.045	**1.603**	0.007480
2010	1.333	0.300	0.274	0.644	0.309	0.028	0.045	**1.600**	0.007466
2011	1.330	0.299	0.274	0.642	0.308	0.028	0.045	**1.596**	0.007446
2012	1.325	0.298	0.273	0.640	0.307	0.028	0.045	**1.590**	0.007421
2013	1.320	0.297	0.272	0.637	0.306	0.028	0.045	**1.584**	0.007393

4.2.9.4. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions are compared to the previous years in order to detect calculation errors.

4.2.9.5. Source-specific planned improvements

No major improvements are planned for the next submission.

4.2.10. Other solvent use (NFR 2D3i)

4.2.10.1. Source category description

This sector includes activities such as fat, edible and non-edible oil extraction, application of glues and adhesives, preservation of wood, underseal treatment and conservation of vehicles and vehicles dewaxing.

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.

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 the NFR source category 2D3a, 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.

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 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, while others do only the driver’s door; some do the horizontal surfaces while others do the sides as well.

There are various 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.

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 insignificant.

5) Industrial application of adhesives

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

Relevant sectors include 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, the wood material and furniture industry (EGTEI, 2003[15]).

In 2013, NMVOC emissions from the NFR 2D3i sector decreased by 68.2% compared to the year 1990.

4.2.10.2. Methodological issues

1) Glass and Mineral wool enduction (SNAP 060401, 060402)

This is not included in the emissions inventory due to the lack of information on whether these activities have been conducted in Estonia.

[15] EGTEI (2003). Final background documents on the sectors 'Industrial application of adhesives' and 'Fat, Edible and Non-Edible Oil Extraction'. Prepared in the framework of EGTEI by CITEPA, Paris.

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 carried out in 2010 with a representative of the company determined that the company does not use solvents for oil extraction.

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

In the second largest oil producer, 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 discovered 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 mechanically cold pressed.

As 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 adhere to the environmental permit.

3) Application of glues and adhesives (SNAP 060405)

The Tier 2 emission factor is used for calculations – 780 g/kg adhesive[16] for the period of 1990-2000, 522 g/kg adhesive[17] for the period of 2005 and onward. The emission factors for the period of 2001-2004 are interpolated.

Activity data

Solvent borne adhesives have the CN code 3506 91 00 (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 3506 91 00). Import and export data are available from Statistics Estonia and Eurostat. Production data are available from the OSIS database for the years 2006-2013. At present, there is no information available regarding adhesive production between 1990 and 1999.

[16] EMEP/EEA Emission Inventory Guidebook 2009.
[17] EMEP/EEA Emission Inventory Guidebook 2013.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2013, activity data regarding adhesives use in point sources are collected in the OSIS database (SNAP 060405).

For the years 2006-2013, activity data for calculations are calculated as follows:

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

In 2000-2005, according to CollectER, some companies reported as point sources, but no activity data are available. Emissions from point sources are subtracted from the total calculated NMVOC emissions.

4) Preservation of wood (SNAP 060406)

The Estonian Forest Industries Association was questioned in 2010 regarding wood preservation.

Most of the preservation operations are carried out using waterborne preservatives. Before it was banned in 2004, chromated copper arsenate (CCA) was used. CCA is a waterborne preservative. Some creosote and shale oil were used in the past. Nowadays, creosote is not believed to be used; hence, 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 fm (Festmeter[18]). The largest wood impregnation companies were the following (only waterborne preservatives were used):

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

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

The major solvent borne supplier VBH was contacted, and it was discovered that companies that apply 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.

[18] The Festmeter is that amount of solid wood which is contained in a one-meter cube; it is therefore identical with one cubic meter of solid wood.

5) Underseal treatment and conservation of vehicles (SNAP 060407)

There is no statistical information regarding the treatment of vehicles. Therefore, in 2010 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 lower than the number of cars per inhabitant in the European Union, a reduction coefficient for the emission factor is applied.

Table 4.31 Motorisation rate - cars per 1,000 inhabitants[19]

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%
2001	298	480	62%
2002	294	485	61%
2003	320	489	65%
2004	349	490	71%

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 considered equal with the year 1991.

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

The customised 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, emission factors for the years 2001-2004 are not calculated using the previous method and are reduced 10% per year from the year 2000.

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 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 as it is difficult to obtain relevant data. Most dewaxing operations of imported cars are conducted in a treatment centre located in the port of Hanko in Finland.

According to the information collected, NMVOC emissions from this source are considered to be approximately zero and historical emissions are considered negligible.

7) Other (SNAP 060412)

NMVOC emissions and activity data for the years 2000-2013 are gathered from OSIS and CollectER databases, and are reported by operators.

4.2.10.3. Results

Table 4.32 NMVOC emissions from other solvent use and the activity data by SNAP codes in the period 1990-2013

SNAP code	060400		060404		060405	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt
1990	0.817	NA	NA	NA	0.324	0.415
1991	1.014	NA	NA	NA	0.215	0.275
1992	0.332	NA	NA	NA	0.155	0.198
1993	0.224	NA	NA	NA	0.127	0.163
1994	0.223	NA	NA	NA	0.155	0.199
1995	0.412	NA	NA	NA	0.218	0.279
1996	0.325	NA	NA	NA	0.438	0.562
1997	0.316	NA	NA	NA	0.296	0.379
1998	0.506	NA	NA	NA	0.448	0.574
1999	0.357	NA	NA	NA	0.556	0.712

SNAP code	060400		060404		060405	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, kt
2000	--	--	NA	NA	0.907	1.162
2001	--	--	NA	NA	0.866	1.189
2002	--	--	0.0013	NA	1.202	1.776
2003	--	--	0.0017	NA	1.282	2.051
2004	--	--	0.0016	NA	1.183	2.063
2005	--	--	0.0018	NA	1.379	2.642
2006	--	--	0.0018	NA	1.555	3.364
2007	--	--	0.0017	NA	1.194	3.967
2008	--	--	0.0017	NA	1.068	2.516
2009	--	--	0.0016	NA	0.736	1.794
2010	--	--	0.0015	NA	0.399	1.260
2011	--	--	0.0009	NA	0.483	1.476
2012	--	--	0.0003	NA	0.584	1.721
2013	--	--	0.0012	NA	0.352	1.510

SNAP code	060406		060407		060412	
Year	NMVOC, kt	Activity data, kt	NMVOC, kt	Activity data, mln.inhab.	NMVOC, kt	Activity data, kt
1990	NA	NA	0.124	1.571	NA	NA
1991	NA	NA	0.136	1.568	NA	NA
1992	NA	NA	0.141	1.555	NA	NA
1993	NA	NA	0.154	1.511	NA	NA
1994	NA	NA	0.161	1.477	NA	NA
1995	NA	NA	0.180	1.448	NA	NA
1996	NA	NA	0.187	1.425	NA	NA
1997	NA	NA	0.195	1.406	NA	NA
1998	NA	NA	0.201	1.393	NA	NA
1999	NA	NA	0.199	1.379	NA	NA
2000	0.00050	NA	0.200	1.401	0.008	NA
2001	0.00193	NA	0.180	1.393	0.008	NA
2002	0.00014	NA	0.159	1.384	0.030	NA
2003	NA	NA	0.138	1.375	0.025	NA
2004	NA	NA	0.118	1.366	0.001	NA
2005	0.00001	NA	NO	--	0.003	NA
2006	0.00306	0.069	NO	--	0.028	0.238
2007	0.01457	0.029	NO	--	0.005	0.289
2008	0.00736	0.017	NO	--	0.020	0.353
2009	0.01376	0.026	NO	--	0.013	0.052
2010	0.01143	0.018	NO	--	0.012	0.069
2011	0.01075	0.022	NO	--	0.022	0.081
2012	0.01061	0.022	NO	--	0.034	0.137
2013	0.01128	0.029	NO	--	0.037	0.108

4.2.10.4. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions and emission data from the OSIS database are 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 are studied. The data reported and entered into the OSIS database by operators are firstly checked by specialists from the Environmental Board and then by specialists in the ESTEA.

4.2.10.5. Source-specific planned improvements

As some activities are not included in this inventory, there is a need for research to determine whether emissions from these activities are important for this inventory. Also, it is necessary to review NMVOC emissions for the years 1990-1999 and to study the possibility of obtaining activity data for these emissions.

4.2.11. Other product use (NFR 2G)

4.2.11.1. Source category description

This sector includes emissions from activities such as the use of fireworks, combustion (smoking) of tobacco and the use of shoes. The use of shoes is not currently included in the IIR.

4.2.11.2. Methodological issues

1) Use of fireworks (SNAP 060601)

The Tier 2 emission factors are used for pollutant emissions calculations.

Table 4.33 Emission factors from the EMEP/EEA Guidebook 2013 for calculating pollutant emissions from the use of fireworks

Pollutant	Emission Factor	Unit
SO_2	3020	g/t product
NO_x	260	g/t product
CO	7150	g/t product
TSP	109,830	g/t product
PM_{10}	99,920	g/t product
$PM_{2.5}$	51,940	g/t product
As	1.33	g/t product
Cd	1.48	g/t product
Cr	15.6	g/t product
Cu	444	g/t product
Hg	0.057	g/t product
Ni	30	g/t product
Pb	784	g/t product
Zn	260	g/t product

2) Use of tobacco (SNAP 060602)

The Tier 2 emission factors are used for pollutant emissions calculations.

Table 4.34 Emission factors from the EMEP/EEA Guidebook 2013 for calculating pollutant emissions from tobacco combustion

Pollutant	Emission Factor	Unit
NMVOC	4.84	kg/Mg tobacco
NO_x	1.8	kg/Mg tobacco
CO	55.1	kg/Mg tobacco
NH_3	4.15	kg/Mg tobacco
TSP	27	kg/Mg tobacco
PM_{10}	27	kg/Mg tobacco
$PM_{2.5}$	27	kg/Mg tobacco
BC	0.45	% of $PM_{1.8}$
PCDD/PCDF	0.1	µg I-TEQ/Mg tobacco
B(a)p	0.111	g/Mg tobacco
B(b)f	0.045	g/Mg tobacco
B(k)f	0.045	g/Mg tobacco
I(1,2,3-cd)p	0.045	g/Mg tobacco
Cd	5.4	g/Mg tobacco
Ni	2.7	g/Mg tobacco
Zn	2.7	g/Mg tobacco
Cu	5.4	g/Mg tobacco

4.2.11.3. Results

1) Use of fireworks

The quantity of used fireworks in Estonia is estimated by the import and export data (CN code 3604) available from Statistics Estonia. Data regarding production of fireworks are not available.

Data regarding import and export are not available for the years 1990-1994. As a result, the amounts of used fireworks are calculated by multiplying each year the amount of used fireworks with 0.65 starting from 1995 back to 1990.

Table 4.35 The use of fireworks and pollutant emissions in the period 1990-2013

Year	Product, t	SO_2	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$
		kt					
1990	2.539	0.000008	0.000018	0.000001	0.0002788	0.0002537	0.0001319
1991	3.906	0.000012	0.000028	0.000001	0.0004290	0.0003903	0.0002029
1992	6.009	0.000018	0.000043	0.000002	0.0006599	0.0006004	0.0003121
1993	9.244	0.000028	0.000066	0.000002	0.0010153	0.0009237	0.0004801
1994	14.222	0.000043	0.000102	0.000004	0.0015620	0.0014210	0.0007387
1995	21.880	0.000066	0.000156	0.000006	0.0024030	0.0021862	0.0011364

Year	Product, t	SO_2	CO	NO_x	TSP	PM_{10}	$PM_{2.5}$
		kt					
1996	29.528	0.000089	0.000211	0.000008	0.0032430	0.0029504	0.0015337
1997	67.817	0.000205	0.000485	0.000018	0.0074484	0.0067763	0.0035224
1998	90.045	0.000272	0.000644	0.000023	0.0098897	0.0089973	0.0046770
1999	110.417	0.000333	0.000789	0.000029	0.0121271	0.0110329	0.0057351
2000	68.993	0.000208	0.000493	0.000018	0.0075775	0.0068938	0.0035835
2001	83.688	0.000253	0.000598	0.000022	0.0091914	0.0083621	0.0043467
2002	98.639	0.000298	0.000705	0.000026	0.0108336	0.0098560	0.0051233
2003	127.588	0.000385	0.000912	0.000033	0.0140130	0.0127486	0.0066269
2004	191.336	0.000578	0.001368	0.000050	0.0210144	0.0191183	0.0099380
2005	332.275	0.001003	0.002376	0.000086	0.0364938	0.0332009	0.0172584
2006	388.849	0.001174	0.002780	0.000101	0.0427073	0.0388538	0.0201968
2007	492.507	0.001487	0.003521	0.000128	0.0540920	0.0492113	0.0255808
2008	313.097	0.000946	0.002239	0.000081	0.0343874	0.0312847	0.0162623
2009	127.661	0.000386	0.000913	0.000033	0.0140210	0.0127559	0.0066307
2010	276.950	0.000836	0.001980	0.000072	0.0304174	0.0276728	0.0143848
2011	293.392	0.000886	0.002098	0.000076	0.0322232	0.0293157	0.0152388
2012	393.956	0.001190	0.002817	0.000102	0.0432682	0.0393641	0.0204621
2013	439.705	0.001328	0.003144	0.000114	0.0482928	0.0439353	0.0228383

Year	Product, t	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
		t							
1990	2.539	0.000003	0.000004	0.000040	0.001127	0.0000001	0.000076	0.001990	0.000660
1991	3.906	0.000005	0.000006	0.000061	0.001734	0.0000002	0.000117	0.003062	0.001015
1992	6.009	0.000008	0.000009	0.000094	0.002668	0.0000003	0.000180	0.004711	0.001562
1993	9.244	0.000012	0.000014	0.000144	0.004104	0.0000005	0.000277	0.007247	0.002403
1994	14.222	0.000019	0.000021	0.000222	0.006314	0.0000008	0.000427	0.011150	0.003698
1995	21.880	0.000029	0.000032	0.000341	0.009714	0.0000012	0.000656	0.017154	0.005689
1996	29.528	0.000039	0.000044	0.000461	0.013110	0.0000017	0.000886	0.023150	0.007677
1997	67.817	0.000090	0.000100	0.001058	0.030111	0.0000039	0.002035	0.053169	0.017632
1998	90.045	0.000120	0.000133	0.001405	0.039980	0.0000051	0.002701	0.070596	0.023412
1999	110.417	0.000147	0.000163	0.001723	0.049025	0.0000063	0.003313	0.086567	0.028708
2000	68.993	0.000092	0.000102	0.001076	0.030633	0.0000039	0.002070	0.054091	0.017938
2001	83.688	0.000111	0.000124	0.001306	0.037157	0.0000048	0.002511	0.065611	0.021759
2002	98.639	0.000131	0.000146	0.001539	0.043796	0.0000056	0.002959	0.077333	0.025646
2003	127.588	0.000170	0.000189	0.001990	0.056649	0.0000073	0.003828	0.100029	0.033173
2004	191.336	0.000254	0.000283	0.002985	0.084953	0.0000109	0.005740	0.150007	0.049747
2005	332.275	0.000442	0.000492	0.005183	0.147530	0.0000189	0.009968	0.260504	0.086392
2006	388.849	0.000517	0.000575	0.006066	0.172649	0.0000222	0.011665	0.304858	0.101101
2007	492.507	0.000655	0.000729	0.007683	0.218673	0.0000281	0.014775	0.386125	0.128052
2008	313.097	0.000416	0.000463	0.004884	0.139015	0.0000178	0.009393	0.245468	0.081405
2009	127.661	0.000170	0.000189	0.001992	0.056681	0.0000070	0.003830	0.100086	0.033192
2010	276.950	0.000368	0.000410	0.004320	0.122966	0.0000160	0.008309	0.217129	0.072007
2011	293.392	0.000390	0.000434	0.004577	0.130266	0.0000167	0.008802	0.230019	0.076282
2012	393.956	0.000524	0.000583	0.006146	0.174916	0.0000220	0.011819	0.308862	0.102429
2013	439.705	0.000585	0.000651	0.006859	0.195229	0.0000250	0.013191	0.344729	0.114323

2) Use of 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, export and production of tobacco products are not available for the years 1990-1994.

Tobacco products were produced in Estonia until 1996; as a result, the production and consumption amounts for the years 1990-1994 are considered equal (Table 4.36).

Table 4.36 The use of tobacco and pollutant emissions from tobacco combustion in the period 1990-2013

Year	Use of tobacco, kt	NMVOC	NO_x	CO	NH_3	TSP	PM_{10}	$PM_{2.5}$	PCDD/F
		kt							g I-Teq
1990	4.165	0.020158	0.007497	0.229482	0.017284	0.112451	0.112451	0.112451	0.000416
1991	3.577	0.017312	0.006438	0.197085	0.014844	0.096575	0.096575	0.096575	0.000358
1992	1.780	0.008615	0.003204	0.098074	0.007387	0.048058	0.048058	0.048058	0.000178
1993	2.630	0.012729	0.004734	0.144907	0.010914	0.071007	0.071007	0.071007	0.000263
1994	2.287	0.011069	0.004116	0.126009	0.009491	0.061747	0.061747	0.061747	0.000229
1995	2.218	0.010737	0.003993	0.122236	0.009207	0.059898	0.059898	0.059898	0.000222
1996	2.097	0.010149	0.003775	0.115542	0.008702	0.056618	0.056618	0.056618	0.000210
1997	3.199	0.015481	0.005757	0.176238	0.013274	0.086360	0.086360	0.086360	0.000320
1998	2.035	0.009849	0.003663	0.112123	0.008445	0.054942	0.054942	0.054942	0.000203
1999	2.148	0.010397	0.003867	0.118361	0.008915	0.057999	0.057999	0.057999	0.000215
2000	1.949	0.009433	0.003508	0.107387	0.008088	0.052621	0.052621	0.052621	0.000195
2001	1.948	0.009431	0.003507	0.107361	0.008086	0.052609	0.052609	0.052609	0.000195
2002	2.308	0.011170	0.004154	0.127164	0.009578	0.062313	0.062313	0.062313	0.000231
2003	2.345	0.011350	0.004221	0.129209	0.009732	0.063315	0.063315	0.063315	0.000234
2004	2.339	0.011322	0.004211	0.128894	0.009708	0.063161	0.063161	0.063161	0.000234
2005	2.598	0.012572	0.004676	0.143124	0.010780	0.070133	0.070133	0.070133	0.000260
2006	2.461	0.011912	0.004430	0.135612	0.010214	0.066453	0.066453	0.066453	0.000246
2007	3.552	0.017192	0.006394	0.195722	0.014741	0.095907	0.095907	0.095907	0.000355
2008	1.548	0.007491	0.002786	0.085281	0.006423	0.041789	0.041789	0.041789	0.000155
2009	2.389	0.011561	0.004300	0.131615	0.009913	0.064494	0.064494	0.064494	0.000239
2010	1.231	0.005958	0.002216	0.067826	0.005108	0.033236	0.033236	0.033236	0.000123
2011	1.884	0.009118	0.003391	0.103803	0.007818	0.050865	0.050865	0.050865	0.000188
2012	1.795	0.008689	0.003231	0.098913	0.007450	0.048469	0.048469	0.048469	0.000180
2013	1.835	0.008880	0.003303	0.101098	0.007614	0.049540	0.049540	0.049540	0.000183

Year	Use of tobacco, kt	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Cd	Hg	As	Cu
		t							
1990	4.165	0.000462	0.000187	0.000187	0.000187	0.022490	0.011245	0.011245	0.022490
1991	3.577	0.000397	0.000161	0.000161	0.000161	0.019315	0.009658	0.009658	0.019315
1992	1.780	0.000198	0.000080	0.000080	0.000080	0.009612	0.004806	0.004806	0.009612
1993	2.630	0.000292	0.000118	0.000118	0.000118	0.014201	0.007101	0.007101	0.014201
1994	2.287	0.000254	0.000103	0.000103	0.000103	0.012349	0.006175	0.006175	0.012349
1995	2.218	0.000246	0.000100	0.000100	0.000100	0.011980	0.005990	0.005990	0.011980
1996	2.097	0.000233	0.000094	0.000094	0.000094	0.011324	0.005662	0.005662	0.011324
1997	3.199	0.000355	0.000144	0.000144	0.000144	0.017272	0.008636	0.008636	0.017272
1998	2.035	0.000226	0.000092	0.000092	0.000092	0.010988	0.005494	0.005494	0.010988
1999	2.148	0.000238	0.000097	0.000097	0.000097	0.011600	0.005800	0.005800	0.011600
2000	1.949	0.000216	0.000088	0.000088	0.000088	0.010524	0.005262	0.005262	0.010524
2001	1.948	0.000216	0.000088	0.000088	0.000088	0.010522	0.005261	0.005261	0.010522
2002	2.308	0.000256	0.000104	0.000104	0.000104	0.012463	0.006231	0.006231	0.012463
2003	2.345	0.000260	0.000106	0.000106	0.000106	0.012663	0.006331	0.006331	0.012663

Year	Use of tobacco, kt	B(a)p	B(b)f	B(k)f	I(1,2,3-cd)p	Cd	Hg	As	Cu
		t							
2004	2.339	0.000260	0.000105	0.000105	0.000105	0.012632	0.006316	0.006316	0.012632
2005	2.598	0.000288	0.000117	0.000117	0.000117	0.014027	0.007013	0.007013	0.014027
2006	2.461	0.000273	0.000111	0.000111	0.000111	0.013291	0.006645	0.006645	0.013291
2007	3.552	0.000394	0.000160	0.000160	0.000160	0.019181	0.009591	0.009591	0.019181
2008	1.548	0.000172	0.000070	0.000070	0.000070	0.008358	0.004179	0.004179	0.008358
2009	2.389	0.000265	0.000107	0.000107	0.000107	0.012899	0.006449	0.006449	0.012899
2010	1.231	0.000137	0.000055	0.000055	0.000055	0.006647	0.003324	0.003324	0.006647
2011	1.884	0.000209	0.000085	0.000085	0.000085	0.010173	0.005087	0.005087	0.010173
2012	1.795	0.000199	0.000081	0.000081	0.000081	0.009694	0.004847	0.004847	0.009694
2013	1.835	0.000204	0.000083	0.000083	0.000083	0.009908	0.004954	0.004954	0.009908

4.2.11.4. Source-specific QA/QC and verification

Normal statistical quality checking related to the assessment of magnitude and trends is carried out. Calculated emissions are 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 are studied.

4.2.11.5. Source-specific planned improvements

No major improvements are planned for the next submission.

Source: www.public.delfi.ee

5. AGRICULTURE (NFR 3)

Agriculture (NFR 3)

5.1. Overview of the sector

5.1.1. 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 5.1.

Table 5.1 Reporting activities for the agriculture sector

NFR	Source	Description	Emissions reported
3B1a	Cattle dairy	Includes emissions from dairy cows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3B1b	Cattle non-dairy	Includes emissions from young cattle, beef cattle and suckling cows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3B2	Sheep	Includes emissions from sheep and goats	NO_x, NMVOC, NH_3
3B3	Swine	Includes emissions from fattening pigs and sows	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3B4d	Goats	Emissions from this sector are allocated to NFR 3B2	IE
3B4e	Horses	Includes emissions from horses	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$
3B4gi	Laying hens	Includes emissions from laying hens	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3B4gii	Broilers	Includes emissions from broilers	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3B4giii	Turkeys	Emissions from this sector are allocated to NFR 3B4giv	IE
3B4giv	Other poultry	Includes emission from cocks, ducks, geese and turkeys	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3B4h	Manure management - Other animals	Includes emission from foxes, minks, racoons and chinchillas	NO_x, NMVOC, NH_3, TSP, PM_{10}, $PM_{2.5}$
3Da1	Synthetic N-fertilizers	Includes emissions from application of nitrogen fertilizers and field preparation	NO_x, NMVOC, NH_3, PM_{10}, $PM_{2.5}$
3Da2a	Animal manure applied to soils	NH_3 emissions from this sector are allocated to NFR 3B1a, 3B1b and 3B2	IE

The share of agriculture sources in total emissions in 2013 was: NO_x – 3.0%, NH_3 – 93.6%, NMVOC – 12.3%, PM_{10} and TSP – 1.0%. The share of other pollutants was not so significant.

The emissions of NO_x, NH_3 and NMVOC decreased by 55%, 58% and 63% compared to 1990, and the trend of the emissions of these categories is given in Figure 5.1. The emissions from the agriculture sector are presented in Table 5.2. The decrease in air pollution is mainly the result of rapid economic changes in the 1990s.

In 2013 the emissions of NMVOC, NH_3 and particles decreased compared to 2012 by 1%, 0.6%, and 4% mainly due to the decrease in livestock (especially poultry and swine) and the use of fertilisers during the same period.

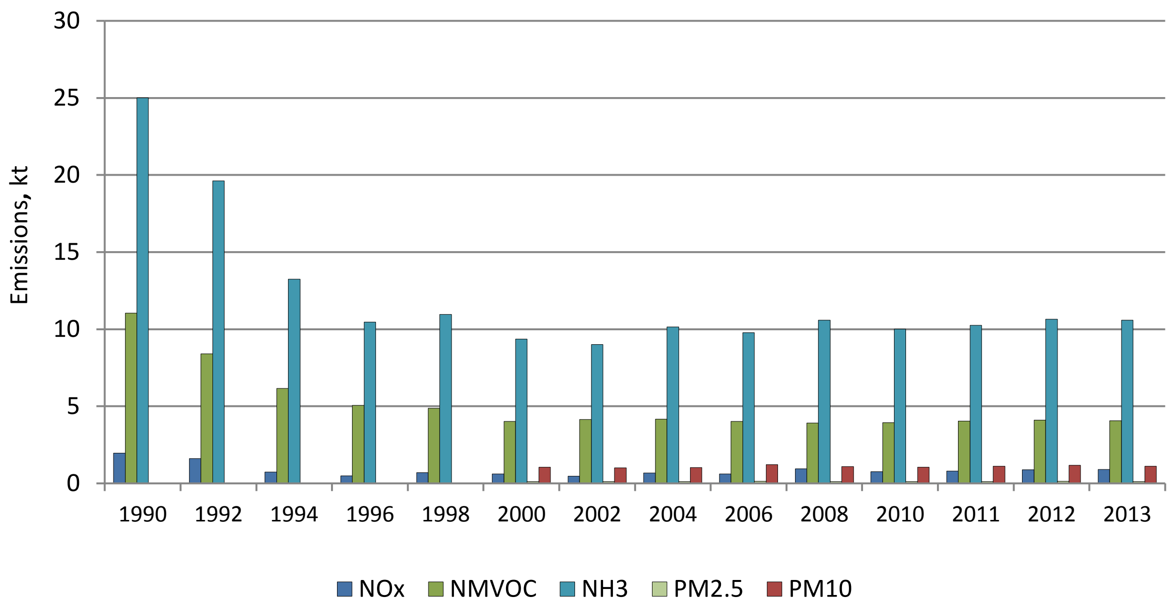


Figure 5.1 NO_x, NH_3, NMVOC, $PM_{2.5}$ and PM_{10} emissions from the agriculture sector in the period 1990-2013 (kt)

Table 5.2 Total emissions from the agriculture sector in the period 1990-2013 (kt)

Year	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}
1990	1.971	11.033	25.001	NR	NR
1991	1.615	10.026	22.079	NR	NR
1992	1.603	8.411	19.626	NR	NR
1993	0.845	6.671	14.399	NR	NR
1994	0.738	6.170	13.255	NR	NR
1995	0.545	5.494	11.485	NR	NR
1996	0.480	5.066	10.460	NR	NR
1997	0.578	5.001	10.720	NR	NR
1998	0.691	4.882	10.954	NR	NR
1999	0.554	4.134	9.356	NR	NR
2000	0.616	4.020	9.367	0.119	1.046
2001	0.542	4.213	9.634	0.125	0.970
2002	0.463	4.138	9.015	0.123	1.003
2003	0.632	4.221	9.965	0.124	0.999

Year	NO_x	NMVOC	NH_3	$PM_{2.5}$	PM_{10}
2004	0.671	4.167	10.152	0.125	1.035
2005	0.544	4.060	9.502	0.127	1.200
2006	0.607	4.029	9.768	0.125	1.222
2007	0.667	3.942	9.734	0.129	1.325
2008	0.940	3.919	10.583	0.117	1.087
2009	0.729	3.881	9.773	0.117	1.032
2010	0.763	3.944	10.013	0.117	1.043
2011	0.794	4.046	10.255	0.121	1.108
2012	0.877	4.102	10.647	0.127	1.166
2013	0.894	4.061	10.581	0.125	1.115
trend 1990-2013, %	**-54.640**	**-63.191**	**-57.677**	**4.402**	**6.658**

The largest part of NH_3 emissions comes from manure management – 73.3%, and 26.7% is from the use of synthetic fertilizers (Figure 5.2). The main polluter of PM_{10} is agricultural crop operations – 33.7% (Figure 5.3).

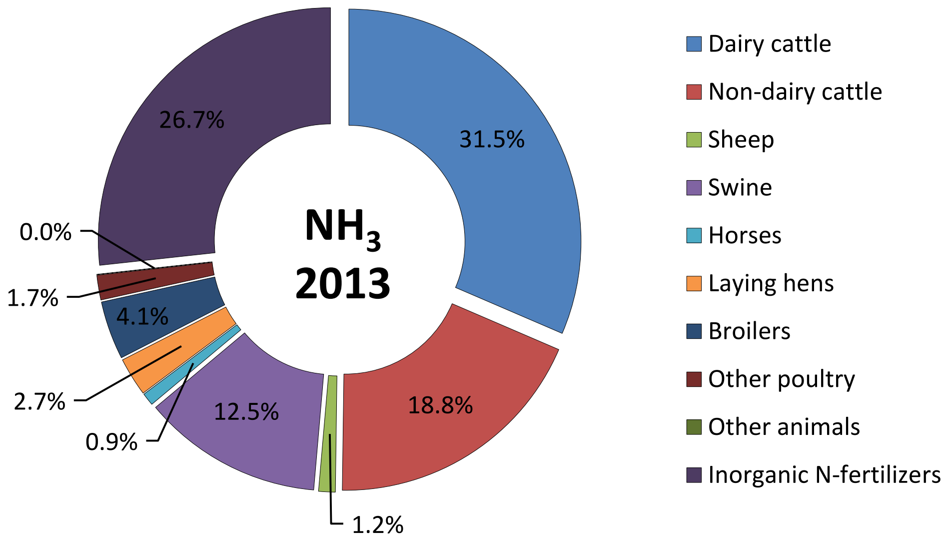


Figure 5.2 NH_3 emission distributions by the agriculture sector activities in 2013

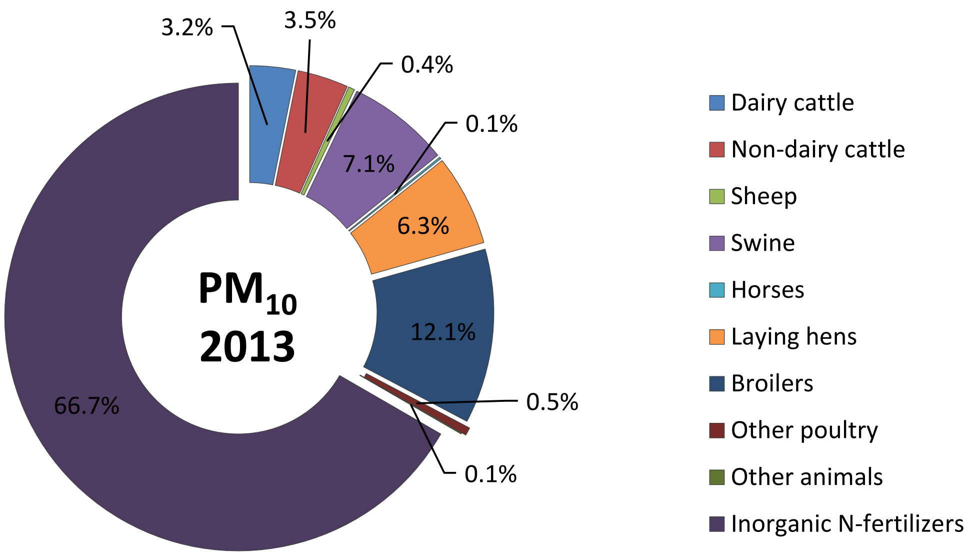


Figure 5.3 PM_{10} emissions from livestock and agricultural soils in 2013

5.2. Manure Management (NFR 3B)

5.2.1. Source category description

Manure management is the main source of NH_3 emissions in Estonia. The share of manure management in total emissions in 2013 was 68.6%. The sector covers the management of manure from domestic livestock. Estonia reports emissions from the manure management of cattle, swine, horses, goats, sheep, poultry and fur animals.

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 5.3-5.7.

(*Manure storage in Ekseko swine farm; source: www.arhliit.ee*)

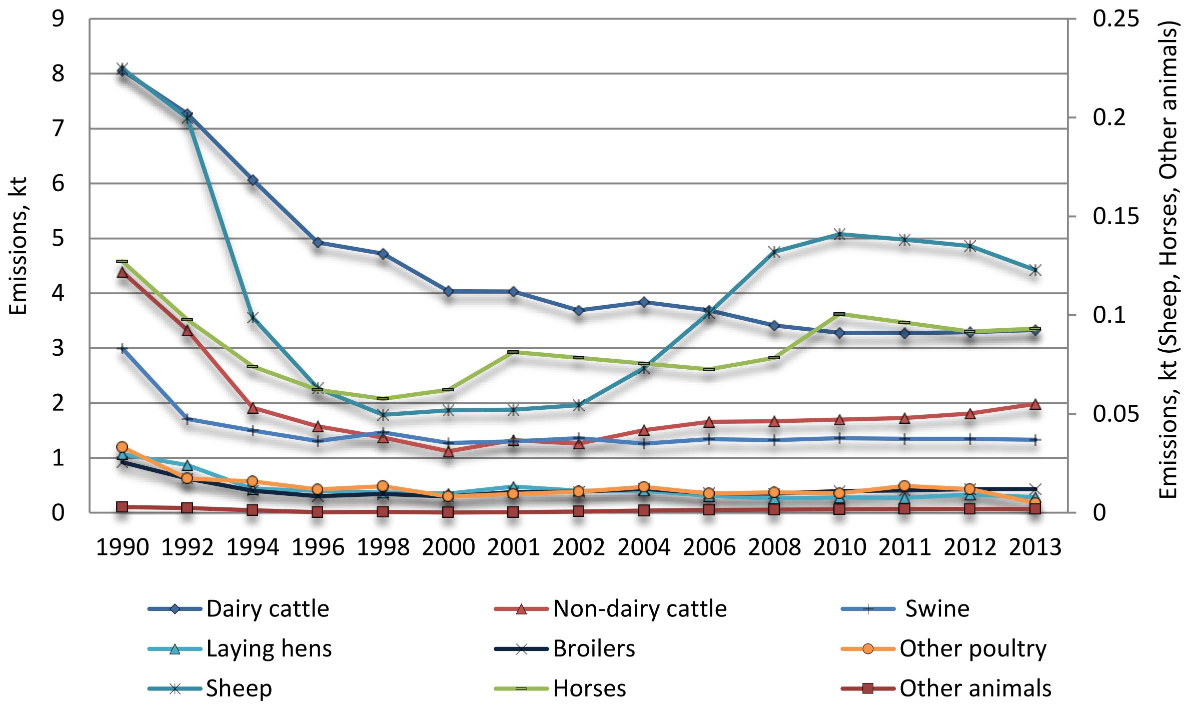


Figure 5.4 NH_3 emissions from manure management in the period 1990-2013

During the period 1990-2013, the emission of NH_3 decreased 59% (Figure 5.4). The reduction in air pollution was mainly due to the rapid economic changes in agriculture in the 1990s.

In 2013 all emissions have decreased compared to 2012 by 1.6% due to decrease in livestock during the same period.

Table 5.3 Total emissions of NO_x from manure management in the period 1990-2013 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
1990	0.043	0.045	0.001	0.001	0.001	0.007	0.004	0.005	0.00003
1991	0.041	0.042	0.001	0.000	0.001	0.005	0.003	0.004	0.00003
1992	0.039	0.034	0.001	0.000	0.001	0.005	0.003	0.003	0.00002
1993	0.035	0.022	0.000	0.000	0.001	0.004	0.002	0.002	0.00002
1994	0.033	0.020	0.000	0.000	0.001	0.003	0.002	0.002	0.00001
1995	0.029	0.017	0.000	0.000	0.001	0.002	0.002	0.002	0.00001
1996	0.026	0.016	0.000	0.000	0.001	0.003	0.001	0.002	0.00000
1997	0.025	0.015	0.000	0.000	0.001	0.002	0.001	0.002	0.00000
1998	0.022	0.014	0.000	0.000	0.001	0.002	0.002	0.002	0.00000
1999	0.018	0.012	0.000	0.000	0.001	0.002	0.001	0.001	0.00000
2000	0.016	0.011	0.000	0.000	0.001	0.002	0.001	0.001	0.00000
2001	0.015	0.010	0.000	0.000	0.001	0.003	0.002	0.001	0.00000
2002	0.013	0.009	0.000	0.000	0.001	0.003	0.002	0.002	0.00001
2003	0.012	0.008	0.000	0.000	0.001	0.002	0.002	0.002	0.00001
2004	0.011	0.006	0.000	0.000	0.001	0.003	0.002	0.002	0.00001
2005	0.010	0.005	0.000	0.000	0.001	0.002	0.002	0.001	0.00002
2006	0.009	0.004	0.000	0.000	0.001	0.002	0.002	0.001	0.00001
2007	0.008	0.004	0.000	0.000	0.001	0.002	0.002	0.001	0.00002
2008	0.008	0.004	0.000	0.000	0.001	0.002	0.002	0.002	0.00002

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
2009	0.008	0.004	0.000	0.000	0.001	0.002	0.002	0.001	0.00002
2010	0.008	0.004	0.001	0.000	0.001	0.002	0.002	0.002	0.00002
2011	0.008	0.004	0.000	0.000	0.001	0.002	0.002	0.002	0.00002
2012	0.008	0.004	0.000	0.000	0.001	0.002	0.002	0.002	0.00002
2013	0.008	0.005	0.000	0.000	0.001	0.002	0.002	0.001	0.00002
trend 1990-2013, %	**-81.7**	**-89.2**	**-45.3**	**-51.7**	**-26.8**	**-73.4**	**-53.3**	**-84.7**	**-33.3**

Table 5.4 Total emissions of NMVOC from manure management in the period 1990-2013(kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Laying hens	Broilers	Other poultry	Other animals
1990	3.818	3.531	0.032	1.937	0.367	0.451	0.616	0.283
1991	3.594	3.286	0.033	1.642	0.295	0.372	0.522	0.283
1992	3.446	2.673	0.029	1.107	0.300	0.306	0.322	0.228
1993	3.083	1.750	0.011	0.916	0.199	0.234	0.304	0.173
1994	2.875	1.540	0.014	0.981	0.151	0.196	0.295	0.118
1995	2.521	1.369	0.011	0.924	0.137	0.183	0.274	0.075
1996	2.334	1.268	0.009	0.921	0.139	0.148	0.219	0.028
1997	2.281	1.168	0.008	1.019	0.119	0.134	0.245	0.027
1998	2.157	1.102	0.007	1.032	0.129	0.168	0.248	0.039
1999	1.882	0.954	0.007	0.814	0.131	0.155	0.171	0.021
2000	1.782	0.901	0.007	0.899	0.119	0.145	0.153	0.013
2001	1.749	0.976	0.007	0.921	0.164	0.186	0.176	0.034
2002	1.572	1.023	0.008	0.946	0.138	0.190	0.198	0.063
2003	1.588	1.039	0.008	0.919	0.133	0.206	0.220	0.107
2004	1.584	0.986	0.010	0.877	0.139	0.214	0.242	0.113
2005	1.534	1.012	0.012	0.887	0.120	0.190	0.137	0.169
2006	1.474	1.009	0.014	0.933	0.105	0.175	0.180	0.138
2007	1.401	1.018	0.017	1.011	0.106	0.173	0.062	0.155
2008	1.365	1.018	0.019	0.909	0.091	0.171	0.193	0.152
2009	1.315	1.021	0.019	0.903	0.106	0.187	0.154	0.176
2010	1.312	1.035	0.020	0.934	0.095	0.193	0.184	0.170
2011	1.308	1.052	0.020	0.931	0.094	0.202	0.251	0.189
2012	1.317	1.104	0.019	0.925	0.114	0.212	0.223	0.187
2013	1.331	1.210	0.018	0.909	0.097	0.211	0.094	0.191
trend 1990-2013, %	**-65.1**	**-65.7**	**-45.4**	**-53.1**	**-73.4**	**-53.2**	**-84.8**	**-32.8**

Table 5.5 Total emissions of NH_3 from manure management in the period 1990-2013 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
1990	8.056	4.389	0.225	2.995	0.127	1.068	0.919	1.197	0.003
1991	7.585	4.085	0.230	2.528	0.115	0.859	0.757	1.014	0.003
1992	7.273	3.323	0.200	1.707	0.098	0.872	0.624	0.626	0.002
1993	6.506	2.176	0.080	1.395	0.077	0.580	0.478	0.591	0.002
1994	6.067	1.915	0.099	1.498	0.074	0.438	0.400	0.573	0.001
1995	5.321	1.702	0.080	1.422	0.068	0.398	0.372	0.533	0.001

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry	Other animals
1996	4.925	1.577	0.063	1.309	0.062	0.405	0.302	0.426	0.000
1997	4.902	1.453	0.057	1.432	0.062	0.345	0.272	0.476	0.000
1998	4.720	1.370	0.050	1.462	0.058	0.375	0.343	0.482	0.000
1999	4.192	1.186	0.050	1.171	0.058	0.380	0.316	0.332	0.000
2000	4.037	1.121	0.052	1.273	0.062	0.347	0.295	0.298	0.000
2001	4.032	1.324	0.052	1.300	0.081	0.478	0.379	0.341	0.000
2002	3.685	1.261	0.054	1.360	0.078	0.400	0.387	0.384	0.001
2003	3.785	1.528	0.055	1.320	0.086	0.388	0.421	0.428	0.001
2004	3.838	1.506	0.073	1.262	0.075	0.403	0.436	0.471	0.001
2005	3.775	1.602	0.082	1.282	0.071	0.348	0.387	0.266	0.002
2006	3.686	1.656	0.101	1.339	0.073	0.306	0.356	0.351	0.001
2007	3.502	1.669	0.120	1.485	0.078	0.309	0.352	0.120	0.002
2008	3.414	1.669	0.132	1.322	0.078	0.264	0.348	0.376	0.002
2009	3.288	1.675	0.134	1.311	0.080	0.310	0.380	0.299	0.002
2010	3.281	1.697	0.141	1.357	0.101	0.278	0.394	0.358	0.002
2011	3.271	1.725	0.138	1.348	0.096	0.273	0.411	0.488	0.002
2012	3.291	1.811	0.135	1.347	0.092	0.333	0.432	0.434	0.002
2013	3.329	1.985	0.123	1.327	0.093	0.284	0.430	0.182	0.002
trend 1990-2013, %	**-58.7**	**-54.8**	**-45.4**	**-55.7**	**-26.7**	**-73.4**	**-53.2**	**-84.8**	**-32.3**

Table 5.6 Total emissions of $PM_{2.5}$ from manure management in the period 2000-2013 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry
2000	0.030	0.019	0.001	0.011	0.001	0.017	0.012	0.001
2001	0.030	0.021	0.001	0.012	0.001	0.023	0.015	0.001
2002	0.027	0.022	0.001	0.013	0.001	0.019	0.016	0.002
2003	0.027	0.022	0.001	0.012	0.001	0.019	0.017	0.002
2004	0.027	0.021	0.001	0.012	0.001	0.019	0.018	0.002
2005	0.026	0.022	0.001	0.012	0.001	0.017	0.016	0.001
2006	0.025	0.022	0.001	0.012	0.001	0.015	0.015	0.001
2007	0.024	0.022	0.001	0.014	0.001	0.015	0.014	0.001
2008	0.023	0.022	0.002	0.012	0.001	0.013	0.014	0.002
2009	0.022	0.022	0.002	0.012	0.001	0.015	0.016	0.001
2010	0.022	0.022	0.002	0.013	0.001	0.013	0.016	0.002
2011	0.022	0.023	0.002	0.013	0.001	0.013	0.017	0.002
2012	0.022	0.024	0.002	0.013	0.001	0.016	0.018	0.002
2013	0.023	0.026	0.001	0.013	0.001	0.014	0.018	0.001
trend 1990-2013, %	**-25.3**	**34.2**	**137.1**	**10.3**	**75.0**	**-18.3**	**45.7**	**-38.9**

Table 5.7 Total emissions of PM_{10} from manure management in the period 2000-2013 (kt)

Year	Dairy cattle	Non-dairy cattle	Sheep	Swine	Horses	Laying hens	Broilers	Other poultry
2000	0.047	0.029	0.002	0.072	0.001	0.086	0.092	0.010
2001	0.046	0.032	0.002	0.073	0.001	0.118	0.119	0.011
2002	0.042	0.033	0.002	0.079	0.001	0.099	0.121	0.013
2003	0.042	0.034	0.002	0.077	0.001	0.096	0.132	0.014
2004	0.042	0.032	0.003	0.073	0.001	0.100	0.137	0.016
2005	0.041	0.033	0.003	0.075	0.001	0.086	0.121	0.009
2006	0.039	0.033	0.004	0.078	0.001	0.076	0.112	0.012
2007	0.037	0.033	0.005	0.089	0.001	0.077	0.110	0.004
2008	0.036	0.033	0.005	0.078	0.001	0.065	0.109	0.013
2009	0.035	0.033	0.005	0.077	0.001	0.077	0.119	0.010
2010	0.035	0.034	0.006	0.080	0.001	0.069	0.124	0.012
2011	0.035	0.034	0.005	0.079	0.001	0.068	0.129	0.016
2012	0.035	0.036	0.005	0.080	0.001	0.083	0.135	0.015
2013	0.035	0.039	0.005	0.079	0.001	0.070	0.135	0.006
trend 1990-2013, %	**-25.3**	**34.2**	**136.9**	**10.1**	**83.3**	**-18.3**	**45.7**	**-38.9**

5.2.2. Methodological issues

Emission calculations from manure management based on the Tier 1 method from the renewed EMEP/EEA Guidebook 2013.

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:

$$E = AAP_{animal} \times EF_{pollutant\_animal}$$

where

AAP_{animal} - number of animals of a particular category present on average within the year
$EF_{pollutant\_animal}$ - emission factor for this process and the technology.

Emissions from manure are calculated separately for each animal category; the separate calculation for a slurry or solid manure management system depends on the animal category (Table 5.9). According to the EMEP/EEA Guidebook 2013, there are different emission factors for solid and slurry manure types (Table 5.8). The share of dairy cattle manure management in Estonia is 50% solid and 50% slurry according to an article by Allan Kaasik (Saasteainete kasvuhoonegaside emissioon loomakasvatusest. Kaasik, Allan 2007, Tõulooma-kasvatus, 2, 21–24). The share of manure management from non-dairy cattle is 70% slurry and 30% solid.

For swine and dairy, old emissions factors from the previous guidebook were used. For other livestock new EMEP/EEA Guidebook 2013 emissions factors were used when appropriate.

Table 5.8 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	0.017	0.056	0.139
Horses		0.131			14.800	0.140	0.220	0.480
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	1.287
Laying hens		0.003	0.165		0.480	0.023	0.119	0.119
Broilers		0.001	0.108		0.220	0.009	0.069	0.069
Other poultry		0.004	0.489		0.950	0.004	0.032	0.068
Fur animals		0.0002	1.941		0.020	0.004	0.008	0.018

Activity data

Information regarding the numbers of livestock in agriculture is available from Statistics Estonia (www.stat.ee) for the years 1990-2013. For dairy and swine the annual livestock number was still used. For other livestock, the average annual population from livestock specific data (e.g. the production cycle, the proportion dying) was calculated.

Table 5.9 Number of livestock (1,000 head)

Year	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry	Fur animals
1990	280.7	477.1	160.6	8.6	336.0	47.1	2,224.0	4,175.8	1,259.5	145.6
1991	264.3	444.0	164.0	7.8	279.5	41.5	1,788.9	3,442.6	1,067.2	145.6
1992	253.4	361.2	142.8	6.6	189.4	27.7	1,816.1	2,836.7	658.6	117.4
1993	226.7	236.5	57.2	5.2	148.5	25.3	1,207.8	2,171.1	621.6	89.1
1994	211.4	208.1	70.7	5.0	160.9	26.6	912.5	1,817.2	603.1	60.9
1995	185.4	185.0	57.3	4.6	157.1	23.4	828.3	1,690.5	561.0	38.5
1996	171.6	171.4	45.0	4.2	104.4	38.6	843.4	1,371.6	448.0	14.3
1997	167.7	157.9	40.9	4.2	107.2	45.2	719.2	1,236.7	501.4	14.0
1998	158.6	148.9	35.4	3.9	114.2	44.1	780.9	1,560.0	507.9	19.9
1999	138.4	128.9	35.5	3.9	98.8	32.2	791.7	1,437.1	349.3	10.6
2000	131.0	121.8	37.0	4.2	99.0	38.6	723.5	1,340.2	313.5	6.8
2001	128.6	131.9	37.3	5.5	99.5	40.1	995.6	1,720.5	359.0	17.5
2002	115.6	138.3	38.9	5.3	114.1	37.7	834.3	1,758.9	404.6	32.3
2003	116.8	140.4	39.4	5.8	110.7	36.6	807.9	1,911.5	450.1	55.2
2004	116.5	133.3	52.3	5.1	106.6	34.7	839.6	1,981.8	495.7	58.4
2005	112.8	136.7	58.6	4.8	110.4	34.3	725.7	1,759.5	279.8	87.2
2006	108.4	136.4	72.2	4.9	111.7	37.4	637.6	1,618.5	369.0	71.0
2007	103.0	137.5	85.6	5.3	137.4	35.7	643.3	1,599.3	125.9	80.1
2008	100.4	137.5	94.3	5.3	116.9	34.1	550.1	1,581.1	395.6	78.6
2009	96.7	138.0	95.8	5.4	115.2	34.1	644.8	1,728.0	314.4	90.6

Year	Cattle dairy	Cattle non-dairy	Sheep	Horses	Fattening pigs	Sows	Laying hens	Broilers	Other poultry	Fur animals
2010	96.5	139.8	100.8	6.8	119.7	35.1	578.2	1,790.4	377.2	87.7
2011	96.2	142.1	98.8	6.5	117.2	35.6	568.9	1,867.2	513.7	97.6
2012	96.8	149.2	96.4	6.2	120.2	34.3	693.9	1,961.8	456.5	96.6
2013	97.9	163.5	87.7	6.3	119.6	33.3	590.8	1,952.3	191.5	98.4

5.3. Agricultural Soils (NFR 3D)

5.3.1. Source category description

Direct NH_3 emissions from fertilizers and particle emissions from grain fields are reported under NFR 3D1a. The share of agricultural soils in total NH_3 emissions in 2013 was 25%.

In addition to NH_3, NO_x, NMVOC, PM_{10} and $PM_{2.5}$ are generated from this sector.

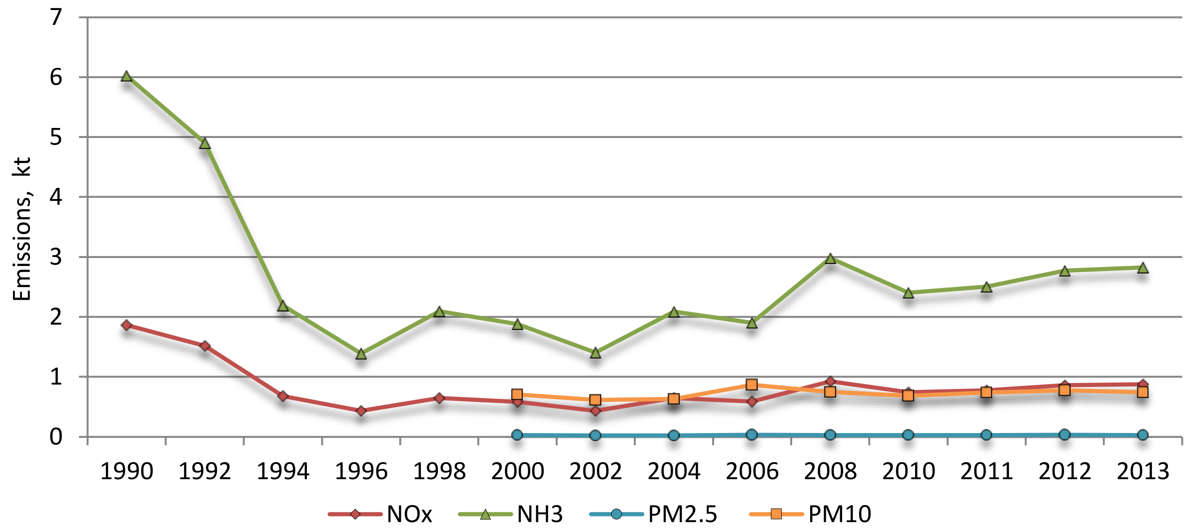


Figure 5.5 NO_x, NH_3, PM_{10} and $PM_{2.5}$ emissions from agricultural soils in the period 1990-2013

During the period 1990-2013, the emission of NH_3 decreased to 53% (Figure 5.5), mainly due to changes in Estonian agriculture. All the emission time series are presented in Table 5.10.

In 2013 NO_x, and NH_3 emissions increased compared to 2012 by 2% mainly due to an increase in the use of fertilisers. The particles emissions have decreased by 4% mainly due to a decrease in the use of agricultural soils.

Table 5.10 Total emissions from agricultural soils in the period 1990-2013 (kt)

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	1.517	4.902	NR	NR
1993	0.779	2.516	NR	NR
1994	0.678	2.190	NR	NR
1995	0.492	1.588	NR	NR
1996	0.431	1.391	NR	NR
1997	0.532	1.720	NR	NR
1998	0.648	2.094	NR	NR
1999	0.517	1.671	NR	NR
2000	0.582	1.881	0.027	0.706
2001	0.510	1.647	0.022	0.567
2002	0.434	1.403	0.024	0.612
2003	0.605	1.953	0.023	0.601
2004	0.646	2.086	0.024	0.631
2005	0.522	1.687	0.032	0.830
2006	0.588	1.899	0.033	0.867
2007	0.650	2.098	0.037	0.968
2008	0.922	2.978	0.029	0.745
2009	0.711	2.296	0.026	0.674
2010	0.744	2.405	0.026	0.682
2011	0.775	2.503	0.028	0.740
2012	0.857	2.770	0.030	0.776
2013	0.875	2.827	0.029	0.744
trend 1990-2013, %	**-53.1**	**-53.1**	**5.3**	**5.3**

5.3.2. Methodological issues

Emission calculations from agricultural soils are based on the Tier 1 method from the renewed EMEP/EEA Guidebook 2013. 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 5.11) and default emission factors (Table 5.12).

Table 5.11 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 1990-2013.

Table 5.12 Synthetic N-fertilizer use and the area covered by these crops in the period 1990-2013

Year	Synthetic N-fertilizers, tonnes	Area covered by crop, ha
1990	58,360	952,103
1991	58,360	754,579
1992	58,360	952,103
1993	29,949	545,833
1994	26,068	517,607
1995	18,905	415,952
1996	16,560	355,638
1997	20,471	422,690
1998	24,932	478,345
1999	19,895	421,067
2000	22,396	452,538
2001	19,603	363,504
2002	16,700	392,196
2003	23,255	384,951
2004	24,833	404,309
2005	20,083	532,319
2006	22,610	556,083
2007	24,982	620,449
2008	35,455	477,786
2009	27,328	432,051
2010	28,628	437,302
2011	29,803	474,102
2012	32,978	497,269
2013	33,659	476,623

5.4. Source-specific QA/QC and verification

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

5.5. Sources-specific planned improvements

- Improve data quality to introduce other Tier 2 or Tier 3 methods for emissions estimating which is based on detailed activities data and emission factors.
- Provide uncertainty analysis.

Source: www.bioneer.ee

6.WASTE (NFR 5)

Waste (NFR 5)

6.1. Overview of the sector

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 (NFR 5B, 5D and 5E).

Table 6.1 Reported emissions for the waste sector (NFR 5)

NFR	Source	Description	Emissions reported
5A	Solid waste disposal on land	Includes emissions from landfill on the base of 8 operators reports. Only point sources data.	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO
5B1	Compost production	Includes data from 2 operators Additional data from waste management system	NMVOC, NH_3
5B2	Anaerobic digestion at biogas facilities	Includes data from 6 operators	NO_x, NMVOC, SO_x, TSP, CO
5Cbi	Industrial waste incineration	Includes emission from flaring in chemical industry and waste oil incineration. Data from 3 operators.	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs
5C1biv	Sewage sludge incineration	Includes emissions from 2 operators	NO_x, NMVOC, SO_x, TSP, CO
5C1d	Cremation	Includes data from 2 operators	NO_x, NMVOC, SO_x, NH_3, TSP, CO
5C2	Open burning of waste	Calculated data that is based on expert estimation. Activity data from waste management system.	NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10}, TSP, BC, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, Total PAHs, HCB, PCB
5D1	Domestic wastewater handling	Point sources data includes emissions from 2 waste water treatment plants. Additionally, the calculation of emissions from diffuse sources.	NO_x, NMVOC, SO_x, NH_3
5D2	Industrial wastewater handling	Includes data from 6 operators	NO_x, NMVOC, SO_x, NH_3, CO
5E	Other waste handling	Includes data from 3 point sources Additionally, the calculation of emissions from diffuse sources (fires).	NO_x, NMVOC, SO_x, NH_3, $PM_{2.5}$, PM_{10}, TSP, CO, Pb, Cd, Hg, As, Cr, Cu, Ni, Zn, PCDD/PCDF, B(a)p, B(b)f, B(k)f, I(1,2,3-cd)p, Total PAHs
5C1biii	Clinical waste incineration	Only one operator reports data about hospital waste inceneration. Only point sources data.	NO_x, SO_x, NMVOC, NH_3, TSP, CO, HM (emissions located in NFR 5C1bi), PCDD/PCDF (expert estimation)

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 2013 and expert opinions are used in the additional calculations.

The share of waste sources (mainly waste from other waste sector) into total dioxins emissions in 2013 was 32.2%. This share has increased because of increased emission factors. The shares of other pollutants are not so significant. The emissions of dioxins decreased in 2013 by 10.2% compared to 2012 due to the decrease in the number of fires in the other waste sector.

6.2. Solid waste disposal on land (NFR 5A)

6.2.1. 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.

Table 6.2 Emissions from solid waste disposal on land in the period 2000-2013

Year	NMVOC	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	kt	t				kt
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
2013	0.007	0.025	NA	0.243	0.775	0.012

6.2.2. Methodological issues

All the emissions are based only on operator reports. In 2013 there were 8 operators. Data is available from the year 2000.

6.2.3. Source-specific QA/QC and verification

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

6.2.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Emission calculations from landfills by using data from the waste management system.

6.3. Biological treatment of waste (NFR 5B)

6.3.1. Sources category description

This chapter covers the emissions from the biological treatment of waste – compost production (NFR 5B1) and anaerobic digestion at biogas facilities (NFR 5B2). Small quantities of non-methane volatile organic compounds and ammonia may be emitted.

Table 6.3 Emissions of NH_3 from compost production in the period 1990-2013 (kt)

Year	NH_3
1990	0.005
1991	0.005
1992	0.005
1993	0.005
1994	0.005
1995	0.006
1996	0.004
1997	0.007
1998	0.001
1999	0.004
2000	0.013
2001	0.012
2002	0.011
2003	0.044
2004	0.050
2005	0.069
2006	0.076
2007	0.122
2008	0.137
2009	0.153

Year	NH_3
2010	0.144
2011	0.104
2012	0.099
2013	0.120

Table 6.4 Emissions from anaerobic digestion at biogas facilities in 2013

NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
kt	t		kt			t	kt
0.008	0.676	0.348	0.000	0.000	0.000	0.011	0.008

Recalculations

NH_3 emissions in composting sector are recalculated for the period of 1992-2012. An overview of the updated data is given in Chapter 8.

6.3.2. Methodological issues

Emissions are based on operator reports. In 2013 there were 6 anaerobic digestion operators and 2 composting operators.

Additional data to calculate emissions of ammonia in compost production sector are obtained from the waste management system. For these calculations, the Tier 2 method is used. Default emission factor for NH_3 is obtained from the EMEP/EEA Guidebook 2013 (Table 6.5).

Table 6.5 Emission factor for composting

Pollutant	Unit	Value
NH_3	Kg/Mg waste	0.66

6.3.3. Source-specific QA/QC and verification

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

6.3.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations, if necessary.

6.4. Waste incineration (NFR 5C)

6.4.1. 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 and sewage sludge incineration.

Table 6.6 Emissions from industrial waste incineration in the period 1990-2013

Year	NO_x	NMVOC	SO_2	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	kt				t			kt
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
2013	0.006	0.001	0.039	0.137	NA	NA	0.076	0.002

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs	PCBs
	kg	g		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

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn	PCDD/ PCDF	PAHs	PCBs
	kg	g		kg					g I-Teq	kg	
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
2013	NA	NA	NA	NA	NA	0.010	NA	NA	0.220	NA	NA

Table 6.7 Emissions from sewage sludge incineration in 2013

NO_X	NMVOC	SO_X	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
t		kt				t	
0.993	0.0665	0.002	NA	NA	NA	0.008	0.342

This chapter also covers emissions from open waste burning in households. This is a poorly quantified sector. Uncontrolled domestic waste burning should include all instances where waste is burned with no pollution controls and therefore includes burning in the open: in piles, in barrels or in home fires. Activity data and emissions are shown in the Tables 6.8-6.11. The share of this sector into total emission for all pollutants is not significant comparing to other pollution sources.

Table 6.8 Amount of domestic waste burned (tonnes)

Year	Total MSW	MSW burned
1990	382,150.6	7,643.0
1991	382,150.6	7,643.0
1992	432,580.0	8,651.6
1993	371,770.0	7,435.4
1994	472,639.3	9,452.8
1995	522,097.2	10,441.9
1996	564,703.6	11,294.1
1997	593,258.1	11,865.2
1998	557,157.1	11,143.1
1999	564,264.7	11,285.3
2000	570,582.4	11,411.6
2001	398,710.1	7,974.2
2002	431,674.7	8,633.5
2003	451,115.8	9,022.3
2004	470,851.1	4,708.5
2005	465,437.9	4,654.4

Year	Total MSW	MSW burned
2006	470,257.1	4,702.6
2007	395,304.7	3,953.0
2008	365,630.1	3,656.3
2009	310,382.1	3,103.8
2010	289,423.3	2,894.2
2011	292,716.2	2,927.2
2012	277,826.1	2,778.3
2013	294,720.2	2,947.2

Table 6.9 Main pollutant emissions from domestic waste burning (kt)

Year	NO_x	NMVOC	SO_2	CO	TSP	PM_{10}	$PM_{2.5}$	BC
1990	0.01376	0.00015	0.0130	0.0054	0.1399	NR	NR	NR
1991	0.01376	0.00015	0.0130	0.0054	0.1399	NR	NR	NR
1992	0.01557	0.00017	0.0147	0.0061	0.1583	NR	NR	NR
1993	0.01338	0.00015	0.0126	0.0052	0.1361	NR	NR	NR
1994	0.01702	0.00019	0.0161	0.0066	0.1730	NR	NR	NR
1995	0.01880	0.00021	0.0178	0.0073	0.1911	NR	NR	NR
1996	0.02033	0.00023	0.0192	0.0079	0.2067	NR	NR	NR
1997	0.02136	0.00024	0.0202	0.0083	0.2171	NR	NR	NR
1998	0.02006	0.00022	0.0189	0.0078	0.2039	NR	NR	NR
1999	0.02031	0.00023	0.0192	0.0079	0.2065	NR	NR	NR
2000	0.02054	0.00023	0.0194	0.0080	0.2088	0.1563	0.1050	NR
2001	0.01435	0.00016	0.0136	0.0056	0.1459	0.1092	0.0734	NR
2002	0.01554	0.00017	0.0147	0.0060	0.1580	0.1183	0.0794	NR
2003	0.01624	0.00018	0.0153	0.0063	0.1651	0.1236	0.0830	NR
2004	0.00848	0.00009	0.0080	0.0033	0.0862	0.0645	0.0433	NR
2005	0.00838	0.00009	0.0079	0.0033	0.0852	0.0638	0.0428	NR
2006	0.00846	0.00009	0.0080	0.0033	0.0861	0.0644	0.0433	NR
2007	0.00712	0.00008	0.0067	0.0028	0.0723	0.0542	0.0364	NR
2008	0.00658	0.00007	0.0062	0.0026	0.0669	0.0501	0.0336	NR
2009	0.00559	0.00006	0.0053	0.0022	0.0568	0.0425	0.0286	NR
2010	0.00521	0.00006	0.0049	0.0020	0.0530	0.0397	0.0266	NR
2011	0.00527	0.00006	0.0050	0.0020	0.0536	0.0401	0.0269	NR
2012	0.00500	0.00006	0.0047	0.0019	0.0508	0.0381	0.0256	NR
2013	0.00530	0.00006	0.0050	0.0021	0.0539	0.0404	0.0271	0.00095

Table 6.10 Heavy metals emissions from domestic waste burning (tonnes)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	0.7949	0.0260	0.0214	0.0164	0.0014	0.0007	0.0009	0.0069
1991	0.7949	0.0260	0.0214	0.0164	0.0014	0.0007	0.0009	0.0069
1992	0.8998	0.0294	0.0242	0.0185	0.0016	0.0008	0.0010	0.0078
1993	0.7733	0.0253	0.0208	0.0159	0.0014	0.0007	0.0009	0.0067

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1994	0.9831	0.0321	0.0265	0.0202	0.0017	0.0009	0.0011	0.0085
1995	1.0860	0.0355	0.0292	0.0223	0.0019	0.0010	0.0013	0.0094
1996	1.1746	0.0384	0.0316	0.0242	0.0021	0.0011	0.0014	0.0102
1997	1.2340	0.0403	0.0332	0.0254	0.0022	0.0011	0.0014	0.0107
1998	1.1589	0.0379	0.0312	0.0238	0.0021	0.0010	0.0013	0.0100
1999	1.1737	0.0384	0.0316	0.0242	0.0021	0.0010	0.0014	0.0102
2000	1.1868	0.0388	0.0320	0.0244	0.0021	0.0011	0.0014	0.0103
2001	0.8293	0.0271	0.0223	0.0171	0.0015	0.0007	0.0010	0.0072
2002	0.8979	0.0294	0.0242	0.0185	0.0016	0.0008	0.0010	0.0078
2003	0.9383	0.0307	0.0253	0.0193	0.0017	0.0008	0.0011	0.0081
2004	0.4897	0.0160	0.0132	0.0101	0.0009	0.0004	0.0006	0.0042
2005	0.4841	0.0158	0.0130	0.0100	0.0009	0.0004	0.0006	0.0042
2006	0.4891	0.0160	0.0132	0.0101	0.0009	0.0004	0.0006	0.0042
2007	0.4111	0.0134	0.0111	0.0085	0.0007	0.0004	0.0005	0.0036
2008	0.3803	0.0124	0.0102	0.0078	0.0007	0.0003	0.0004	0.0033
2009	0.3228	0.0106	0.0087	0.0066	0.0006	0.0003	0.0004	0.0028
2010	0.3010	0.0098	0.0081	0.0062	0.0005	0.0003	0.0003	0.0026
2011	0.3044	0.0100	0.0082	0.0063	0.0005	0.0003	0.0004	0.0026
2012	0.2889	0.0094	0.0078	0.0059	0.0005	0.0003	0.0003	0.0025
2013	0.3065	0.0100	0.0083	0.0063	0.0005	0.0003	0.0004	0.0027

Table 6.11 POPs emissions from domestic waste burning

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	HCB	PCB
	g	kg				
1990	0.3057	0.0321	0.0245	0.0237	0.0153	0.0405
1991	0.3057	0.0321	0.0245	0.0237	0.0153	0.0405
1992	0.3461	0.0363	0.0277	0.0268	0.0173	0.0459
1993	0.2974	0.0312	0.0238	0.0230	0.0149	0.0394
1994	0.3781	0.0397	0.0302	0.0293	0.0189	0.0501
1995	0.4177	0.0439	0.0334	0.0324	0.0209	0.0553
1996	0.4518	0.0474	0.0361	0.0350	0.0226	0.0599
1997	0.4746	0.0498	0.0380	0.0368	0.0237	0.0629
1998	0.4457	0.0468	0.0357	0.0345	0.0223	0.0591
1999	0.4514	0.0474	0.0361	0.0350	0.0226	0.0598
2000	0.4565	0.0479	0.0365	0.0354	0.0228	0.0605
2001	0.3190	0.0335	0.0255	0.0247	0.0159	0.0423
2002	0.3453	0.0363	0.0276	0.0268	0.0173	0.0458
2003	0.3609	0.0379	0.0289	0.0280	0.0180	0.0478
2004	0.1883	0.0198	0.0151	0.0146	0.0094	0.0250
2005	0.1862	0.0195	0.0149	0.0144	0.0093	0.0247
2006	0.1881	0.0198	0.0150	0.0146	0.0094	0.0249
2007	0.1581	0.0166	0.0126	0.0123	0.0079	0.0210

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	HCB	PCB
	g	kg				
2008	0.1463	0.0154	0.0117	0.0113	0.0073	0.0194
2009	0.1242	0.0130	0.0099	0.0096	0.0062	0.0165
2010	0.1158	0.0122	0.0093	0.0090	0.0058	0.0153
2011	0.1171	0.0123	0.0094	0.0091	0.0059	0.0155
2012	0.1111	0.0117	0.0089	0.0086	0.0056	0.0147
2013	0.1179	0.0124	0.0094	0.0091	0.0059	0.0156

6.4.2. Methodological issues

Emissions from cremation, clinical and industrial waste incineration and sewage sludge incineration are based on data from facilities. In 2013 there were 7 operators. 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.

The pollutant emissions from the open domestic waste burning are calculated based on an expert judgement about the amount of burned waste (before 2004 - 2% from total amount of municipal waste and from 2004 – 1% of MSW) and EMEP/EEA Guidebook 2013 emission factors. Unfortunately, in Guidebook there is no emission factor applicable for this category and therefore the calculation method is applied for uncontrolled municipal waste incineration (NFR 5C1a). Emission factors are presented in mass per unit mass of waste burned (Table 6.12).

Table 6.12 Emission factors for domestic waste incineration

Pollutant	Unit	Value
NO_X	kg/Mg waste	1.8
NMVOC	kg/Mg waste	0.02
SO_2	kg/Mg waste	1.7
CO	kg/Mg waste	0.7
TSP	kg/Mg waste	18.3
PM_{10}	kg/Mg waste	13.7
$PM_{2.5}$	kg/Mg waste	9.2
BC	kg/Mg waste	0.322
Pb	g/Mg waste	104
Cd	g/Mg waste	3.4

Pollutant	Unit	Value
Hg	g/Mg waste	2.8
As	g/Mg waste	2.14
Cr	g/Mg waste	0.185
Cu	g/Mg waste	0.093
Ni	g/Mg waste	0.12
Zn	g/Mg waste	0.9
PCDD/PCDF	µg/Mg waste	40
B(a)p	mg/Mg waste	4.2
B(b)f	mg/Mg waste	3.2
B(k)f	mg/Mg waste	3.1
HCB	g/Mg waste	0.002
PCB	mg/Mg waste	5.3

6.4.3. Source-specific QA/QC and verification

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

6.4.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations, if necessary.

6.5. Waste water handling (NFR 5D)

6.5.1. Sources category description

This chapter covers emissions from domestic and industrial wastewater 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.

Table 6.13 Emissions from domestic wastewater handling in 2013

NO_x	NMVOC	SO_x	NH_3	CO
t				kt
0.128	0.051	0.068	0.173	NA

Table 6.14. Emissions from industrial wastewater handling in the period 1994-2013

Year	NO_x	NMVOC	SO_x	NH_3	CO
	t	kt	t		kt
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
2013	0.316	0.029	0.056	0.149	NA

6.5.2. Methodological issues

Emissions from waste water handling are based on data from facilities. In 2013 there were 6 operators.

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.

6.5.3. Source-specific QA/QC and verification

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

6.5.4. 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.

6.6. Other waste (NFR 5E)

6.6.1. Sources category description

This chapter covers emissions from other waste, which includes data from facilities and from car fires, detached and undetached house fires, apartment and industrial building fires. Data about fires is obtained from Estonian Rescue Service. In 2013 there were 3 operators.

Recalculations

Emissions of TSP, Pb, Cd, Hg, As, Cr, Cu and dioxins are recalculated for the period of 1998-2012. In addition the emissions of $PM_{2.5}$ and PM_{10} are recalculated for the period of 2000-2012. An overview of the updated data is given in Chapter 8.

Table 6.15. Emissions from other waste in the period 1990-2013

Year	NO_x	NMVOC	SO_x	NH_3	$PM_{2.5}$	PM_{10}	TSP	CO
	t	kt	t	kt				t
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	0.209	NA
1999	NA	NA	NA	NA	NR	NR	0.208	NA
2000	NA	NA	NA	NA	0.200	0.200	0.200	NA
2001	NA	NA	NA	NA	0.202	0.202	0.202	NA
2002	NA	NA	NA	NA	0.208	0.208	0.208	NA
2003	NA	NA	NA	NA	0.182	0.182	0.182	NA
2004	NA	NA	NA	NA	0.161	0.161	0.161	NA
2005	NA	NA	NA	NA	0.170	0.170	0.170	NA
2006	NA	NA	NA	NA	0.172	0.172	0.172	NA
2007	NA	NA	NA	NA	0.153	0.153	0.153	NA
2008	NA	0.005	NA	NA	0.138	0.138	0.138	NA
2009	NA	0.004	NA	NA	0.129	0.129	0.129	NA
2010	0.475	0.005	NA	NA	0.099	0.099	0.099	0.475
2011	1.329	0.006	0.068	NA	0.091	0.091	0.091	1.444
2012	3.486	0.007	0.276	NA	0.091	0.091	0.091	3.727
2013	0.385	0.005	0.018	NA	0.075	0.075	0.075	0.247

Year	Pb	Cd	Hg	As	Cr	Cu	PCDD/ PCDF
	kg						g I-Teq
1990	NA	NA	NA	NA	NA	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA
1993	NA	NA	NA	NA	NA	NA	NA
1994	NA	NA	NA	NA	NA	NA	NA
1995	NA	NA	NA	NA	NA	NA	NA
1996	NA	NA	NA	NA	NA	NA	NA
1997	NA	NA	NA	NA	NA	NA	NA
1998	0.611	1.230	1.230	1.942	1.853	4.318	2.101
1999	0.609	1.227	1.227	1.939	1.850	4.310	2.103
2000	0.583	1.175	1.175	1.856	1.770	4.126	2.012
2001	0.589	1.186	1.186	1.873	1.787	4.164	2.034
2002	0.607	1.222	1.222	1.931	1.842	4.292	2.094
2003	0.533	1.074	1.074	1.697	1.619	3.773	1.841
2004	0.470	0.947	0.947	1.496	1.428	3.326	1.627
2005	0.496	0.998	0.998	1.576	1.504	3.505	1.711
2006	0.503	1.013	1.013	1.600	1.527	3.559	1.740
2007	0.449	0.904	0.904	1.431	1.365	3.175	1.545
2008	0.403	0.811	0.811	1.281	1.222	2.849	1.396
2009	0.376	0.756	0.756	1.194	1.139	2.656	1.301
2010	0.288	0.580	0.580	0.916	0.874	2.038	0.999
2011	0.264	0.532	0.532	0.839	0.800	1.867	0.920
2012	0.865	0.531	0.690	0.839	0.799	1.867	0.919
2013	0.906	0.497	0.581	0.688	0.656	1.530	0.757

6.6.2. Methodological issues

Emissions from the other waste sector are based on data from facilities and additional calculations.

In addition to the facility data, emissions of particulate matter, heavy metals and dioxins are calculated according to the Tier 2 method giving default emission factors. In this calculation, data from the Estonian Rescue Service were used.

Table 6.16 Emission factors for other waste sector

Category	$PM_{2.5}$	PM_{10}	TSP	Pb	Cd	Hg	As	Cr	Cu	PCDD/ PCDF
	kg/fire			mg/fire						µg/fire
Car fire	2.3	2.3	2.3							48
Detached house fire	143.82	143.82	143.82	420	850	850	1350	1290	2990	1440
Undetached house fire	61.62	61.62	61.62	180	360	360	0.58	0.55	1280	620
Apartment building fire	43.78	43.78	43.78	130	260	260	410	390	910	440
Industrial building fire	27.23	27.23	27.23	80	160	160	250	240	570	270

6.6.3. Source-specific QA/QC and verification

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

6.6.4. Sources-specific planned improvements

Uncertainty analysis for the sector.

Specify activity data and make recalculations if necessary.

Golden Spring Morning (Photo by Sven Začek)

Nature Year Photo 2011

7. OTHER AND NATURAL EMISSIONS (NFR 6 & 11)

Other and natural emissions (NFR 6 & 11)

7.1. Overview of the sector

The emissions are not included in the present inventory.

Source: www.driverlayer.com

8. RECALCULATIONS AND IMPROVEMENTS

Recalculations and improvements

The latest recalculations in the emission inventory were done for the time period from 1990 to 2012. 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.

8.1. Energy sector (NFR 1)

8.1.1. Stationary combustion in energy sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2014 and 2015 are made by using exact calculation numbers.

1A2gviii Stationary combustion in manufacturing industries and construction: Other

PAHs and HCB emissions have been recalculated for the 1990-2012. Additionally calculated POPs emission from the cement production.

Table 8.1 The differences in Stationary combustion in manufacturing industries and construction emissions for the year 1990-2012 between 2014 and 2015 submissions (%)

Year	B(a)p	B(b)f	B(k)f	I(1.2.3-cd)p	PAHs total	HCB
1990	3.3	6.8	3.9	3.3	4.4	100*
1991	3.4	6.9	3.8	3.2	4.7	100*
1992	3.9	8.3	5.1	3.9	5.7	100*
1993	4.3	8.6	4.4	4.7	5.9	100*
1994	6.1	12.1	7.5	6.8	8.8	100*
1995	8.6	18.4	9.9	10.8	12.7	100*
1996	5.9	12.1	6.8	5.6	8.3	100*
1997	8.4	16.3	9.0	8.2	11.4	100*
1998	8.5	18.6	11.4	8.3	12.6	100*
1999	10.7	19.0	13.6	11.1	14.7	100*
2000	5.1	9.9	7.2	4.7	7.2	498.5
2001	2.6	4.8	3.6	2.2	3.6	168.8
2002	2.1	3.9	3.1	1.7	2.9	237.6
2003	1.5	2.8	2.2	1.2	2.1	225.1
2004	1.5	2.8	2.3	1.3	2.1	125.3

Year	B(a)p	B(b)f	B(k)f	I(1.2.3-cd)p	PAHs total	HCB
2005	1.4	2.7	2.2	1.2	2.0	127.8
2006	2.5	4.6	3.6	2.0	3.4	272.3
2007	5.0	9.0	7.2	4.4	6.9	839.1
2008	3.1	5.8	4.6	2.6	4.3	363.8
2009	2.1	4.0	3.2	1.8	3.0	284.2
2010	2.0	3.8	3.1	1.7	2.8	173.6
2011	2.7	4.9	4.0	2.2	3.7	302.0
2012	2.8	5.2	4.2	2.4	3.9	259.6

**For HCB old data were available only from 2000*

1A4bi Residential: Stationary

Heavy metals and POPs emissions have been recalculated for the 1990-2012. Recalculation concern using new national emission factors of persistent organic pollutants for wood combustion (on the base of real measurements for different types of technologies) and using new EMEP/EEA Guidebook 2013 heavy metals and POPs emission factors for all fuels in domestic sector.

Table 8.2 The differences in Residential: Stationary emissions for the year 1990-2012 between 2014 and 2015 submissions (%)

Year	Pb	Cd	Hg	As	Cr	Cu	Ni	Zn
1990	-30.3	273.2	-26.9	-68.6	132.5	-38.4	-39.9	81.7
1991	-29.0	252.2	-42.8	-50.4	74.5	-33.3	-87.2	77.8
1992	-39.8	533.1	-53.7	-60.2	206.2	-44.7	-75.6	119.1
1993	-38.2	555.5	-32.6	-70.5	306.8	-43.1	-62.5	159.4
1994	-55.1	637.4	-58.1	-82.3	338.9	-53.6	-73.8	141.9
1995	-36.6	880.0	-40.7	-77.4	486.8	-39.0	-52.9	234.3
1996	-33.6	1,048.4	-47.2	-69.5	420.0	-35.1	-71.3	234.4
1997	-30.7	1,098.8	-44.9	-68.3	520.3	-32.3	-68.2	249.1
1998	-30.2	831.7	-36.9	-75.6	461.6	-30.8	-74.1	256.1
1999	-21.6	802.5	-20.8	-68.4	454.1	-23.2	-79.0	255.5
2000	-26.9	811.7	-27.8	-71.6	316.5	-26.8	-80.5	256.7
2001	-28.8	793.4	-36.2	-75.1	363.2	-27.1	-72.2	257.9
2002	-24.8	797.5	-32.0	-73.5	445.0	-29.8	-78.5	262.5
2003	-25.8	841.6	-38.8	-76.6	579.6	-31.7	-45.5	275.3
2004	-25.5	839.7	-30.4	-72.8	469.8	-27.4	-67.6	264.5
2005	-24.5	1,518.7	-38.9	-51.9	489.5	-27.5	-69.5	265.2
2006	-26.1	1,485.1	-44.9	-57.0	474.2	-26.2	-74.1	272.5
2007	-27.9	934.3	-42.8	-78.6	639.7	-30.4	-69.0	287.8
2008	-28.4	1,128.0	-35.7	-74.3	566.4	-31.2	-72.9	283.3
2009	-30.3	1,149.6	-39.2	-76.3	593.1	-32.3	-69.1	286.4
2010	-29.8	1,150.8	-38.2	-75.8	602.1	-31.8	-65.3	286.1
2011	-28.4	1,133.0	-36.3	-73.9	575.2	-31.0	-69.5	284.1
2012	-29.3	1,139.5	-37.2	-74.9	144.8	92.2	-67.5	284.3

Year	PCDD/ PCDF	B(a)p	B(b)f	B(k)f	I(1.2.3-cd)p	PAHs total	HCB	PCB
1990	226.4	-33.4	-36.8	-30.1	-5.0	-28.8	110.8	-75.2
1991	256.7	-33.0	-34.9	-30.6	-10.3	-29.1	92.3	-72.6
1992	102.6	-46.2	-50.2	-43.3	-22.0	-42.4	145.4	-89.2
1993	68.1	-45.2	-51.2	-41.6	-17.0	-41.0	154.7	-93.8
1994	-10.2	-58.5	-65.3	-54.6	-32.0	-54.6	71.9	-99.2
1995	37.6	-40.9	-50.1	-35.5	-4.3	-35.6	145.6	-98.0
1996	50.3	-40.1	-49.0	-35.1	-4.1	-35.0	128.4	-96.8
1997	52.9	-39.5	-48.2	-34.2	-3.3	-34.2	131.8	-96.8
1998	48.8	-40.1	-49.2	-34.9	-3.6	-34.9	115.2	-97.0
1999	81.2	-37.2	-44.7	-32.5	-2.4	-31.9	127.3	-94.5
2000	63.5	-39.8	-47.6	-35.0	-5.5	-34.7	98.6	-95.6
2001	45.7	-44.0	-51.7	-39.6	-11.6	-39.3	110.2	-97.1
2002	46.3	-45.8	-53.2	-41.5	-14.3	-41.2	102.0	-96.7
2003	23.4	-49.9	-57.4	-45.5	-19.7	-45.5	79.6	-97.7
2004	32.9	-51.8	-58.2	-48.1	-24.9	-47.9	70.8	-96.8
2005	29.2	-54.1	-60.1	-50.6	-28.8	-50.4	57.8	-96.9
2006	16.7	-56.1	-62.2	-52.7	-31.2	-52.5	51.0	-97.5
2007	-8.4	-59.7	-66.2	-56.1	-34.6	-56.1	52.8	-98.8
2008	-11.5	-61.5	-67.6	-58.0	-37.6	-58.0	52.4	-98.7
2009	-21.6	-64.0	-70.1	-60.7	-41.1	-60.7	42.4	-99.2
2010	-23.6	-65.7	-71.3	-62.6	-44.3	-62.7	42.2	-99.1
2011	-22.1	-67.1	-72.3	-64.3	-47.2	-64.3	29.9	-98.7
2012	-28.3	-68.9	-73.9	-66.2	-49.9	-66.2	30.6	-98.9

8.1.2. Transport sector

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2014 and 2015 are made by using exact calculation numbers.

1A3di (i) International maritime navigation

All the NO_x, NMVOC, SO_x, $PM_{2.5}$, PM_{10} and TSP emissions have been recalculated for the period 2005-2012. Recalculations in the international maritime sector were made based on the correction of the average gross tonnage of vessels by Statistics Estonia.

In addition, all emissions were recalculated for the year 2012 as a result of correction of fuel consumption by Statistics Estonia.

The differences in international maritime navigation sector emissions between the 2014 and 2015 submissions are presented in Table 8.3 and Table 8.4.

Table 8.3 The differences in international maritime sector emissions between the 2014 and 2015 submissions (%)

Year	NO_x	NMVOC	$PM_{2.5}$	PM_{10}	TSP
2005	-63.7	3.7	-9.0	-30.6	-30.6
2006	-21.1	1.9	-3.3	-10.0	-10.0
2007	-17.4	1.6	-2.7	-7.9	-7.9
2008	-14.7	1.3	-2.3	-6.5	-6.5
2009	-11.7	1.0	-1.9	-5.2	-5.2
2010	-15.5	1.2	-2.2	-6.2	-6.2
2011	-19.2	1.5	-2.7	-7.7	-7.7
2012	46.4	43.7	53.0	53.8	53.8

Table 8.4 The differences in international maritime emissions for the year 2012 between the 2014 and 2015 submissions (%)

Pollutant	2014	2015	Difference,%
NO_x	16.855	31.457	46.4
NMVOC	0.636	1.130	43.7
SO_x	4.432	9.922	55.3
$PM_{2.5}$	0.910	1.936	53.0
PM_{10}	0.977	2.115	53.8
TSP	0.977	2.115	53.8
CO	1.687	3.041	44.5
Pb	0.037	0.070	47.3
Cd	0.004	0.007	49.7
Hg	0.005	0.009	40.3
As	0.100	0.224	55.4
Cr	0.107	0.238	55.3
Cu	0.253	0.482	47.5
Ni	4.630	10.486	55.8
Se	0.038	0.077	50.0
Zn	0.274	0.493	44.5
PCDD/ PCDF	0.078	0.164	52.5
HCB	0.027	0.052	48.9
PCBs	0.114	0.218	47.9

8.2. Industrial processes and product use (NFR 2)

8.2.1. Industrial processes

$PM_{2.5}$ and PM_{10} emissions from industrial processes have been recalculated for the period 2000-2012. Recalculation concern using new emission factors from renewed Guidebook.

Table 8.5 The differences in mineral products and chemical industry sectors $PM_{2.5}$ emissions between 2014 and 2015 submissions (%)

Year	Cement production	Lime production	Quarrying and mining of minerals other than coal	Construction and demolition	Other mineral products	Ammonia production	Chemical industry: Other	Storage, handling and transport of chemical products
2000				0.0	3.7		346.2	
2001				0.0	1.0		255.5	
2002				0.0	3.6		327.7	
2003	-50.0			0.0	-0.1		316.0	
2004				0.0	1.9		348.3	
2005				0.0	-6.1		387.2	
2006				0.0	68.7		321.5	
2007				0.0	3.1		395.4	
2008	354.7	-30.0		0.0	0.0		330.1	0.0
2009	354.6	-9.3	-55.5	0.0	-0.1		190.9	-2.0
2010	354.4	-9.3	-55.5	0.0	0.0			
2011	354.4	-9.5	-55.5	0.0	0.0			
2012	354.6	-9.3	-55.5	0.0	0.0	400.0		

Table 8.2 The differences in metal production, pulp, paper and food industry sectors $PM_{2.5}$ emissions between 2014 and 2015 submissions (%)

Year	Iron and steel produc-tion	Aluminium produc-tion	Lead produc-tion	Zinc produc-tion	Copper produc-tion	Other metal produc-tion	Pulp and paper industry	Food and beverages industry	Wood processing	Other production, consumption, storage, transportation or handling of bulk products
2000						40.1	320			
2001						40.1	560.0			
2002						133.5	455.0			
2003						60.1	442.6	-23.0		
2004						40.1	560.0			
2005						133.5	530.0			
2006						40.1	460.0			
2007	86.8						470.0			
2008	-0.6					324.6	445.5	-0.2		
2009	-5.8	-29.0	-13.7	29.3	28.8	-0.7	178.4	-90.0	0.0	0.0
2010	-0.7	-29.0	-16.0	25.8	100.0	-0.7	445.5	0.0	0.0	-1.7

Year	Iron and steel produc-tion	Aluminium produc-tion	Lead produc-tion	Zinc produc-tion	Copper produc-tion	Other metal produc-tion	Pulp and paper industry	Food and beverages industry	Wood processing	Other production, consumption, storage, transportation or handling of bulk products
2011	-0.6	-29.0	-14.3	27.5	42.9	-0.6	-7.3	0.0	-3.3	0.2
2012	42.0	-29.0	-15.8	27.0	21.4	-0.6	445.5	0.0	0.0	3.6

Table 8.4 The differences in mineral products and chemical industry sectors PM_{10} emissions between 2014 and 2015 submissions (%)

Year	Fugitive emission from solid fuels: Solid fuel transformation	Fugitive emissions oil: Refining/ storage	Cement production	Lime production	Quarrying and mining of minerals other than coal	Other mineral products
2000						-1.0
2001						1.0
2002						0.8
2003			-10.0			0.2
2004						-0.3
2005						-1.8
2006						-10.7
2007						3.1
2008		-25.4	172.8	17.9		1.3
2009		-25.4	172.7	-4.3	49.3	0.6
2010	-40.0	-25.4	172.7	-4.4	50.0	0.8
2011	-40.0	-25.4	172.7	-4.3	36.2	-0.7
2012	-27.8	-25.4	172.7	-4.4	335.6	2.0

Table 8.5 The differences in metal production, pulp, paper and food industry sectors PM_{10} emissions between 2014 and 2015 submissions (%)

Year	Ammonia produc-tion	Chemical industry: Other	Storage, handling and transport of chemical products	Iron and steel produc-tion	Aluminium produc-tion	Lead produc-tion	Zinc produc-tion	Copper produc-tion	Other metal produc-tion	Pulp and paper industry	Food and beverages industry	Other production, consumption, storage, transportation or handling of bulk products
2000		171.0							-10.0	124.0		
2001		158.6							-40.0	120.0		
2002		164.8							-25.0	146.7		
2003		154.1							-24.2	141.2	15.5	
2004		172.0							-28.0	151.4		
2005		166.1							-25.0	140.0		
2006		158.0							-40.0	148.9		
2007		162.5		-40.0						153.3		
2008		160.8	0.0	0.0					81.9	142.4		
2009		93.1	-1.9	-5.2	11.1	35.1	27.5	33.8	-0.1	11.3		0.7

Year	Ammonia produc-tion	Chemical industry: Other	Storage, handling and transport of chemical products	Iron and steel produc-tion	Aluminium produc-tion	Lead produc-tion	Zinc produc-tion	Copper produc-tion	Other metal produc-tion	Pulp and paper industry	Food and beverages industry	Other production, consumption, storage, transportation or handling of bulk products
2010				39.4	11.2	35.5	25.0			142.4		51.3
2011				-6.6	11.2	33.3	29.0	44.4	-4.3	8.9		7.9
2012	300.0		-0.1	65.5	11.2	32.7	29.8	27.8	0.0	142.4		11.0

8.2.2. Solvent and Other Product Use

There has been made some recalculations of NMVOC emissions for the period 1990-2012 due to the emission factor and statistical data corrections.

Table 8.6 The differences in solvent sector NMVOC emissions between the 2014 and 2015 submissions (%)

Year	2D3a	2D3d	2D3e	2D3g	2D3h	2D3i	Total
	Domestic solvent use including fungicides	Coating applications	Degreasing	Chemical products	Printing	Other solvent use	
1990					-6.69		0.15
1991					-6.75		0.12
1992					-6.84		0.06
1993					-6.92		0.11
1994					-6.89		0.05
1995					-6.89		0.01
1996					1.93		0.13
1997					-9.00		-0.02
1998					2.17		0.13
1999					-10.90		-0.16
2000	2.13		1.79		-5.22	0.38	1.11
2001	3.68		1.64		-10.87	-5.21	0.63
2002	5.81	-0.01	1.39		-3.47	-11.48	-0.14
2003	8.83	-0.01	1.22		-4.85	-17.96	-1.37
2004	13.38	-0.02	0.95		-18.57	-24.59	-3.19
2005	21.01	-0.01	0.72		-3.83	-32.98	-4.48
2006	20.54	-0.03	0.37		-1.64	-31.67	-4.77
2007	20.05	-0.01	0.02		-7.93	-31.40	-3.52
2008	19.78	-0.02	-1.53		-1.04	-31.72	-3.38
2009	19.58	-2.22	-0.48		-10.62	-38.05	-4.22
2010	19.39	0.53	-0.55		-0.03	-27.59	1.92
2011	19.06	-1.31	-0.84		0.08	-29.51	0.09
2012	18.71	5.31	-1.12	0.00	-2.30	-30.85	1.31

Table 8.7 The differences in other product use sector emissions between the 2014 and 2015 submissions

Year	NMVOC	NO_x	SO_2	NH_3	CO	TSP	PM_{10}	$PM_{2.5}$
	kt							
1990	0.020141	0.007485	0.000008	0.017284	0.229074	0.057619	NR	NR
1991	0.017298	0.006429	0.000012	0.014844	0.196747	0.042013	NR	NR
1992	0.008608	0.003200	0.000018	0.007387	0.097935	-0.005762	NR	NR
1993	0.012718	0.004728	0.000028	0.010914	0.144704	0.019039	NR	NR
1994	0.011059	0.004113	0.000043	0.009491	0.125876	0.011538	NR	NR
1995	0.010729	0.003993	0.000066	0.009207	0.122175	0.011547	NR	NR
1996	0.010141	0.003776	0.000089	0.008702	0.115548	0.009912	NR	NR
1997	0.015468	0.005766	0.000205	0.013274	0.176397	0.044492	NR	NR
1998	0.009841	0.003681	0.000272	0.008445	0.112574	0.016011	NR	NR
1999	0.010388	0.003889	0.000333	0.008915	0.118936	0.021782	NR	NR
2000	0.009425	0.003520	0.000208	0.008088	0.107681	0.012111	0.011427	0.008117
2001	0.009423	0.003523	0.000253	0.008086	0.107761	0.013892	0.013062	0.009047
2002	0.011161	0.004173	0.000298	0.009578	0.127634	0.025426	0.024448	0.019716
2003	0.011340	0.004247	0.000385	0.009732	0.129882	0.029788	0.028524	0.022402
2004	0.011313	0.004254	0.000578	0.009708	0.130025	0.036810	0.034913	0.025733
2005	0.012562	0.004755	0.001003	0.010780	0.145245	0.059381	0.056088	0.040145
2006	0.011902	0.004524	0.001174	0.010214	0.138143	0.062014	0.058160	0.039504
2007	0.017178	0.006512	0.001487	0.014741	0.198883	0.102897	0.098016	0.074386
2008	0.007485	0.002863	0.000946	0.006423	0.087362	0.029192	0.026089	0.011067
2009	0.011552	0.004326	0.000386	0.009913	0.132285	0.031521	0.030255	0.024130
2010	0.005953	0.002284	0.000836	0.005108	0.069681	0.016708	0.013963	0.000675
2011	0.009111	0.003462	0.000886	0.007818	0.105710	0.036119	0.033212	0.019135
2012	0.008681	0.003328	0.001190	0.007450	0.101548	0.044789	0.040885	0.021983

Year	PCDD/ PCDF	PAHs total	Pb	Cd	Hg	As	Cr	Cu	Zn	Ni
	g I-Teq	t								
1990	0.000412	0.000996	0.001990	0.022494	0.011245	0.011248	0.000038	0.023617	0.000660	0.000076
1991	0.000354	0.000855	0.003062	0.019321	0.009657	0.009662	0.000060	0.021049	0.001015	0.000117
1992	0.000176	0.000425	0.004711	0.009620	0.004806	0.004814	0.000093	0.012279	0.001562	0.000180
1993	0.000260	0.000629	0.007247	0.014215	0.007101	0.007113	0.000143	0.018305	0.002403	0.000277
1994	0.000226	0.000547	0.011150	0.012370	0.006175	0.006193	0.000221	0.018663	0.003698	0.000427
1995	0.000220	0.000531	0.017153	0.012012	0.005991	0.006019	0.000341	0.021694	0.005689	0.000656
1996	0.000208	0.000502	0.023150	0.011367	0.005663	0.005701	0.000460	0.024434	0.007677	0.000886
1997	0.000316	0.000765	0.053168	0.017372	0.008640	0.008726	0.001057	0.047382	0.017632	0.002035
1998	0.000201	0.000488	0.070595	0.011122	0.005499	0.005614	0.001404	0.050968	0.023412	0.002701
1999	0.000213	0.000514	0.086567	0.011763	0.005806	0.005946	0.001722	0.060625	0.028708	0.003313
2000	0.000193	0.000466	0.054091	0.010626	0.005266	0.005354	0.001076	0.041157	0.017938	0.002070
2001	0.000193	0.000466	0.065611	0.010645	0.005266	0.005372	0.001305	0.047679	0.021759	0.002511
2002	0.000228	0.000552	0.077333	0.012608	0.006237	0.006362	0.001538	0.056258	0.025646	0.002959
2003	0.000232	0.000561	0.100029	0.012852	0.006339	0.006501	0.001990	0.069312	0.033173	0.003828
2004	0.000231	0.000559	0.150007	0.012915	0.006327	0.006570	0.002984	0.097585	0.049747	0.005740
2005	0.000257	0.000622	0.260503	0.014518	0.007032	0.007455	0.005183	0.161556	0.086392	0.009968
2006	0.000243	0.000588	0.304858	0.013866	0.006667	0.007162	0.006065	0.185939	0.101101	0.011665
2007	0.000351	0.000849	0.386125	0.019910	0.009619	0.010245	0.007682	0.237854	0.128052	0.014775
2008	0.000153	0.000370	0.245468	0.008821	0.004197	0.004595	0.004884	0.147373	0.081405	0.009393
2009	0.000236	0.000571	0.100086	0.013087	0.006456	0.006619	0.001991	0.069580	0.033192	0.003830
2010	0.000122	0.000294	0.217129	0.007057	0.003339	0.003692	0.004320	0.129613	0.072007	0.008309
2011	0.000186	0.000450	0.230019	0.010607	0.005103	0.005476	0.004576	0.140439	0.076282	0.008802
2012	0.000178	0.000429	0.308861	0.010277	0.004869	0.005371	0.006145	0.184610	0.102429	0.011819

8.3. Agriculture sector (NFR 4)

Overviews of recalculations are given below by each subsector. The comparison between the submissions for 2014 and 2015 are made by using exact calculation numbers.

8.3.1. Manure management

NO_x, NH_3, NMVOC, $PM_{2.5}$ and PM_{10} emissions from sheep and poultry manure management have been recalculated for the 1990-2012. Recalculations concern using corrected activity data (average animal number). Additionally calculated NO_x, NH_3, NMVOC, $PM_{2.5}$ and PM_{10} emissions emission from the fur animals.

Table 8.8 The differences in manure management NO_x emissions (kt) for the year 1990-2012 between 2014 and 2015 submissions (%)

Year	Sheep			Laying hens			Broilers			Other poultry		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1990	0.0007	0.0008	14.7	0.006	0.007	3.1	0.004	0.004	2.2	0.001	0.005	328.2
1991	0.0007	0.0008	14.8	0.005	0.005	-2.1	0.003	0.003	-1.3	0.001	0.004	381.9
1992	0.0006	0.0007	14.8	0.003	0.005	61.0	0.002	0.003	31.8	0.001	0.003	380.8
1993	0.0004	0.0003	-31.4	0.003	0.004	13.4	0.002	0.002	6.8	0.001	0.002	382.6
1994	0.0003	0.0004	14.6	0.003	0.003	-11.6	0.002	0.002	-7.9	0.001	0.002	381.0
1995	0.0002	0.0003	15.3	0.003	0.002	-13.8	0.002	0.002	-7.8	0.000	0.002	380.7
1996	0.0002	0.0002	14.8	0.002	0.003	9.9	0.001	0.001	-6.3	0.000	0.002	381.2
1997	0.0002	0.0002	15.2	0.003	0.002	-16.2	0.002	0.001	-24.5	0.000	0.002	383.2
1998	0.0002	0.0002	14.9	0.003	0.002	-10.2	0.002	0.002	-6.1	0.000	0.002	381.0
1999	0.0002	0.0002	14.8	0.002	0.002	-2.5	0.002	0.001	-7.4	0.000	0.001	255.3
2000	0.0002	0.0002	14.9	0.002	0.002	-7.3	0.001	0.001	-10.1	0.000	0.001	231.6
2001	0.0002	0.0002	14.8	0.003	0.003	5.7	0.001	0.002	31.5	0.000	0.001	691.2
2002	0.0002	0.0002	14.8	0.002	0.003	9.1	0.001	0.002	34.7	0.000	0.002	1,472.8
2003	0.0002	0.0002	14.5	0.002	0.002	3.1	0.001	0.002	66.8	0.000	0.002	2,803.2
2004	0.0002	0.0003	27.8	0.002	0.003	3.9	0.001	0.002	46.4	0.000	0.002	2,202.3
2005	0.0003	0.0003	11.8	0.002	0.002	1.3	0.001	0.002	60.9	0.000	0.001	1,042.9
2006	0.0003	0.0004	9.4	0.002	0.002	16.7	0.001	0.002	52.3	0.000	0.001	1,154.2
2007	0.0004	0.0004	12.0	0.003	0.002	-24.2	0.001	0.002	86.6	0.000	0.001	825.9
2008	0.0004	0.0005	15.4	0.002	0.002	0.0	0.001	0.002	34.7	0.000	0.002	1,079.1
2009	0.0004	0.0005	19.2	0.002	0.002	-3.0	0.001	0.002	56.5	0.000	0.001	615.9
2010	0.0004	0.0005	21.7	0.002	0.002	0.5	0.001	0.002	26.1	0.000	0.002	674.4
2011	0.0004	0.0005	12.0	0.002	0.002	0.0	0.001	0.002	31.6	0.000	0.002	759.9
2012	0.0004	0.0005	20.5	0.002	0.002	-0.9	0.001	0.002	40.1	0.000	0.002	510.0

Table 8.9 The differences in manure management NH_3 emissions (kt) for the year 1990-2012 between 2014 and 2015 submissions (%)

Year	Sheep			Laying hens			Broilers			Other poultry		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1990	0.196	0.225	14.9	1.035	1.068	3.1	0.899	0.919	2.2	0.279	1.197	328.1
1991	0.200	0.230	14.9	0.877	0.859	-2.1	0.768	0.757	-1.3	0.210	1.014	381.8
1992	0.174	0.200	14.9	0.541	0.872	61.0	0.474	0.624	31.7	0.130	0.626	381.8

Year	Sheep			Laying hens			Broilers			Other poultry		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1993	0.117	0.080	-31.3	0.511	0.580	13.5	0.447	0.478	6.8	0.123	0.591	381.9
1994	0.086	0.099	14.9	0.496	0.438	-11.6	0.434	0.400	-7.8	0.119	0.573	381.7
1995	0.070	0.080	15.1	0.461	0.398	-13.8	0.404	0.372	-7.8	0.111	0.533	381.5
1996	0.055	0.063	14.9	0.368	0.405	9.9	0.322	0.302	-6.4	0.088	0.426	381.7
1997	0.050	0.057	14.9	0.412	0.345	-16.2	0.361	0.272	-24.6	0.099	0.476	381.6
1998	0.043	0.050	14.9	0.418	0.375	-10.2	0.365	0.343	-6.1	0.100	0.482	381.9
1999	0.043	0.050	15.0	0.390	0.380	-2.5	0.341	0.316	-7.3	0.094	0.332	254.6
2000	0.045	0.052	15.0	0.375	0.347	-7.4	0.328	0.295	-10.1	0.090	0.298	231.2
2001	0.045	0.052	15.0	0.452	0.478	5.7	0.288	0.379	31.6	0.043	0.341	689.1
2002	0.047	0.054	15.0	0.367	0.400	9.1	0.287	0.387	34.7	0.025	0.384	1,468.2
2003	0.048	0.055	15.0	0.376	0.388	3.1	0.252	0.421	66.8	0.015	0.428	2,804.1
2004	0.057	0.073	27.6	0.388	0.403	3.9	0.298	0.436	46.4	0.020	0.471	2,216.3
2005	0.073	0.082	11.8	0.344	0.348	1.2	0.241	0.387	60.9	0.023	0.266	1,041.9
2006	0.092	0.101	9.4	0.262	0.306	16.7	0.234	0.356	52.3	0.028	0.351	1,146.6
2007	0.107	0.120	12.0	0.407	0.309	-24.2	0.188	0.352	86.7	0.013	0.120	832.6
2008	0.115	0.132	15.3	0.264	0.264	0.0	0.258	0.348	34.7	0.032	0.376	1,081.0
2009	0.113	0.134	19.2	0.319	0.310	-3.0	0.243	0.380	56.6	0.042	0.299	616.1
2010	0.116	0.141	21.8	0.276	0.278	0.5	0.312	0.394	26.1	0.046	0.358	672.9
2011	0.123	0.138	12.0	0.273	0.273	0.0	0.309	0.411	32.9	0.057	0.488	762.0
2012	0.114	0.135	18.4	0.333	0.333	0.0	0.309	0.432	39.8	0.070	0.434	516.9

Table 8.10 The differences in manure management NMVOC emissions (kt) for the year 1990-2012 between 2014 and 2015 submissions (%)

Year	Sheep			Laying hens			Broilers			Other poultry		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
1990	0.028	0.032	14.9	0.647	1.035	60.0	0.409	0.451	10.4	0.265	0.616	132.6
1991	0.029	0.033	14.9	0.548	0.877	60.0	0.349	0.372	6.6	0.199	0.522	161.8
1992	0.025	0.029	14.9	0.338	0.541	60.0	0.215	0.306	42.3	0.123	0.322	161.8
1993	0.017	0.011	-31.3	0.319	0.511	60.0	0.203	0.234	15.4	0.116	0.304	161.8
1994	0.012	0.014	14.9	0.310	0.496	60.0	0.197	0.196	-0.5	0.113	0.295	161.7
1995	0.010	0.011	15.2	0.288	0.461	60.0	0.183	0.183	-0.5	0.105	0.274	161.6
1996	0.008	0.009	14.9	0.230	0.368	60.0	0.146	0.148	1.1	0.084	0.219	161.7
1997	0.007	0.008	14.9	0.258	0.412	60.0	0.164	0.134	-18.5	0.094	0.245	161.7
1998	0.006	0.007	14.9	0.261	0.418	60.0	0.166	0.168	1.5	0.095	0.248	161.8
1999	0.006	0.007	15.0	0.244	0.390	60.0	0.155	0.155	0.1	0.089	0.171	92.7
2000	0.006	0.007	15.1	0.234	0.375	60.0	0.149	0.145	-2.9	0.085	0.153	80.0
2001	0.006	0.007	15.0	0.283	0.452	60.0	0.131	0.186	42.1	0.041	0.176	328.8
2002	0.007	0.008	15.1	0.229	0.367	60.0	0.131	0.190	45.5	0.023	0.198	752.1
2003	0.007	0.008	15.0	0.235	0.376	60.0	0.115	0.206	80.1	0.014	0.220	1,477.9
2004	0.008	0.010	27.6	0.242	0.388	60.0	0.135	0.214	58.1	0.019	0.242	1,158.5
2005	0.010	0.012	11.8	0.215	0.344	60.0	0.109	0.190	73.8	0.022	0.137	520.4
2006	0.013	0.014	9.4	0.164	0.262	60.0	0.106	0.175	64.5	0.027	0.180	577.3
2007	0.015	0.017	12.0	0.255	0.407	60.0	0.086	0.173	101.6	0.012	0.062	406.7
2008	0.016	0.019	15.3	0.165	0.264	60.0	0.117	0.171	45.5	0.030	0.193	541.7
2009	0.016	0.019	19.2	0.199	0.319	60.0	0.110	0.187	69.1	0.040	0.154	289.1
2010	0.017	0.020	21.8	0.173	0.276	60.0	0.142	0.193	36.2	0.044	0.184	319.9
2011	0.018	0.020	12.0	0.171	0.273	60.0	0.142	0.202	42.1	0.054	0.251	368.3
2012	0.016	0.019	18.3	0.208	0.333	60.0	0.140	0.212	51.0	0.067	0.223	235.2

Table 8.11 The differences in manure management $PM_{2.5}$ emissions (kt) for the year 2000-2012 between 2014 and 2015 submissions (%)

Year	Laying hens			Broilers			Other poultry		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
2000	0.002	0.017	965.5	0.010	0.012	15.6	0.0004	0.001	231.2
2001	0.002	0.023	1,115.8	0.009	0.015	69.2	0.0002	0.001	689.0
2002	0.002	0.019	1,154.8	0.009	0.016	73.2	0.0001	0.002	1,467.8
2003	0.002	0.019	1,086.0	0.008	0.017	114.4	0.0001	0.002	2,804.8
2004	0.002	0.019	1,095.0	0.009	0.018	88.2	0.0001	0.002	2,216.6
2005	0.001	0.017	1,064.3	0.008	0.016	106.9	0.0001	0.001	1,041.8
2006	0.001	0.015	1,242.1	0.007	0.015	95.8	0.0001	0.001	1,146.6
2007	0.002	0.015	771.7	0.006	0.014	140.0	0.0001	0.001	831.8
2008	0.001	0.013	1,050.0	0.008	0.014	73.2	0.0001	0.002	1,081.3
2009	0.001	0.015	1,015.4	0.008	0.016	101.3	0.0002	0.001	616.4
2010	0.001	0.013	1,056.4	0.010	0.016	62.2	0.0002	0.002	673.8
2011	0.001	0.013	1,050.0	0.010	0.017	69.2	0.0002	0.002	762.0
2012	0.001	0.016	1,040.0	0.010	0.018	80.2	0.0003	0.002	508.7

Table 8.12 The differences in manure management PM_{10} emissions (kt) for the year 2000-2012 between 2014 and 2015 submissions (%)

Year	Laying hens			Broilers			Other poultry		
	Old	Recalc.	%	Old	Recalc.	%	Old	Recalc.	%
2000	0.013	0.086	548.5	0.078	0.092	19.3	0.003	0.010	231.2
2001	0.016	0.118	640.0	0.068	0.119	74.6	0.001	0.011	689.1
2002	0.013	0.099	663.8	0.068	0.121	78.7	0.001	0.013	1,468.2
2003	0.013	0.096	621.9	0.060	0.132	121.3	0.000	0.014	2,804.2
2004	0.014	0.100	627.4	0.070	0.137	94.3	0.001	0.016	2,216.3
2005	0.012	0.086	608.7	0.057	0.121	113.5	0.001	0.009	1,042.0
2006	0.009	0.076	716.9	0.055	0.112	102.1	0.001	0.012	1,146.6
2007	0.014	0.077	430.6	0.045	0.110	147.7	0.000	0.004	832.7
2008	0.009	0.065	600.0	0.061	0.109	78.8	0.001	0.013	1,081.0
2009	0.011	0.077	578.9	0.057	0.119	107.8	0.001	0.010	616.1
2010	0.010	0.069	603.7	0.074	0.124	67.4	0.002	0.012	672.7
2011	0.010	0.068	600.0	0.073	0.129	76.5	0.002	0.016	761.9
2012	0.012	0.083	599.8	0.073	0.135	85.4	0.002	0.015	508.7

8.3.2. Agricultural Soils (NFR 3D)

Table 8.13 The differences in agricultural soils NO_x emissions (kt) for the year 1990-2012 between 2014 and 2015 submissions (%)

Year	Old	Recalc.	Difference, %
1992	2.395	1.517	-36.6
1993	1.391	0.779	-44.1
1994	1.306	0.678	-48.1
1995	0.913	0.492	-46.2
1996	0.782	0.431	-44.9
1997	0.846	0.532	-37.1
1998	0.934	0.648	-30.6
1999	0.800	0.517	-35.3
2000	0.808	0.582	-27.9
2001	0.697	0.510	-26.8
2002	0.661	0.434	-34.3
2003	0.764	0.605	-20.8
2004	0.891	0.646	-27.5
2005	0.759	0.522	-31.2
2006	0.790	0.588	-25.6
2007	0.958	0.650	-32.2
2008	1.184	0.922	-22.1
2009	0.975	0.711	-27.2
2010	1.046	0.744	-28.8
2011	1.092	0.775	-29.1
2012	1.174	0.857	-27.0

8.4. Waste sector (NFR 5)

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.

5B Biological treatment of waste

Emissions of NH_3 in the composting sector (NFR 5B1) have been recalculated for the period of 1992-2012. Recalculations in this sector were made based on a new emission factor in EMEP/EEA Guidebook 2013.

The differences in emissions between the 2014 and 2015 submissions are presented in Table 8.14.

Table 8.14 The differences in composting NH_3 emissions between the 2014 and 2015 submissions (kt)

Year	Old	Recalc.	Difference, kt
1990	0.002	0.002	0.000
1991	0.002	0.002	0.000
1992	0.002	0.005	-0.003
1993	0.002	0.005	-0.003
1994	0.002	0.005	-0.003
1995	0.002	0.006	-0.004
1996	0.001	0.004	-0.003
1997	0.003	0.007	-0.005
1998	0.001	0.001	-0.001
1999	0.002	0.004	-0.003
2000	0.005	0.013	-0.008
2001	0.004	0.012	-0.008
2002	0.004	0.011	-0.007
2003	0.016	0.044	-0.028
2004	0.018	0.050	-0.032
2005	0.025	0.069	-0.044
2006	0.028	0.076	-0.048
2007	0.045	0.122	-0.078
2008	0.050	0.137	-0.087
2009	0.056	0.153	-0.097
2010	0.052	0.144	-0.091
2011	0.038	0.104	-0.066
2012	0.037	0.099	-0.062

5E Other waste

Emissions of TSP, Pb, Cd, Hg, As, Cr, Cu and dioxins are recalculated for the period of 1998-2012. Emissions of $PM_{2.5}$ and PM_{10} are recalculated for the period of 2000-2012.

All recalculations in other waste sector were based on new emission factors in EMEP/EEA Guidebook 2013. Additional recalculations of heavy metals were based on corrections of estimation errors. As a result, there are enormous differences between As and Cr submissions for the year 2011 and 2012 (Table 8.15).

Table 8.15 The differences in other waste sector emissions between the 2014 and 2015 submissions (%)

Year	$PM_{2.5}$	PM_{10}	TSP	Pb	Cd	Hg	As	Cr	Cu	PCDD/ PCDF
1998	NR	NR	99.5	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
1999	NR	NR	99.3	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2000	99.4	99.4	99.4	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2001	99.3	99.3	99.3	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2002	99.4	99.4	99.4	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2003	99.3	99.3	99.3	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2004	99.2	99.2	99.2	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2005	99.3	99.3	99.3	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2006	99.2	99.2	99.2	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2007	99.5	99.5	99.5	99.9	99.9	99.9	-2.3	-0.5	99.9	99.9
2008	99.2	99.1	99.1	99.9	99.9	99.9	-2.3	-0.7	99.9	99.9
2009	99.2	99.2	99.2	99.9	99.9	99.9	-2.4	-0.7	99.9	99.9
2010	99.1	99.1	99.1	99.9	99.9	99.9	-2.7	-0.8	99.9	99.9
2011	98.8	98.8	98.8	0.0	0.0	0.0	-102,379.7	-100,690.8	-0.2	99.9
2012	99.9	99.9	99.9	15.6	51.6	39.7	-48,544.6	-48,581.4	50.5	99.9

Source: www.cakover.hr

9. PROJECTIONS

Projections

Emission projections have been calculated based on national strategic documents, also action plans of biggest stakeholders have been taken into account where possible. In some cases projections exceed the national emission ceilings agreed for Estonia during amendments made to LRTAP Gothenburg Protocol in 2012. In these cases further work identifying need for further measures and/or development of projection methodologies is planned in the future.

Table 9.1 National emission projections for 2015, 2020 and 2030

	Emission projections for 2020 (kt)	Emission projections for 2025 (kt)	Emission projections for 2030 (kt)
NO_x	36.37	32.50	33.68
NMVOC	45.99	48.73	38.26
SO_x (as SO_2)	44.70	37.91	37.94
NH_3	10.48	10.59	10.47

ANNEX I

Key sources categories level assessment

Table 1 Key source categories for NO_x emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
1A1a	**Public electricity and heat production**	**10.3785**	**34.9%**
1A3biii	**Road transport: Heavy duty vehicles and buses**	**4.9701**	**51.6%**
1A3bi	**Road transport: Passenger cars**	**3.0698**	**62.0%**
1A4cii	**Agriculture/Forestry/Fishing: Off-road vehicles and other machinery**	**2.2646**	**69.6%**
1A4bi	**Residential: Stationary**	**1.4446**	**74.4%**
1A2f	**Stationary combustion in manufacturing industries and construction: Non-metallic minerals**	**1.4033**	**79.2%**
1A3c	**Railways**	**1.3685**	**83.8%**
3Da1	Inorganic N-fertilizers (includes also urea application)	0.8751	86.7%
1A3bii	Road transport: Light duty vehicles	0.6710	89.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.6558	91.2%
1A2gviii	Stationary combustion in manufacturing industries and construction	0.5055	92.9%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.3417	94.0%
1A4ai	Commercial/institutional: Stationary	0.3262	95.1%
1A4aii	Commercial/institutional: Mobile	0.3133	96.2%
1A1c	Manufacture of solid fuels and other energy industries	0.2633	97.1%
1A3dii	National navigation (shipping)	0.1697	97.6%
2B1	Ammonia production	0.1344	98.1%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0869	98.4%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0825	98.7%
1A3ai(i)	International aviation LTO (civil)	0.0735	98.9%
1A4bii	Residential: Household and gardening (mobile)	0.0608	99.1%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0604	99.3%
2H1	Pulp and paper industry	0.0431	99.5%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0381	99.6%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0205	99.7%
2C7c	Other metal production	0.0145	99.7%
1A3biv	Road transport: Mopeds & motorcycles	0.0098	99.7%
3B1a	Manure management - Dairy cattle	0.0079	99.8%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0079	99.8%
2A5a	Quarrying and mining of minerals other than coal	0.0076	99.8%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0068	99.8%
1A1b	Petroleum refining	0.0066	99.9%
5C1bi	Industrial waste incineration	0.0060	99.9%
5C2	Open burning of waste	0.0053	99.9%
3B1b	Manure management - Non-dairy cattle	0.0048	99.9%
5A	Biological treatment of waste - Solid waste disposal on land	0.0043	99.9%
2G	Other product use	0.0034	99.9%
3B4gii	Manure management - Broilers	0.0020	100.0%
3B4gi	Manure management - Laying hens	0.0018	100.0%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0017	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0015	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0015	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0011	100.0%
5C1biv	Sewage sludge incineration	0.0010	100.0%
3B4e	Manure management - Horses	0.0008	100.0%

Table 2 Key source categories for NMVOC emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
1A4bi	**Residential: Stationary**	**15.7402**	**47.8%**
2D3d	**Coating applications**	**2.5643**	**55.6%**
2D3a	**Domestic solvent use including fungicides**	**1.5842**	**60.4%**
1A3bi	**Road transport: Passenger cars**	**1.3608**	**64.5%**
3B1a	**Manure management - Dairy cattle**	**1.3314**	**68.6%**
3B1b	**Manure management - Non-dairy cattle**	**1.2099**	**72.2%**
1B2av	**Distribution of oil products**	**1.1999**	**75.9%**
2D3e	**Degreasing**	**1.0001**	**78.9%**
3B3	**Manure management - Swine**	**0.9093**	**81.7%**
2H2	Food and beverages industry	0.7200	83.9%
1A1a	Public electricity and heat production	0.6000	85.7%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.5172	87.3%
1A4bii	Residential: Household and gardening (mobile)	0.4598	88.7%
2D3h	Printing	0.4213	89.9%
2D3i	Other solvent use	0.4019	91.2%
2D3g	Chemical products	0.2680	92.0%
1B2aiv	Fugitive emissions oil: Refining / storage	0.2502	92.7%
1A3bv	Road transport: Gasoline evaporation	0.2265	93.4%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.2175	94.1%
3B4gii	Manure management - Broilers	0.2109	94.7%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1927	95.3%
3B4h	Manure management - Other animals	0.1911	95.9%
1A3biii	Road transport: Heavy duty vehicles and buses	0.1798	96.4%
1A3c	Railways	0.1214	96.8%
3B4gi	Manure management - Laying hens	0.0975	97.1%
3B4giv	Manure management - Other poultry	0.0936	97.4%
1A3bii	Road transport: Light duty vehicles	0.0858	97.6%
1A3biv	Road transport: Mopeds & motorcycles	0.0828	97.9%
1A4ai	Commercial/institutional: Stationary	0.0811	98.1%
1A1c	Manufacture of solid fuels and other energy industries	0.0689	98.4%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0677	98.6%
1A4aii	Commercial/institutional: Mobile	0.0599	98.7%
2B10b	Storage, handling and transport of chemical products	0.0597	98.9%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0420	99.0%
1A3dii	National navigation (shipping)	0.0329	99.1%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0325	99.2%
5D2	Industrial wastewater handling	0.0293	99.3%

Table 3 Key source categories for SO_x emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
1A1a	**Public electricity and heat production**	**30.1145**	**82.5%**
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	3.4831	92.0%
1A1c	Manufacture of solid fuels and other energy industries	1.0166	94.8%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.8358	97.1%
1A4bi	Residential: Stationary	0.4292	98.3%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.1657	98.8%
1A4ai	Commercial/institutional: Stationary	0.1581	99.2%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and	0.0596	99.4%

NFR code	NFR name	2013 (kt)	Cumulative Total
	Print		
1A3c	Railways	0.0522	99.5%
5C1bi	Industrial waste incineration	0.0388	99.6%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0285	99.7%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0255	99.7%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0237	99.8%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0192	99.9%
1A3dii	National navigation (shipping)	0.0088	99.9%
1A3ai(i)	International aviation LTO (civil)	0.0066	99.9%
1A3bi	Road transport: Passenger cars	0.0050	99.9%
5C2	Open burning of waste	0.0050	99.9%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0047	99.9%
5A	Biological treatment of waste - Solid waste disposal on land	0.0047	100.0%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0024	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0022	100.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0021	100.0%
5C1biv	Sewage sludge incineration	0.0019	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0014	100.0%
2G	Other product use	0.0013	100.0%
1A3bii	Road transport: Light duty vehicles	0.0008	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0005	100.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction:	0.0004	100.0%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0003	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0003	100.0%

Table 4 Key source categories for NH_3 emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
3B1a	**Manure management - Dairy cattle**	**3.3286**	**29.4%**
3Da1	**Inorganic N-fertilizers (includes also urea application)**	**2.8274**	**54.5%**
3B1b	**Manure management - Non-dairy cattle**	**1.9849**	**72.0%**
3B3	**Manure management - Swine**	**1.3275**	**83.8%**
3B4gii	Manure management - Broilers	0.4295	87.6%
3B4gi	Manure management - Laying hens	0.2836	90.1%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.1913	91.8%
3B4giv	Manure management - Other poultry	0.1819	93.4%
1A3bi	Road transport: Passenger cars	0.1634	94.8%
3B2	Manure management - Sheep	0.1228	95.9%
5B1	Biological treatment of waste - Composting	0.1201	97.0%
3B4e	Manure management - Horses	0.0932	97.8%
2C7c	Other metal production	0.0741	98.5%
1A4bi	Residential: Stationary	0.0637	99.0%
2B10a	Chemical industry: Other	0.0585	99.5%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0111	99.6%
2B1	Ammonia production	0.0107	99.7%
2G	Other product use	0.0076	99.8%
2B10b	Storage, handling and transport of chemical products	0.0071	99.9%
1A3bii	Road transport: Light duty vehicles	0.0041	99.9%
1A1a	Public electricity and heat production	0.0030	99.9%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0029	99.9%
2D3g	Chemical products	0.0023	100.0%
3B4h	Manure management - Other animals	0.0020	100.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0005	100.0%

NFR code	NFR name	2013 (kt)	Cumulative Total
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0003	100.0%

Table 5 Key source categories for $PM_{2.5}$ emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
1A4bi	**Residential: Stationary**	**11.2408**	**57.4%**
1A1a	**Public electricity and heat production**	**4.6357**	**81.0%**
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	1.4930	88.6%
1A4ai	Commercial/institutional: Stationary	0.3508	90.4%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.1762	91.3%
1A3bi	Road transport: Passenger cars	0.1608	92.2%
1A1c	Manufacture of solid fuels and other energy industries	0.1479	92.9%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1340	93.6%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1123	94.2%
1A3bvi	Road transport: Automobile tyre and brake wear	0.0920	94.6%
2B10a	Chemical industry: Other	0.0920	95.1%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0900	95.6%
2H1	Pulp and paper industry	0.0776	96.0%
5E	Other waste	0.0745	96.3%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0743	96.7%
2G	Other product use	0.0724	97.1%
1A3bvii	Road transport: Automobile road abrasion	0.0509	97.4%
1A3bii	Road transport: Light duty vehicles	0.0432	97.6%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0417	97.8%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0387	98.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0383	98.2%
1A3c	Railways	0.0358	98.4%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.0286	98.5%
5C2	Open burning of waste	0.0271	98.6%
3B1b	Manure management - Non-dairy cattle	0.0262	98.8%
2I	Wood processing	0.0231	98.9%
3B1a	Manure management - Dairy cattle	0.0225	99.0%
1A4aii	Commercial/institutional: Mobile	0.0203	99.1%
1A3dii	National navigation (shipping)	0.0203	99.2%
2C7c	Other metal production	0.0194	99.3%
3B4gii	Manure management - Broilers	0.0176	99.4%
3B4gi	Manure management - Laying hens	0.0136	99.5%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0133	99.5%
3B3	Manure management - Swine	0.0126	99.6%
2A5a	Quarrying and mining of minerals other than coal	0.0115	99.7%
1A4bii	Residential: Household and gardening (mobile)	0.0097	99.7%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0094	99.8%
2A5b	Construction and demolition	0.0070	99.8%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0069	99.8%
2A1	Cement production	0.0056	99.9%
2H2	Food and beverages industry	0.0055	99.9%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0045	99.9%
2A6	Other mineral products	0.0026	99.9%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0022	99.9%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0017	99.9%
3B2	Manure management - Sheep	0.0015	100.0%

NFR code	NFR name	2013 (kt)	Cumulative Total
1A3biv	Road transport: Mopeds & motorcycles	0.0013	100.0%
2C3	Aluminium production	0.0013	100.0%
2D3b	Road paving with asphalt	0.0012	100.0%
3B4e	Manure management - Horses	0.0009	100.0%
3B4giv	Manure management - Other poultry	0.0008	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0008	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0007	100.0%
1A3ai(i)	International aviation LTO (civil)	0.0004	100.0%
3B4h	Manure management - Other animals	0.0004	100.0%
2B10b	Storage, handling and transport of chemical products	0.0004	100.0%
2C1	Iron and steel production	0.0001	100.0%
2C5	Lead production	0.0001	100.0%
2A2	Lime production	0.0001	100.0%
2C6	Zinc production	0.0000	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0000	100.0%
2C7a	Copper production	0.0000	100.0%
2B1	Ammonia production	0.0000	100.0%
1A1b	Petroleum refining	0.0000	100.0%
5B2	Biological treatment of waste - Anaerobic digestion at biogas facilities	0.0000	100.0%

Table 6 Key source categories for PM_{10} emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
1A4bi	**Residential: Stationary**	**11.2408**	**44.3%**
1A1a	**Public electricity and heat production**	**8.3823**	**77.3%**
1A2gviii	**Stationary combustion in manufacturing industries and construction: Other**	**1.6348**	**83.8%**
3Da1	Inorganic N-fertilizers (includes also urea application)	0.7435	86.7%
1A4ai	Commercial/institutional: Stationary	0.3883	88.3%
1A1c	Manufacture of solid fuels and other energy industries	0.3090	89.5%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.1887	90.2%
1A3bvi	Road transport: Automobile tyre and brake wear	0.1716	90.9%
2B10a	Chemical industry: Other	0.1699	91.6%
1A3bi	Road transport: Passenger cars	0.1608	92.2%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1418	92.8%
3B4gii	Manure management - Broilers	0.1347	93.3%
2A5a	Quarrying and mining of minerals other than coal	0.1219	93.8%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1123	94.2%
2H1	Pulp and paper industry	0.1035	94.6%
1A3bvii	Road transport: Automobile road abrasion	0.0936	95.0%
2G	Other product use	0.0935	95.4%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0900	95.7%
3B3	Manure management - Swine	0.0791	96.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0785	96.3%
5E	Other waste	0.0745	96.6%
2I	Wood processing	0.0729	96.9%
3B4gi	Manure management - Laying hens	0.0703	97.2%
2A5b	Construction and demolition	0.0697	97.5%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.0677	97.7%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0603	98.0%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0500	98.2%
1A3bii	Road transport: Light duty vehicles	0.0432	98.3%

NFR code	NFR name	2013 (kt)	Cumulative Total
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0417	98.5%
5C2	Open burning of waste	0.0404	98.7%
3B1b	Manure management - Non-dairy cattle	0.0392	98.8%
1A3c	Railways	0.0376	99.0%
3B1a	Manure management - Dairy cattle	0.0353	99.1%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0335	99.2%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0262	99.3%
2C7c	Other metal production	0.0252	99.4%
2D3b	Road paving with asphalt	0.0237	99.5%
1A4aii	Commercial/institutional: Mobile	0.0203	99.6%
1A3dii	National navigation (shipping)	0.0203	99.7%
2H2	Food and beverages industry	0.0166	99.8%
2A1	Cement production	0.0101	99.8%
1A4bii	Residential: Household and gardening (mobile)	0.0097	99.8%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0085	99.9%
2A6	Other mineral products	0.0082	99.9%
3B4giv	Manure management - Other poultry	0.0061	99.9%
3B2	Manure management - Sheep	0.0049	99.9%
2C3	Aluminium production	0.0025	100.0%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0025	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0018	100.0%
3B4e	Manure management - Horses	0.0014	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0013	100.0%
2B10b	Storage, handling and transport of chemical products	0.0012	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0010	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0009	100.0%
3B4h	Manure management - Other animals	0.0008	100.0%
1A3ai(i)	International aviation LTO (civil)	0.0004	100.0%
2A2	Lime production	0.0003	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0002	100.0%
2C1	Iron and steel production	0.0001	100.0%
2C5	Lead production	0.0001	100.0%
2C6	Zinc production	0.0001	100.0%
2D3e	Degreasing	0.0000	100.0%
1A3aii(i)	Domestic aviation LTO (civil)	0.0000	100.0%
2C7a	Copper production	0.0000	100.0%
2B1	Ammonia production	0.0000	100.0%

Table 7 Key source categories for TSP emissions for 2013, level assessment

NFR code	NFR name	2013 (kt)	Cumulative Total
1A4bi	**Residential: Stationary**	**12.8450**	**44.1%**
1A1a	**Public electricity and heat production**	**9.5932**	**77.1%**
1A2gviii	**Stationary combustion in manufacturing industries and construction**	**1.7348**	**83.0%**
1A4ai	Commercial/institutional: Stationary	0.4800	84.7%
1A1c	Manufacture of solid fuels and other energy industries	0.4102	86.1%
2A5a	Quarrying and mining of minerals other than coal	0.2351	86.9%
1A3bvi	Road transport: Automobile tyre and brake wear	0.2221	87.6%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.2123	88.4%
2I	Wood processing	0.2097	89.1%
2B10a	Chemical industry: Other	0.2094	89.8%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.2014	90.5%
1A3bvii	Road transport: Automobile road abrasion	0.1872	91.2%

NFR code	NFR name	2013 (kt)	Cumulative Total
2D3b	Road paving with asphalt	0.1775	91.8%
3B3	Manure management - Swine	0.1758	92.4%
1A3bi	Road transport: Passenger cars	0.1608	92.9%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1495	93.4%
2A5b	Construction and demolition	0.1390	93.9%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.1381	94.4%
3B4gii	Manure management - Broilers	0.1347	94.8%
2H1	Pulp and paper industry	0.1294	95.3%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.1123	95.7%
2G	Other product use	0.0978	96.0%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0925	96.3%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0900	96.6%
3B1b	Manure management - Non-dairy cattle	0.0871	96.9%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0856	97.2%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0828	97.5%
3B1a	Manure management - Dairy cattle	0.0783	97.8%
5E	Other waste	0.0745	98.0%
3B4gi	Manure management - Laying hens	0.0703	98.3%
5C2	Open burning of waste	0.0539	98.5%
2H2	Food and beverages industry	0.0502	98.6%
1B2aiv	Fugitive emissions oil: Refining / storage	0.0493	98.8%
1A3bii	Road transport: Light duty vehicles	0.0432	99.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0417	99.1%
2C7c	Other metal production	0.0411	99.2%
1A3c	Railways	0.0397	99.4%
3Da1	Inorganic N-fertilizers (includes also urea application)	0.0286	99.5%
2A6	Other mineral products	0.0232	99.6%
1A4aii	Commercial/institutional: Mobile	0.0203	99.6%
1A3dii	National navigation (shipping)	0.0203	99.7%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0131	99.7%
3B4giv	Manure management - Other poultry	0.0131	99.8%
3B2	Manure management - Sheep	0.0122	99.8%
2A1	Cement production	0.0112	99.9%
1A4bii	Residential: Household and gardening (mobile)	0.0097	99.9%
2C3	Aluminium production	0.0038	99.9%
2B10b	Storage, handling and transport of chemical products	0.0037	99.9%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0031	99.9%
3B4e	Manure management - Horses	0.0030	99.9%
2D3g	Chemical products	0.0027	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0018	100.0%
3B4h	Manure management - Other animals	0.0018	100.0%
1B1b	Fugitive emission from solid fuels: Solid fuel transformation	0.0016	100.0%
2D3d	Coating applications	0.0016	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0013	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0011	100.0%
2D3e	Degreasing	0.0010	100.0%
2A2	Lime production	0.0008	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0008	100.0%
1A3ai(i)	International aviation LTO (civil)	0.0004	100.0%
2C1	Iron and steel production	0.0002	100.0%
2C5	Lead production	0.0002	100.0%
2D3h	Printing	0.0001	100.0%

NFR code	NFR name	2013 (kt)	Cumulative Total
2C6	Zinc production	0.0001	100.0%

Table 8 Key source categories for CO emissions for 2013, level assessment

NFR code	NFR name	2013 (t)	Cumulative Total
1A4bi	**Residential: Stationary**	**98.4356**	**62.3%**
1A1c	**Manufacture of solid fuels and other energy industries**	**24.9446**	**78.1%**
1A3bi	**Road transport: Passenger cars**	**12.5227**	**86.1%**
1A1a	Public electricity and heat production	6.5390	90.2%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	4.1470	92.8%
1A4bii	Residential: Household and gardening (mobile)	2.4765	94.4%
1A3biii	Road transport: Heavy duty vehicles and buses	1.2370	95.2%
1B2aiv	Fugitive emissions oil: Refining / storage	1.1949	95.9%
1A4ai	Commercial/institutional: Stationary	0.9453	96.5%
1A3bii	Road transport: Light duty vehicles	0.7925	97.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.7071	97.5%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.6341	97.9%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.3934	98.1%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.3893	98.4%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.3560	98.6%
1A3biv	Road transport: Mopeds & motorcycles	0.3503	98.8%
2B10a	Chemical industry:	0.3256	99.0%
1A3c	Railways	0.2794	99.2%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.2147	99.3%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.1732	99.5%
1A4aii	Commercial/institutional: Mobile	0.1731	99.6%
1B1a	Fugitive emission from solid fuels: Coal mining and handling	0.1550	99.7%
1A3ai(i)	International aviation LTO (civil)	0.1138	99.7%
2G	Other product use	0.1042	99.8%
1A3dii	National navigation (shipping)	0.0875	99.9%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0658	99.9%
1A3aii(i)	Domestic aviation LTO (civil)	0.0507	99.9%
2H1	Pulp and paper industry	0.0190	99.9%
2L	Other production, consumption, storage, transportation or handling of bulk products	0.0159	99.9%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0151	100.0%
5A	Biological treatment of waste - Solid waste disposal on land	0.0116	100.0%

Table 9 Key source categories for Pb emissions for 2013, level assessment

NFR code	NFR name	2013 (t)	Cumulative Total
1A1a	**Public electricity and heat production**	**37.2079**	**94.3%**
1A4bi	Residential: Stationary	0.4752	95.5%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.4166	96.6%
2G	Other product use	0.3447	97.4%
5C2	Open burning of waste	0.3065	98.2%
1A3bvi	Road transport: Automobile tyre and brake wear	0.2343	98.8%
1A3bi	Road transport: Passenger cars	0.1804	99.3%
1A4ai	Commercial/institutional: Stationary	0.0936	99.5%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0535	99.6%

NFR code	NFR name	2013 (t)	Cumulative Total
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0395	99.7%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0282	99.8%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0217	99.9%
1A4bii	Residential: Household and gardening (mobile)	0.0178	99.9%
2C5	Lead production	0.0105	99.9%
1A3bii	Road transport: Light duty vehicles	0.0076	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0040	100.0%
1A1c	Manufacture of solid fuels and other energy industries	0.0028	100.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0019	100.0%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0015	100.0%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0012	100.0%
5E	Other waste	0.0009	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0008	100.0%
1A4aii	Commercial/institutional: Mobile	0.0006	100.0%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0005	100.0%
2C7c	Other metal production	0.0004	100.0%
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0002	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0001	100.0%
2D3e	Degreasing	0.0001	100.0%

Table 10 Key source categories for Cd emissions for 2013, level assessment

NFR code	NFR name	2013 (t)	Cumulative Total
1A1a	**Public electricity and heat production**	**0.7088**	**73.4%**
1A4bi	**Residential: Stationary**	**0.2053**	**94.7%**
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0111	95.8%
2G	Other product use	0.0106	96.9%
5C2	Open burning of waste	0.0100	97.9%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0057	98.5%
1A3bi	Road transport: Passenger cars	0.0041	98.9%
1A4ai	Commercial/institutional: Stationary	0.0026	99.2%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0017	99.4%
1A3bvi	Road transport: Automobile tyre and brake wear	0.0011	99.5%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0010	99.6%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0007	99.7%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0006	99.7%
1A3bii	Road transport: Light duty vehicles	0.0006	99.8%
5E	Other waste	0.0005	99.9%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0004	99.9%
1A3c	Railways	0.0003	99.9%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0002	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0002	100.0%
1A4aii	Commercial/institutional: Mobile	0.0001	100.0%
1A1c	Manufacture of solid fuels and other energy industries	0.0001	100.0%
1A3dii	National navigation (shipping)	0.0000	100.0%
1A4bii	Residential: Household and gardening (mobile)	0.0000	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0000	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%

NFR code	NFR name	2013 (t)	Cumulative Total
1A2d	Stationary combustion in manufacturing industries and construction: Pulp, Paper and Print	0.0000	100.0%

Table 11 Key source categories for Hg emissions for 2013, level assessment

NFR code	NFR name	2013 (t)	Cumulative Total
1A1a	**Public electricity and heat production**	**0.6421**	**94.7%**
1A4bi	Residential: Stationary	0.0112	96.4%
5C2	Open burning of waste	0.0083	97.6%
2D3a	Domestic solvent use including fungicides	0.0074	98.7%
2G	Other product use	0.0050	99.4%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0026	99.8%
5E	Other waste	0.0006	99.9%
1A4ai	Commercial/institutional: Stationary	0.0004	99.9%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0002	99.9%
1A1a	Public electricity and heat production	0.6421	94.7%
1A4bi	Residential: Stationary	0.0112	96.4%
5C2	Open burning of waste	0.0083	97.6%
2D3a	Domestic solvent use including fungicides	0.0074	98.7%
2G	Other product use	0.0050	99.4%
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.0026	99.8%
5E	Other waste	0.0006	99.9%
1A4ai	Commercial/institutional: Stationary	0.0004	99.9%
1A2e	Stationary combustion in manufacturing industries and construction: Food processing, beverages and tobacco	0.0002	99.9%
1A2c	Stationary combustion in manufacturing industries and construction: Chemicals	0.0002	100.0%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0001	100.0%
1A2a	Stationary combustion in manufacturing industries and construction: Iron and steel	0.0000	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%
1A2f	Stationary combustion in manufacturing industries and construction: Non-metallic minerals	0.0000	100.0%
1A1c	Manufacture of solid fuels and other energy industries	0.0000	100.0%
1A2b	Stationary combustion in manufacturing industries and construction: Non-ferrous metals	0.0000	100.0%

Table 12 Key source categories for PCB emissions for 2013, level assessment

NFR code	NFR name	2013 (kg)	Cumulative Total
1A1a	**Public electricity and heat production**	**2.6879**	**68.3%**
1A2gviii	**Stationary combustion in manufacturing industries and construction**	**0.8861**	**90.8%**
1A4ai	Commercial/institutional: Stationary	0.1849	95.5%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0856	97.7%
1A4bi	Residential: Stationary	0.0695	99.4%
5C2	Open burning of waste	0.0156	99.8%
1A1c	Manufacture of solid fuels and other energy industries	0.0068	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0000	100.0%
1A1b	Petroleum refining	0.0000	100.0%
1A3c	Railways	0.0000	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0000	100.0%

Table 13 Key source categories for PCDD/PCDF emissions for 2013, level assessment

NFR code	NFR name	2013 (g I-TEQ)	Cumulative Total
1A4bi	**Residential: Stationary**	**1.1027**	**31.9%**
1A1a	**Public electricity and heat production**	**0.8027**	**55.1%**
5E	**Other waste**	**0.7572**	**77.0%**
1A2gviii	**Stationary combustion in manufacturing industries and construction**	**0.2593**	**84.5%**
5C1bi	Industrial waste incineration	0.2199	90.9%
5C2	Open burning of waste	0.1179	94.3%
1A3bi	Road transport: Passenger cars	0.1133	97.6%
1A4ai	Commercial/institutional: Stationary	0.0309	98.5%
5C1biii	Clinical waste incineration	0.0174	99.0%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0125	99.3%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0105	99.6%
1A1c	Manufacture of solid fuels and other energy industries	0.0076	99.8%
1A3bii	Road transport: Light duty vehicles	0.0042	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0009	100.0%
2G	Other product use	0.0002	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
1A1b	Petroleum refining	0.0001	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0000	100.0%

Table 14 Key source categories for PAHs emissions for 2013, level assessment

NFR code	NFR name	2013 (t)	Cumulative Total
1A4bi	**Residential: Stationary**	**3.5947**	**49.8%**
1A1a	**Public electricity and heat production**	**2.4979**	**84.4%**
1A2gviii	Stationary combustion in manufacturing industries and construction: Other	0.9043	96.9%
1A4ai	Commercial/institutional: Stationary	0.1214	98.6%
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0406	99.2%
1A3bi	Road transport: Passenger cars	0.0274	99.6%
1A3biii	Road transport: Heavy duty vehicles and buses	0.0133	99.7%
1A3bii	Road transport: Light duty vehicles	0.0053	99.8%
1A4cii	Agriculture/Forestry/Fishing: Off-road vehicles and other machinery	0.0052	99.9%
1A3c	Railways	0.0032	99.9%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0002	99.9%
1A1c	Manufacture of solid fuels and other energy industries	0.0017	100.0%
1A2gvii	Mobile Combustion in manufacturing industries and construction	0.0016	100.0%
1A4aii	Commercial/institutional: Mobile	0.0008	100.0%
2G	Other product use	0.0005	100.0%
1A3dii	National navigation (shipping)	0.0004	100.0%
1A4bii	Residential: Household and gardening (mobile)	0.0003	100.0%
1A3biv	Road transport: Mopeds & motorcycles	0.0001	100.0%
5C2	Open burning of waste	0.0000	100.0%

Table 15 Key source categories for HCB emissions for 2013, level assessment

NFR code	NFR name	2013 (kg)	Cumulative Total
1A4bi	**Residential: Stationary**	**0.1196**	**42.3%**
1A2gviii	**Stationary combustion in manufacturing industries and construction**	**0.0776**	**69.7%**
1A1a	**Public electricity and heat production**	**0.0773**	**97.0%**
5C2	Open burning of waste	0.0059	99.1%
1A4ai	Commercial/institutional: Stationary	0.0022	99.9%

NFR code	NFR name	2013 (kg)	Cumulative Total
1A4ci	Agriculture/Forestry/Fishing: Stationary	0.0003	100.0%
1A4ciii	Agriculture/Forestry/Fishing: National fishing	0.0001	100.0%
1A1c	Manufacture of solid fuels and other energy industries	0.0000	100.0%
1A1b	Petroleum refining	0.0000	100.0%
1A3c	Railways	0.0000	100.0%
1B2c	Venting and flaring (oil, gas, combined oil and gas)	0.0000	100.0%

ANNEX II

INDEX OF TABLES

ANNEX III

INDEX OF FIGURES