SIA Estonian, Latvian & Lithuanian Environment

Estimation of NMVOC emissions

from diffuse sources

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1 METHODOLOGY

1.1 Emission estimation

Emissions can be estimated at different levels of complexity. Within the IPCC Guidelines and adopted by EMEP/EEA Guidebook, these are expressed in three tiers of increasing complexity.

The 'Tier 1' method is a 'simple' method using default emission factors only. To upgrade a Tier 1 to a Tier 2 method, the default emission factors should be replaced by country-specific or technology-specific emission factors. This might also require a further split of the activity data over a range of different technologies, implicitly aggregated in the Tier 1 method. A Tier 3 method could be regarded as a method that uses the latest scientific knowledge in more sophisticated approaches and models; more detailed definitions follow.

Tier 1:

A method uses readily available statistical data on the intensity of processes (activity rates) and default emission factors. These emission factors assume a linear relation between the intensity of the process and the resulting emissions. The Tier 1 default emission factors also assume an average or typical process description. This method is the simplest method, has the highest level of uncertainty and should not be used to estimate emissions from key categories.

The Tier 1 approach uses the general equation:

$$E_{NMVOC} = AR_{production,\ process,\ use,\ technology} \times EF_{NMVOC,}$$

where,

$AR_{production,\ process,\ use}$ = activity rate for specific activity

EF = emission factor for this process, technology

Tier 2: More complex method

Tier 2 is similar to Tier 1 but uses more specific emission factors developed on the basis of knowledge of the types of processes and specific process conditions that apply in the country for which the inventory is being developed. Tier 2 methods are more complex, will reduce the level of uncertainty, and are considered adequate for estimating emissions for key categories.

$$E_{NMVOC} = \sum AR_{production,\ process,\ use,\ technology} \times EF_{NMVOC,}$$

where,

$AR_{production,\ process,\ use}$ = activity rate for specific activity

EF = emission factor for this process, technology

Tier 3:

Tier 3 is defined as any methodology more detailed than Tier 2; hence there is a wide range of Tier 3 methodologies. At one end of the range there are methodologies similar to Tier 2 (i.e. activity data x emission factor) but with a greater disaggregation of activity data and emission factors. At the other end of the range are complex, dynamic models in which the processes leading to emissions are described in great detail. The key criterion to be met before a Tier 3 methodology can replace a Tier 2 methodology is a more accurate estimation of the relevant emissions, reducing the following common sources of error.

1.2 Gridding

An appropriate approach is chosen according to the sector and recommendations provided in relevant EMEP Guidebook chapter.

In several cases population statistics is used as a basis for disaggregation.

In these cases when the emission factor is connected with activity data concerning production, product use or handling or similar, average population (share by county in percentage) is used for disaggregation, because there is no considerable difference in share by counties in different years. See Annex I.

In these cases, emission factor is connected by population, a more exact approach is applied. The emission for each county is estimated by taking into account actual population data.

2 ENERGY SECTOR (NFR 1)

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

2.1.1 Source description

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

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

Situation in Estonia

In Estonia, oil terminals and service stations must have permits when the total loading turnover exceeds 2000 m^3 per year[1]. That means only the smallest service stations are considered as diffuse sources. Oil terminals and service stations that are permitted are not included in this project.

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

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

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

- from January 2004 for service stations with turnover over 500 m^3,

- from January 2005 for service stations with turnover over 100 m^3.

Most probably the majority of the not-permitted gasoline stations are having turnover from 100 to 2000 m^3. From 2005 these must have vapour collection and recovery equipment.

2.1.2 Emission factors

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

1) For the years 1990, 1995 and 2000 the emission factor from Corinair 2007 is applied;
2) For the years 2005-2008 the emission factor from EMEP Guidebook 2009 is applied

2.1.2.1 Emission factor for 1990-2000

The emission factor for gasoline distribution was 3930 g NMVOC/Mg of total gasoline handled.

2.1.2.2 Emission factor for 2005-2008

Tier 2 emission factors are used for NMVOC emission calculations in 2005-2008.

<u>Service Stations</u>

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

In the tables below, the technology specific emission factors for Service Stations are provided. 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.

Table 1 Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products, Service Stations, Storage tank Filling

Tier 2 emission factors					
	Code	Name			
NFR Source Category	1.B.2.a.v	Distribution of oil products			
Fuel	NA				
SNAP (if applicable)	050503	Service stations (including refuelling of cars)			
Technologies/Practices	Storage tank Filling without Stage 1B				
Region or regional conditions					
Abatement technologies	uncontrolled				
Not applicable	NOx, CO, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	SOx, PCDD/F				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	24	g/m3 throughput/kPa TVP	14	34	CONCAWE (2007)

Table 2 Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products, Service Stations, Storage tank breathing

Tier 2 emission factors					
	Code	Name			
NFR Source Category	1.B.2.a.v	Distribution of oil products			
Fuel	NA				
SNAP (if applicable)	050503	Service stations (including refuelling of cars)			
Technologies/Practices	Storage tank Breathing				
Region or regional conditions					
Abatement technologies	uncontrolled				
Not applicable	NOx, CO, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	SOx, PCDD/F				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	3	g/m3 throughput/kPa TVP	2	4	CONCAWE (2007)

Table 3 Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products, Service Stations, Automobile refuelling

Tier 2 emission factors					
	Code	Name			
NFR Source Category	1.B.2.a.v	Distribution of oil products			
Fuel	NA				
SNAP (if applicable)	050503	Service stations (including refuelling of cars)			
Technologies/Practices	Automobile refuelling with no emission controls in operation				
Region or regional conditions					
Abatement technologies	uncontrolled				
Not applicable	NOx, CO, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	SOx, PCDD/F				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	37	g/m3 throughput/kPa TVP	22	52	CONCAWE (2007)

Table 4 Tier 2 emission factors for source category 1.B.2.a.v Distribution of Oil Products, Service Stations, Automobile refuelling: drips and spills

Tier 2 emission factors					
	Code	Name			
NFR Source Category	1.B.2.a.v	Distribution of oil products			
Fuel	NA				
SNAP (if applicable)	050503	Service stations (including refuelling of cars)			
Technologies/Practices	Automobile refuelling Drips and minor spillage				
Region or regional conditions					
Abatement technologies	uncontrolled				
Not applicable	NOx, CO, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	SOx, PCDD/F				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	2	g/m3 throughput/kPa TVP	1	3	CONCAWE (2007)

Abatement

In the previous chapter Stage 1B 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:

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

Table 5 Abatement efficiencies ($\eta_{abatement}$) for source category 1.B.2.a.v Distribution of oil products, Service stations, Storage tank filling

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	1.B.2.a.v	Distribution of oil products			
Fuel	NA	not applicable			
SNAP (if applicable)	050503	Service stations			
Technologies/Practices	Storage tank filling Stage 1B - Vapour balancing during bulk gasoline tank filling				
Abatement technology	**Pollutant**	**Efficiency**	**95% confidence interval**		**Reference**
		Default Value	**Lower**	**Upper**	
Vapour recovery	NMVOC	95%	93%	97%	Guidebook (2006)

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

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

where $A=0.000007047 \times RVP+0.0132$ and $B=0.0002311 \times RVP-0.5236$, 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.

2.1.3 Emission factor calculation for Estonia

The annual average temperature in Estonia is equal to 5˚C.[2]

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

Table 6 Annual average RVP of gasoline 95 in Estonia in 2005-2008

Year	Annual average RVP, kPa
2008	75,3
2007	74,8
2006	75,8
2005	72,3
Average	**74,6**

RVP for gasoline is up to 74,6 kPa.

$TVP = 74,6 \text{ x } 10^{(0,000007047x74,6+0,0132)*5+(0,0002311x74,6-0,5236)} = 27,2 \text{ kPa}$

Consequently an average true vapour pressure for gasoline is 27,2 kPa (5˚C).

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

Table 7 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	Storage tank Filling with no Stage 1B	24	95%	27,2	33

[2] www.emhi.ee

stations	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**

2.1.4 Activity data

Activity data on the subject of gasoline consumption is available from Statistics Estonia.

Table 8 Consumption of motor gasoline by counties in 1990-2008 (thousand tons)

Year	1990	1995	2000	2005	2006	2007	2008
Eesti	**523**	**247**	**282**	**290**	**308**	**323**	**320**
By county:							
Harju	174	97	123	145	156	168	164
Hiiu	11	3	2	1	2	2	1
Ida-Viru	54	24	22	23	26	25	24
Jõgeva	18	7	9	7	7	8	7
Järva	24	8	8	8	8	7	7
Lääne	17	6	7	5	5	5	5
Lääne-Viru	28	15	16	11	13	14	15
Põlva	13	6	5	6	5	6	6
Pärnu	37	17	17	18	18	18	19
Rapla	17	7	6	6	7	7	8
Saare	18	6	7	6	6	8	8
Tartu	45	24	35	31	31	33	32
Valga	15	8	8	6	6	5	6
Viljandi	24	11	10	10	11	11	11
Võru	28	8	7	7	7	6	6

The assumed liquid gasoline density is 730 kg/m^3.[3]

For calculations consumption values are converted from thousand tons to thousand m^3.

Table 9 Consumption of motor gasoline by counties in 1990-2008 (thousand m^3)

Year	1990	1995	2000	2005	2006	2007	2008
Eesti	**716**	**338**	**386**	**397**	**422**	**442**	**438**
By county:							
Harju	238	133	168	199	214	230	225
Hiiu	15	4	3	1	3	3	1
Ida-Viru	74	33	30	32	36	34	33
Jõgeva	25	10	12	10	10	11	10
Järva	33	11	11	11	11	10	10
Lääne	23	8	10	7	7	7	7
Lääne-Viru	38	21	22	15	18	19	21
Põlva	18	8	7	8	7	8	8
Pärnu	51	23	23	25	25	25	26
Rapla	23	10	8	8	10	10	11

[3] EMEP/EEA emission inventory guidebook 2009

Saare	25	8	10	8	8	11	11
Tartu	62	33	48	42	42	45	44
Valga	21	11	11	8	8	7	8
Viljandi	33	15	14	14	15	15	15
Võru	38	11	10	10	10	8	8

2.1.5 Results

As a part of service stations are permitted, data regarding point sources is subtracted in following ways.

- In 1990 and 1995 no companies were reporting as point sources, all gasoline distribution was handled like diffuse sources,
- In 2000 only one company was reporting as a point source according to CollectER, situated in Lääne county. No activity data is available. Emission from point sources is subtracted from total calculated VOC emission.
  In 2005 more than 200 companies were reporting as point sources according to CollectER. In one case (Hiiu county) reported NMVOC emission exceeds calculated NMVOC emission. In this case diffuse emission is estimated to be equal to zero and emissions from other counties have been reduced accordingly in even parts.
- CollectER does not provide emission by counties, emission from point sources is divided evenly by consumption. Divided emission from point sources is subtracted from total calculated VOC emission.
- For 2006-2008 activity data relating to point sources is available and activity data for emission calculations from point sources is calculated as following:

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

  In some cases gasoline consumption by county is smaller than reported gasoline distribution by county. This is most probably affected by the fact that in OSIS data regarding point sources is connected to actual location and in Statistics Estonia data is connected to the legal address of the company.
  In those cases "gasoline distribution in diffuse sources" is estimated to be equal to zero and gasoline distribution in other counties has been reduced accordingly in even parts.

Table 10 NMVOC emission from gasoline distribution in service stations and emission distribution by counties

NMVOC emission from gasoline distribution in service stations																								
Year	1990		1995		2000				2005				2006				2007				2008			
Emission factor	3930	g NMVOC/ Mg	3930	g NMVOC/ Mg	3930		g NMVOC/Mg		1175		g/m3 throughput		1175		g/m3 throughput		1175		g/m3 throughput		1175		g/m3 throughput	
County	Gasoline consumption, 10^3 t	NMVOC emission, t	Gasoline consumption, 10^3 t	NMVOC emission, t	Gasoline consumption, 10^3 t	NMVOC emission, t	NMVOC from point sources, t	NMVOC from diffuse sources, t	Gasoline consumption, 10^3 m^3	NMVOC emission, t	NMVOC from point sources, t	NMVOC from diffuse sources, t	Gasoline consumption, 10^3 m^3	Gasoline distribution point sources, 10^3 m^3	Gasoline distribution diffuse sources, 10^3 m^3	NMVOC from diffuse sources, t	Gasoline consumption, 10^3 m^3	Gasoline distribution point sources, 10^3 m^3	Gasoline distribution diffuse sources, 10^3 m^3	NMVOC from diffuse sources, t	Gasoline consumption, 10^3 m^3	Gasoline distribution point sources, 10^3 m^3	Gasoline distribution diffuse sources, 10^3 m^3	NMVOC from diffuse sources, t
Estonia	523	**2055**	247	**971**	282	1108	22	**1087**	397	467	360,68	**106**	422	340,8	81,1	**95,257**	442	360,6	81,8	**96,164**	438,4	361,2	77,1	**90,627**
By county:																								
Harju	174	684	97	381	123	483		483	199	233	221,11	12	214	185,6	27,1	31,864	230	192,6	36,8	43,197	224,7	185,3	38,9	45,659
Hiiu	11	43	3	12	2	8		8	1	2	5,37	0	3	4,6	0,0	0,000	3	2,9	0,0	0,000	1,4	2,7	0,0	0,000
Ida-Viru	54	212	24	94	22	86		86	32	37	12,09	25	36	14,4	20,3	23,813	34	18,7	14,8	17,438	32,9	17,9	14,5	17,048
Jõgeva	18	71	7	28	9	35		35	10	11	4,28	7	10	5,7	2,9	3,438	11	6,9	3,3	3,886	9,6	8,4	0,7	0,867
Järva	24	94	8	31	8	31		31	11	13	5,13	7	11	4,8	5,1	6,040	10	5,3	3,5	4,153	9,6	8,2	0,9	1,085
Lääne	17	67	6	24	7	28	21,72	6	7	8	6,81	1	7	8,4	0,0	0,000	7	8,3	0,0	0,000	6,8	8,3	0,0	0,000
Lääne-Viru	28	110	15	59	16	63		63	15	18	11,08	6	18	9,2	7,7	8,999	19	11,6	6,9	8,085	20,5	12,3	7,8	9,166
Põlva	13	51	6	24	5	20		20	8	10	1,53	8	7	3,0	2,8	3,315	8	2,2	5,3	6,253	8,2	2,7	5,0	5,893
Pärnu	37	145	17	67	17	67		67	25	29	21,13	8	25	19,4	4,3	5,008	25	21,0	2,9	3,418	26,0	24,9	0,6	0,746
Rapla	17	67	7	28	6	24		24	8	10	7,64	2	10	12,9	0,0	0,000	10	12,6	0,0	0,000	11,0	11,7	0,0	0,000
Saare	18	71	6	24	7	28		28	8	10	2,79	7	8	5,2	2,1	2,415	11	5,1	5,1	5,970	11,0	7,1	3,3	3,914
Tartu	45	177	24	94	35	138		138	42	50	41,70	8	42	46,7	0,0	0,000	45	48,2	0,0	0,000	43,8	45,6	0,0	0,000
Valga	15	59	8	31	8	31		31	8	10	3,40	6	8	3,9	3,4	3,947	7	5,7	0,4	0,443	8,2	5,4	2,3	2,700
Viljandi	24	94	11	43	10	39		39	14	16	12,65	3	15	10,3	3,8	4,418	15	11,5	2,8	3,326	15,1	12,9	1,6	1,932
Võru	28	110	8	31	7	28		28	10	11	3,96	7	10	6,9	1,7	2,032	8	8,0	0,0	0,000	8,2	7,8	0,0	0,000

2.2 Natural gas (NFR 1B2b)

2.2.1 Source description

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

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

Situation in Estonia[4]

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

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

Figure 1 Map of high-pressure gas distribution pipelines

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

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

[4] http://www.gaas.ee/index.php?page=95&

[5] Eesti Gaas. Annual Report 2006.

2.2.2 Emission factors

EMEP/EEA air pollutant emission inventory guidebook (2009) does not provide calculations methodology for NMVOC calculations from gas distribution. Therefore IPPC Guidelines for National Greenhouse inventories (2006) is used.

Tier 1 emission factors are used (Equation 1).

The activity rate for this sector is natural gas consumption. Unit: million m^3
Emission factor unit: Gg per 10^6 of marketable gas/Utility sales.

The available default emission factors are presented below in Table 11. 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 11 Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations

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

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

Table 12 Tier 1 emission factors for fugitive emissions (including venting and flaring) from gas operations for different years

Category	Sub-category	Emission source	IPCC Code	NMVOC				
				1990	1995	2000	2005-2008	Units of measure
Gas transmission & Storage	Transmission	Fugitives	1.B.2.b.iii.4	1,6E-05	1,3E-05	9,6E-06	7,0E-06	Gg per 10^6 m^3 of marketable gas
		Venting	1.B.2.b.i	1,1E-05	8,7E-06	6,4E-06	4,6E-06	Gg per 10^6 m^3 of marketable gas
Gas Distribution	All	All	1.B.2.b.iii.5	3,6E-05	2,9E-05	2,2E-05	1,6E-05	Gg per 10^6 m^3 of utility sales
Total	-	-	-	**6,3E-05**	**5,0E-05**	**3,8E-05**	**2,8E-05**	**Gg per 10^6 m^3 of utility sales**

2.2.3 Activity data

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

Table 13 Activity data used for NMVOC emission calculation in 1990 – 2008 (million m^3)

Year	1991	1995	2000	2005	2006	2007	2008
Estonia	1521	723	826	997	1009	1003	961
By county							
Harju	757	351	506	611	621	591	527
Hiiu	0	0	0	0	0	0	0
Ida-Viru	468	261	219	275	275	279	279
Jõgeva	14	4	4	8	4	5	6
Järva	0	0	0	0	0	0	0
Lääne	0	0	0	0	0	0	0
Lääne-Viru	73	24	28	35	35	40	36
Põlva	34	11	12	8	8	10	11
Pärnu	0	0	0	0	0	0	9
Rapla	0	6	17	17	20	22	24
Saare	0	0	0	0	0	0	0
Tartu	175	66	39	41	43	49	61
Valga	0	0	0	0	0	0	0
Viljandi	0	0	1	2	3	7	8
Võru	0	0	0	0	0	0	0

2.2.4 Results

Table 14 NMVOC emissions from natural gas distribution, in tons (NFR 1 B 2 b)

Year	1990		1995		2000		2005		2006		2007		2008	
Emission factor, Gg/10^6 m^3	**6,3E-05**		**5,0E-05**		**3,8E-05**		**2,8E-05**		**2,8E-05**		**2,8E-05**		**2,8E-05**	
	Gas consumption, 10^6 m^3	NMVOC emission, t	Gas consumption, 10^6 m^3	NMVOC emission, t	Gas consumption, 10^6 m^3	NMVOC emission, t	Gas consumption, 10^6 m^3	NMVOC emission, t	Gas consumption, 10^6 m^3	NMVOC emission, t	Gas consumption, 10^6 m^3	NMVOC emission, t	Gas consumption, 10^6 m^3	NMVOC emission, t
Estonia	1516	**95,508**	723	**36,408**	826	**31,152**	997	**27,517**	1009	**27,848**	1003	**27,683**	961	**26,524**
By county														
Harju	755	47,565	351	17,675	506	19,083	611	16,864	621	17,140	591	16,312	527	14,545
Hiiu	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000
Ida-Viru	466	29,358	261	13,143	219	8,259	275	7,590	275	7,590	279	7,700	279	7,700
Jõgeva	14	0,882	4	0,201	4	0,151	8	0,221	4	0,110	5	0,138	6	0,166
Järva	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000
Lääne	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000
Lääne-Viru	73	4,599	24	1,209	28	1,056	35	0,966	35	0,966	40	1,104	36	0,994
Põlva	34	2,142	11	0,554	12	0,453	8	0,221	8	0,221	10	0,276	11	0,304
Pärnu	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	9	0,248
Rapla	0	0,000	6	0,302	17	0,641	17	0,469	20	0,552	22	0,607	24	0,662
Saare	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000
Tartu	174	10,962	66	3,324	39	1,471	41	1,132	43	1,187	49	1,352	61	1,684
Valga	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000
Viljandi	0	0,000	0	0,000	1	0,038	2	0,055	3	0,083	7	0,193	8	0,221
Võru	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000	0	0,000

Results are smaller than previously reported in NFR reports due to the change of emission factor.

3 INDUSTRIAL PROCESSES (NFR 2)

3.1 Road paving with asphalt (NFR 2.A.6)

3.1.1 Source description

Asphalt roads are a compacted mixture of aggregate and an asphalt binder. Natural gravel, manufactured stone (from quarries) or by-products from metal ore refining are used as aggregates. Asphalt cement or liquefied asphalt may be used as asphalt binder.

The most significant source of ducted emissions from batch mix plants is the dryer, which emits particulate matter and small amounts of VOCs derived from combustion exhaust gases. Aggregate dust, VOCs and a fine aerosol of liquids are also emitted from the hot-side conveying, classifying and mixing equipment.

For any given amount of asphalt, total emissions are believed to be the same, regardless of stockpiling, mixing and application times. The major source of NMVOCs from the use of liquefied asphalts is the cutback asphalt.

Since most of the emissions occur at the paving locations themselves, emissions can be disaggregated based on the percentage of total paved road surfaces. If this information is not available, the emissions may also be disaggregated based on mobile sources emission estimates or even population.

3.1.2 Default emission factors

EMEP/EEA Guidebook provides the Tier 1 emission factor table for emissions from road paving with asphalt. The default emission factors are constructed based on an assessment of the available emission factors from a detailed review of the hot mix industry (US EPA, 2004). The emission factor represents an average between batch mix and drum mix hot mix asphalt plants.

Tier 1 emission factors are used for calculations. Equation 1 is applied.

Table 15 Tier 1 emission factors for source category 2.A.6 Road paving with asphalt

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	2.A.6	Road paving with asphalt			
Fuel	NA				
Not applicable	NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCP, SCCP				
Not estimated	NOx, CO, SOx, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	16	g/Mg asphalt	3	100	US EPA (2004)

3.1.3 Activity data

Information regarding asphalt production and laying is available from Estonian Asphalt Pavement Association (www.asfaldiliit.ee) for the years 1995-2008. For the year 1990 the asphalt production rate is given in the Estonian Road Administration Annual Report 1990.

According to the Asphalt Pavement Association all production companies but not all asphalt laying companies are members of the association. Values for the asphalt produced are higher than the quantity of laid asphalt. For that reason asphalt production values are used for emission calculations from road paving with asphalt.

Table 16 Activity data for NMVOC emission calculations from asphalt production in 1990 – 2008 (in tons)

Produced Asphalt Mixtures	1990	1995	2000	2005	2006	2007	2008

Dense Asphalt concrete		-	-	-	881724	831935	900123
Open-Graded Asphalt Concrete		-	-	-	439958	425103	442298
Cold Mixtures		-	-	-	24123	10863	10719
Light Asphalt Concrete		-	-	-	72461	67338	57455
Stone Mastic Asphalt		-	-	-	31354	77711	69467
Other types		-	-	-	32288	73622	26783
All types total	**864 000**	**475000**	**667000**	**1164000**	**1481908**	**1486572**	**1506846**

3.1.4 Results

Table 17 NMVOC emission from road paving with asphalt (NFR 2.A.6) in tons

NFR	**2.A.6**	
SNAP	**NA**	
Activity	**Road Paving with Asphalt**	
Emission factor:	16	g/Mg asphalt
Year	Produced Asphalt Mixtures, t	NMVOC, t
1990	864 000	13,824
1995	475000	7,600
2000	667000	10,672
2005	1164000	18,624
2006	1481908	23,711
2007	1486572	23,785
2008	1506846	24,110

Emission is disaggregated by the length of roads which are constructed or repaired by the asphalt concrete surface in the county. Data about construction and repair work is collected from the Estonian Road Administration Annual Reports 1990-2008.[6]

The Estonian Asphalt Pavement Association does not publish county-specific information.

The structure of the Estonian Road Administration has changed over the years and for the years 1995-2000 annual reports do not provide information regarding the total length of asphalt roads constructed and repaired by counties. For these years the division is made by the total length of road and streets. Data regarding the length of all roads and streets by county is available from the Statistical office for the year 2004. This is used as a basis for distribution. It is assumed that the share by counties has not been changed over the years.

Table 18 Length of roads and streets by county, in kilometers, and share by county

Year	2004			
Road type	National roads	Local roads and streets	All roads	Share by county
Estonia	**16459**	**18507,2**	**34966,2**	**100%**
Harju	1547	2534,2	4081,2	11,67%
Hiiu	473	358,5	831,5	2,38%
Ida-Viru	917	706,6	1623,6	4,64%

[6] Annual Report 2008. http://www.mnt.ee/atp/failid/2008/ar_www.pdf
Annual Report 2007. http://www.mnt.ee/atp/failid/ar_2007.pdf
Annual Report 2006. http://www.mnt.ee/atp/failid/ar_2006.pdf
Annual Report 2005. http://www.mnt.ee/atp/failid/ar_2005.pdf
Annual Reports 1990, 1995 and 2000 are available in Estonian Road Administration office as paper copy

Jõgeva	1110	608,6	1718,6	4,92%
Järva	973	1260,9	2233,9	6,39%
Lääne	749	1108,9	1857,9	5,31%
Lääne-Viru	1160	1660,3	2820,3	8,07%
Põlva	1155	1080	2235	6,39%
Pärnu	1433	1297	2730	7,81%
Rapla	1011	1332	2343	6,70%
Saare	1087	1317	2404	6,88%
Tartu	1254	1876,4	3130,4	8,95%
Valga	1117	819,2	1936,2	5,54%
Viljandi	1223	991,8	2214,8	6,33%
Võru	1250	1555,8	2805,8	8,02%

Table 19 Length of constructed and repaired by counties and emission distribution shares by counties

Year	1990		1995		2000		2005				2006				2007				2008			
County	Construction and repair of asphalt concrete paved roads, km	Share by county, %	Total length of asphalt concrete laid (construction + repair), km	Share by county, % (by total length of roads)	Total length of asphalt concrete laid (construction + repair), km	Share by county, % (by total length of roads)	Construction of asphalt concrete paved roads, km	Repairs of asphalt concrete roads (overlays), km	Total length of asphalt concrete laid, km	Share by county, %	Construction of asphalt concrete paved roads, km	Repairs of asphalt concrete roads (overlays), km	Total length of asphalt concrete laid, km	Share by county, %	Construction of asphalt concrete paved roads, km	Repairs of asphalt concrete roads (overlays), km	Total length of asphalt concrete laid, km	Share by county, %	Construction of asphalt concrete paved roads, km	Repairs of asphalt concrete roads (overlays), km	Total length of asphalt concrete laid, km	Share by county, %
Estonia	**200,7**	**100,0%**	**65,2**	**100%**	**104,4**	**100%**	28,4	146,1	**174,5**	**100%**	20,5	235	**255,5**	**100%**	34,6	130,3	**164,9**	**100%**	43,5	250,5	**294**	**100%**
By county																						
Harju	20,4	10,2%	-	*11,67%*		*11,67%*	8,1	72,1	80,2	45,96%		49,5	47,9	18,75%	4,7	48	52,7	31,96%	33,409	70,354	103,763	35,30%
Hiiu		0,0%	-	*2,38%*		*2,38%*			0	0,00%	0,9	6,9	7,8	3,05%	0,1		0,1	0,06%		2,500	2,500	0,85%
Ida-Viru	14,8	7,4%	-	*4,64%*		*4,64%*	9,1		9,1	5,21%	8,1	13,7	21,8	8,53%	5,6		5,6	3,40%	5,228	4,179	9,407	3,20%
Jõgeva	1,2	0,6%	-	*4,92%*		*4,92%*		14,8	14,8	8,48%		16,7	16,7	6,54%	4,6	5,4	10	6,06%			0,000	0,00%
Järva	17,4	8,7%	-	*6,39%*		*6,39%*		11,9	11,9	6,82%		19,8	19,8	7,75%		27,3	27,3	16,56%	3,577	35,311	38,888	13,23%
Lääne	15,2	7,6%	-	*5,31%*		*5,31%*			0	0,00%		9,8	9,8	3,84%		2,5	2,5	1,52%		2,488	2,488	0,85%
Lääne-Viru	21,7	10,8%	-	*8,07%*		*8,07%*			0	0,00%			0	0,00%		12,9	12,9	7,82%	1,250	65,582	66,832	22,74%
Põlva		0,0%	-	*6,39%*		*6,39%*	2,5	5,9	8,4	4,81%		9,8	9,8	3,84%	3,5	5,5	9	5,46%			0,000	0,00%
Pärnu	23,2	11,6%	-	*7,81%*		*7,81%*		22,4	22,4	12,84%	1,6	5,5	7,1	2,78%	16,1	7,4	23,5	14,25%		11,952	11,952	4,07%
Rapla	32,1	16,0%	-	*6,70%*		*6,70%*	1,3		1,3	0,74%		10,9	10,9	4,27%			0	0,00%		9,400	9,400	3,20%
Saare		0,0%	-	*6,88%*		*6,88%*		8,7	8,7	4,99%	9,7	20,8	30,5	11,94%			0	0,00%		5,950	5,950	2,02%
Tartu	29,5	14,7%	-	*8,95%*		*8,95%*	3,7		3,7	2,12%		13,9	13,9	5,44%		12,8	12,8	7,76%		13,360	13,360	4,54%
Valga		0,0%	-	*5,54%*		*5,54%*			0	0,00%	0,2	42,2	42,4	16,59%			0	0,00%		16,655	16,655	5,67%
Viljandi		0,0%	-	*6,33%*		*6,33%*	2	10,3	12,3	7,05%		17,1	17,1	6,69%		8,5	8,5	5,15%		11,106	11,106	3,78%
Võru	25,2	12,6%	-	*8,02%*		*8,02%*	1,7		1,7	0,97%			0	0,00%			0	0,00%		1,650	1,650	0,56%

Table 20 NMVOC emission from road paving with asphalt

NMVOC emission from road paving with asphalt, t														
Year	1990		1995		2000		2005		2006		2007		2008	
County	Share by county, %	NMVOC, t	Share by county, %	NMVOC, t	Share by county, %	NMVOC, t	Share by county, %	NMVOC, t	Share by county, %	NMVOC, t	Share by county, %	NMVOC, t	Share by county, %	NMVOC, t
Estonia	100%	13,824	100%	7,600	100%	10,672	100%	18,624	100%	23,711	100%	23,785	100%	24,110
By county														
Harju	10,2%	1,405	*11,67%*	0,887	*11,67%*	1,246	45,96%	8,560	18,75%	4,445	31,96%	7,601	35,30%	8,511
Hiiu	0,0%	0,000	*2,38%*	0,181	*2,38%*	0,254	0,00%	0,000	3,05%	0,724	0,06%	0,014	0,85%	0,205
Ida-Viru	7,4%	1,019	*4,64%*	0,353	*4,64%*	0,496	5,21%	0,971	8,53%	2,023	3,40%	0,808	3,20%	0,772
Jõgeva	0,6%	0,083	*4,92%*	0,374	*4,92%*	0,525	8,48%	1,580	6,54%	1,550	6,06%	1,442	0,00%	0,000
Järva	8,7%	1,198	*6,39%*	0,486	*6,39%*	0,682	6,82%	1,270	7,75%	1,837	16,56%	3,938	13,23%	3,190
Lääne	7,6%	1,047	*5,31%*	0,404	*5,31%*	0,567	0,00%	0,000	3,84%	0,909	1,52%	0,361	0,85%	0,204
Lääne-Viru	10,8%	1,495	*8,07%*	0,613	*8,07%*	0,861	0,00%	0,000	0,00%	0,000	7,82%	1,861	22,74%	5,482
Põlva	0,0%	0,000	*6,39%*	0,486	*6,39%*	0,682	4,81%	0,897	3,84%	0,909	5,46%	1,298	0,00%	0,000
Pärnu	11,6%	1,598	*7,81%*	0,593	*7,81%*	0,833	12,84%	2,391	2,78%	0,659	14,25%	3,390	4,07%	0,980
Rapla	16,0%	2,211	*6,70%*	0,509	*6,70%*	0,715	0,74%	0,139	4,27%	1,012	0,00%	0,000	3,20%	0,771
Saare	0,0%	0,000	*6,88%*	0,523	*6,88%*	0,734	4,99%	0,929	11,94%	2,830	0,00%	0,000	2,02%	0,488
Tartu	14,7%	2,032	*8,95%*	0,680	*8,95%*	0,955	2,12%	0,395	5,44%	1,290	7,76%	1,846	4,54%	1,096
Valga	0,0%	0,000	*5,54%*	0,421	*5,54%*	0,591	0,00%	0,000	16,59%	3,935	0,00%	0,000	5,67%	1,366
Viljandi	0,0%	0,000	*6,33%*	0,481	*6,33%*	0,676	7,05%	1,313	6,69%	1,587	5,15%	1,226	3,78%	0,911
Võru	12,6%	1,736	*8,02%*	0,610	*8,02%*	0,856	0,97%	0,181	0,00%	0,000	0,00%	0,000	0,56%	0,135

3.2 Food and drink (2.D.2)

3.2.1 Source description

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

For food processing, major facilities may be identified and national emissions could be disaggregated based on plant capacity or employment. For the remaining emissions, it is good practice to disaggregate data by population.

The manufacture of most beverages is associated with particular regions of a country. The lowest level of accuracy is obtained by disaggregating the net emission according to population density. Greater accuracy is achieved by identifying regions where particular beverages are produced and confining the distribution of emissions to those regions.

3.2.2 Emission factors

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

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

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

Tier 2 emission factors are used for emission calculations. The relevant emission factors are given in the tables below.

Emission factors are believed to be constant over the years 1990-2008.

Default emission factors based on products: food

Table 21 Tier 2 emission factors for source category 2.D.2 Food and drink, Bread (typical)

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)	040605	Bread			
Technologies/Practices	Bread, typical				
Region or regional conditions	Europe				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	4.5	kg/Mg bread	0.45	45	Guidebook (2006)

Table 22 Tier 2 emission factors for source category 2.D.2 Food and drink, Cakes, biscuits and breakfast cereals

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)	040605	Bread			
Technologies/Practices	Cakes, biscuits and breakfast cereals				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	1	kg/Mg product	0.1	10	Guidebook (2006)

Table 23 Tier 2 emission factors for source category 2.D.2 Food and drink, Meat, fish and poultry

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)	040627	Meat, fish etc. frying / curing			
Technologies/Practices	Meat, fish and poultry				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.3	kg/Mg product	0.03	3	Guidebook (2006)

Table 24 Tier 2 emission factors for source category 2.D.2 Food and drink, Margarine and solid cooking fats

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Margarine and solid cooking fats				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	10	kg/Mg product	1	100	Guidebook (2006)

Table 25 Tier 2 emission factors for source category 2.D.2 Food and drink, Animal feed

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Animal feed				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	1	kg/Mg feed	0.1	10	Guidebook (2006)

Default emission factors based on products: drinks

Table 26 Tier 2 emission factors for source category 2.D.2 Food and drink, Wine

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)	040606	Wine			
Technologies/Practices	Wine unspecified colour				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.08	kg/hl wine	0.008	0.8	Guidebook (2006)

Table 27 Tier 2 emission factors for source category 2.D.2 Food and drink, Beer

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)	040607	Beer			
Technologies/Practices	Beer (including de-alcoholized)				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.035	kg/hl beer	0.012	0.11	Guidebook (2006)

Table 28 Tier 2 emission factors for source category 2.D.2 Food and drink, Other spirits

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.2	Food and drink			
Fuel	NA				
SNAP (if applicable)	040608	Spirits			
Technologies/Practices	Other spirits				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	TSP, PM10, PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.4	kg/hl alcohol	0.13	1.2	Guidebook (2006)

3.2.3 Activity data

Activity data on the subject of food and drink production is available from Statistics Estonia.

<u>Meat and fish</u>

Data regarding meat also includes home-killed meat.

Data regarding the nominal catch of fish from Statistics Estonia is only available since 1995.

Table 29 Total fish landed

Area	Nominal catch, tons					
Year	1995	2000	2005	2006	2007	2008
Atlantic ocean	70107	24695	16538	13723	14930	14559
Baltic Sea	59169,8	85176	79760,7	73039,4	80244,1	83575,053
Inland waters	2365,1	3189,2	2400,5	2856,1	2567,844	2748,897
Aquaculture production	316,8	360	554,1	702,6	781	814,2
TOTAL	133636,9	115060,2	100704,2	91624,5	99748,944	102890,95

Table 30 Activity data for NMVOC emission calculation in 1990 – 2008

NFR	SNAP	Product group (food and drink)	Unit of activity data	Emission factor		1990		1995		2000		2005		2006		2007		2008	
				value	unit	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t
2.D.2	**040605**	**Bread**	**thousand t**	**4,5**	**kg/Mg bread**	**151**	**679,500**	**99,7**	**448,650**	**76,5**	**344,250**	**72,4**	**325,800**	**74,4**	**334,800**	**78,8**	**354,600**	**77,6**	**349,200**
2.D.2	**040606**	**Cakes, biscuits and breakfast cereals**	**thousand t**	**1**	**kg/Mg product**	**14,9**	**14,900**	**5**	**5,000**	**4,4**	**4,400**	**.**		**9,4**	**9,400**	**9,7**	**9,700**	**8,9**	**8,900**
2.D.2	**040627**	**Meat, fish and poultry etc. frying/curing**	**thousand t**	**0,3**	**kg/Mg product**	**182,5**	**54,750**	**201,34**	**60,401**	**168,4**	**50,508**	**167,804**	**50,341**	**161,02**	**48,306**	**170,25**	**51,075**	**177,49**	**53,247**
		Meat products (Statistics and home-killed)	thousand t	0,3	kg/Mg product	182,5	54,750	67,7	20,310	53,3	15,990	67,1	20,130	69,4	20,820	70,5	21,150	74,6	22,380
		Fish products	thousand t	0,3	kg/Mg product		0,000	133,64	40,091	115,1	34,518	100,704	30,211	91,62	27,486	99,75	29,925	102,89	30,867
2.D.2	**NA**	**Margarine and solid cooking fats**	**thousand t**	**10**	**kg/Mg product**	**6,6**	**66,000**	**3,7**	**37,000**	**0,8**	**8,000**	**1,2**	**12,000**	**0**	**0,000**	**0**	**0,000**	**0**	**0,000**
		Solid cooking fats	*thousand t*	10	kg/Mg product	*0*	0,000	*3,6*	36,000	*0,8*	8,000	*1,2*	12,000	.		.		.	
		Margarine	*thousand t*	10	kg/Mg feed	*6,6*	66,000	*0,1*	1,000	*0*	0,000	*0*	0,000	..		..		..	
2.D.2	**NA**	**Animal feed**	**thousand t**	**1**	**kg/Mg product**	**851,8**	**851,800**	**162,8**	**162,800**	**133,3**	**133,300**	**177**	**177,000**	**208,9**	**208,900**	**214,2**	**214,200**	**215,3**	**215,300**
2.D.2	**040606**	**Wine**	**thousand hl**	**0,08**	**kg/hl wine**	**37**	**2,960**	**14**	**1,120**	**32,6**	**2,608**	**88,8**	**7,104**	**77,5**	**6,200**	**53,5**	**4,280**	**38,8**	**3,104**
2.D.2	**040607**	**Beer**	**thousand hl**	**0,035**	**kg/hl beer**	**769**	**26,915**	**499,6**	**17,486**	**950,1**	**33,254**	**1342,5**	**46,988**	**1431,1**	**50,089**	**1411,6**	**49,406**	**1281,8**	**44,863**
2.D.2	**040608**	**Other sprits**	**thousand hl**	**0,4**	**kg/hl alcohol**	**229**	**91,600**	**267**	**106,800**	**106,8**	**42,720**	**205**	**82,000**	**244,7**	**97,880**	**255,3**	**102,120**	**191,5**	**76,600**
		Crude spirits	*thousand hl*	0,4	kg/hl alcohol	*82*	32,800	*91*	36,400	*20,4*	8,160	*37,1*	14,840	*61,6*	24,640	*39,3*	15,720	*15,5*	6,200
		Distilled spirits	*thousand hl*	0,4	kg/hl alcohol	*147*	58,800	*176*	70,400	*86,4*	34,560	*167,9*	67,160	*183,1*	73,240	*216*	86,400	*176*	70,400
							1788,425		**839,257**		**619,040**		**701,233**		**755,575**		**785,381**		**751,214**

3.2.4 Emission calculations and results

The emission factor for bread and white bread production is the same (4,5 kg/MgNMVOC bread). Statistical data for white bread production (shortened process, emission factor 2 kg/MgNMVOC bread), wholemeal bread production (EF 3 kg/MgNMVOC bread) and light rye bread production (EF 3 kg/MgNMVOC bread) is not available.

For spirits the emission factor 0,4 kg/hl alcohol is chosen since Estonia produces mainly vodka whose production does not involve maturation processes.

Table 31 NMVOC emissions from food and drink production, in tons (NFR 2.D.2)

NFR	SNAP	Product group (food and drink)	Unit of activity data	Emission factor		1990		1995		2000		2005		2006		2007		2008	
				value	unit	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t	Production	NMVOC, t
2.D.2	**040605**	**Bread**	**thousand t**	**4,5**	**kg/Mg bread**	**151**	**679,500**	**99,7**	**448,650**	**76,5**	**344,250**	**72,4**	**325,800**	**74,4**	**334,800**	**78,8**	**354,600**	**77,6**	**349,200**
2.D.2	**040606**	**Cakes, biscuits and breakfast cereals**	**thousand t**	**1**	**kg/Mg product**	**14,9**	**14,900**	**5**	**5,000**	**4,4**	**4,400**	**.**		**9,4**	**9,400**	**9,7**	**9,700**	**8,9**	**8,900**
2.D.2	**040627**	**Meat, fish and poultry etc. frying/curing**	**thousand t**	**0,3**	**kg/Mg product**	**182,5**	**54,750**	**201,34**	**60,401**	**168,4**	**50,508**	**167,804**	**50,341**	**161,02**	**48,306**	**170,25**	**51,075**	**177,49**	**53,247**
		Meat processed	thousand t	0,3	kg/Mg product	182,5	54,750	67,7	20,310	53,3	15,990	67,1	20,130	69,4	20,820	70,5	21,150	74,6	22,380
		Fish processed	thousand t	0,3	kg/Mg product		0,000	133,64	40,091	115,1	34,518	100,704	30,211	91,62	27,486	99,75	29,925	102,89	30,867
2.D.2	**NA**	**Margarine and solid cooking fats**	**thousand t**	**10**	**kg/Mg product**	**6,6**	**66,000**	**3,7**	**37,000**	**0,8**	**8,000**	**1,2**	**12,000**	**0**	**0,000**	**0**	**0,000**	**0**	**0,000**
		Solid cooking fats	*thousand t*	10	kg/Mg product	*0*	0,000	*3,6*	36,000	*0,8*	8,000	*1,2*	12,000	.		.		.	
		Margarine	*thousand t*	10	kg/Mg feed	*6,6*	66,000	*0,1*	1,000	*0*	0,000	*0*	0,000	..		..		..	
2.D.2	**NA**	**Animal feed**	**thousand t**	**1**	**kg/Mg product**	**851,8**	**851,800**	**162,8**	**162,800**	**133,3**	**133,300**	**177**	**177,000**	**208,9**	**208,900**	**214,2**	**214,200**	**215,3**	**215,300**
2.D.2	**040606**	**Wine**	**thousand hl**	**0,08**	**kg/hl wine**	**37**	**2,960**	**14**	**1,120**	**32,6**	**2,608**	**88,8**	**7,104**	**77,5**	**6,200**	**53,5**	**4,280**	**38,8**	**3,104**
2.D.2	**040607**	**Beer**	**thousand hl**	**0,035**	**kg/hl beer**	**769**	**26,915**	**499,6**	**17,486**	**950,1**	**33,254**	**1342,5**	**46,988**	**1431,1**	**50,089**	**1411,6**	**49,406**	**1281,8**	**44,863**
2.D.2	**040608**	**Other sprits**	**thousand hl**	**0,4**	**kg/hl alcohol**	**229**	**91,600**	**267**	**106,800**	**106,8**	**42,720**	**205**	**82,000**	**244,7**	**97,880**	**255,3**	**102,120**	**191,5**	**76,600**
		Crude spirits	*thousand hl*	0,4	kg/hl alcohol	*82*	32,800	*91*	36,400	*20,4*	8,160	*37,1*	14,840	*61,6*	24,640	*39,3*	15,720	*15,5*	6,200
		Distilled spirits	*thousand hl*	0,4	kg/hl alcohol	*147*	58,800	*176*	70,400	*86,4*	34,560	*167,9*	67,160	*183,1*	73,240	*216*	86,400	*176*	70,400
							1788,425		**839,257**		**619,040**		**701,233**		**755,575**		**785,381**		**751,214**

In some cases the emissions are underestimated due to confidentiality issues. If there are less than three producers in the group the data is confidential. This is relevant to margarine and solid cooking fats.

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

3.2.5 NMVOC from food and drink production by county

Bread production

Major bread and pastry producers[7] are presented in the following table.

Table 32 Bread companies in Estonia in 2002

Company	County	Approximate market share, %
Leibur	Harju	31%
ETK Leib / AS Eesti Pagar	Järva	18%
Pere Leib	Tartu	16%
Fazer	Harju	7%
Järle	Ida-Viru	6%
Hallik	Lääne-Viru	5%
Vilma	Viljandi	3%

The remaining 14% of emission is disaggregated by population.

Most probably the bread production division by counties has changed only slightly over the years. The Estonian Association of Bakeries gives market shares by production for 2006. This is not used for calculations, because for example AS Eesti Pagar which holds a large market share is not a member of the association. Therefore distribution by the year 2002 is used for all years.

Table 33 Bread companies and production shares in 2006[8]

Company	Production share
Leibur	42,8%
Fazer	19,1%
Pere L	18,0%
Hallik	7,6%
Lõuna P	2,6%
Saare L	2,3%
Pagarip.	2,1%
Euroleib	1,9%
Balti Sep.	1,9%
Hiiu P	1,2%
Lihula L	0,5%
Eng.Serv.	0,0%

Table 34 NMVOC emission from bread production by counties

		NMVOC emission from bread production, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**679,500**	**448,650**	**344,250**	**325,800**	**334,800**	**354,600**	**349,200**
By county	*Share by county*							

[7] Pagaritööstuste turujaotus (2002). http://paber.ekspress.ee/viewdoc/7B355BE693F6E5DAC2256ED7003EF1A9

[8] Turu osalused Leivaliidus (.xls). http://www.leivaliit.ee/leib.php?id=13

Harju	43,41%	294,979	194,765	149,443	141,434	145,341	153,936	151,592
Hiiu	0,11%	0,719	0,474	0,364	0,345	0,354	0,375	0,369
Ida-Viru	7,84%	53,298	35,191	27,002	25,555	26,261	27,814	27,390
Jõgeva	0,39%	2,635	1,739	1,335	1,263	1,298	1,375	1,354
Järva	18,39%	124,947	82,498	63,301	59,909	61,563	65,204	64,211
Lääne	0,29%	1,987	1,312	1,006	0,952	0,979	1,037	1,021
Lääne-Viru	5,70%	38,722	25,567	19,618	18,566	19,079	20,207	19,900
Põlva	0,33%	2,236	1,477	1,133	1,072	1,102	1,167	1,149
Pärnu	0,92%	6,252	4,128	3,167	2,997	3,080	3,262	3,213
Rapla	0,38%	2,569	1,696	1,301	1,232	1,266	1,340	1,320
Saare	0,36%	2,477	1,636	1,255	1,188	1,221	1,293	1,273
Tartu	17,52%	119,080	78,624	60,329	57,095	58,673	62,142	61,196
Valga	0,36%	2,473	1,633	1,253	1,186	1,218	1,290	1,271
Viljandi	3,59%	24,381	16,098	12,352	11,690	12,013	12,723	12,530
Võru	0,40%	2,745	1,812	1,391	1,316	1,352	1,432	1,411

Cakes, biscuits and other flour confectionery are also produced in the same factories as bread and pastry and the shares by county are expected to be the same.

Table 35 NMVOC emission from cakes and biscuits production by counties

		NMVOC emission from flour confectionery, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**14,900**	**5,000**	**4,400**		**9,400**	**9,700**	**8,900**
By county	*Share by county*							
Harju	43,41%	6,468	2,171	1,910	0,000	4,081	4,211	3,864
Hiiu	0,11%	0,016	0,005	0,005	0,000	0,010	0,010	0,009
Ida-Viru	7,84%	1,169	0,392	0,345	0,000	0,737	0,761	0,698
Jõgeva	0,39%	0,058	0,019	0,017	0,000	0,036	0,038	0,035
Järva	18,39%	2,740	0,919	0,809	0,000	1,728	1,784	1,637
Lääne	0,29%	0,044	0,015	0,013	0,000	0,027	0,028	0,026
Lääne-Viru	5,70%	0,849	0,285	0,251	0,000	0,536	0,553	0,507
Põlva	0,33%	0,049	0,016	0,014	0,000	0,031	0,032	0,029
Pärnu	0,92%	0,137	0,046	0,040	0,000	0,086	0,089	0,082
Rapla	0,38%	0,056	0,019	0,017	0,000	0,036	0,037	0,034
Saare	0,36%	0,054	0,018	0,016	0,000	0,034	0,035	0,032
Tartu	17,52%	2,611	0,876	0,771	0,000	1,647	1,700	1,560
Valga	0,36%	0,054	0,018	0,016	0,000	0,034	0,035	0,032
Viljandi	3,59%	0,535	0,179	0,158	0,000	0,337	0,348	0,319
Võru	0,40%	0,060	0,020	0,018	0,000	0,038	0,039	0,036

Meat processing

Major meat processing companies[9] are presented in following table.

Table 36 Meat processing companies

Company	County	Approximate market share
Rakvere LK	Lääne-Viru	30%
Atria Grupp	Valga, Võru, Põlva	14 (4,6+4,6+4,6)
Maag	Lääne, Lääne-Viru	10% (5+5)

[9] http://uudisvoog.postimees.ee/?DATE=20091203&ID=218716 (AC Nielsen lihatoodete turuuuringust 2009)

As some of the meat is processed locally in small facilities and at home the remaining 46% of emission is disaggregated by population.

Table 37 NMVOC emission from meat processing by counties

		NMVOC emission from meat processing, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**54,750**	**20,310**	**15,990**	**20,130**	**20,820**	**21,150**	**22,380**
By county	*Share by county*							
Harju	17,78%	9,734	3,611	2,843	3,579	3,702	3,760	3,979
Hiiu	0,35%	0,190	0,071	0,056	0,070	0,072	0,073	0,078
Ida-Viru	6,06%	3,317	1,230	0,969	1,219	1,261	1,281	1,356
Jõgeva	1,27%	0,697	0,259	0,204	0,256	0,265	0,269	0,285
Järva	1,28%	0,698	0,259	0,204	0,257	0,266	0,270	0,285
Lääne	5,96%	3,263	1,211	0,953	1,200	1,241	1,261	1,334
Lääne-Viru	37,30%	20,419	7,575	5,964	7,508	7,765	7,888	8,347
Põlva	5,75%	3,147	1,167	0,919	1,157	1,197	1,216	1,286
Pärnu	3,02%	1,655	0,614	0,483	0,609	0,629	0,639	0,677
Rapla	1,24%	0,680	0,252	0,199	0,250	0,259	0,263	0,278
Saare	1,20%	0,656	0,243	0,192	0,241	0,249	0,253	0,268
Tartu	5,01%	2,743	1,017	0,801	1,008	1,043	1,060	1,121
Valga	5,86%	3,210	1,191	0,937	1,180	1,221	1,240	1,312
Viljandi	1,93%	1,058	0,392	0,309	0,389	0,402	0,409	0,432
Võru	5,99%	3,282	1,217	0,958	1,207	1,248	1,268	1,341

Fish processing

Fish production is divided by the number of companies within the county[10].

Table 38 Number of fish processing companies by counties

County	Nr of companies	% of total number of companies in Estonia
Harju	27	30
Hiiu	2	2
Ida-Viru	8	9
Jõgeva	5	6
Järva	1	1
Lääne	6	7
Lääne-Viru	1	1
Põlva	1	1
Pärnu	17	19
Saare	10	11
Tartu	12	13
Total	90	100

Table 39 NMVOC emission from fish processing by counties

		NMVOC emission from fish processing, t					
County	Year	1995	2000	2005	2006	2007	2008
Estonia	100%	**40,091**	**34,518**	**30,211**	**27,486**	**29,925**	**30,867**
By county	*Share by county*						
Harju	30%	12,027	10,355	9,063	8,246	8,978	9,260
Hiiu	2%	0,802	0,690	0,604	0,550	0,599	0,617

[10] Kalatöötlemise struktuuri areng. 2006. www.agri.ee/public/.../**KALA**MAJANDUS/**Kala**tootlemine_2006.doc

Ida-Viru	9%	3,608	3,107	2,719	2,474	2,693	2,778
Jõgeva	6%	2,405	2,071	1,813	1,649	1,796	1,852
Järva	1%	0,401	0,345	0,302	0,275	0,299	0,309
Lääne	7%	2,806	2,416	2,115	1,924	2,095	2,161
Lääne-Viru	1%	0,401	0,345	0,302	0,275	0,299	0,309
Põlva	1%	0,401	0,345	0,302	0,275	0,299	0,309
Pärnu	19%	7,617	6,558	5,740	5,222	5,686	5,865
Rapla	0%	0,000	0,000	0,000	0,000	0,000	0,000
Saare	11%	4,410	3,797	3,323	3,023	3,292	3,395
Tartu	13%	5,212	4,487	3,927	3,573	3,890	4,013
Valga	0%	0,000	0,000	0,000	0,000	0,000	0,000
Viljandi	0%	0,000	0,000	0,000	0,000	0,000	0,000
Võru	0%	0,000	0,000	0,000	0,000	0,000	0,000

Margarine and solid cooking fats production

Solid cooking fats are produced in Põlva Piim Tootmine OÜ, situated in Põlva county.

Table 40 NMVOC emission from solid cooking fats production by counties

		NMVOC emission from solid cooking fats production, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**0,000**	**36,000**	**8,000**	**12,000**	**0,000**	**0,000**	**0,000**
By county	*Share by county*							
Harju	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Hiiu	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Ida-Viru	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Jõgeva	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Järva	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne-Viru	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Põlva	100%	0,000	36,000	8,000	12,000	0,000	0,000	0,000
Pärnu	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Rapla	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Saare	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Tartu	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Valga	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Viljandi	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Võru	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Margarine was produced in Tallinna Parfümeeria ja Toidurasvade Kombinaat in the beginning of the 90s, situated in Harju county.

Table 41 NMVOC emission from margarine production by counties

		NMVOC emission from margarine production, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**66,000**	**1,000**	**0,000**	**0,000**	**0,000**	**0,000**	**0,000**
By county	*Share by county*							
Harju	100%	66,000	1,000	0,000	0,000	0,000	0,000	0,000
Hiiu	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Ida-Viru	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Jõgeva	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Järva	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne-Viru	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Põlva	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Pärnu	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Rapla	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Saare	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Tartu	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Valga	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Viljandi	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Võru	0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Animal feed production

Emission from animal feed production is disaggregated by agricultural land use.

Table 42 Agricultural land use in counties

County	Agricultural land distribution by counties
Harju	6,3%
Hiiu	1,8%
Ida-Viru	2,9%
Jõgeva	8,2%
Järva	9,5%
Lääne	4,7%
Lääne-Viru	12,1%
Põlva	5,4%
Pärnu	8,8%
Rapla	6,3%
Saare	5,8%
Tartu	8,8%
Valga	4,7%
Viljandi	9,8%
Võru	4,8%

Table 43 NMVOC emission from animal feed production by counties

		NMVOC emission from animal feed production, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**851,800**	**162,800**	**133,300**	**177,000**	**208,900**	**214,200**	**215,300**
By county	*Share by county*							
Harju	6,3%	53,936	10,309	8,441	11,208	13,228	13,563	13,633
Hiiu	1,8%	15,462	2,955	2,420	3,213	3,792	3,888	3,908
Ida-Viru	2,9%	24,818	4,743	3,884	5,157	6,087	6,241	6,273
Jõgeva	8,2%	69,847	13,349	10,931	14,514	17,130	17,564	17,654
Järva	9,5%	80,798	15,443	12,644	16,789	19,815	20,318	20,422
Lääne	4,7%	39,714	7,590	6,215	8,252	9,740	9,987	10,038
Lääne-Viru	12,1%	103,043	19,694	16,125	21,412	25,271	25,912	26,045
Põlva	5,4%	46,314	8,852	7,248	9,624	11,358	11,646	11,706
Pärnu	8,8%	74,747	14,286	11,697	15,532	18,331	18,796	18,893

Rapla	6,3%	53,299	10,187	8,341	11,075	13,071	13,403	13,472
Saare	5,8%	49,238	9,411	7,705	10,231	12,075	12,382	12,445
Tartu	8,8%	75,165	14,366	11,763	15,619	18,434	18,901	18,999
Valga	4,7%	40,298	7,702	6,306	8,374	9,883	10,134	10,186
Viljandi	9,8%	83,897	16,035	13,129	17,433	20,575	21,097	21,206
Võru	4,8%	41,224	7,879	6,451	8,566	10,110	10,366	10,420

Wine production

Between 1990 and 2005 emission from wine production is disaggregated by the market situation in 1999. The situation has slightly changed over the years but this is estimated as an average distribution.

Table 44 Wine producers in Estonia 1999[11]

Company	County	Turnover 1999, million kroons	Approximate market share, %
AS Karme	Viljandi	11,957	6,8%
AS Valtu Vein	Rapla	20,225	11,6%
AS Tarco Vein	Harju	5,806	3,3%
AS Linda Nektar	Võru	8,198	4,7%
AS Nurga	Jõgeva	2,717	1,6%
AS Võhu Vein	Lääne-Viru	29,002	16,6%
Põltsamaa Felix	Jõgeva	76,624	43,9%
Viru Joogid AS	Ida-Viru	20,175	11,5%
Total		**174,704**	**100,00%**

In 2003 the biggest wine producers were AS Võhu Vein, AS Linda Nektar, AS Põltramaa Felix, AS Valtu Vein, AS Karme, AS Tarco vein, AS Nurga and AS Tallinna Karastusjoogid.[12] Production numbers or shares are not given, but the main list is close to 1999.

In the year 2006, AS Linda Nektar produced 61% of the total amount of natural wine produced. Natural wine accounts for 98% of the total wine production.[13] Põltsamaa Felix holds a production share of 17%. The remaining 22% are disaggregated by population. Linda Nektar assumes a leading position in the wine production market in 2007 and 2008. Therefore the division by counties is estimated similarly for the period from 2006 to 2008.

Table 45 NMVOC emission from wine production by counties

		NMVOC emission from wine production, t							
County	Year	1990	1995	2000	2005		2006	2007	2008
Estonia	100%	**2,960**	**1,120**	**2,608**	**7,104**	100%	**6,200**	**4,280**	**3,104**
By county	*Share by county 1990-2005*					*Share by county 2006-2008*			
Harju	3,3%	0,098	0,037	0,086	0,234	8,50%	0,527	0,364	0,264
Hiiu	0,0%	0,000	0,000	0,000	0,000	0,17%	0,010	0,007	0,005
Ida-Viru	11,5%	0,340	0,129	0,300	0,817	2,90%	0,180	0,124	0,090
Jõgeva	45,5%	1,347	0,510	1,187	3,232	17,61%	1,092	0,754	0,547
Järva	0,0%	0,000	0,000	0,000	0,000	0,61%	0,038	0,026	0,019
Lääne	0,0%	0,000	0,000	0,000	0,000	0,46%	0,028	0,020	0,014
Lääne-Viru	16,6%	0,491	0,186	0,433	1,179	1,10%	0,068	0,047	0,034

[11] Euroopa Liiduga liitumise mõju Eesti veinitööstusele. www-1.mtk.ut.ee/varska/2001/Str_ettevotluspol/Hinno.pdf

[12] Eesti Alkoholiturg 2003. aastal. http://www.agri.ee/public/juurkataloog/UURINGUD/eki_alkoholiuuringud/Eesti_alkoholiturg_2003_aasta.pdf

[13] Eesti Alkoholiturg 2006. aastal

Põlva	0,0%	0,000	0,000	0,000	0,000	0,52%	0,032	0,022	0,016
Pärnu	0,0%	0,000	0,000	0,000	0,000	1,45%	0,090	0,062	0,045
Rapla	11,6%	0,343	0,130	0,303	0,824	0,59%	0,037	0,025	0,018
Saare	0,0%	0,000	0,000	0,000	0,000	0,57%	0,036	0,025	0,018
Tartu	0,0%	0,000	0,000	0,000	0,000	2,40%	0,149	0,103	0,074
Valga	0,0%	0,000	0,000	0,000	0,000	0,57%	0,035	0,024	0,018
Viljandi	6,8%	0,201	0,076	0,177	0,483	0,92%	0,057	0,040	0,029
Võru	4,7%	0,139	0,053	0,123	0,334	61,63%	3,821	2,638	1,913

Beer production

NMVOC emission from beer production is divided by the beer sales statistics for 2007.[14]

Table 46 Beer production companies in 2007

Producer	County	Beer sold in Estonia 2007, hl	Approximate market share %
Saku Õlletehase AS	Harju	590899	47,7%
AS A.Le Coq	Tartu	519950	42,0%
AS Viru Õlu	Lääne-Viru	115400	9,3%
AS Puls Brewery	Lääne-Viru	11478	0,9%
AS Sillamäe Õlletehas	Ida-Viru	1346	0,1%
Total		**1239073**	**100,0%**

In 2000 Tartu Õlletehas (nowadays AS A Le Coq) put 42,9 million litres of beer on the market, Saku Õlletehas sold 45,9 million litres of beer. The share of Viru Õlu was 9%.[15] Therefore, it is estimated, that the beer market has been stable at least for the last ten years.

Table 47 NMVOC emission from beer production by counties

		NMVOC emission from beer production, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**26,915**	**17,486**	**33,254**	**46,988**	**50,089**	**49,406**	**44,863**
By county	*Share by county*							
Harju	47,7%	12,838	8,341	15,862	22,413	23,892	23,567	21,400
Hiiu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Ida-Viru	0,1%	0,027	0,017	0,033	0,047	0,050	0,049	0,045
Jõgeva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Järva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne-Viru	10,2%	2,745	1,784	3,392	4,793	5,109	5,039	4,576
Põlva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Pärnu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Rapla	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Saare	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Tartu	42,0%	11,304	7,344	13,966	19,735	21,037	20,751	18,842
Valga	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Viljandi	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Võru	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000

[14] Eesti õlleturg 2007. a. http://www.eestiolu.ee/alam.php?cat=lmenu&page=5&parent=12
[15] http://www.beerguide.ee/uudised_2001_veebr.html

Spirits production

Crude spirits were produced in Lääne-Viru County (Rakvere Piiritusetehas ja Moe Piiritusetehas) untill 2008.

Table 48 NMVOC emission from crude spirits production by counties

		NMVOC emission from crude spirits production, t						
County	Year	1990	1995	2000	2005	2006	2007	2008
Estonia	100%	**32,800**	**36,400**	**8,160**	**14,840**	**24,640**	**15,720**	**6,200**
By county	*Share by county*							
Harju	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Hiiu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Ida-Viru	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Jõgeva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Järva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Lääne-Viru	100,0%	32,800	36,400	8,160	14,840	24,640	15,720	6,200
Põlva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Pärnu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Rapla	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Saare	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Tartu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Valga	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Viljandi	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Võru	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,000

Emissions from other spirits production are disaggregated by production volumes in 2007. In 2003, Liviko was the market leader (production share 53%). Ofelia held 1/5, Onistar 17% and Liiwi Heliis 9% of the remaining market shares. The market situation is similar to the situation in 2007, therefore the 2007 distribution is used for disaggregation for the year 1990 to 2007.

In the first half of 2008 Onistar stopped production, significantly changing the market situation. Therefore, emissions are disaggregated based on the 2008 division. The production share of the Offex Group is not given but it is estimated based on the remaining percentage, i.e 4%.

Major spirit producers and production shares are presented in the following table.

Table 49 Spirit production companies[16][17]

Company	County	Approximate production share 2007, %	Approximate production share 2008, %
AS Liviko	Harju	60%	64%
AS Altia Eesti (formerly: Ofelia)	Harju	18%	19%
AS Onistar	Harju	12%	
OÜ Offex Grupp	Harju	4%	*4%*
AS Liiwi Heliis	Viljandi	3%	8%
AS Remedia	Harju	3%	5%
Total		100%	100%

Table 50 NMVOC emission from distilled spirits production by counties

		NMVOC emission from distilled spirits production, t

[16] Eesti alkoholiturg 2007. aastal. http://www.agri.ee/public/juurkataloog/UURINGUD/eki_alkoholiuuringud/Eesti_alkoholiturg_2007_aastal.pdf
[17] Eesti alkoholiturg 2008. aastal http://www.agri.ee/public/juurkataloog/Pollumajandus_ja_toiduturg/2008/Eesti_alkoholiturg_2008._aastal.pdf

County	Year	1990	1995	2000	2005	2006	2007		2008
Estonia	100%	**58,800**	**70,400**	**34,560**	**67,160**	**73,240**	**86,400**	100%	**70,400**
By county	*Share by county 1990-2007*							*Share by county 2008*	
Harju	97,0%	57,036	68,288	33,523	65,145	71,043	83,808	92,0%	64,768
Hiiu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Ida-Viru	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Jõgeva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Järva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Lääne	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Lääne-Viru	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Põlva	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Pärnu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Rapla	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Saare	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Tartu	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Valga	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000
Viljandi	3,0%	1,764	2,112	1,037	2,015	2,197	2,592	8,0%	5,632
Võru	0,0%	0,000	0,000	0,000	0,000	0,000	0,000	0,0%	0,000

4 PRODUCT USE (NFR 3)

4.1 Paint application (3.A)

4.1.1 Source description

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

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

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

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

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

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

4.1.1.1 Decorative coating application (3.A.1)

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

Paint application: construction and buildings (SNAP activity 060103)

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

Paint application: domestic use (SNAP activity 060104)

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

4.1.1.2 Industrial coating application (3.A.2)

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

1) manufacture of automobiles;
2) car repairing;
3) coil coating;
4) boat building;
5) wood
6) and other industrial paint application.

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

Paint application: car repairing (SNAP activity 060102)

This category refers to the coating of road vehicles carried out as part of vehicle repair, conservation or decoration outside of manufacturing sites, or any use of refinishing-type coatings which is carried out as part of an original manufacturing process. In some countries, specialist paints which are used for coating small volume vehicles such as heavy goods vehicles and buses are classified as vehicle refinishing paints.

4.1.1.3 Other coating application (3.A.3)

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

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

4.1.2 Default emission factors

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

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

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

Emission factors presented in the EMEP Guidebook 2009 version were developed for 2000.

Emission factors from previous Corinair version (2000, 2nd edition) are used for the years 1990 and 1995.

4.1.2.1 Decorative coating application (3.A.1)

For years 2000-2008 EMEP Guidebook 2009 Tier 1 emission factors are used for calculations. Equation 1 is applied.

Table 51 Tier 1 emission factors for source category 3.A.1 Decorative coating application

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	3.A.1	Decorative coating application			
Fuel	NA				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP				
Not estimated	SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	150	g/kg paint applied	100	400	IIASA (2008)

For the years 1990-1995 Corinair (2000) emission factors are used for calculations. As this guidebook provides different emission factors for solventborne and waterborne paints, averaged emission factor is calculated taking into account the proportion of solventborne and waterborne paints used.

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

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

Weighted average emission factor can be calculated as follows:

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

4.1.2.2 Industrial coating application (3.A.2)

For the years 2000-2008 EMEP Guidebook 2009 Tier 1 emission factors are used for calculations. Equation 1 is applied.

Table 52 Tier 1 emission factors for source category 3.A.2 Industrial coating application

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	3.A.2	Industrial coating application			
Fuel	NA				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP				
Not estimated	SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	400	g/kg paint applied	100	800	IIASA (2008)

For years 1990-1995 Corinair (2000) emission factor is used for calculations.

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

4.1.3 Activity data

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

Data regarding import and export is not available for 1990, therefore the total amount of paint used in this year in Estonia is not known.

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

Also some of the paint is used for car repairing (3.A.2).

Table 53 Total amount of paint used in Estonia (Statistics Estonia)

Year	Solventborne paints (CN 3208), t		Waterborne paints (CN 3209), t		Other paints and varnishes (CN 3210), t		Paints and varnishes, t	Total consumption of paints and varnishes, t
	Import	Export	Import	Export	Import	Export	Production	
1995	4435,2	3890,9	1002,8	872,6	671,3	405,1	11700	12640,7
2000	6375,7	7367,5	4220,3	2871,4	681,8	92,2	13100	14046,7
2005	9958,1	10913,1	8671,5	9038,8	1139,9	306,3	21600	21111,3
2006	11771	13571,2	10339,7	12626,4	1230,7	332,4	24100	20911,4
2007	9627,6	13972,3	12257,4	16275,9	1496	500,7	28700	21332,1
2008	7733,6	11965,6	9516	17186,7	1979,1	762,2	24600	13914,2

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

The expert opinion was received from Benefit AS which is the leading car body and car paint shops technology and materials supplier. The total amount of paint used for car repairing in Estonia is estimated to have risen from 100 tons in 1990 up to 180 tons in 2008.

As this is a rough estimate, the growth is estimated to be equal.

Table 54 Use of paints for car repairing in Estonia (3.A.2)

Year	Use of paints for car repairing, t
1990	100
1995	122
2000	144
2005	166
2006	171
2007	175
2008	180

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)

Data regarding import and export is not available for 1990, therefore the total amount of paint used in this year is not known and emission from decorative coating applications cannot be estimated.

It is unknown how much paint has been used by permitted companies between 1995 and 2005. Hence, a reverse calculation is carried out taking into account the emission factor for industrial coating application (400 g/kg NMVOC paint applied).

Sub-sectors have moved under NFR codes 3A1 and 3A2. Therefore all reported emission from point sources is estimated to be from industrial coating applications (3A2).

Table 55 Use of paint in 1995-2005 (calculated)

Year	NMVOC emission from point sources, t	Calculated paint use in point sources, t
1995	937,26	*2343,15*
2000	460,87	*1152,18*
2005	539,57	*1348,93*

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

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

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

Main paint production companies (AS Sadolin, AS Eskaro, AS Tikkurila and AS Caparol) were not able to give answer to this question. Some of them do not have direct sales department.

Also big construction stores (AS ESPAK, Ehitus Service OÜ, Rautakesko AS) were contacted and in interviews it was found that:

1. Sales division by companies and private customers depends on the marketing policy of the store,
2. A change in the division between 1995 and 2008 also depends on the marketing policy,
3. In the years 2004 till 2007 an increase of paint use is mainly caused by the rapid increase of the developments and construction; the elevated use of paint was mainly caused by professional painters and construction companies.

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

In the period from 2005 to 2007 there was a lot of development and construction in Estonia and it is estimated that the private use of paints was similar to the amount used in 2000.

Therefore the following assumptions are made

- In 1995, 2000 and 2008 it is estimated that up to 60% of paint went to professional painters and the remaining 40% to private customers
- Consumption of private consumers in 2005-2007 is assumed to be equal to consumption in 2000 and the remaining part is estimated to be used by professional painters and construction companies.

Table 56 Use of paint for decorative coating application (3.A.1) – construction and buildings and domestic use

Year	Total consumption of paints and varnishes, t	Paint used in point sources, t	Car paint used in diffuse sources, t*	Paint used for decorative coating application, t	Paint used for construction and buildings, t	Paint used for domestic purposes, t
1995	12640,7	*2343,15*	122,0	10175,6	6105	4070
2000	14046,7	*1152,18*	144,0	12750,5	7650	5100
2005	21111,3	*1348,93*	166,0	19596,4	14496	5100
2006	20911,4	1180,968	166,6	19563,9	14464	5100
2007	21332,1	2614,001	172,3	18545,8	13446	5100
2008	13914,2	3252,258	176,5	10485,5	6291	4194

*-car paint used in point sources is subtracted from total car paint use for repairing (see Table 57).

4.1.4 Results

4.1.4.1 Industrial coating application

A part of the car paint shops is permitted.

Between 2006 and 2008, activity data regarding paint use in point sources is collected in the OSIS database.

For the years 2006-2008 activity data for calculations is obtained using the following equation:

car paint use in diffuse sources = total car paint use – car paint use in point sources

In 2000 and 2005, according to CollectER some companies were reporting as point sources. No activity data is available. Emission from point sources is subtracted from the total calculated VOC emission.

Table 57 NMVOC emission from car repairing activities (NFR 3.A.2) in tons

NFR	3.A.2				
SNAP:	060102	Activity:	Industrial coating application (car repairing)		
Emission factor (1990-1995)		600	g/kg paint applied		
Emission factor (2000-2008)		400	g/kg paint applied		
	Total paint use	Paint used in, point sources, t	Paint used in diffuse sources, t	NMVOC from paint use, point sources, t	NMVOC emission from diffuse sources, t
1990	100	NA	100,0	0,0	60,0
1995	122	NA	122,0	0,0	73,2
2000	144	NA	144,0	13,44	44,2
2005	166	NA	166,0	1,36	65,0
2006	171	3,923	166,6	NA	66,6
2007	175	2,69	172,3	NA	68,9
2008	180	3,533	176,5	NA	70,6

Emission is disaggregated by population. See Annex I.

Table 58 NMVOC emission from car repairing activities by counties

County	Year	NMVOC emission from car repairing, t						
		1990	1995	2000	2005	2006	2007	2008
Estonia	100%	60,0	73,2	44,2	65,0	66,6	68,9	70,6
By county	*Share by county*							
Harju	38,7%	23,2	28,3	17,1	25,1	25,8	26,6	27,3
Hiiu	0,8%	0,5	0,6	0,3	0,5	0,5	0,5	0,5
Ida-Viru	13,2%	7,9	9,6	5,8	8,6	8,8	9,1	9,3
Jõgeva	2,8%	1,7	2,0	1,2	1,8	1,8	1,9	2,0
Järva	2,8%	1,7	2,0	1,2	1,8	1,8	1,9	2,0
Lääne	2,1%	1,3	1,5	0,9	1,4	1,4	1,4	1,5
Lääne-Viru	5,0%	3,0	3,7	2,2	3,2	3,3	3,4	3,5
Põlva	2,4%	1,4	1,7	1,0	1,5	1,6	1,6	1,7
Pärnu	6,6%	3,9	4,8	2,9	4,3	4,4	4,5	4,6
Rapla	2,7%	1,6	2,0	1,2	1,8	1,8	1,9	1,9
Saare	2,6%	1,6	1,9	1,2	1,7	1,7	1,8	1,8
Tartu	10,9%	6,5	8,0	4,8	7,1	7,3	7,5	7,7
Valga	2,6%	1,6	1,9	1,1	1,7	1,7	1,8	1,8
Viljandi	4,2%	2,5	3,1	1,9	2,7	2,8	2,9	3,0
Võru	2,9%	1,7	2,1	1,3	1,9	1,9	2,0	2,0

4.1.4.2 Decorative coating application

Emission from decorative coating application is presented in the following table.

Table 59 NMVOC emission from decorative coating application (NFR 3.A.1) in tons

NFR	3.A.1			
SNAP:	060103-060104			
Activity:	Decorative coating application			
Emission factor (1995)		211	g/kg paint	
Emission factor (2000-2008)		150	g/kg of paint applied	
Year	Construction and buildings (060103)		Domestic use (060104)	
	Paint use, t	NMVOC emission, t	Paint use, t	NMVOC emission, t
1995	6105	1288,2	4070,2	858,8
2000	7650	1147,5	5100,2	765,0
2005	14496	2174,5	5100,0	765,0
2006	14464	2169,6	5100,0	765,0
2007	13446	2016,9	5100,0	765,0
2008	6291	943,7	4194,2	629,1

Both emission from construction and domestic use are disaggregated by population. See Annex I.

Table 60 NMVOC emission from decorative coating application (construction and buildings) by counties

County	Year	NMVOC emission from decorative coating application (construction and buildings), t					
		1995	2000	2005	2006	2007	2008
Estonia	100%	1288,2	1147,5	2174,5	2169,6	2016,9	943,7
By county	*Share by county*						
Harju	38,7%	497,9	443,5	840,5	838,6	779,6	364,8
Hiiu	0,8%	9,7	8,7	16,4	16,4	15,2	7,1
Ida-Viru	13,2%	169,7	151,1	286,4	285,7	265,6	124,3
Jõgeva	2,8%	35,7	31,8	60,2	60,1	55,9	26,1
Järva	2,8%	35,7	31,8	60,3	60,1	55,9	26,2
Lääne	2,1%	26,9	24,0	45,4	45,3	42,1	19,7
Lääne-Viru	5,0%	64,3	57,3	108,5	108,3	100,7	47,1
Põlva	2,4%	30,3	27,0	51,1	51,0	47,4	22,2
Pärnu	6,6%	84,7	75,4	142,9	142,6	132,5	62,0
Rapla	2,7%	34,8	31,0	58,7	58,6	54,5	25,5
Saare	2,6%	33,5	29,9	56,6	56,5	52,5	24,6
Tartu	10,9%	140,3	125,0	236,8	236,3	219,6	102,8
Valga	2,6%	33,5	29,8	56,5	56,4	52,4	24,5
Viljandi	4,2%	54,1	48,2	91,3	91,1	84,7	39,6
Võru	2,9%	37,2	33,1	62,7	62,6	58,2	27,2

Table 61 NMVOC emission from decorative coating application (domestic use) by counties

County	Year	NMVOC emission from decorative coating application (domestic use), t					
		1995	2000	2005	2006	2007	2008
Estonia	100%	858,8	765,0	765,0	765,0	765,0	629,1
By county	*Share by county*						
Harju	38,7%	331,9	295,7	295,7	295,7	295,7	243,2
Hiiu	0,8%	6,5	5,8	5,8	5,8	5,8	4,8
Ida-Viru	13,2%	113,1	100,8	100,7	100,7	100,7	82,9

Jõgeva	2,8%	23,8	21,2	21,2	21,2	21,2	17,4
Järva	2,8%	23,8	21,2	21,2	21,2	21,2	17,4
Lääne	2,1%	17,9	16,0	16,0	16,0	16,0	13,1
Lääne-Viru	5,0%	42,9	38,2	38,2	38,2	38,2	31,4
Põlva	2,4%	20,2	18,0	18,0	18,0	18,0	14,8
Pärnu	6,6%	56,4	50,3	50,3	50,3	50,3	41,3
Rapla	2,7%	23,2	20,7	20,7	20,7	20,7	17,0
Saare	2,6%	22,4	19,9	19,9	19,9	19,9	16,4
Tartu	10,9%	93,5	83,3	83,3	83,3	83,3	68,5
Valga	2,6%	22,3	19,9	19,9	19,9	19,9	16,4
Viljandi	4,2%	36,1	32,1	32,1	32,1	32,1	26,4
Võru	2,9%	24,8	22,1	22,1	22,1	22,1	18,2

4.2 Degreasing (NFR 3.B.1)

4.2.1 Source description

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

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

Metal degreasing by using organic solvents takes place in either open top or closed tanks. The open top tanks however have been phased out in the European Union due to the Solvents Emissions Directive 1999/13/EC. Only small facilities, using not more than 1 or 2 tons of solvent per year (depending on the risk profile of the solvent) are still allowed to use open top tanks. Closed tanks offer much better opportunities for the recycling of solvents.

Vapour cleaning[18]

The most common organic solvents for vapour cleaning are:

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

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

Cold cleaning[19]

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

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

4.2.2 Methodology and default emission factors

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

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

[18] EMEP Guidebook 2009
[19] AP 42, Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. http://www.epa.gov/ttn/chief/ap42/ch04/final/c4s06.pdf

1) vapour cleaning – consumption of most common organic solvents for vapour cleaning (according to EMEP Guidebook 2009) are considered for emission calculations,
2) cold cleaning – emission from the rest of vapour cleaning is estimated by different emission factor by inhabitant

Emission factor for vapour cleaning

Tier 1 emission factors are used for calculations. Equation 1 is applied.

Table 62 Tier 1 emission factors for source category 3.B.1 Degreasing

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	3.B.1	Degreasing			
Fuel	NA				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	460	g/kg cleaning products	20	700	IIASA (2008)

Emission factor for cold cleaning

Emission factor for cold cleaning is taken from the US EPA AP-42[20] emission factor database.

Table 63 Non-methane VOC emissions from small cold cleaning degreasing operations

Operating Period	Per Capita Emission Factor
Annual	1.8 kg

4.2.3 Activity data

Vapour cleaning operations

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

As PER is used also for dry cleaning, this is not included as degreaser (see explanations in Dry Cleaning chapter).

The consumption of organic solvents can be estimated by the import and export data from Statistics Estonia (by relevant CN codes). Data regarding import and export is not available for 1990. There is no information available regarding production for the years 1990-2005. The OSIS database provides some information regarding xylenes production between 2006 and 2008.

The data is summarized in the following table.

Data regarding import and export is in some cases inconsistent, for example data regarding the export of p-xylene in 2006 and xylene (for other purposes) in 2008. An explanation could be that the solvents have been imported in a previous period and the material is stored till 2006 or 2008 and then exported. To take this assumption into account 50% of the product is considered to be stored in previous years for further export (included under column Export).

[20] AP 42, Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. http://www.epa.gov/ttn/chief/ap42/ch04/final/c4s06.pdf

Table 64 Activity data for NMVOC emission calculations from vapour degreasing activities in 1995 – 2008 (in tons)

CN code	Name of the chemical	1995			2000			2005			2006				2007				2008			
		Import	Export	Use	Import	Export	Use	Import	Export	Use	Import	Export	Prod.	Use	Import	Export	Prod.	Use	Import	Export	Prod.	Use
2903 12 00	Dichloromethane (methylene chloride)	138,0	93,0	45,0	38,9	0,2	38,7	31,9	0,3	31,6	33,2	0,0	0	33,2	31,4	0,0	0	31,4	42,6	1,1	0	41,5
2903 22 00	trichloroethylene	35,8	0	35,8	46,3	3,2	43,1	30,8	2,4	28,4	25,8	0,1	0	25,7	25,2	0,4	0	24,8	11,1	0,8	0	10,3
2707 30 90	Xylole (xylenes): For other purposes	25,0	0	25,0	8,7	0,1*	8,6	0	0	0,0	1,4	0,7*	0	0,7	0,2	0,1*	0	0,1	0,0	0,9	0	0,0
2902 41 00	o-xylene	100,5	0,1	100,4	958,8	0,0	958,8	1,8	0,0	1,8	1,4	0,0	0	1,4	1,3	0,0	0	1,3	0,4	0,0	0	0,4
2902 42 00	m-xylene	0	0	0,0	0,0	0,0	0,0	0,5	0,0	0,5	0,0	0,0	0	0,0	0,0	0,0	0	0,0	0,0	0,0	0	0,0
2902 43 00	p-xylene	0	0	0,0	437,5	218,8*	218,8	0	0	0,0	14,6	9 643,1	0	0,0	3,9	0,0	8,035	11,9	0,0	0,0	6,936	6,9
2902 44 00	Mixed xylene isomers	0	0	0,0	300,2	2,7	297,5	263,8	0,0	263,8	306,2	0,0	6,1	312,3	233,0	0,0	0	233,0	170,2	0,3	0	169,9
	Solvents used for vapour degreasing	299,3	93,1	**206,2**	1 790,4	225,0	**1 565,5**	328,8	2,7	**326,1**	382,6	9 643,9	6,1	**373,3**	295,0	0,5	8,0	**302,5**	224,3	3,1	6,9	**229,0**

* stored

Cold cleaning operations

The basic activity statistics for using the AP-42 emission factor are national population figures.

Data regarding population by counties is available from Statistics Estonia and is presented in Annex I.

4.2.4 Results

Vapour cleaning operations

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

Between 2006 and 2008, activity data regarding solvent use for degreasing in point sources is collected into OSIS database.

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

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

There were some companies reporting emissions between 1995 and 2005. No activity data is available. Emission from point sources is subtracted from the total calculated VOC emission.

Table 65 NMVOC emission from vapour degreasing activities (NFR 3.B.1) in tons

NFR	3.B.1				
SNAP:	0602	Activity:	Degreasing (vapour cleaning)		
Emission factor:		460	g/kg cleaning products		
	Total solvent use	Solvent used in point sources, t	Solvent used in diffuse sources, t	NMVOC from degreasing use, point sources, t	NMVOC emission from diffuse sources, t
1995	206,2	NA	206,2	14,7	80,1
2000	1 565,5	NA	1565,5	0,62	719,5
2005	326,1	NA	326,1	3,7	146,3
2006	373,3	32,243	341,057	NA	156,9
2007	302,5	21,471	281,064	NA	129,3
2008	229,0	52,464	176,572	NA	81,2

NMVOC emission from vapour cleaning operations is disaggregated by population.

Table 66 NMVOC emission from degreasing activities (vapour cleaning) by counties

County	Year	NMVOC emission from degreasing (vapour cleaning), t					
		1995	2000	2005	2006	2007	2008
Estonia	100%	**80,1**	**719,5**	**146,3**	**156,9**	**129,3**	**81,2**
By county	*Share by county*						
Harju	38,7%	31,0	278,1	56,5	60,6	50,0	31,4
Hiiu	0,8%	0,6	5,4	1,1	1,2	1,0	0,6
Ida-Viru	13,2%	10,6	94,8	19,3	20,7	17,0	10,7
Jõgeva	2,8%	2,2	19,9	4,1	4,3	3,6	2,2
Järva	2,8%	2,2	19,9	4,1	4,3	3,6	2,3
Lääne	2,1%	1,7	15,0	3,1	3,3	2,7	1,7
Lääne-Viru	5,0%	4,0	35,9	7,3	7,8	6,5	4,1
Põlva	2,4%	1,9	16,9	3,4	3,7	3,0	1,9
Pärnu	6,6%	5,3	47,3	9,6	10,3	8,5	5,3
Rapla	2,7%	2,2	19,4	4,0	4,2	3,5	2,2
Saare	2,6%	2,1	18,7	3,8	4,1	3,4	2,1
Tartu	10,9%	8,7	78,4	15,9	17,1	14,1	8,8
Valga	2,6%	2,1	18,7	3,8	4,1	3,4	2,1

Viljandi	4,2%	3,4	30,2	6,1	6,6	5,4	3,4
Võru	2,9%	2,3	20,8	4,2	4,5	3,7	2,3

Cold cleaning operations

Table 67 NMVOC emission from degreasing activities (cold cleaning) (by counties)

NFR	3.B.1													
SNAP:	0602	Activity:	Degreasing (cold cleaning)											
Emission factor,	1,8	kg per capita												
Year	1990		1995		2000		2005		2006		2007		2008	
	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t
Estonia	1570599	**2827,078**	1448075	**2606,535**	1372071	**2469,728**	1347510	**2425,518**	1344684	**2420,431**	1342409	**2416,336**	1340935	**2413,683**
By county														
Harju	607158	1092,884	553193	995,747	526155	947,079	521038	937,868	521313	938,363	522147	939,865	523277	941,899
Hiiu	11332	20,398	11170	20,106	10458	18,824	10246	18,443	10222	18,400	10168	18,302	10118	18,212
Ida-Viru	221807	399,253	197899	356,218	180143	324,257	173777	312,799	172775	310,995	171748	309,146	170719	307,294
Jõgeva	42607	76,693	40598	73,076	38372	69,070	37473	67,451	37305	67,149	37108	66,794	36922	66,460
Järva	43715	78,687	41152	74,074	38871	69,968	38141	68,654	36457	65,623	36328	65,390	36208	65,174
Lääne	33694	60,649	30606	55,091	28695	51,651	27990	50,382	27853	50,135	27713	49,883	27552	49,594
Lääne-Viru	79767	143,581	70604	127,087	67910	122,238	66464	119,635	67770	121,986	67560	121,608	67375	121,275
Põlva	36186	65,135	34760	62,568	32743	58,937	31752	57,154	31547	56,785	31387	56,497	31175	56,115
Pärnu	99863	179,753	94424	169,963	91363	164,453	89343	160,817	89017	160,231	88727	159,709	88563	159,413
Rapla	39717	71,491	38560	69,408	37671	67,808	37032	66,658	36869	66,364	36743	66,137	36684	66,031
Saare	39890	71,802	38233	68,819	36010	64,818	35208	63,374	35076	63,137	34978	62,960	34845	62,721
Tartu	162924	293,263	153307	275,953	149744	269,539	148886	267,995	148969	268,144	149001	268,202	149283	268,709
Valga	41515	74,727	38407	69,133	35861	64,550	34867	62,761	34661	62,390	34455	62,019	34265	61,677
Viljandi	65135	117,243	62043	111,677	58087	104,557	56616	101,909	56370	101,466	56075	100,935	55877	100,579
Võru	45289	81,520	43119	77,614	39988	71,978	38677	69,619	38480	69,264	38271	68,888	38072	68,530

4.3 Dry cleaning (NFR 3.B.2)

4.3.1 Source description

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

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

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

4.3.2 Methodology and default emission factors

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

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

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

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

Table 68 Tier 1 emission factors for source category 3.B.2 Dry Cleaning

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	3.B.2	Dry cleaning			
Fuel	NA				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	40	g/kg textile treated	10	200	IIASA (2008)

4.3.3 Situation in Estonia

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

Main findings:

- in Estonia mainly closed-circuit equipment are used for dry cleaning,
- closed-circuit equipment were the main practice already in the 90s,
- main cleaning agent is PER (tetrachloroethylene/perchloroethylene),
- solvent waste (used solvent) is collected and given to hazardous waste companies,
- the quantity of cleaned textile is registered by cleaned items (for example number of cleaned coats or curtains) not by mass units.

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

Questions and answers are given in the table below.

	Answers			
Question	*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	1070 kg per year
Quantity of cleaned textiles?	Ca 2000 kg	do not have statistics	Register by pieces (app. equal to 6,2 tons)	Register by pieces
Waste management?	collected	Collected and given to hazardous waste company	Collected and given to hazardous waste company	Collected and given to hazardous waste company

4.3.4 Activity data

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

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

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

Used solvent goes to hazardous waste companies.

The quantity of PER used in Estonia can be estimated by the import and export data. Data regarding import and export is not available for 1990.

According to OSIS, no production of tetrachloroethylene/perchloroethylene is reported for 2006-2008.

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

Table 69 Activity data for NMVOC emission calculations from dry cleaning activities in 1995 – 2008 (in tons)

Year	Import, t	Export, t	Total solvent use, t
1995	62,1	-	62,1

2000	132,8	6,6	126,2
2005	148,5	-	148,5
2006	157,8	-	157,8
2007	131,4	-	131,4
2008	124,1	-	124,1

Methodological issues

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

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

4.3.5 Results

Table 70 NMVOC emission from dry cleaning activities (NFR 3.B.2) in tons

NFR	3.B.2			
SNAP:	060202	Activity:	Dry cleaning	
Emission factor:		400	g/kg solvent used	
Year	Total solvent use	Solvent used in point sources, t	Solvent used in diffuse sources, t	NMVOC emission from diffuse sources, t
1995	62,1	NA	62,1	24,8
2000	126,2	NA	126,2	50,5
2005	148,5	9,4	139,120	55,6
2006	157,8	5,430	152,370	60,9
2007	131,4	6,5	124,930	50,0
2008	124,1	8,379	115,721	46,3

Emission is disaggregated down to counties by population (see Annex I), although some companies are permitted. The part of solvent used in facilities having permits is less than 10% of the total consumption and does not give much influence to the results of distribution by counties.

Table 71 NMVOC emission from dry cleaning activities by counties

		NMVOC emission from dry cleaning, t					
County	Year	1995	2000	2005	2006	2007	2008
Estonia	100%	**24,8**	**50,5**	**55,6**	**60,9**	**50,0**	**46,3**
By county	*Share by county*						
Harju	38,7%	9,6	19,5	21,5	23,6	19,3	17,9
Hiiu	0,8%	0,2	0,4	0,4	0,5	0,4	0,3
Ida-Viru	13,2%	3,3	6,6	7,3	8,0	6,6	6,1
Jõgeva	2,8%	0,7	1,4	1,5	1,7	1,4	1,3
Järva	2,8%	0,7	1,4	1,5	1,7	1,4	1,3
Lääne	2,1%	0,5	1,1	1,2	1,3	1,0	1,0
Lääne-Viru	5,0%	1,2	2,5	2,8	3,0	2,5	2,3
Põlva	2,4%	0,6	1,2	1,3	1,4	1,2	1,1

Pärnu	6,6%	1,6	3,3	3,7	4,0	3,3	3,0
Rapla	2,7%	0,7	1,4	1,5	1,6	1,3	1,2
Saare	2,6%	0,6	1,3	1,4	1,6	1,3	1,2
Tartu	10,9%	2,7	5,5	6,1	6,6	5,4	5,0
Valga	2,6%	0,6	1,3	1,4	1,6	1,3	1,2
Viljandi	4,2%	1,0	2,1	2,3	2,6	2,1	1,9
Võru	2,9%	0,7	1,5	1,6	1,8	1,4	1,3

4.4 Printing (NFR 3.D.1)

4.4.1 Source 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 different extents. Printing can also require the use of cleaning solvents and organic dampeners. Ink solvents, diluents, cleaners and dampeners may all make a significant contribution to emissions from industrial printing involves the application of inks using presses.

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

- Heat set offset printing

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

- Publication packaging

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

- Rotogravure & Flexography

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

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

Situation in Estonia[21]

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

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

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

[21] Association of Estonian Printing Industry http://www.trykiliit.ee/index.php?lang=est&main_id=3

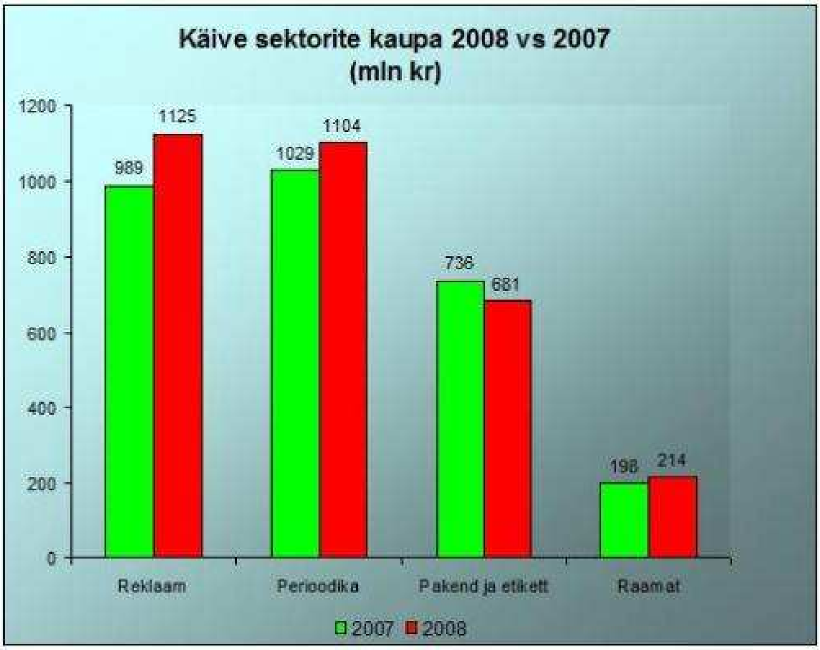

Figure 2 Revenue of different sectors, in million kroons in 2007 and 2008

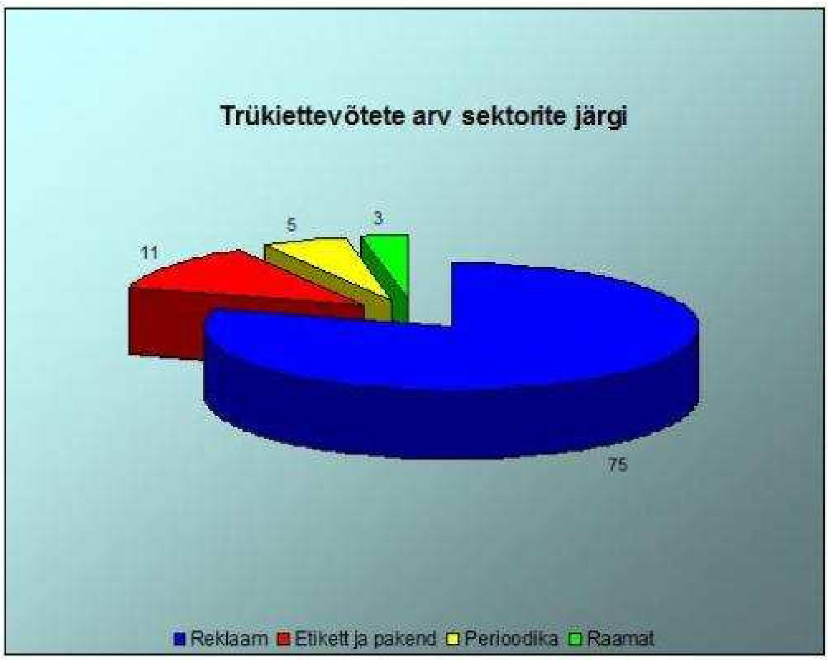

Figure 3 Number of printing houses by sector

4.4.2 Default emission factors

Tier 1 emission factors are used for calculations. Equation 1 is applied.

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

An approach combining ink consumption with emission factor is applied.

Table 72 Tier 1 emission factors for source category 3.D.1 Printing

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	3.D.1	Printing			
Fuel	NA				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	500	g/kg ink	30	2100	IIASA (2008)

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[22] is can be concluded that for press and edition/publication the following techniques are applied (with relevant emission factors):

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

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

4.4.3 Activity data

The quantity of ink (CN code 3215) used in Estonia can be estimated by the import and export data from Statistics Estonia. Data regarding import and export is not available for the year 1990.

Information regarding ink production is not available. According to OSIS, no production of ink is reported between 2006 and 2008.

Table 73 Activity data for NMVOC emission calculations from printing activities in 1995 – 2008 (in tons)

Year	Import	Export	Use
1995	301,6	30,5	**271,1**
2000	538,3	13,3	**525,0**
2005	2966,1	105,4	**2860,7**
2006	1860,6	445,0	**1415,6**
2007	2095,4	580,2	**1515,2**
2008	2267,9	295,4	**1972,5**

4.4.4 Results

A number of printing facilities is permitted.

Between 2006 and 2008, activity data regarding ink use in point sources is collected in the OSIS database.

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

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

In 2005, according to CollectER five companies were reporting as point sources. No activity data is available. Emission from point sources is subtracted from total calculated VOC emission.

Table 74 NMVOC emission from printing activities (NFR 3.D.1) in tons

NFR	3.D.1				

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

SNAP:	060403	Activity:	Printing		
Emission factor:		500	g/kg ink		
	Total ink use	Inks used in, point sources, t	Ink used in diffuse sources, t	NMVOC from inks use, point sources, t	NMVOC emission from diffuse sources, t
1995	271,1	NA	271,1	0,0	135,6
2000	525,0	NA	525,0	0,0	262,5
2005	2860,7	NA	2860,7	168,25	1262,1
2006	1415,6	398,110	1017,490	NA	508,7
2007	1515,2	866,668	648,532	NA	324,3
2008	1972,5	818,506	1153,994	NA	577,0

As the biggest printing facilities are permitted, emission from diffuse sources is disaggregated by population as it is also suggested by the guidebook.

Table 75 NMVOC emission from printing activities by counties

County	Year	NMVOC emission from printing, t					
		1995	2000	2005	2006	2007	2008
Estonia	100%	**135,6**	**262,5**	**1262,1**	**508,7**	**324,3**	**577,0**
By county	*Share by county*						
Harju	38,7%	52,4	101,5	487,8	196,6	125,3	223,0
Hiiu	0,8%	1,0	2,0	9,5	3,8	2,4	4,4
Ida-Viru	13,2%	17,9	34,6	166,2	67,0	42,7	76,0
Jõgeva	2,8%	3,8	7,3	35,0	14,1	9,0	16,0
Järva	2,8%	3,8	7,3	35,0	14,1	9,0	16,0
Lääne	2,1%	2,8	5,5	26,4	10,6	6,8	12,0
Lääne-Viru	5,0%	6,8	13,1	63,0	25,4	16,2	28,8
Põlva	2,4%	3,2	6,2	29,7	12,0	7,6	13,6
Pärnu	6,6%	8,9	17,3	82,9	33,4	21,3	37,9
Rapla	2,7%	3,7	7,1	34,1	13,7	8,8	15,6
Saare	2,6%	3,5	6,8	32,9	13,2	8,4	15,0
Tartu	10,9%	14,8	28,6	137,4	55,4	35,3	62,8
Valga	2,6%	3,5	6,8	32,8	13,2	8,4	15,0
Viljandi	4,2%	5,7	11,0	53,0	21,4	13,6	24,2
Võru	2,9%	3,9	7,6	36,4	14,7	9,4	16,6

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

4.5.1 Source description

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

4.5.2 Default emission factors

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

Tier 1 emission factors are used for calculations. Equation 1 is applied.

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

Table 76 Tier 1 emission factors for source category 3.D.2 Domestic solvent use including fungicides

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	1	kg/person/year	0.5	3	IIASA (2008)

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

The emission factor according to Corinair (2007)[23] is 2590g (VOC) person^{-1}year-^{1}. This equals to 2,59 kg/person/year.

4.5.3 Activity data

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

Data regarding population by counties is available from Statistics Estonia and is presented in Annex I.

[23] Other use of solvents & related activities. Emission Inventory Guidebook. December 2006.

4.5.4 Results

Table 77 NMVOC emission from domestic solvent use (NFR 3.D.2) in tons

Year	1990		1995		2000		2005		2006		2007		2008	
Emission factor, kg/person/year	**2,59**		**2,59**		**2,59**		**1**		**1**		**1**		**1**	
	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t
Estonia	1570599	**4067,851**	1448075	**3750,514**	1372071	**3553,664**	1347510	**1347,510**	1344684	**1344,684**	1342409	**1342,409**	1340935	**1340,935**
By county														
Harju	607158	1572,539	553193	1432,770	526155	1362,741	521038	521,038	521313	521,313	522147	522,147	523277	523,277
Hiiu	11332	29,350	11170	28,930	10458	27,086	10246	10,246	10222	10,222	10168	10,168	10118	10,118
Ida-Viru	221807	574,480	197899	512,558	180143	466,570	173777	173,777	172775	172,775	171748	171,748	170719	170,719
Jõgeva	42607	110,352	40598	105,149	38372	99,383	37473	37,473	37305	37,305	37108	37,108	36922	36,922
Järva	43715	113,222	41152	106,584	38871	100,676	38141	38,141	36457	36,457	36328	36,328	36208	36,208
Lääne	33694	87,267	30606	79,270	28695	74,320	27990	27,990	27853	27,853	27713	27,713	27552	27,552
Lääne-Viru	79767	206,597	70604	182,864	67910	175,887	66464	66,464	67770	67,770	67560	67,560	67375	67,375
Põlva	36186	93,722	34760	90,028	32743	84,804	31752	31,752	31547	31,547	31387	31,387	31175	31,175
Pärnu	99863	258,645	94424	244,558	91363	236,630	89343	89,343	89017	89,017	88727	88,727	88563	88,563
Rapla	39717	102,867	38560	99,870	37671	97,568	37032	37,032	36869	36,869	36743	36,743	36684	36,684
Saare	39890	103,315	38233	99,023	36010	93,266	35208	35,208	35076	35,076	34978	34,978	34845	34,845
Tartu	162924	421,973	153307	397,065	149744	387,837	148886	148,886	148969	148,969	149001	149,001	149283	149,283
Valga	41515	107,524	38407	99,474	35861	92,880	34867	34,867	34661	34,661	34455	34,455	34265	34,265
Viljandi	65135	168,700	62043	160,691	58087	150,445	56616	56,616	56370	56,370	56075	56,075	55877	55,877
Võru	45289	117,299	43119	111,678	39988	103,569	38677	38,677	38480	38,480	38271	38,271	38072	38,072

4.6 *Other product use (NFR 3.D.3)*

4.6.1 Fat, edible and non edible oil extraction

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

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

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

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

Situation in Estonia

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

The main oil extracting company in Estonia is Werol Tehased AS.

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

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

The second biggest oil producer is Oru Taimeõlitööstuse OÜ. The oil is pressed out only mechanically. The production was started in 1985 but no solvents have ever been employed.

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

As solvents are not used for oil extraction in Estonia, this sector is not considered part of the project.

4.6.2 Preservation of wood

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

Situation in Estonia

The Estonian Forest Industries Association was questioned regarding wood preservation.

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

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

The amount of wood impregnated accounted for ca 135000 tm (theoretical cubic meter of wood). The biggest wood impregnation companies were following: (only waterborne preservatives were used)

- OÜ Hansacom – 33 000 m^3

- AS Kestvuspuit 30 000 m^3
- AS Imprest 15 000 m^3
- OÜ Kehra Puutööstus – 8000 m^3
- AS Natural – 5000 m^3.

Solventborne preservatives are used by some companies producing windows, doors and loghouses.

The major solventborne supplier VBH was contacted and it was found out that companies, that use solvent-borne preservatives, use more than five tons in year. This is the threshold for air pollution permit. Therefore it is estimated that these installations are covered with permits and are not subject to diffuse emissions.

4.6.3 Vehicles dewaxing

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

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

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

Situation in Estonia

Autode Müügi- ja Teenindusettevõtete Eesti Liit (Association of Estonian Automobile Sales and Maintenance Companies) and Toyota Baltic AS were interviewed regarding this activity.

It was found that at least during the last five years no dewaxing operations have been carried out. If needed paint protection is provided by using (polyethylene) film. Waxing is only used in very rare cases, for example special deliveries by sea transport from long distances.

In the period from 1995 to 2005 dewaxing was carried out in rare cases, i.e. special delivery directly from Japan. For these cases it is not known if dewaxing was carried out in Finland or in Estonia. Relevant data is very difficult to get. Most of the dewaxing operations of imported cars are conducted in a treatment centre that is located port Hanko in Finland.

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

4.6.4 Treatment of vehicles

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

Before the early 1980s, car manufacturers did not apply any coating to the underside of their cars. If a car owner wanted to protect their car against rust and stone chip damage they had to pay to have their car 'undersealed' at a garage or workshop. This involved the application of a bituminous coating. The market for this service is no longer very large in much of Western Europe. It may still occur in

Eastern Europe, in countries having cold climatic conditions and in the restoration and maintenance of vintage cars, but this activity is likely to be relatively small.

Situation in Estonia

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

Between 1990 and 2000 a treatment with bituminous materials was wide spread but there is no statistics available. Nowadays treatment with bituminous coating is negligible and if needed, treatment is done by special polymers.

So, NMVOC emission from this activity is calculated for the years 1990 to 2000 and since 2005 emission from treatment of vehicles is considered negligible.

Emission factor

Tier 2 emission factor is used for calculations.

Table 78 Tier 2 emission factors for source category 3.D.3 Other product use, Treatment of vehicles

Tier 2 emission factors						
	Code	Name				
NFR Source Category	3.D.3	Other product use				
Fuel	NA					
SNAP (if applicable)	060407	Underseal treatment and conservation of vehicles				
Technologies/Practices	Treatment of vehicles					
Region or regional conditions						
Abatement technologies						
Not applicable						
Not estimated	NOx, CO, SOx, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP					
Pollutant	Value	Unit	95% confidence interval		Reference	
			Lower	Upper		
NMVOC	0.2	kg/person/year	0.01	2	IIASA (2008)	

As the number of cars in Estonia per inhabitant was smaller than the number of cars per inhabitant in the European Union then a reduction coefficient for emission factor is applied.

Table 79 Motorisation rate - cars per 1 000 inhabitants[24]

Year	Number of vehicles per 1000 inhabitants		Coefficient , %
	Estonia	EU-15	
1995	269	427	63%
2000	339	472	72%

It means that in 1995 the number of cars per inhabitant accounted for 63% of the average European Union country value and in 2000 for 72%. Information for 1990 was not found but it is estimated to be similar to the value for the 1995.

The customized emission factors are the following

Years 1990 and 1995: 0,2 x 63% = 0,126 kg/person/year

Year 2000: 0,2 x 72% = 0,144 kg/person/year

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

Results

Table 80 NMVOC emission from vehicle treatment (Other product use, NFR 3.D.3) in tons

NFR	3.D.3					
SNAP:	060407	Activity:	Underseal treatment and conservation of vehicles			
Year	1990		1995		2000	
Emission factor, kg/person/year	**0,126**		**0,126**		**0,144**	
	Population	VOC emission, t	Population	VOC emission, t	Population	VOC emission, t
Estonia	1570599	**197,895**	1448075	**182,457**	1372071	**197,578**
By county						
Harju	607158	76,502	553193	69,702	526155	75,766
Hiiu	11332	1,428	11170	1,407	10458	1,506
Ida-Viru	221807	27,948	197899	24,935	180143	25,941
Jõgeva	42607	5,368	40598	5,115	38372	5,526
Järva	43715	5,508	41152	5,185	38871	5,597
Lääne	33694	4,245	30606	3,856	28695	4,132
Lääne-Viru	79767	10,051	70604	8,896	67910	9,779
Põlva	36186	4,559	34760	4,380	32743	4,715
Pärnu	99863	12,583	94424	11,897	91363	13,156
Rapla	39717	5,004	38560	4,859	37671	5,425
Saare	39890	5,026	38233	4,817	36010	5,185
Tartu	162924	20,528	153307	19,317	149744	21,563
Valga	41515	5,231	38407	4,839	35861	5,164
Viljandi	65135	8,207	62043	7,817	58087	8,365
Võru	45289	5,706	43119	5,433	39988	5,758

4.6.5 Industrial application of adhesives

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

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

Emission factor

Tier 2 emission factor is used for calculations.

Table 81 Tier 2 emission factors for source category 3.D.3 Other product use, Industrial application of adhesives, Use of traditional solvent based adhesives

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.3	Other product use			
Fuel	NA				
SNAP (if applicable)	060405	Application of glues and adhesives			
Technologies/Practices	Industrial application of adhesives				
Region or regional conditions					
Abatement technologies	Traditional solvent-based adhesives (65% solvent, 35% solid) No secondary measure				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, TSP, PM10, PM2.5, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	780	g/kg adhesives	600	1000	EGTEI (2003)

Activity data

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

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

The quantity of industrially used adhesives is estimated by import, export and production data (CN code 35069100). Import and export data is available from Statistics Estonia. Production data is available from the OSIS for the years 2006-2008. At the moment there is no information regarding adhesives production between 1995 and 2005 available.

Table 82 Activity data for NMVOC emission calculations from adhesives application in 1995 – 2008 (in tons)

Year	Adhesives (CN 35069100), t			
	Import	Export	Production	Consumption
1995	290,2	11,3		278,9
2000	1147,3	214,3		933,0
2005	3150,6	1271,7		1878,9
2006	3927	1192,2	618*	3352,8
2007	4281,7	1084,9	706,399	3903,2
2008	3012,2	1028,5	532,799	2516,5

*Production is given in m3. the density is estimated to be equal to 1 t/m3.

Results

A number of facilities using adhesives are permitted.

In the period from 2006 to 2008, activity data regarding adhesives use in point sources is collected in the OSIS database (SNAP 060405).

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

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

In 2000 and 2005, according to CollectER some companies were reporting as point sources. No activity data is available. Emission from point sources is subtracted from total calculated VOC emission.

Table 83 NMVOC emission from application of adhesives (Other product use, NFR 3.D.3) in tons

NFR	3.D.3				
SNAP:	060405	Activity:	Application of glues and adhesives		
Emission factor:		780	g/kg adhesives		
Year	Total use of adhesives, t	Adhesives used in point sources, t	Adhesives used in diffuse sources, t	NMVOC from adhesive application, point sources, t	NMVOC emission from diffuse sources, t
1995	278,9	NA	278,9	0,0	217,5
2000	933	NA	933,0	259,98	467,8
2005	1878,9	NA	1878,9	302,9	1162,6
2006	3352,8	2118,881	1233,9	NA	962,5
2007	3903,199	2679,022	1224,2	NA	954,9
2008	2516,499	541,844	1974,7	NA	1540,2

As the biggest facilities are permitted, emission from diffuse sources is disaggregated by population.

Table 84 NMVOC emission from industrial application of adhesives by counties

		NMVOC emission from industrial application of adhesives, t					
County	Year	1995	2000	2005	2006	2007	2008
Estonia	100%	**217,5**	**467,8**	**1162,6**	**962,5**	**954,9**	**1540,2**
By county	*Share by county*						
Harju	38,7%	84,1	180,8	449,4	372,0	369,1	595,3
Hiiu	0,8%	1,6	3,5	8,8	7,3	7,2	11,6
Ida-Viru	13,2%	28,6	61,6	153,1	126,8	125,8	202,8
Jõgeva	2,8%	6,0	13,0	32,2	26,7	26,4	42,7
Järva	2,8%	6,0	13,0	32,2	26,7	26,5	42,7
Lääne	2,1%	4,5	9,8	24,3	20,1	19,9	32,2
Lääne-Viru	5,0%	10,9	23,3	58,0	48,0	47,7	76,9
Põlva	2,4%	5,1	11,0	27,3	22,6	22,4	36,2
Pärnu	6,6%	14,3	30,7	76,4	63,3	62,8	101,2
Rapla	2,7%	5,9	12,6	31,4	26,0	25,8	41,6
Saare	2,6%	5,7	12,2	30,3	25,1	24,9	40,1
Tartu	10,9%	23,7	50,9	126,6	104,8	104,0	167,7
Valga	2,6%	5,7	12,2	30,2	25,0	24,8	40,0
Viljandi	4,2%	9,1	19,6	48,8	40,4	40,1	64,7
Võru	2,9%	6,3	13,5	33,5	27,8	27,6	44,4

4.6.6 Tobacco combustion

Emissions arising from the combustion (smoking) of tobacco.

Emission factor

Table 85 Tier 2 emission factors for source category 3.D.3 Other product use, Tobacco combustion

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.3	Other product use			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Tobacco combustion				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	SOx, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	4.8	g/ton tobacco	2	10	Statistics Norway, Directorate for

Activity data

The quantity of tobacco combusted (smoked) in Estonia is estimated by the import and export data (CN code 2402) available from Statistics Estonia.

Data regarding import and export and production is not available for 1990.

Tobacco products were produced in Estonia until 1996. Accurate production data was not available.

According to the newspaper[25] in 1995 the turnover of Eesti Tubakas was 215,9 million kroons with a production of approximately 2 billion cigarettes.

The production of cigarettes is estimated by the average weight of cigarettes. Ten cigarettes equal approximately 8,39 g.[26] Thus, the production of cigarettes is estimated at approximately 1680 tons.

Table 86 Activity data for NMVOC emission calculations from tobacco combustion in 1995 – 2008 (in tons)

Year	Import	Export	Production	Use
1995	720,4	86,1	*1680*	2314,3
2000	2496,7	0,3	-	2496,4
2005	3224,7	49,2	-	3175,5
2006	3425,9	24,9	-	3401
2007	3543,8	13,2	-	3530,6
2008	1547,3	10,6	-	1536,7

Results

Table 87 NMVOC emission from tobacco combustion (Other product use, NFR 3.D.3) in tons

NFR	**3.D.3**	
SNAP:	**NA**	
Activity:	**Tobacco combustion**	
Emission factor:	4,8	g/ton tobacco
Year	Use of tobacco, t	NMVOC emission, t
1995	2314,3	0,011
2000	2496,4	0,012

[25] http://www.postimees.ee/leht/96/04/26/kuum.htm
[26] weighted

2005	3175,5	0,015
2006	3401	0,016
2007	3530,6	0,017
2008	1536,7	0,007

Emission is disaggregated by population.

Table 88 NMVOC emission from tobacco combustion by counties

		NMVOC emission from tobacco combustion, t					
County	Year	1995	2000	2005	2006	2007	2008
Estonia	100%	**0,011**	**0,012**	**0,015**	**0,016**	**0,017**	**0,007**
By county	*Share by county*						
Harju	38,7%	0,004	0,005	0,006	0,006	0,007	0,003
Hiiu	0,8%	0,000	0,000	0,000	0,000	0,000	0,000
Ida-Viru	13,2%	0,001	0,002	0,002	0,002	0,002	0,001
Jõgeva	2,8%	0,000	0,000	0,000	0,000	0,000	0,000
Järva	2,8%	0,000	0,000	0,000	0,000	0,000	0,000
Lääne	2,1%	0,000	0,000	0,000	0,000	0,000	0,000
Lääne-Viru	5,0%	0,001	0,001	0,001	0,001	0,001	0,000
Põlva	2,4%	0,000	0,000	0,000	0,000	0,000	0,000
Pärnu	6,6%	0,001	0,001	0,001	0,001	0,001	0,000
Rapla	2,7%	0,000	0,000	0,000	0,000	0,000	0,000
Saare	2,6%	0,000	0,000	0,000	0,000	0,000	0,000
Tartu	10,9%	0,001	0,001	0,002	0,002	0,002	0,001
Valga	2,6%	0,000	0,000	0,000	0,000	0,000	0,000
Viljandi	4,2%	0,000	0,001	0,001	0,001	0,001	0,000
Võru	2,9%	0,000	0,000	0,000	0,000	0,000	0,000

5 AGRICULTURE (NFR 4)

5.1 Crop production and agricultural soils (NFR 4.D)

5.1.1 Source description

Crop production and agricultural soils are currently estimated to emit < 1% of total NMVOC emissions, and therefore do not yet require a methodology for calculation. However, given current uncertainties over the magnitude of NMVOC emissions from agricultural crops, some information is given in this chapter, in order to provide background information and a tool to estimate the order of magnitude of these emissions as well as to highlight current uncertainties.

5.1.2 Default emission factors

Tier 1 emission factors are used for calculations. Equation 1 is applied.

Table 89 Tier 1 emission factors for source category 4.D crop production and agricultural soils

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	4D	Agricultural Soils			
Fuel	NA				
Not estimated	NO_X, CO, SO_X, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not applicable	TSP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	5.95539E-09	kg kg^{-1} fertilizer-N applied	1.92E-10	8.51E-08	Steinbrecher et al (2008)

5.1.3 Activity data

Information on the annual national consumption of total N-fertilizer is required.

Data regarding fertilizers applied is available from Statistics Estonia:

1) mineral fertilizer-N applied, ton
2) organic fertilizer applied, ton

There is no information available regarding the year 1990.

For estimating the amount of organic fertilizer-N applied the average nitrogen content in manure[27] is used.

Table 90 Activity data for NMVOC emission calculations from nitrogen fertilizer use in 1995 – 2008 (in tons)

Years	Mineral fertilizers	Organic fertilizers			Fertilizer-N applied, ton
	Nitrogen (N), ton	Fertilizer, ton	Average nitrogen content, kg/t	Nitrogen (N), ton	
1995	18905	3485000	8,5	29623	48528
2000	22396	1863611	8,5	15841	38237
2005	20083	2025777	8,5	17219	37302
2006	22610	1748634	8,5	14863	37473
2007	24982	2704346	8,5	22987	47969

[27]Methods for determination of emission levels of pollutants from animal and poultry production. Regulation No. 48 of the Minister of Environment of 5 December 2008.

2008	35455	2285041	8,5	19423	54878

5.1.4 Results

Table 91 NMVOC emission from agriculture (agricultural soils, NFR 4.D) in tons

NFR	**4.D**	
SNAP:	**NA**	
Activity:	**Agricultural soils**	
Emission factor:	5,95539E-09	kg/kg fertilizer-N applied
Year	Fertilizer-N applied, ton	NMVOC emission, t
1995	48528	0,000289
2000	38237	0,000228
2005	37302	0,000222
2006	37473	0,000223
2007	47969	0,000286
2008	54878	0,000327

Disaggregation is carried out by agricultural land use.

Table 92 Agricultural land use in counties

County	Agricultural land distribution by counties
Harju	6,3%
Hiiu	1,8%
Ida-Viru	2,9%
Jõgeva	8,2%
Järva	9,5%
Lääne	4,7%
Lääne-Viru	12,1%
Põlva	5,4%
Pärnu	8,8%
Rapla	6,3%
Saare	5,8%
Tartu	8,8%
Valga	4,7%
Viljandi	9,8%
Võru	4,8%

Table 93 NMVOC emission from agriculture by county

County	Year	NMVOC emission from agriculture, t					
		1995	2000	2005	2006	2007	2008
Estonia	100%	**0,000289**	**0,000228**	**0,000222**	**0,000223**	**0,000286**	**0,000327**
By county	*Share by county*						
Harju	6,3%	0,0000183	0,0000144	0,0000141	0,0000141	0,0000181	0,0000207
Hiiu	1,8%	0,0000052	0,0000041	0,0000040	0,0000041	0,0000052	0,0000059
Ida-Viru	2,9%	0,0000084	0,0000066	0,0000065	0,0000065	0,0000083	0,0000095
Jõgeva	8,2%	0,0000237	0,0000187	0,0000182	0,0000183	0,0000234	0,0000268
Järva	9,5%	0,0000274	0,0000216	0,0000211	0,0000212	0,0000271	0,0000310
Lääne	4,7%	0,0000135	0,0000106	0,0000104	0,0000104	0,0000133	0,0000152
Lääne-Viru	12,1%	0,0000350	0,0000275	0,0000269	0,0000270	0,0000346	0,0000395

Põlva	5,4%	0,0000157	0,0000124	0,0000121	0,0000121	0,0000155	0,0000178
Pärnu	8,8%	0,0000254	0,0000200	0,0000195	0,0000196	0,0000251	0,0000287
Rapla	6,3%	0,0000181	0,0000142	0,0000139	0,0000140	0,0000179	0,0000204
Saare	5,8%	0,0000167	0,0000132	0,0000128	0,0000129	0,0000165	0,0000189
Tartu	8,8%	0,0000255	0,0000201	0,0000196	0,0000197	0,0000252	0,0000288
Valga	4,7%	0,0000137	0,0000108	0,0000105	0,0000106	0,0000135	0,0000155
Viljandi	9,8%	0,0000285	0,0000224	0,0000219	0,0000220	0,0000281	0,0000322
Võru	4,8%	0,0000140	0,0000110	0,0000108	0,0000108	0,0000138	0,0000158

Emissions from this sector are less than 1 kg per year. This sector does not contribute to the total NMVOC emission.

6 LAND USE CHANGE AND FORESTRY (NFR 11)

6.1 Other natural sources (NFR 11C)

6.1.1 Source description

Natural sources include non-managed deciduous/ coniferous forests and managed deciduous/coniferous forests as well as emissions of grassland and other low vegetation including crops. Foliage is primarily a source of VOC, and it is distinguished between isoprene, monoterpenes and 'other VOC'.

6.1.2 Methodology

6.1.2.1 Algorithm

All methodologies for calculating biogenic emissions essentially involve multiplying an emissions factor for a type of vegetation by a statistic giving the amount of vegetation in the country or grid square. Two major alternatives for this are:

- to perform these calculations at a genera or preferably species specific level (applied for forests in this report), or
- to perform the calculations for different ecosystem types (applied for grassland and crops).

Based on the EMEP/EEA air pollutant emission inventory guidebook (2009), in conclusion, total VOC emissions per year from these activities can be calculated based on the following equation:

$$\begin{aligned}\text{Emission of VOC per vegetation type} &= F \times A \\ &= (\varepsilon \times D \times \Gamma) \times A \\ &= D.A.\left[\Gamma - \text{iso} \times \varepsilon_{\text{iso}} + \Gamma - \text{mts/ovoc} \times \left(\varepsilon_{\text{mts}} + \varepsilon_{\text{ovoc}}\right)\right]\end{aligned}$$

where:

- A (m²) - area used per vegetation type;
- D (g/m²) - foliar biomass density per vegetation type;
- Γ- the integrated value of a unitless environmental correction factor over the growing season of the vegetation concerned;
- ε-iso (µg/g.h)- isoprenes standard emission potential[28] per vegetation type;
- ε-mts (µg/g.h)- monoterpenes standard emission potential[28] per vegetation type;
- ε-ovoc (µg/g.h)- other VOC standard emission potential[28] per vegetation type.

Average data on Γ, D and ε for European trees and other vegetation are given in the EMEP/EEA air pollutant emission inventory guidebook (2009).

6.1.2.2 Default emission factors

Using meteorological data from the EMEP MSC-W models the integrated values, Γ-iso and Γ-mts, have been calculated for both six monthly (May-October) and 12 monthly growing seasons, as averages over Estonia:

- Γ-mts = Γ-ovoc - 565 hours (6-month) and 669 hours (12-month)
- Γ-iso - 422 hours (6-month) and 491 hours (12-month).

[28] Emission potential at 30°C and PAR(photosynthetically active radiation)=1000 µmol.m^{-2}.s^{-1}

Table 94 gives an overview of the input parameters for trees and ecosystem types used to calculate emission factors. There are also emission factors for Estonia included in the table.

Table 95 Standard emission potentials and biomass densities for European trees (EMEP/EEA, 2009)

Common name	Latin name	Type (1)	Biomass density D, g/m²	Isoprenes ε-iso, µg/g*h	Monoterpenes ε-mts, µg/g*h	o-VOC ε-ovoc, µg/g*h	Emission factor, t/km²
Pine	Pinus sylvestris	e	700	0	1.5	1.5	1.41
Spruce	Picea abies	e	1400	1	1.5	1.5	3.50
Birch	Betula	d	320	0	0.2	1.5	0.31
Asp	Populus		320	60	0	1.5	8.37
Common Alder	Alnus	d	320	0	1.5	1.5	0.54
Ash	Fraxinus	d	320	0	0	1.5	0.27
Oak	Quercus robur	d	320	60	0.2	1.5	8.41
Grassland (meadows/ pastures)	-	-	400	0	0.1	1.5	0.36
Grass related crops	-	-	800	0.002	0.1	1.5	0.72

(1) D=deciduous; E=evergreen

6.1.3 Activity data

The area used per vegetation type can be obtained from Statistics Estonia. For the years 1990 and 1995 information on forest land is not available, therefore the information from the Yearbook FORESTS (2008) was used. From this reference the available information about the closest years - 1988 and 1994 was applied accordingly for the years 1990 and 1995. The distribution of forest land area by dominant tree species in counties is performed using information from the Forest register (Centre of Forest Protection and Silviculture).

Statistics about agriculture lands obtained from Statistics Estonia contain information on crop fields and cereal field area for years 1990 – 2008. These data were used for calculating the total emission. Information on permanent grasslands is available for the years 2005 – 2008. There is no information in the Statistical database for the years 1990 – 2000. For calculating the total emission areas were calculated using data from CORINE Land Cover 1990 and 2000.

Table 96 Activity data used for NMVOC emission calculation in 1990 – 2008 (thousand ha)

Forest land area by dominant tree species	1990	1995	2000	2005	2006	2007	2008
Area of pine-woods	749.6	731.7	724.0	682.0	667.1	674.3	706.6
Area of spruce-woods	454.2	457.6	370.5	370.4	360.4	362.7	362.9
Area of birch-woods	540.4	585.3	649.4	654.0	649.1	659.0	646.8
Area of aspen-woods	30.1	31.5	114.0	109.9	113.0	115.1	116.7
Area of common alder-woods	28.9	28.2	61.6	65.0	57.5	64.4	67.5
Area of grey alder-woods	90.1	82.9	164.0	178.6	173.5	197.5	199.6
Area of other stands	23.1	20.6	31.0	31.3	31.3	39.8	38.4

Table 97 Activity data used for NMVOC emission calculation in 1990 – 2008 (thousand ha)

Forest land area by dominant tree species	1990	1995	2000	2005	2006	2007	2008

Area of cereals	397,0	304,3	329,3	282,1	280,3	292,3	309,3
Area of permanent grasslands	278,9	257,9	257,9	231,0	193,6	215,7	196,6

6.1.4 Results

The species distribution in different ecosystem types is obtained from the Forest register (Centre of Forest Protection and Silviculture). The disaggregation is based on information from CORINE Land Cover.

Table 98 NMVOC emission from non-managed deciduous/ coniferous forests and managed deciduous/coniferous forests (NFR 11C) in tons

County	NMVOC emission from non-managed deciduous/ coniferous forests and managed deciduous/coniferous forests, t						
	1990	1995	2000	2005	2006	2007	2008
Estonia	**31 548.2**	**31 594.9**	**36 304.7**	**35 597.0**	**35 486.5**	**34 762.9**	**35 034.8**
By county							
Harju	2 730.5	2 721.1	2 744.4	2 693.3	2 689.5	2 645.4	2 624.7
Hiiu	771.0	767.2	835.3	819.9	822.1	820.2	813.2
Ida-Viru	2 534.9	2 533.3	2 906.3	2 846.5	2 845.8	2 809.9	2 816.3
Jõgeva	1 899.4	1 918.6	2 486.6	2 435.9	2 417.5	2 349.2	2 406.3
Järva	1 984.8	1 993.2	2 144.6	2 100.9	2 084.1	2 024.1	2 041.2
Lääne	906.5	904.1	1 186.3	1 171.7	1 175.3	1 156.8	1 170.8
Lääne-Viru	3 280.4	3 289.2	3 571.5	3 497.6	3 474.0	3 381.5	3 408.7
Põlva	1 749.0	1 744.2	1 929.6	1 884.2	1 885.6	1 865.8	1 861.9
Pärnu	3 504.0	3 511.8	4 017.3	3 945.4	3 933.5	3 858.2	3 882.1
Rapla	2 278.1	2 284.9	2 471.4	2 422.3	2 407.8	2 348.1	2 362.0
Saare	1 487.4	1 473.4	2 064.5	2 023.8	2 044.6	2 035.1	2 059.2
Tartu	1 680.9	1 696.5	2 247.5	2 198.3	2 185.2	2 135.5	2 186.1
Valga	1 967.4	1 969.4	2 208.4	2 165.1	2 157.4	2 109.6	2 122.8
Viljandi	2 627.6	2 640.2	3 133.1	3 086.4	3 067.3	2 974.1	3 020.3
Võru	2 146.2	2 147.9	2 358.0	2 305.6	2 296.7	2 249.4	2 259.2

Total emissions from agricultural lands were calculated based on the Statistical database and CORINE Land Cover. Emissions where disaggregated by counties based on the CORINE Land Cover database for years 1990, 2000 and 2006.

Table 99 NMVOC emission permanent grasslands and cereal fields (NFR 11C) in tons

County	NMVOC emission permanent grasslands and cereal fields, t						
	1990	1995	2000	2005	2006	2007	2008
Estonia	**3890,0**	**3135,0**	**3316,0**	**2877,0**	**2729,0**	**2896,0**	**2950,0**
By county							
Harju	351,2	274,8	291,3	250,8	238,8	253,1	258,6
Hiiu	47,1	39,0	40,9	35,6	33,4	35,6	36,0
Ida-Viru	169,7	134,4	142,9	123,2	117,9	124,7	127,9
Järva	335,4	269,0	284,9	246,8	235,5	249,4	255,3
Jõgeva	328,6	261,2	278,1	239,8	230,5	243,4	250,6
Lääne	201,5	156,0	166,4	143,4	138,5	146,0	150,9
Lääne-Viru	433,9	351,9	371,0	322,7	304,3	323,7	328,0
Pärnu	373,2	294,9	313,5	270,0	259,0	273,7	281,4
Põlva	165,2	138,0	144,0	126,6	116,6	125,2	124,3
Rapla	314,5	243,8	261,1	223,3	217,3	228,3	237,6
Saare	177,8	152,4	158,2	141,5	128,8	138,9	136,6
Tartu	335,1	273,1	288,7	250,8	237,5	252,2	256,5

Valga	171,3	147,2	153,6	136,9	125,9	135,2	134,1
Viljandi	334,1	270,7	287,1	247,4	236,3	250,1	256,2
Võru	151,4	128,7	134,4	118,0	108,8	116,7	116,2

ANNEX I Disaggregation by county

In many cases emission disaggregation by counties is carried out partly or entirely by population. Population distribution by counties has been changed slightly over the years, average distribution within years 1990-2008 is used in calculations.

Table 100 Population distribution by counties 1990-2008

	1990		1995		2000		2005		2006		2007		2008		Average distribution by counties
	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%	Population	%	%
Estonia	1570599	100,0%	1448075	100,0%	1372071	100,0%	1347510	100,0%	1344684	100,0%	1342409	100,0%	1340935	100,0%	100%
By counties															
Harju	607158	38,7%	553193	38,2%	526155	38,3%	521038	38,7%	521313	38,8%	522147	38,9%	523277	39,0%	38,7%
Hiiu	11332	0,7%	11170	0,8%	10458	0,8%	10246	0,8%	10222	0,8%	10168	0,8%	10118	0,8%	0,8%
Ida-Viru	221807	14,1%	197899	13,7%	180143	13,1%	173777	12,9%	172775	12,8%	171748	12,8%	170719	12,7%	13,2%
Jõgeva	42607	2,7%	40598	2,8%	38372	2,8%	37473	2,8%	37305	2,8%	37108	2,8%	36922	2,8%	2,8%
Järva	43715	2,8%	41152	2,8%	38871	2,8%	38141	2,8%	36457	2,7%	36328	2,7%	36208	2,7%	2,8%
Lääne	33694	2,1%	30606	2,1%	28695	2,1%	27990	2,1%	27853	2,1%	27713	2,1%	27552	2,1%	2,1%
Lääne-Viru	79767	5,1%	70604	4,9%	67910	4,9%	66464	4,9%	67770	5,0%	67560	5,0%	67375	5,0%	5,0%
Põlva	36186	2,3%	34760	2,4%	32743	2,4%	31752	2,4%	31547	2,3%	31387	2,3%	31175	2,3%	2,4%
Pärnu	99863	6,4%	94424	6,5%	91363	6,7%	89343	6,6%	89017	6,6%	88727	6,6%	88563	6,6%	6,6%
Rapla	39717	2,5%	38560	2,7%	37671	2,7%	37032	2,7%	36869	2,7%	36743	2,7%	36684	2,7%	2,7%
Saare	39890	2,5%	38233	2,6%	36010	2,6%	35208	2,6%	35076	2,6%	34978	2,6%	34845	2,6%	2,6%
Tartu	162924	10,4%	153307	10,6%	149744	10,9%	148886	11,0%	148969	11,1%	149001	11,1%	149283	11,1%	10,9%
Valga	41515	2,6%	38407	2,7%	35861	2,6%	34867	2,6%	34661	2,6%	34455	2,6%	34265	2,6%	2,6%
Viljandi	65135	4,1%	62043	4,3%	58087	4,2%	56616	4,2%	56370	4,2%	56075	4,2%	55877	4,2%	4,2%
Võru	45289	2,9%	43119	3,0%	39988	2,9%	38677	2,9%	38480	2,9%	38271	2,9%	38072	2,8%	2,9%