Methodology on the calculation of emissions from Product usage by consumers, construction and services.

RIVM Report 2018-0011

Colophon

B.I. Jansen (Auteur), TNO
J.A.J. Meesters (Auteur), RIVM
M.M. Nijkamp (Auteur), RIVM

Contact:
Johannes Adrianus Jacobus Meesters
CPV
joris.meesters@rivm.nl

This report has been compiled by order and for the account of the Directorate-General for the Environment and International Affairs, within the framework of the project Emission Registration M/240107, 'Netherlands Pollutant Release & Transfer Register'.

This is a publication of:
National Institute for Public Health and the Environment
P.O. Box 1 | 3720 BA Bilthoven
The Netherlands
www.rivm.nl/en

Publiekssamenvatting

Methodiekrapport om emissies door productgebruik en servicebedrijven te berekenen

In deze rapportage wordt beschreven hoe de Nederlandse Emissieregistratie de uitstoot van verontreinigende stoffen berekend door productgebruik en servicebedrijven.

Nederland is vanwege internationale verdragen, zoals het Kyoto-protocol, de EU-Emissieplafonds (NEC-Directive) en de Convention on Long-range Transboundary Air Pollution (CLRTAP), verplicht om steeds volgens de meest actuele wetenschappelijk inzichten te rapporteren over de uitstoot van broeikasgassen, verzurende stoffen en stoffen die gerelateerd zijn aan grootschalige luchtverontreiniging. Met deze beschrijving wordt de gerapporteerde uitstoot onderbouwd.

Doelgroep voor deze rapportage zijn de (internationale) reviewers die de Nederlandse rapportages aan de EU en VN valideren

Kernwoorden: Emissie, Productgebruik, Broeikasgassen, Luchtverontreiniging

Synopsis

Methods used for the Dutch Emission Inventory

Methods used to calculate emissions from product usage by consumers, construction and services. These methods are used by the Dutch PRTR for the reporting of greenhouse gas (GHG) emissions under UNFCCC, Kyoto Protocol, EU Monitoring Mechanism Regulation (MMR) and EU Effort Sharing Decision (ESD) and for international reporting obligations of other pollutants under CLRTAP and the NEC Directive.

Keywords: Emissions, Product use, Air pollution, greenhouse gases

Contents

1 Introduction

In this document the calculation methods for the emissions caused by consumers and some small trade and service companies within the taskforce WESP is reported. This document is only available online and is updated periodically or when needed. The emissions described in this document are part of the total Dutch emission inventory. For more information, check the website http://www.emissieregistratie.nl/ERPUBLIEK/bumper.en.aspx.

The emissions calculated by the taskforce WESP are mainly emissions caused by product use and are mainly emitted to air. The emissions to the compartment water are calculated by the taskforce MEWAT. The emissions caused by industrial production, waste management and energy production are reported by the taskforce ENINA.

Within this document the background of the process causing the emissions is described, but also the method of data collection, the source of the emission factors and some other important information. It's important to give a description of the method, because in some cases, for example, the calculation is based on a single measurement or data of a single year. The base year needs to be corrected or interpreted to get an estimation method for all years.

One of the purposes of this document is to give information on the estimation of the emissions. Only the direct emissions caused by the process or product use are calculated within WESP and therefore here described. The environmental effects such as acidification, greenhouse gas effect or ozone layer depletion are not considered. The waste produced, the amount of energy used and the resources needed for production or the described process are not included. Waste management and energy used are calculated on country scale within taskforce ENINA. The emissions caused by the production of the products used are calculated in other parts of the Dutch emission inventory, but only if the production occurs in the Netherlands.

In the method description it is also explained how the spatial allocation occurs. The spatial allocation describes how the emissions are geographically distributed throughout the Netherlands. This is based on the location were the emissions are assumed to take place. For example, if a product is mainly used by consumers, the distribution is based on the amount of people living in a certain area. The spatially distributed emissions are used as input for the (air quality) models calculating the concentrations of the substances in the environment. This is used to get an estimation of the environmental quality in the Netherlands.

Appendix A gives an explanation on the quality indicators. The indicators are A till E, with A being the highest and E the lowest.

2 General assurance and quality control (QA/QC)

In accordance with the basic work agreements within the Dutch emission registration, the responsible work package leader checks that:
1. the basic data are well documented and adopted (check for typing errors, use of the correct units and correct conversion factors);
2. the calculations have been implemented correctly;
3. assumptions are consistent and specific parameters (e.g. activity data) are used consistently;
4. complete and consistent data sets have been supplied.

Any actions that result from these checks are noted on an 'action list' by the ER secretary. The work package leaders carry out these actions and they communicate by e-mail regarding these QC checks, actions and results with the ER secretary. While adding a new emission year the task forces perform a trend analysis, in which data from the new year are compared with data from the previous year. The work package leader provides an explanation if the increase or decrease of emissions exceeds the minimum level of 5% at target group level or 0.5% at national level. These explanations are also sent by e-mail to the ER secretary by the work package leaders The ER secretary keeps a logbook of all these QC checks and trend explanations and archives all concerned e-mails. This shows explicitly that the required checks and corrections have been carried out. Based on the results of the trend analysis and the feedback on the control and correction process ('action list') the Working Group on Emissions Monitoring (WEM) gives advice to the institute representatives (Deltares on behalf of Rijkswaterstaat, Statistics Netherlands (CBS) and Netherlands Environmental Assessment Agency (PBL)) to approve the dataset. The ER project leader at RIVM defines the dataset, on receipt of an e-mail by the institute representatives, in which they give their approval. Furthermore, all changes of emissions in the whole timeseries as a result of recalculations are documented in CRF table 8(b).

3 Emissions of greenhouse gases

This report also provides the methodology descriptions of the greenhouse gas emissions, which are reported in the national greenhouse gas inventory. The relevant emission sources are presented in the following table, including a reference to the chapter and the CRF code.

CRF	Chapter	ES code	Emission source (English)	Emission source (Dutch)
1.A.4.b	21	0801801	Charcoal use for barbecuing	Houtskoolverbruik door consumenten: barbecuen
	25	T012200	Residential combustion, wood stoves and fire places	Vuurhaarden consumenten, sfeerverwarming woning
2.D.2	9	0801000	Burning of candles	Branden van kaarsen
2.G.3.a	8	9310100	Solvent and other product use: anaesthesia	Oplosmiddel- en ander productgebruik: anesthesie, narcosegas
2.G.3.b	5	0811301	Solvent and other product use: sprays	Oplosmiddel- en ander productgebruik: spuitbussen, drijfgas/oplosmiddel, consumenten
2.G.4	18	0801700	Fireworks at new year	Afsteken vuurwerk
	17	0850000	Degassing of groundwater, production of drinking water	Ontgassen drinkwater

Emissions from the use of compost by consumers is described in the methodology report for agriculture (Vonk et al, 2015: Methodology for estimating emissions from agriculture in the Netherlands)

In the next table an overview is provided on the tier used to calculate the emissions and the source of the emission factor.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2**		**CH_4**		**N_2O**	
	Method applied	**Emission factor**	**Method applied**	**Emission factor**	**Method applied**	**Emission factor**
1. Energy						
A. Fuel combustion						
4. Other sectors	T1	D	T1	D	T1	D
2. Industrial processes						
D. Non-energy products from fuels and solvent use	T1	D				
G. Other product manufacture and use	T1	CS	T1	CS	T1	CS, D

4 Emissions of air pollutants

This report also provides the methodology descriptions of the air pollutant emissions, which are reported under the LRTAP convention in the Informative Inventory Report (IIR). The relevant emission sources are presented in the following table, including a reference to the chapter and the NFR code.

NFR	Chapter	ES code	Emission source (English)	Emission source (Dutch)
1A4bi	21	0801800	Barbecuing	Vleesbereiden: Bakken, braden en barbecuen
	21	0801801	Charcoal use for barbecuing	Houtskoolverbruik door consumenten: barbecuen
	25	T012200	Residential combustion, wood stoves and fire places	Vuurhaarden consumenten, sfeerverwarming woning
1B2aiv	24	8920900	NACE 47.3: gas stations, spills tank refill	SBI 47.3: Benzinestations, lekverliezen vullen autotank
	24	8920901	NACE 47.3: gas stations, vapour expel - tank refill	SBI 47.3: Benzinestations, verdrijvingsverliezen - autotanks
	24	8920902	NACE 47.3: gas stations, vapour expel - storage tanks	SBI 47.3: Benzinestations, verdrijvingsverliezen - opslagtanks
	27	8921100	NACE 46.71: wholesale trade in fuels and other mineral oil products	SBI 46.71: Groothandel in brandstoffen en overige minerale olieproducten
2D3a	15	0801100	Solvent and other product use: cosmetics	Oplosmiddel- en ander productgebruik: Cosmetica en artikelen voor persoonlijke verzorging. consumenten
	10	0802300	Solvent and other product use: car products	Oplosmiddel- en ander productgebruik: Autoprodukten, consumenten
	31	0802400	Solvent and other product use: domestic pesticides	Oplosmiddel- en ander productgebruik: NMVOS huishoudelijke bestrijdingsmiddelen
	20	0802800	Solvent and other product use: leather maintenance products	Oplosmiddel- en ander productgebruik: Leer- en meubelonderhoud
	7	0802901	Solvent and other product use: glues	Oplosmiddel- en ander productgebruik: Lijmen, consumenten
	13	0803000	Solvent and other product use: detergents	Oplosmiddel- en ander productgebruik: Schoonmaakmiddelen, consumenten
	20	0820600	Solvent and other product use: office products	Oplosmiddel- en ander productgebruik: kantoorartikelen, consumenten
	36	0890401	Solvent and other product use: foam, applied in residential refrigerators	Oplosmiddel- en ander productgebruik: diffusie isolatieschuim koelkast/diepvriezer consumenten

2D3d	22	0119800	Solvent and other product use: roadpaint rural areas	Oplosmiddel- en ander productgebruik: Wegenverf buiten bebouwde kom
	22	0129800	Solvent and other product use: roadpaint urban areas	Oplosmiddel- en ander productgebruik: Wegenverf binnen bebouwde kom
	22	0802200	Solvent and other product use: paint in the construction	Oplosmiddel- en ander productgebruik: Verfgebruik bouw
	22	0802201	Solvent and other product use: paint by consumers	Oplosmiddel- en ander productgebruik: Verfgebruik consumenten
	6	0803100	Solvent and other product use: air fresheners	Oplosmiddel- en ander productgebruik: Luchtverfrissers, consumenten
	22	8920800	NACE 45.2: specialized restoration of cars (painting and lacquering)	SBI 45.2: Gespecialiseerde reparatie van auto's (verven en lakken)
2D3f	33	8922100	NACE 96.012: washing and (dry-)cleaning and dye-works (> 10 employees)	SBI 96.012: Chemische wasserijen en ververijen (> 10 werknemers)
	32	8922200	NACE 96.012: washing and (dry-)cleaning and dye-works (< 10 employees)	SBI 96.012: Chemische wasserijen en ververijen (< 10 werknemers)
2D3i	23	0010300	Solvent and other product use: PCP pressure treated wood, stock	Oplosmiddel- en ander productgebruik: Emissie gevelbetimmering
	9	0801000	Burning of candles	Branden van kaarsen
	28	0801001	Smoking of cigars	Roken van sigaren
	28	0801002	Smoking of cigarettes	Roken van sigaretten
	15	0801101	Solvent and other product use: cosmetics	Oplosmiddel- en ander productgebruik: Cosmetica en artikelen voor persoonlijke verzorging. HDO
	18	0801700	Fireworks at new year	Afsteken vuurwerk
	10	0802301	Solvent and other product use: car products	Oplosmiddel- en ander productgebruik: Autoprodukten, HDO
	11	0802500	Solvent and other product use: carbolized wood	Oplosmiddel- en ander productgebruik: Gecarbolineumd hout, consumenten
	11	0802501	Solvent and other product use: carbolized wood	Oplosmiddel- en ander productgebruik: Gecarbolineumd hout, landbouw
	11	0802600	Solvent and other product use: carbol like wood preservatives	Oplosmiddel- en ander productgebruik: Gebruik carbolineum, consumenten
	11	0802601	Solvent and other product use: carbol like wood preservatives	Oplosmiddel- en ander productgebruik: Gebruik carbolineum, landbouw
	7	0802900	Solvent and other product use: glues	Oplosmiddel- en ander productgebruik: Lijmen, bouw
	13	0803001	Solvent and other product use: detergents	Oplosmiddel- en ander productgebruik: Schoonmaakmiddelen,

				HDO
	35	0804000	Solvent and other product use: creosote pressure treated wood, new	Oplosmiddel- en ander productgebruik: gecreosoteerd hout in de bouw, consumenten
	35	0804001	Solvent and other product use: creosote pressure treated wood, new	Oplosmiddel- en ander productgebruik: gecreosoteerd hout in de bouw, HDO
	35	0804002	Solvent and other product use: creosote pressure treated wood, new	Oplosmiddel- en ander productgebruik: gecreosoteerd hout in de bouw, landbouw
	35	0804003	Solvent and other product use: creosote pressure treated wood, new	Oplosmiddel- en ander productgebruik: gecreosoteerd hout in de bouw, verkeer en vervoer
	35	0804100	Solvent and other product use: creosote pressure treated wood, stock	Oplosmiddel- en ander productgebruik: opstand van gecreosoteerd hout in de bouw, consumenten
	35	0804101	Solvent and other product use: creosote pressure treated wood, stock	Oplosmiddel- en ander productgebruik: opstand van gecreosoteerd hout in de bouw, HDO
	35	0804102	Solvent and other product use: creosote pressure treated wood, stock	Oplosmiddel- en ander productgebruik: opstand van gecreosoteerd hout in de bouw, landbouw
	35	0804103	Solvent and other product use: creosote pressure treated wood, stock	Oplosmiddel- en ander productgebruik: opstand van gecreosoteerd hout in de bouw, verkeer en vervoer
	37	0811200	Industrial cleaning of road tankers	Reinigen van tankauto's
	31	0812400	Solvent and other product use: domestic pesticides	Oplosmiddel- en ander productgebruik: NMVOS niet landbouw bestrijdingsmiddelen
	20	0820601	Solvent and other product use: office products	Oplosmiddel- en ander productgebruik: kantoorartikelen, HDO
	36	0890400	Solvent and other product use: foam of refrigerators in waste dumps	Oplosmiddel- en ander productgebruik: diffusie isolatieschuim koelkast/diepvriezer afvalfase
	29	8920700	NACE 45.1: service stations, anti-corrosive treatment	SBI 45.1: Garagebedrijven, antiroest beh.
	34	E800000	Solvent and other product use: fumigation of transports	Oplosmiddel- en ander productgebruik: ontsmetten transporten
2H3	14	0802302	Building and construction sites	Stofemissies bouwplaatsen
5C1bv	16	8922001	NACE 96.032: crematories, mortuaries and cemeteries	SBI 96.032: Crematoria, mortuaria en begraafplaatsen
5E	38	0801200	House fires	Woningbranden
	38	0801300	Car fires	Autobranden
	12	0890200	Solvent and other product use: scrapping of refrigerators	Oplosmiddel- en ander productgebruik: afdanken koelkast/diepvriezer

6A	19	0801600	Other sources and sinks: human transpiration and breathing	Transpiratie en ademen
	30	0802000	Manure of domestic animals	Huisdieren mest

5 Aerosol cans (CRF 2.G.3.b)

In this paragraph the emission of nitrous oxide from aerosol cans is described.

Process description	Emk_code	CRF_code	Sector
Aerosol cans	811301	2.G.3b	Consumers

5.1 Description emission source

Nitrous oxide (N_2O) is used as a propelling agent in aerosol cans (for example, cans of cream).

Contribution to the national emission
The contribution of this source to the total national N_2O emission was 0.82% in 2013.

5.2 Calculation

For the complete time series, the emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Number of N_2O containing aerosol cans sold
Emission factor = N_2O emission per aerosol can

a) Activity data
The Dutch Association of Aerosol Producers (NAV) reports data on the annual sales of N_2O-containing spray cans. Since the 2014 submission the annual sales are based on real sales figures instead of estimated sales. As a result of these improved activity data the N_2O emissions have been recalculated for the whole time series.

b) Emission factor
The EF for N_2O from aerosol cans is estimated to be 7.6 g/can (based on data provided by one producer) and is assumed to be constant over time.

5.3 Uncertainty and Quality checks

For N_2O emissions, the uncertainty is estimated to be approximately 50 per cent based on the judgement of experts. Uncertainty in the activity data of N_2O use is estimated to be 50 per cent and that of the EF to be less than 1 per cent (the assumption is that all gas is released).

Quality checks
There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

5.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on population density.

Emission source/process	Allocation-parameter
Aerosol cans	population density.

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

5.5 References

The Dutch Association of Aerosol Producers (NAV)

5.6 Version, dates and sources

Version: 1.3
Date: September 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
C.J. Peek	RIVM/ER	kees.peek@rivm.nl

6 Air Fresheners

This paragraph describes the NMVOC emission from consumer air fresheners.

Process description	Emkcode	NFR code	Sector
Air freshener	0803100	2D3d	Consumers

6.1 Description of emission source

Air fresheners are used indoors to cover unpleasant odors and to fill the room with a nice scent. The ingredients used include volatile organic compounds (VOCs) which enter the atmosphere as they travel from indoor to outdoor air. Such emission of VOC is calculated for the use of passive, electric and combustible air fresheners.

6.2 Calculation

Emissions from the use of air fresheners are calculated as follows:

Emission = Activity data x Emission Factor

Activity data = number of households in The Netherlands
Emission factor = kg NMVOC emission from air fresheners averaged per household

a) Activity data
The number of households in The Netherlands is reported every year by the Dutch Central Bureau of Statistics (CBS) (www.cbs.nl).

b) Emission factor
The emission factor is calculated as sum of three separate emission factors derived for combustible, electric and passive air freshener products.

$$EF = EF_{combustible} + EF_{electric} + EF_{passive}$$

The emission factor per air freshener product is calculated as the emission rate of the product (g per hour) multiplied with the fraction of households using the products, the number of air freshener present in the households that use the product and the duration per year in which the product is used (hours per year).

$$EF_{product} = e_{NMVOC\ per\ product} \times FR_{households\ using\ AF\ product} \times N_{AF\ product\ samples\ per\ household} \times t_{use}$$

The emission rate (g per hour) of an air freshener product is calculated by multiplying the weight of the product (g) with the weight fraction of the product that is NMVOC (g_{NMVOC} per $g_{product}$) divided by the product exhaustion time (hour), i.e. the duration at which all NMVOC has left the product.

$e_{\text{NMVOC per product}}$ = (Product Weight X WF_{NMVOC})/ $t_{Exhaustion}$

The VOC emissions per household are calculated per type of air freshener based on the use patterns described in the EPHECT ("Emissions, Exposure Patterns and Health Effects of Consumer Products in the EU") survey report (EPHECT, 2012) and product information of the most used brands of air fresheners reported in material safety data sheets (MSDSs). The EPHECT project is a European collaborative project, co-funded by the European Union, in which important information has been gathered about the use of products by European consumers (EPHECT, 2015). The EPHECT survey was performed in 2012 (EPHECT, 2012) and published in 2015 (Dimitroulopoulou et al., 2015a, b; Trantallidi et al., 2015) and includes survey data that describes the declared consumer use patterns of 4335 respondent including the use and non-use of air fresheners across Europe. Emission rates are calculated from the product information given in the MSDSs (SC Johnson, 2014; 2016a-e).

AF class	AF Products included	% households using AF class using product [A]	Number of product samples in households using products [A,B]	Product Weight [B]	Weight fraction NMVOCs (g per g) [B]	Product Exhaustion time (hour) [B]	Product use (hours per year) [B]	NMVOC Emission factor (g per year per household)
Combustible	Scented candles	22.6[A]	1.7	96 g	0.025	27	219	4.4
Electric	Active evaporators	22	2.14	38.6 g	0.76	1440	4061	38.9
Passive	Passive evaporator	20	1.62	170	0.01	1440	8760[C]	3.4
Total								46.7

A: EPHECT, 2012
B: Annex I
C: continuous emission (24 hours/day)

As such, an emission factor of 46.7 g NMVOC per household per year is calculated for the consumer use of air fresheners.

6.3 Uncertainty

Substance	Activity data	Emission factors	Emission
NMVOC	E	C	E

6.4 Spatial allocation

The emissions of consumers are allocated in the Netherlands based on population density. Details are available at http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

6.5 References

CBS. http://statline.cbs.nl/statweb/publication/?vw=t&dm=slnl&pa=37975&d1=0-5,10,15,19&d2=0&d3=0,5,10,15,(l-4)-l&hd=151214-1158&hdr=t&stb=g1,g2

Dimitroulopoulou C., Lucica E., Johnson A., Ashmore M.R., Sakellaris I., Stranger M. and Goelen E. 2015a. EPHECT I: European household survey on domestic use of consumer products and development of worst-case scenarios for daily use. Science of the Total Environment 2015, 536, 880-889.

Dimitroulopoulou C., Trantallidi M., Carrer P., Efthimioua G.C., Bartzis J.G. 2015b. EPHECT II: Exposure assessment to household consumer products. Science of the Total Environment 2015, 536, 890-902.

EPHECT (Emissions, exposure patterns and health effects of consumer products in the EU). 2012. Authored by Johnson A. and Lucica E. Survey on Indoor Use and Use Patterns of Consumer Products in EU Member States. Survey report. EPHECT, Ipsos, Paris. https://esites.vito.be/sites/ephect/

SC Johnson. 2014a. Material Safety Data Sheet GLADE® CANDLE APPLE CINNAMON. MSDS Number 350000023244

SC Johnson. 2016a. Material Safety Data Sheet GLADE® CANDLE BLUE ODYSSEY. MSDS Number 350000022876

SC Johnson. 2016b. Material Safety Data Sheet GLADE® CANDLE CASHMERE WOODS. MSDS Number 350000023246

SC Johnson. 2016c. Material Safety Data Sheet GLADE® CANDLE HAWIIAN BREEZE. MSDS Number 350000027860

SC Johnson. 2016d. Material Safety Data Sheet GLADE® CANDLE PURE VANILLA JOY. MSDS Number 350000023248

SC Johnson. 2016e. Material Safety Data Sheet GLADE® 2 IN1 CANDLE SUNNY DAYS® & CLEAN LINEN. MSDS Number 350000023275

Trantallidi, M., Dimitroulopoulou, C., Wolkoff, P., Kephalopoulos, S. and Carrer, P. 2015. EPHECT III: Health risk assessment of exposure to householdconsumer products. Science of the Total Environment. 2015, 536, 903-913

6.6 Version, dates and sources

Version 1.0
Date: January 2018
Contact:

Emission expert	Organization	E-mail adress
J. Meesters	RIVM	joris.meesters@rivm.nl

6.7 Annex I: Emission rates derived from air freshener product information data

Table AI 1. Product information data scented candles

Product Sample	Sample Weight (g)	Exhaustion Time (h)	VOC Fraction (%)
Glade® 2 In 1 Candle - Sunny Days® & Clean Linen® - Jan 2014	96.3	30	1.5
Glade® 2 In 1 Candle - Vanilla Passionfruit & Hawaiian Breeze® - Aug 2013	96.3	20	2.9
Glade® Candle - Apple Cinnamon - Jan 2014	96.3	30	0.6
Glade® Candle - Blooming Peony & Cherry™ - Aug 2014	96.3	28	2.8
Glade® Candle - Blue Odyssey™ - June 2013	96	28	3.4
Glade® Candle - Hawiian Breeze® (Large Jar) - Feb 2015	96.3	20	4.1
Glade® Candle - Pure Vanilla Joy™ - Jan 2014	96.3	30	4
Glade® Candle Cashmere Woods ® - Aug 2013	96.3	30	1
Average*1	96.3	27	2.54

*1 Average calculated from rows above

Table AI 2. Product information data electric air fresheners

Product Sample	Sample Weight (g)	Exhaustion Time (h)	VOC Fraction (%)
Glade Plugins® Scented Oil - Blooming Peony & Cherry™ -	38.1	1440	84.4

Oct 2014			
Glade Plugins® Scented Oil - Clean Linen™ - Dec 2013	38.8	1680	72
Glade Plugins® Scented Oil - Hawaiian Breeze® - July 2014	37.9	1440	69.6
Glade Plugins® Scented Oil - Lavender & Vanilla - Dec 2013	37.4	1440	59.5
Glade Plugins® Scented Oil - Pure Vanilla Joy™ - Mar 2015	40.9	1440	95.2
Average*1	38.6	1440	76.14

*1 Average calculated from rows above

Table AI 3. Product information data passive Air Fresheners

Product Sample	Sample Weight (g)	Exhaustion Time (h)	VOC Fraction (%)
Glade® Solid Air Freshener - Clean Linen™ - Mar 2015	170	1440	1.5
Glade® Solid Air Freshener - Hawaiian Breeze® - Mar 2015	170	1440	0.5
Average*1	170	1440	1

*1 Average calculated from rows above

6.8 Annex II EPHECT Survey data

According to EPHECT the average duration of scented candle being lit per occasion is '85.6 minutes, ranging from 67 minutes in Spain and Italy to just over 120 minutes in Sweden.'

Table A II1. Average use frequency of combustible air fresheners calculated from EPHECT (2012) survey data

Multiple choice answer	% of respondents	Frequency per year	(% of respondents) X (Frequency per year)
At least once a day	19%	365	69.35
Several times a week	31%	104	32.24
Once a week	15%	52	7.8
Once every two weeks	9%	26	2.34
Once a month	9%	12	1.08
Less than once a month	12%	6	0.72
Weighted average (hours per year)			119.5

The average number of hours per day the consumer lights scented candles is then calculated as 85.6 min X 153.4 per year = 219 hours per year.

Table A II2. Average use frequency of electric plug-in air fresheners calculated from EPHECT (2012) survey data**Multiple choice answer**	**% of respondents**	**Frequency per year**	**(% of respondents) X (Frequency per year)**
At least once a day	40%	365	146
Several times a week	26%	208	54.08
Once a week	10%	52	5.2
Once every two weeks	3%	26	0.78
Once a month	7%	12	0.84
Less than once a month	8%	6	0.48
Weighted average (hours per year)			207

Table A II3. Average duration of electric air fresheners plugged in per occasion excluding the population who permanently leave on the device

Multiple choice answer	**% of respondents**	**Hours per plug-in occasion**	**(% of respondents) X (Hours per plug-in occasion)**
Less than 1 hour	21%	0.5	0.105
Between 1 and 6 hours	28%	3.5	0.98
Between 6 and 12 hours	9%	9	0.81
Between 13 and 24 hours	2%	19	0.38
Between 25 and 48 hours	1%	36.5	0.365
Between 2 and 3 days	1%	60	0.6
More than 3 days	1%	72	0.72
Weighted average (hours per year)			3.96

The average use frequency of electric plug-in air fresheners is 207 times per year, whereas the average duration per occasion is 3.96 hours excluding the consumers who permanently plug in the device. The number of hours per year is then 3.96 X 207 = 820 hours. However, the device is permanently plugged in at 37% of the households, so that on weighted average the number of hours for all households in which an electric air freshener is plugged is 820 + 37% X 24 X 365 = 4061 hours

Table AII 4. The use of in-house air fresheners per room

Room	**% of respondents claiming to have at least one electric freshener in the room**
Living/dining room	60%
Bathroom	32%
Bedroom	30%
Hallway	29%
Kitchen	24%
WC	23%
Closet/Storage room	9%
Other room in the house	7%
Average number of air fresheners in house[A]	2.14

A: calculated as the sum of the % of respondents claiming to have at least one electric freshener in the rooms divided by 100%.

7 Adhesive products

This document describes the emissions of substances from the use of adhesives in consumer glue and the use of adhesives in the construction sector.

Process description	EMK Code	Population	NFR category
Adhesives	0802900	Construction sector	2D3i
Adhesives	0802901	Consumers	2D3a

7.1 Description of the emission source

Volatile organic compounds (VOCs) are used as substance ingredients in adhesive products such as glues available on the consumer market or adhesive products used in the construction sector. These VOCs are released to the air during the application of these adhesive products.

7.2 Calculation

The total emissions of VOCs in the years 1990-2000 from adhesive products are estimated by interpolating monitoring data points (Table 1). The contribution of emissions from adhesives in consumer products and the construction sector is quantified according to the data of MilieuMonitor(1997) and KWS (2002). Annual emissions for the period after 2000 are set equal to the estimated emissions for the year 2000. Emissions of individual VOCs from adhesive use in consumer products and the construction sector are calculated as the total VOC emission from adhesives multiplied with the contribution of consumer products or the contribution construction sector (Table 1) multiplied with the weight fraction of the individual VOC in the emission profile (Table 2).

Table 1. VOC emission for adhesives in consumer products and the construction sector

Year	VOC Emission from adhesives (kt)	Contribution adhesives in consumer products (%)*[A]	Contribution adhesives in construction sector(%)*[A]	Data collection VOC emission
1981	3.95	19.6	36.0	Monitoring (CEA, 1994)
1990	3.84	19.6	36.0	Linear interpolation 1981-1991
1991	3.83	19.6	36.0	Monitoring (KWS, 2002)
1992	3.73	19.6	36.0	Linear interpolation 1991-1995

1993	3.62	19.6	36.0	Linear interpolation 1991-1995
1994	3.52	19.6	36.0	Linear interpolation 1991-1995
1995	3.41	19.6	36.0	Monitoring (KWS, 2002)
1996	3.37	18.7	34.0	Linear interpolation 1995-1998
1997	3.33	17.8	32.0	Linear interpolation 1995-1998
1998	3.30	17.0	30.0	Monitoring (KWS, 2002)
1999	3.30	17.0	30.0	Emission 1998
2000	1.58	17.0	30.0	Monitoring (KWS, 2002)

A: The remaining fraction of the total emission refers to emission from industrial sources

Table 2. Profile of individual substance weight fractions of the VOC emission from adhesives in consumer products and in the construction industry

Substance	ER-Nr	Weight fraction of VOC emission from consumer product adhesives	Weight fraction of VOC emission in construction sector adhesives
propane	1031	0.099	0.070
isobutene	1042	0.099	0.070
Mixture C2-C10	1201	0.093	0.089
methyleenchloride	1303	0.036	
trichloro-ethane	1338	0.090	0.133
monohydroxy compounds	1629	0.047	0.051
esters kp <150 C	1653	0.093	0.103
propanon-2	1680	0.047	0.051
butanon-2	1681	0.233	0.256
dimethylether	1721	0.025	0.024
toluene	2502	0.140	0.153

7.3 Uncertainty and Quality

Substances	Activity data	Emission factors	Emission
VOC			D

7.4 Spatial allocation

Spatial allocation of emissions is based on population density.

7.5 References

MilieuMonitor. 1997. Publicatiereeks emissieregistratie/MilieMonitor. Nr. 37b, maart 2003: elektronische actualisatie: van Nr. 37 juli 1997.

KWS. 2002. KWS 2000 Eindrapportage Final Report

7.6 Version, data and sources

Version 1.0
Date: January 2018
Contact:

Emission expert	Organization	E-mail adress
J. Meesters	RIVM	joris.meesters@rivm.nl

8 Anaesthesia (CRF 2.G.3.a)

In this paragraph the emissions of N_2O used as an anaesthesia is described.

Process description	Emk_code	CRF_code	Sector
Anaesthesia	9310100	2.G.3.a	Trade and services

8.1 Description emission source

Nitrous oxide (N_2O), commonly known as laughing gas, is still used sometimes as an anaesthesia. Besides N_2O, other anaesthesia are in use in the Netherlands, most commonly halothane, desflurane, enflurane and sevoflurane. It’s not known how much of those anaesthesia are used and, because of the decomposition of those gases, how much is exhaled again.

Contribution to the national emission
For the greenhouse gases this emission source is not a key source.

The contribution of this source to the total national N_2O emission was <0.5% in 2009.

8.2 Calculation

For the complete time series, the emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of N_2O sold for anaesthesia
Emission factor = N_2O emission from anaesthesia

This is a tier 1 methodology. The methodology is consistent with the IPCC 2006 Guidelines.

a) Activity data
The amount of nitrous oxide sold in the Netherlands would be the best measure for the activity data. Therefore, since 2011, all companies known to sell nitrous oxide as anaesthesia to the Dutch market are asked annually for their sales to the Dutch market. Those sales combined result in the total amount of nitrous oxide used as anaesthesia in the Netherlands.
In the years before reporting year 2010, an estimate was made based on the sales of the biggest seller. In years in which not all companies report their sales, the total is estimated based on the sales of the other companies. This is based on the estimated market share of the biggest company, selling nitrous oxide as anaesthesia.
If nitrous oxide is sold as a mixture with oxygen, only the nitrous oxide is calculated as sales.

b) Emission factor
The emission factor for nitrous oxide is 1kg per kg nitrous oxide sold in the Netherlands. All nitrous oxide sold in a certain year is considered to be emitted after use in the same year.
This emission factor is consistent with the 2006 IPCC guidelines.

8.3 Uncertainty and Quality checks

In case all companies report their sales, the uncertainty in the activity data is caused by stock changes at the consumer side (mainly hospitals). Those differences are considered negligible.
If, on the other hand, not all companies provide their sales, the uncertainty can be as much as 25%. The uncertainty in emission factor is 0%, because all N_2O will be exhaled over time. Both the uncertainty in activity data and in emission factor are based on expert judgement.

Quality codes

Substance	Activity data	Emission factor	Emission
N_2O	B	A	B

Quality checks
There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

8.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on the number of beds per hospital.

Emission source/process	Allocation-parameter
Anaesthesia	Number of beds per hospital

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

8.5 References

Written (or in early years oral) data on sales from companies selling anaesthesia.

8.6 Version, dates and sources

Version: 1.2
Date: May 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

9 Burning of Candles (CRF 2.D.2)

In this paragraph the emissions as a result of the burning of candles are described.

Process description	Emk_code	CRF_code	NFR_code	Sector
Burning of candles	0801000	2D2	2D3i	CON

9.1 Description emission source

Within households and in some catering industries, candles are burned to create a more cosy atmosphere. The burning of candles causes the emission of several substances, for example particulate matter and PAHs.

Contribution to the national emission
For the greenhouse gases this emission source is not a key source.

The contribution of this source to the national emissions of benzo(ghi)pyrene is <10%. For benzo(a)pyrene the contribution is about 1%.

9.2 Calculation

For the complete time series, the emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of candles burned in kg
Emission factor = Emission per kg candle

This is a tier 1 methodology. The methodology is consistent with the IPCC 2006 Guidelines.

a) Activity data
The activity data consist of two parts, national statistics on the number of inhabitants of the Netherlands (Dutch bureau for statistics) and the amount of candles burned per person in the Netherlands.
The amount of candles burned per person is retrieved from a company selling candles in the Netherlands. Up until 2009 the amount of candles burned per inhabitant is retrieved from www.bolsius.nl. From 2010 it is based on expert judgement by representative from a company selling candles.

b) Emission factor
The emission factors for burning candles are dependent on the type of candle burned. Both tea lights as regular (gothic) candles are taken into account, both estimated at 50% usage. Less used candle types, e.g. beeswax candles, are not considered to be relevant for this calculation. The CO_2 emission factor, given in g/MJ candle, is multiplied with a heating value of 42,7 MJ/kg. Both the CO_2 emission factor and the heating value for candles are derived from the Dutch fuel list 2018 (Zijlema, 2018).

All other emission factors are mainly calculated based on EPA 2001.

Substance	EF	Unit
Benzo(ghi)pyrene	0.278	mg/kg candle
Benzo(a)pyrene	0.150	mg/kg candle
VOC	928	mg/kg candle
CO_2	73.3	g/MJ candle
PM_{10}	0.872	mg/kg candle
$PM_{2.5}$	0.872	mg/kg candle
Pb	1.56	mg/kg candle
Zn	0.127	mg/kg candle

9.3 Uncertainty and Quality checks

The uncertainty of both the activity data and for the emission factor of CO_2 are determined in the report on uncertainties in greenhouse gas emissions Olivier 2009. The uncertainty in activity data is estimated to be 100%. The uncertainty in the emission factor for CO_2 is estimated at 20%.

For the other substances (not greenhouse gases), the uncertainty was not determined. Instead, the reliability of the data is qualitatively indicated in the table below with codes A-E (see Appendix A).
The number of inhabitants in the Netherlands is accurately known, but the amount of candle burned per inhabitant is a rough estimate based on one manufacturer. Therefore the activity data is not very sure, rated with a D.
The emission factors are retrieved by combining different sources, improving the reliability. However, since these sources did not taken different candle types into account, the emission factors are rated with a C.

Quality codes

Substance	Activity data	Emission factor	Emission
Benzo(ghi)pyrene	D	C	D
Benzo(a)pyrene	D	C	D
VOC	D	C	D
CO_2	D	C	D
PM_{10}	D	C	D
$PM_{2.5}$	D	C	D
Pb	D	C	D
Zn	D	C	D

Quality checks

There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

9.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on the population density, following the assumption that most candles are burned in residential areas/households.

Emission source/process	Allocation-parameter
Burning of candles	Population density

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

9.5 References

EPA; January 2001, Candles and incense as potential sources of indoor air pollution: Market analysis and Literature review; EPA-600/R-01-001.

Fine M. Philip, Glen R. Cass, Bernd R.T. Simoneit; Characterization of fine particle emissions from burning church candles; Environmental Science & Technology vol. 33, NO. 14, 1999.

Gruijter H.J. de, A.J.G. van Rossum; De Kaars; Lesbrief KNCV/NVON; first edition1983.

Vebeka BV; Information on sizes and burning times:, http://vebeka.nl.

Dutch Bureau of Statistics, Statline, annual data on the number of inhabitants

Information on the amount of candles burned, http://bolsius.nl.

Te Molder, R. Metadata gegevensbeheer emissieregistratie: beschrijving gegevens t.b.v ruimtelijke verdeling van emissies, PBL, Bilthoven, jaarlijks, intern document.

Zijlema, P.J., 2018; Nederlandse lijst van energiedragers en standaard CO2 emissiefactoren.

Olivier, J.G.J., Brandes, L.J. and te Molder, R.A.B., 2009, Uncertainty in the Netherlands' greenhouse gas emissions inventory, PBL publication 500080013

9.6 Version, dates and sources

Version: 1.3
Date: May 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I.Jansen	TNO	bart.jansen@tno.nl

10 Car Products

This paragraph describes the NMVOC emission from car products.

Process description	Emkcode	NFR code	Sector
Car products	0802300	2D3a	Consumers
Car products	0802301	2D3i	Trade and services

10.1 Description of emission source

NMVOC emission is anticipated from the use of car products to maintain and clean company and private cars. Windscreen fluid is considered to contribute 70% of the NMVOC emission (ER, 2017), whereas other car products such as car wax, plastic cleaners, and cockpit sprays together comprises 30% of the emission. As such there are four different sources of emission defined:

Windscreen fluid used on private cars
Windscreen fluid used on company cars
Other car products used on private cars
Other car products used on company cars

10.2 Calculation

Emissions from the use of windscreen fluids are calculated as follows:

Emission = Activity data x Emission Factor

Windscreen fluids

Activity data = total number of kilometres driven by automobiles in The Netherlands
Emission factor = kg NMVOC emission per driven kilometre in The Netherlands

a) Activity data
The data describing the number of driven kilometres by automobiles in the Netherlands is collected from the website of the Dutch Central Bureau for Statistics (CBS, 2017).

b) Emission factor
Data describing the market volumes of methanol, ethanol, and isopropanol as main ingredients in car windshield fluids in Finland for the years 2002-2014 (Table 1) became publically available in 2015 (ECHA 2015a,b,c). The market volumes of these substances in windscreen fluids sold in The Netherlands are estimated from the Finnish market volumes by correcting for the number of kilometres driven in The Netherlands and Finland as well as the number of frost days in The Netherlands and Finland. Finland is a country with a colder climate compared to The Netherlands, so that relatively more windshield fluid is

used in Finland for the purpose of de-icing. According to the USEPA, the use of windshield fluids at local temperatures above 0°C is about equal to 23% of windshield use at to local temperatures below 0°C (USEPA, 1996; 2012). Finland counts about 233 days of frost per year (Plantmaps.com), whereas the Netherlands only counts 38 days of frost per year (KNMI, 2017). As such a correction factor for the difference in climate in Finland and The Netherlands is calculated as:

$$correction_{climate} = \frac{frost\ days_{Netherlands} + non\ frost\ days_{Netherlands} \times 0.23}{frost\ days_{Finland} + non\ frost\ days_{Finland} \times 0.23} = \frac{38+327\times0.23}{233+132\times0.23} = 0.43$$

Next, the emissions of methanol, ethanol and isopropanol used in windscreen fluids per driven kilometre in the Netherlands are estimated as:

$$\frac{emission_{Netherlands}}{kilometers_{Netherlands}} = \frac{market\ volume_{Finland}}{kilometers_{Finland}} \times correction_{climate}$$

Table 1 includes the market volumes of methanol, ethanol and isopropanol in windscreen fluid in Finland (ECHA, 2015b), the number of kilometres driven by automobiles in Finland (Liikenneviraston Tilastoja, 2017) and the estimated emission per driven kilometre in The Netherlands (g/km).

	Kilometers driven in Finland (million km /y)	**Finnish market volumes (t/y)**			**Estimated emission per kilometer in The Netherlands (g/km)**		
Year		Methanol	Ethanol	Isopropanol	Methanol	Ethanol	Isopropanol
2002	31271	1326	3474	4323	0.02	0.05	0.06
2003	32211	1565	4061	4106	0.02	0.05	0.05
2004	33004	904	5606	3043	0.01	0.07	0.04
2005	33854	1334	4743	1995	0.02	0.06	0.03
2006	34473	1745	5061	2811	0.02	0.06	0.04
2007	34780	1358	5095	2617	0.02	0.06	0.03
2008	35661	1127	5952	1927	0.01	0.07	0.02
2009	35557	1246	6594	2892	0.02	0.08	0.03
2010	35868	1748	6353	1187	0.02	0.08	0.01
2011	36234	2559	7707	1746	0.03	0.09	0.02
2012	36740	935	4382	702	0.01	0.05	0.01
2013	36607	1819	6465	920	0.02	0.08	0.01
2014	36567	1422	4621	73	0.02	0.05	0.00
Average	34833	1468	5393	2180	0.018	0.066	0.028

The proportion of emissions from car products is assigned to originate by 60% from consumers and 40% by trades and services (ER, 2017).

The emission factors for consumers and trades and services are calculated by multiplying the average estimated emission per kilometre in The Netherlands (g/km) over the period of 2002-2014 (Table 1) with these proportions (Table 2).

NMVOC in windscreen fluid	Emission factor consumers (g/km)	Emission factor trades and services(g/km)
Methanol	0.011	0.07
Ethanol	0.040	0.027
Isopropanol	0.017	0.011

Other car products

Activity data = amount of NMVOC in car products other than windscreen fluid sold in the Netherlands
Emission factor = emission per kg NMVOC in car products

a) Activity data
In 1997 bureau CREM conducted a research using car product monitoring data over the years 1994 and 1996 (CREM, 1997). The monitoring data originated from questionnaires filled in producers and suppliers of car products. In 1998 a recall survey by telephone was conducted in which the data for 1997 was established. The recall contained the information of 26 companies (18 companies conducted in the 1997 survey and 8 new companies). It’s estimated that these 26 companies cover 80% of the marked.
The companies provided sales data of car products and the average amount of NMVOC theses products contained. This information is used to determine the NMVOC emissions from car products.
The monitoring data from 1997 (CREM 1998) is still used for calculation of the NMVOC. The data from CREM (1998) is the most recent information available that refers to car products other than windscreen fluid.

b) Emission factor
NMVOC totals are recalculated to individual substances by using an average car product profile. The profiles were established for car products by TNO (1992) in cooperation with the car products branch.

Substance in car product profile	factor
Propane	0.12
Isobutane	0.12
Monohydroxyverbindingen	0.54
Dimethyl ether	0.03
Hydrocarbon. mixture. c2-c10 <25% aromatic.	0.18

These totals include the emission from windscreen fluids. Windscreen fluid is considered to contribute 70% of the NMVOC emission (ER, 2017). Therefore, the NMVOC totals have been multiplied with 30% to correct, so that only emissions from the use of car products other than windscreen are estimated. Furthermore, the emissions from other car products are split up into the target groups consumers (≈ 60%) and trade and services (mostly garages ≈ 40%).

10.3 Uncertainty

The uncertainty in the activity data for windscreen fluids is considered low, since the amount of kilometres driven in the Netherlands is well known, therefore it's qualified with an B. The translation of the emission factors from Finland to the Dutch situation is a bit more uncertain, therefore qualified with a D.
Both the emission factor and the activity data for the other car products are outdated, therefore the uncertainty is considered high and qualified with an E.
Since the NMVOC from windscreen products is about 70% of the emissions, the overall quality of the activity data is estimated with a D. The quality of the emission factors is qualified with a D.

10.4 Spatial allocation

The emissions of consumers and trade and services are allocated in the Netherlands based on population density. Details are available at http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

10.5 References

CBS, (1998 en latere jaren) Statistiek Motorvoertuigen, CBS, Heerlen.

CBS) Dutch Central Bureau for Statistics. 2017. http://statline.cbs.nl/Statweb/publication/?DM=SLNL&PA=80302ned&D1=a&D2=a&D3=6,19,l&HDR=T&STB=G1,G2&VW=T consulted October 3rd 2017

Chemiewinkel UvA,1999, Herziening Milieukeur Autoreinigingsmiddelen, Conceptrapportage, augustus 1999, Amsterdam.

CREM, 1997, NMVOS-emissies auto-onderhoudsproducten, CREM, Amsterdam (niet openbaar).

CREM, december1998, VOS-emissies auto-onderhoudsproducten, herhaalmeting 1997, CREM,
Amsterdam (niet openbaar).

(ECHA) European Chemicals Agency. 2015a. Annex XV restriction report proposal for a restriction
substance name: methanol.

(ECHA) European Chemicals Agency. 2015b Comments and response to comments on Annex XV restriction dossier submitted by Poland on 16/01/2015 public consultation on Annex XV report started on 18/03/2015.

(ECHA) European Chemicals Agency. 2015c. Committee for Risk Assessment (RAC) Committee for Socio-economic Analysis (SEAC) Opinion on an Annex XV dossier proposing restrictions on Methanol ECHA/RAC/RES-O-0000006324-78-01/F ; ECHA/SEAC/ RES-O-0000001412-86-100/F

(ECHA) European Chemicals Agency. 2017 https://echa.europa.eu/previous-consultations-on-restriction-proposals/-/substance-rev/7202/term consulted October 3rd 2017

ER, 2009. Netherlands Emission Registry. Data on 2009 available from www.emissieregistratie.nl

(ER) Emission Registration. 2017. Methods used for the Dutch Emission Inventory
Product usage by consumers, construction and services 2017

KWS2000/InfoMil, 1998, Jaarverslag 1996-1997, InfoMil, Den Haag.
Liikenneviraston Tilastoja. 2017 Tietilasto 2016 Vägstatistik Finnish Road Statistics. 4/2017

10.6 Version, dates and sources

Version: 2.0
Date: January 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

Note: Since 1999 no new data is available on emission variables and emission factors of car products other than windscreen fluids. Therefore, the respective used data for might be outdated.

11 Carbolineum treated wood

Process description	EMK Code	Target group	NFR
Carbolineum treated wood	0802500	Consumers	2D3i
Carbolineum treated wood	0802501	Agriculture	2D3i
Carbolineum use	0802600	Consumers	2D3i
Carbolineum use	0802601	Agriculture	2D3i

Carbolineum is a pesticide that is brushed on wooden surfaces in order to prevent woodworm and moulds from affecting wooden constructions in housings, gardens and agriculture. The use of carbolineum has been for treatment of wood that is in contact with groundwater has been prohibited since and 1999 and as a consumer product since 2001 (KWS, 2002).

11.1 Description of the emission source

Emissions from carbolineum is released via two processes:
- Emissions from wood that has been treated with carbolineum in the past. Carbolineum contains VOCs and PAHs that evaporate to outdoor air or leach to soil from the surfaces of the treated wood.
- Emissions during the treatment of wood with carbolineum (VOC).

11.2 Calculation

The emissions of VOCs and PAHs from carbolineum treated wood are calculated by multiplying activity rates (AR) with respective emission factors (EF).

Emission = AR X EF

a) Activity data

There are four different activity rates considered:
- the area of carbolineum treated wood (treated in the past) for consumer use (m^2)
- the area of carbolineum treated wood (treated in the past) for agricultural purposes (m^2)
- the volume of carbolineum used by consumers during treatment ($t.y^{-1}$)
- the volume of carbolineum for agricultural purposes during treatment ($t.y^{-1}$).

It is assumed that 25% of the total volume of carbolineum used is for agricultural purpose and 75% for consumer use. It is also assumed that 25% of the total area of treated wood is for agricultural purposes and 75% for consumer. The total volumes of carbolineum used as well as the total surfaces area of carbolineum treated wood before 2001 are taken from Infomil (KWS, 2002). The use of carbolineum is prohibited since 2001, so that there is no use activity and no emissions expected ever since from treatment with carbolineum. The surface area of the carbolineum treated wood standing from earlier years is assumed to be removed each year with 20%, which implies that 5 years after prohibition of the carbolineum, there is no carbolineum treated wood standing and no emissions occur from this emission source anymore.

b) Emission factors
The emission factors for PAHs and VOCs released to outdoor during treatment as well as evaporation and leaching from the surface of treated wood is summarized in Table 1. The emission factors apply both to consumer use and agricultural use.

Table 1 Emission factors for carbolineum use and carbolineum treated wood.

Substance	**kg emission per million kg carbinoleum used**	**kg emission per million m^2 treated wood**
Naphthalene	0.02	0.0001
Anthracene	0.0005	0.00006
Fenanthene	0.015	0.0011
Fluoranthene	0.002	0.00049
Benzo(a)-anthracene	0.00027	0.000055
Chrysene	0.000026	0.00001
Benz(k)-Fluoranthene	2.9E-07	1.1E-07
Benzo(a)-pyrene	1.4E-06	5.70E-07
Benz(ghi)-Perylene	3.1E-07	1.20E-07
Pyrene	3.1E-07	1.2E-07
NMVOC	0.25	-

11.3 Uncertainty

Source	**Activity data**	**Emission factors**	**Emission**
Carbinoleum use	D	C	D
Carbinoleum treated wood	D	C	D

11.4 Spatial allocation

Spatial allocation of emissions is based on population density.

11.5 References

KWS 2000 eindrapportage, Infomil, Den Haag 52

11.6 Version, date, sources

Version: 1.0
Date: March, 2018
Task group leader:

Task group leader	Organization	E-mail adress
J. Meesters	RIVM	joris.meesters@rivm.nl

12 CFCs from refrigerators and freezers

In this paragraph the emissions of chlorofluorocarbons (CFCs) as a result of the leakages in the refrigerant system and the processing of discarded refrigerators and freezers are described.

Process description	Emk_code	NFR_code	Sector
Discarding refrigerators and freezers	0890200	5E	Consumers

12.1 Description emission source

Since 1995, the production and sale of refrigerators and freezers (R/F) using chlorofluorocarbons as refrigerant is prohibited in the European Union. However, given an average lifetime of at least 15 years, R/F equipment that uses CFCs is still in use and significant numbers are discarded annually. In the Netherlands, discarded R/F equipment is collected and processed by specialized companies which remove and destroy the CFCs still present in the equipment. Still, in some cases the CFCs have leaked to the environment before the equipment is discarded and processed. This emission source represents these leakage emissions of CFCs and possible processing inefficiencies which lead to the emission of CFCs to the environment.

Before the year 2000, a share of the discarded R/F units were exported to Eastern Europe and Africa. However, from 1999, the export of old R/F equipment has been prohibited.

Contribution to the national total emission
For trichloorfluormethane (CFC-12) the contribution of the discarded refrigerators and freezers is <25%.

12.2 Calculation

Emissions are calculated as follows:
Emission = Activity data x Emission factor

Activity data = Number of refrigerators and freezers that use CFCs as refrigerant that are discarded annually and are not exported abroad.
Emission factor = CFC emission per unit of CFC R/F equipment

a) Activity data
To estimate the number of CFC R/F equipment that is discarded annually from 1990 to 2030, a combination of multiple data is needed. First, the number of R/F units put on the market between 1960 and 1994 in the Netherlands is extracted from CBS data. These R/Fs are assumed to all use CFC-12 as refrigerant. The average amount of CFC refrigerant present per unit is estimated at 165 grams (Brouwer & Hulskotte, 1995).

To estimate the number of CFC R/F units that are discarded annually, the Weibull distribution is used. Based on data from CBS, the average lifetime of a refrigerator is estimated at 16.4 years and of a freezer at 18.6 years. Furthermore, the shape of the Weibull function is 2.2 for refrigerators and 1.3 for freezers (Magalini et al., 2014).

These steps result in an annual number of discarded CFC R/F units from 1990 to 2030. However, since from 1990 to 1999 a share of the discarded units were exported (and therefore did not cause emissions in the Netherlands). From 1990 to 1998 the share of discarded units was assumed to be 20%, in 1999 the share was assumed to be 10%. This ratio is applied to the number of discarded CFC R/F units from 1990 to 1999 to estimate the number of CFC R/F units that were annually processed in the Netherlands. From 2000 onwards, the number of discarded CFC R/F units is assumed to be equal to the number of CFC R/F units that is processed.

b) Emission factor
The emission factor is estimated by subtracting the average amount of CFC refrigerant that is recovered from processed R/F units, from the average amount of CFC refrigerant that was used in CFC R/F units (Brouwer & Hulskotte, 1994).
165 gram – 60 gram = 105 gram/unit.

This calculation was verified by dividing the amount of recovered CFCs by the number of units processed according to CFK aktieprogramma (1994) and subtracting this from the present amount of CFCs, which resulted in an emission factor of 103 grams/unit. Furthermore, the Flanders Environment Agency (MIRA, 2010) reports an average CFC recovery percentage of 33%, which results in an EF of 101 grams per unit.

Substance	EF	Unit
CFC-12	0.105	kg/RF unit

12.3 Uncertainty

The uncertainty of both the activity data and the emission factors are not determined.
Only rough estimates are available of the number of CFC R/F units present, discarded or exported in the Netherlands. Therefore the activity data has a significant level of uncertainty, rated D.
The emission factor is verified by combining different sources, improving the reliability. It is therefore rated C.

Quality codes

Substance	Activity data	Emission factor	Emission
CFC-12	D	C	D

12.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on the population density.

Emission source/process	Allocation-parameter
Discarding refrigerators and freezers	Population density

Details available from:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

12.5 References

Brouwer, J.G.H & Hulskotte, J.H.J. (1995). Verwerking afgedankte koelapparatuur. RIVM rapprtnr. 772414004

Magalini, F., F. Wang, J. Huisman, R. Kuehr, C.P. Baldé, V. v. Straalen, M. Hestin, L. Lecerf, U. Sayman and O. Akpulat (2014). Study on collection rates of waste electrical and electronic equipment (WEEE). Preliminary version, subject to final verification

CFK aktieprogramma (1994). Jaarrapportage 1993. Kenmerk CFK.CIE.94A558

MIRA (2010). Achtergronddocument 2010 Aantasting van de ozonlaag.

12.6 Version, dates and sources

Version: 1.0
Date: June 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

13 Cleaning Products

This document describes the emission from the use of cleaning products.

Table 1.

Process description	EMK Code	Target group	NFR category
Solvent and other product use: detergents	0803000	Consumers	2D3a
Solvent and other product use: detergents	0803001	Trades and services	2D3i

13.1 Description of the emission source

VOCs are applied in cleaning products because of their fat dissolving capacities. The largest fraction of these VOCs is being released to the air during or after the use of the cleaning products. The emissions described here are related to consumer uses, institutional users and cleaning companies. Industrial cleaning products are considered by the task group ENINA.

Methylated spirit, spot removers, glass cleaner, hand cleaner, carpet cleaner and petrol are relevant product groups. A fraction of the methylated spirit (26%) is used as fuel, e.g. for barbecues and fondue sets. It is assumed that the VOCs used in fuels are completely combusted and thus not released. Medical hand disinfectants are incorporated in the emission of VOCs from cleaning products.
Ammonium is classified as cleaning product as well. The ammonia that is solved in the ammonium can be released to the air during the use of the product.
Turpentine is another cleaning product that is considered. The emissions from this product is however already included in the emission estimations from the use of paint products.

13.2 Calculation

The VOC emissions from the use of cleaning products by consumer s (Table 1)and in trades and services (Table 2) are estimated by combing different data sources used: (a) the monitoring data collected for the period 1990-1995 (Motivaction, 1996), (b) estimated emission volumes calculated by multiplying an emission factor with activity data for the period 1997-1999 (InfoMil, 2002) and 2000-2003 (NVZ, 2004; Nielsen, 2001).

Table 1. Monitored and calculated VOC emission from consumer use of cleaning products(Motivaction 1996; InfoMil 2004; NVZ, 2004)

	VOC emission per cleaning product (t/y)								**Refer ence**
Y	**Meth**	**Spot**	**Windo**	**Hand**	**Air**	**Car**	**Was**	**Tot**	

ear	ylated spirit	remover	w cleaner	disinfectant	freshener	pet cleaner	hing petrol	al	
1990	1226	6	39	5	473	63	762	2574	Motivaction, 1996
1991	1226	6	39	5	473	63	762	2574	
1992	1226	6	39	5	473	63	762	2574	
1993	1206	6	70	5	623	8	742	2660	
1994	1206	6	70	5	623	8	742	2660	
1995	1388	1	94	8	630	4	762	2887	
1996	-	-	-	-	-	-	762	2636	InfoMil, 2002
1997	-	-	-	-	-	-	762	2658	
1998	-	-	-	-	-	-	325	2211	
1999	-	-	-	-	-	-	325*A	2214	
2000	1177	200	185	58	662	16	325	2235	NVZ 2004; Nielsen
2001	968	192	89	56	645	15	325	2290	
2002	768	210	105	48	1699	12	325	3167	
2003	750	251	181	38	1654	27	325	3226	

*A Emission from washing petrol is assumed to be equal to that of 1995

Table 2. Monitored and calculated VOC emission from the use of cleaning products in trades and services (Motivaction 1996; InfoMil 2004; NVZ, 2004)

	VOC emission per cleaning product (t/y)							Reference
Year	Methylated spirit	Window cleaner	Hand disinfectant	Air freshener	Carpet cleaner	Washing petrol	Total	
1990	0	156	1476	5	117	369	2123	Motivaction, 1996
1991	0	156	1476	5	117	369	2123	
1992	0	156	1476	5	117	369	2123	
1993	0	344	1508	6	103	379	2340	
1994	0	344	1508	6	103	379	2340	
1995	0	178	1829	15	36	369	2427	
1996	-	-	-	-	-	3889	2636	InfoMil, 2002
1997	-	-	-	-	-	3911	2658	
1998	-	-	-	-	-	3464	2211	
1999	-	-	-	-	-	3523	2270	
2000	198	1934	32	46	325	2536	198	NVZ 2004; Nielsen
2001	184	1714	27	32	325	2283	184	
2002	172	1684	173	16	325	2370	172	
2003	159	1701	212	19	325	2416	159	

*A Emission from washing petrol is assumed to be equal to that of 1995

The research of Motivaction alsoincluded the derivation of emission factors of water solved VOCs in methylated spirit and hand disinfectants. It was calculated that 38% of the VOCs in methylated spirit is released to the air and that the fraction of VOCs in hand disinfectant that is released to the air is 50%. For the other products considered it is assumed that 100% of the VOCs is released to the air. The emissions after the year 1995 are calculated by multiplying these emission factors with the averages amounts of the cleaning products used per household (NVZ, 2001) and the number of households (CBS).
Annual surveys were conducted by the NVZ (Nederlandse Vereniging van Zeepfabrikanten) amongst its members in the period of 1996-2000.

The emission of individual substance was determined by multiplying the total VOC emission volumes with an emission profile. This emission profile that designates the fractions of individual substances in the total emission of VOCs was derived by TNO in cooperation with NVZ.

Washing petrol is however a complicated issue within the product class of cleaning products, because it is sold in several market streams, e.g. do-it-yourself product markets, so that the coverage of the Motivaction monitoring data from 1996 is low. Consequentially, the emission of VOCs from washing petrol is surrounded by a large range of uncertainty. The annual emissions from washing petrol were estimated by InfoMil to be 1.5 kton for the period of 1990-1997, whereas. the research performed in 1999 by AC Nielsen in commissioned by InfoMil indicates 0.65 kton. This number derived for the years 1998-2003.

The emission of the individual substances are calculated by multiplying the emission volumes given above with a emission profile expressing the weight fraction of the substance per ton emission of VOCs (Table 3)

Table 3. Profile of VOC emissions from cleaning products

VOC Substance	Weight fraction of VOC emission from cleaning products (g/g)
Propane	0.02284
Isobutane	0.02284
Methylene	0.005726
Trichlor-ethane	0.004466
Monohydroxy-components	0.700948
Butanone2	0.009348
Dimethylether	0.009559

Ammonia is also considered to be a cleaning product. It is assumed that each household use 1 liter of ammonia per year, so that the estimated emission is 1kton for the year 1990 (RIVM, 1994). The years after 1990 are corrected based on the number of households according to the CBS housing growth index.

The VOC emissions estimated for the years later than 2003 are all set equal to emissions estimated for that year.

13.3 Uncertainty and Quality

Substance	Activity data	Emission factors	Emission
VOCs	D	D	D
Ammonia		D	D

13.4 Spatial allocation

Spatial allocation of emissions is based on population density.

13.5 References

CBS.
http://statline.cbs.nl/statweb/publication/?vw=t&dm=slnl&pa=37975&d

1=0-5,10,15,19&d2=0&d3=0,5,10,15,(l-4)-l&hd=151214-1158&hdr=t&stb=g1,g2

Infomil, 2002. KWS 2000 eindrapportage, Infomil, Den Haag 52

Motivaction. 1996. Emissies van VOS door het gebruik van reinigingsmiddelen -Nulmetingsonderzoek i.o.v het Ministerie van VROM

NVZ (Nederlandse Vereniging van Zeepfabrikanten). 2004. Personal Communication

RIVM. 1994. Berekeningsmethodiek ammoniakemissie in Nederland voor de jaren 1990, 1991 en 1992, RIVM rapport nr 773004003.

13.6 Version, data, sources

Version 1.0
Date: January 2018
Contact:

Emission expert	Organization	E-mail adress
J. Meesters	RIVM	joris.meesters@rivm.nl

14 Construction sites

This document describes the emissions of particulate matter from construction sites.

Process description	EMK code	NFR code	Sector
Building and construction sites	0802302	2H3	Trades and services

14.1 Description of emission sources

Particulate matter < 10 µm (PM10) and < 2.5 µm (PM 2.5) is released as fine dust as a consequence of different work activities at construction sites, such as milling, drilling, grinding, chopping, sawing, and blistering of rocks, bricks or concrete as well as dust suspension from ground movement and heavy transport of debris and construction works.

14.2 Calculation

Emissions are calculated as follows:

Emission = Activity data X Emission Factor

Activity data = index number production revenues of the Dutch construction sector (1997=100)
Emission factor PM 10 = Reported emission of 10,620 kg per index point
Emission factor PM2.5 = 3540 kg per index point

a) Activity data
The activity data refers to the production revenues of the Dutch construction with the year 1997 as baseline with 100 index point. Index numbers for the years 1990-1999 are derived from CBS data that is alas no longer available. The index numbers for the years 2000-2009 are derived from the prognostic reports of TNO (TNO, Bouw en Ondergrond 2005;2007;2008-2009) and the Dutch Ministry of Housing Spatial Planning and Environment (VROM, 2001; 2002), whereas the index numbers for the years 2010-2017 are taken from the website of CBS (CBS, 2018). All index numbers are based on the production revenues of the Dutch construction sector expressed in valuta (fl or €) corrected for economic de- and inflation.

b) Emission factor PM10
The emission factor for PM10 is calculated by dividing the estimated emission of 1062 t PM10 in the year 1997 (Haskoning, 2000) divided by the index number of 100. The 1062 t emission per year is calculated as the sum of the monitored PM10 emissions from (i) ground, water and road, (ii) civil and utility, (iii) demolition, and (iv) finish construction sites (Haskoning, 2000). As such, the emission factor for PM10 is 1062 t divided by 100 index point is 10,620 kg per index point.

c) Emission factor PM2.5
It is assumed that 1/3 of the weight of PM10 comprises PM2.5. As such, the emission factor of PM2.5 is equal to the emission factor of PM10 multiplied with 1/3: 3540 kg per index point.

14.3 Uncertainty

Substance	Activity data	Emission factors	Emission
PM10, PM2.5	C	D	D

14.4 Spatial allocation

Spatial allocation is based on population density.

14.5 References

CBS. 2018.
http://statline.cbs.nl/StatWeb/publication/default.aspx?DM=SLNL&PA=81808ned

Haskoning. 2000. Diffuse emissies van fijn stof door (semi-)industriële activiteiten.
Ministry of VROM, The Hague

TNO, Bouw en Ondergrond. 2005. Bouwprognoses 2005-2010.Rapport I&R. 2005-23

TNO, Bouw en Ondergrond. 2007. Bouwprognoses 2006-2011.TNO rapport 2007-D-R0975-A

TNO, Bouw en Ondergrond. 2008. Bouwprognoses 2007-2012.TNO rapport 2007-D-R0158/A

TNO, Bouw en Ondergrond. 2009. Bouwprognoses 2009-2014.TNO rapport 034-DTM-2009-04560

VROM. 2001. Bouwprognoses 2002-2007.

VROM, 2002. Bouwprognoses 2003-2008.

14.6 Versions, dates and sources

Version :1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	Email address
Joris Meesters	RIVM	Joris.meesters@rivm.nl

15 Cosmetics for personal care

This paragraph describes the emissions of NMVOC resulting from cosmetics and personal care products. The paragraph does not describe the emission of NMVOC.

Process description	Emk_code	NFR_code	Target group
Cosmetics for personal care	0801100	2D3a	Consumers
Cosmetics for personal care	0801101	2D3i	Trade and services

15.1 Description emission source

Cosmetics products for personal care contain NMVOC which emit to the air during and after use. Here, we are dealing with products used by consumers and hairdressing salon, barbershops and beauty parlours. The cosmetics for personal consist of a very wide range of products: hairsprays, deodorants, eau de toilette/perfumes, nail polish/remover, aftershave and miscellaneous. In 2012 the emission were ascribe to consumers for 96% and to trades and services for 4%. The distribution consumers and trades/services shifted from 90 versus 10 in 2004 to 96 versus 4 in 2012 and is based on a communication of the NCV (Dutch Cosmetics Association; 2004 2012).
In 2004 hairspray was with ~65% the main NMVOC contributor of the cosmetics group, followed by deodorants ~29%. However in 2012 the two main contributors switched places. Now deodorants contribute with ~54% (6.41 kton) and hairstyling products with ~35% (4.14 kton).
According to the NCV there are no major changes of NMVOC concentration in products since 1996. Only within the group deodorant there is an increase of the use of NMVOC rich deodorant sprays. The increase of NMVOC emission is ascribed to the increased use of hairspray (flexible hairspray) and deodorant spray (roller sticks replaced by aerosol cans). Ultimately this leads to an increase of NMVOC from cosmetics.

Contribution to the national emission
The contribution of NMVOC by cosmetics for personal care is ~33.6% of consumers NMVOC total and 4.6% of trades and services NMVOC total (ER 2011). The contribution of cosmetics to the Dutch total NMVOC emission is ~7.7% (ER 2011).

15.2 Calculation

The calculation of NMVOC emission cosmetics and personal care products is based on market shares surveillance of these products, annually published by the NCV. In the past the NCV themselves estimated the emission of NMVOC for the years 1997, 2002 and 2003 (NCV 1998, 2003 and 2004). Since 2004 the market shares corrected with the annual Dutch central price index were used to estimate the emission.

In 2013 the NVC, on request of the ER, again estimated NMVOC emissions from cosmetics and personal care products for both consumers and trades and services (NVC 2013). Based on this latest NVC estimation it's concluded that the annual published NVC report contains sufficient information to estimate the NMVOC emission. The ER estimated 11.5 kton for consumers while NVC estimated 11.7 kton. The 11.7 kton in 2012 will be used to index the emissions for the next 5 years. The members of the NCV represent the bulk of the market shares in the Netherlands. The NMVOC total is in its turn split up into the individual substances, using an average profile, established by TNO and the Dutch Cosmetics Association in 1992.

15.3 Uncertainty

The uncertainties of the emission calculation are not quantified.

Quality codes

Substance	Activity data	Emission factors	Emission
NMVOC	B	C	C

15.4 Spatial allocation

The emissions of consumers and trade and services are allocated in the Netherlands based on population density. Details are available at http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

15.5 References

Annual reports NCV., www.NCV-cosmetica.nl

VOC emission cosmetics. Personal communication W.a. Pfeifer. Director Dutch Cosmetics Association (NCV) 2004.

CBS statline: www.statline.cbs.nl

VOC emission cosmetics. Personal communication Dr. ir. R.T.H. van Welie technical director Dutch Cosmetics Association (NCV) 2013.

15.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

16 Crematorium

This paragraph describes the emissions of dioxin, mercury and PM_{10} resulting from cremation of human remains. The paragraph does not describe the emissions of NO_x, SO_x and CO_2.

Procesomschrijving	Emk_code	NFR_code	Target group
Crematoria	8922001	5C1bv	Trade and services

16.1 Description emission source

In the Netherlands there are 71 crematoria for human remains (LEV 2012). In 2011 59% of the deceased were cremated.

Contribution to the national emission
Crematorium were responsible for the emission of 2.8% of the national mercury emission (ER 2012)
Crematorium were responsible for the emission of <<1% of the national dioxin emission (ER 2009)
Crematorium were responsible for the emission of <<1% of the national PM_{10} emission (ER 2009)

16.2 Calculation

Emissions are calculated as follows:
Emission = Activity data (-NeR) x Emission factor (-NeR) + Activity data (+ NeR) x Emission factor (+NeR)

Activity data (-NeR) = amount of cremations (in crematoria not yet in compliance with NeR)

Activity data (+NeR) = amount of cremations (in crematoria in compliance with NeR)

Emission factor (-NeR) = emission per cremation (in crematoria not yet in compliance with NeR)

Emission factor (+NeR) = emission per cremation (in crematoria in compliance with NeR)

a) Activity data
During cremation of human remains substances are emitted. From these substances NO_x, SO_x, CO_2, mercury, dioxin and fly ash (PM_{10}) the most relevant ones.

Emission of NO_x, SO_x and CO_2
The emissions are based on emission factors per cremated human. The emission of the three substances are been added to the other burning emissions of the target group trade and services. The task group ENINA

is responsible for the calculation and reporting of the burning emission from trade and services.

Other emissions:
The emissions are determined by multiplying the number of cremations in the Netherlands with emission factors. The number of cremations in the Netherlands is provided on by the LVC (National Association Crematoria). On the home page of LVC the data can be downloaded.

Year	**Deceased**	**Cremations**		
	absolute	absolute	% total	% with NeR
1950	75,580	1,520	2	0
1980	114,279	39,947	35	0
1990	128,790	57,130	44	0
2000	140,527	68,700	49	5
2005	136,402	70,766	52	18
2010	135,895	77,465	57	75*
2011	135,516	78,599	58	86**

*   interpolation using year 2011
** calculation based on accurate list crematoria with NeR (LVC 2012)

b) Emission factor
<u>*Mercury*</u>
The calculations of mercury are based on a study of Tauw Milieu (1997). Tauw made a list of amalgam sales in the past and combined it with the KUB model (1992). The KUB calculated an emission factor for mercury per age category. The emission factors are 1.15 in 1995, 1.37 in 2000 and 1.73 in 2010. In 2011 a factor of 1.73 g mercury per cremation was used. It's assumed that all the mercury in the amalgam is emitted to the air during cremation.

Implementation of the NeR measures
According to report "crematies" (WESP 1996) 2150 m^3 fume is generated per cremation resulting in 0.43 g Hg/cremation. However measurements resulted in concentration far below 0.43 g Hg/cremation (between 0.001 and 0.004 mg/m^3).
Assumption: emission of mercury with NeR = 0.05 mg/m3 ≈ **0.1 g Hg/cremation.**

Emission Hg (-NeR) (kg) = cremation (-NeR) x Hg emission factor (-NeR)
Emission Hg (+NeR) (kg) = cremation (+NeR) x Hg emission factor (+NeR)
Emission Hg total (kg) = Emission Hg (-NeR) (kg) + Emission Hg (+NeR) (kg)

<u>*PM_{10} (fly ash)*</u>
The emission factor for fly ash is **100g/cremation** (WESP 1996).

Implementation of the NeR measures

The NeR measure require the use of special filter (cloth or electrostatic filters). Due to these filter the emission of fly ash decreases. According to WESP (1996) the emission for fly ash using cloth filters is 25 g/cremation. Measurements in Geleen showed concentrations of <6 mg/m^3, or 13 g per cremation. Measured data from Bilthoven showed even lower values, <0.7 mg/m^3.
Assumption: emission fly ash with NeR = **10 g/cremation**.

Emission fly as (-NeR) (kg) = cremation (-NeR) x fly ash emission factor (-NeR)

Emission fly as (+NeR) (kg) = cremation (+NeR) x fly ash emission factor (+NeR)

Emission fly as total (kg) = Emission fly as (-NeR) (kg) + Emission fly ash (+NeR) (kg)

<u>Dioxins</u>
The emission factor for dioxins is 4 ug I-TEQ per cremation. The 4 ug I-TEQ/cremation is based on measurements in 1991 in fumes from three crematoria (Bremmer et al, 1993).

Implementation of the NeR measures
For dioxins the emission with NeR measures are also lower. Measurements performed by TNO showed 0.024 ng/m^3 = 0.052 ug I-TEQ/cremation at Geleen and 0.013 ng/m^3 = 0.028 ug I-TEQ/cremation at Bilthoven.
According to measurements of the EEFS (Europese branche-organisatione) lower values are possible. 0.1 ng/m^3 (or 0.2 ug I-TEQ/cremation) is the modern German limit (27e BlmSchV) for installation with filters.
Assumption: emission dioxins with NeR = **0.2 ug I-TEQ/cremation.**

Emission Dioxins (-NeR) (kg) = cremation (-NeR) x Dioxine emissie factor (-NeR)

Emission Dioxins (+NeR) (kg) = cremation (+NeR) x Dioxine emissie factor (+NeR)

E. Dioxins total (kg) = Emission dioxins (-NeR) (kg) + Emission Dioxine (+NeR) (kg)

Measures influencing the calculation
Since July 1998, new crematoria or new ovens in exciting crematoria must comply to the NeR with respect to mercury (0.2 mg/m^3). Therefore the emissions of dioxins and fly ash are lower. According to the LVC information (2012) 57 of the 71 crematoria are now in compliance with the NeR. In the 57 crematoria (with NeR) 86% of the cremations occurred. At the end of 2012 all the crematoria must be incompliance with the NeR. From this date only the lower emission factors are used.

16.3 Quality codes

Substance	Activity data	Emission factors	Emission
Dioxins	A	B	B
Fly as	A	B	B
Mercury	A	B	B

16.4 Spatial allocation

The emissions of the crematoria are assigned to the locations of the crematoria (SBI 96.032) in the Netherlands according the ratio of employees at the crematoria.

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

16.5 References

ER, 2009. Netherlands Emission Registry. Data on 2009 available from www.emissieregistratie.nl

WESP 1996, J.G.Elzenga, WESP document Crematoria (H7), 1996.

Tauw Milieu 1997, Onderzoek naar kwikemissies van crematoria en beschikbare RGRtechnieken, B Hoekstra, R3517616 Tauw Milieu, Deventer, mei 1997

RIVM, 1993, Bremmer,H.J,et al, november 1993, Emissies van dioxine in Nederland, RIVM, rapportnr 770501003, Bilthoven

TNO 1996, Smit, E.R., 1996, Massabalans en emissies van in Nederland toegepaste crematieprocessen, TNO-rapport TNO-MEP-R96/059.

NeR op www.infomil.nl, november 2006

LEV 2012. http://www.lvc-online.nl/

16.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

17 Degassing of groundwater (CRF 2.G.4)

In this paragraph the emissions from the degassing of groundwater are described.

Process description	Emk_code	CRF_code	Sector
Degassing groundwater	0850000	2.G.4	Drinkwater companies

17.1 Description emission source

A part of the Dutch drink water is obtained through the production of ground water. Gasses which are dissolved in the water are released during processing. One of those gasses is methane. Shallow ground water extraction for usage in agriculture or on construction sites is not included in this document, since this water contains no methane.

Contribution to the national emission
For the greenhouse gases this emission source is not a key source.

The contribution of this process to the national methane emission was <0.3% in 2009.

17.2 Calculation

For the complete time series, the emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of groundwater produced
Emission factor = Emission per m^3 groundwater

This is a tier 1 methodology. The methodology is not provided within the IPCC 2006 Guidelines.

a) Activity data
The amount of ground water extracted for drink water purposes is used as activity data. This data is retrieved from VeWin, the Dutch society for (drink) water producing companies. Only the amount of ground water is taken into account.
For the year 2009 this results in 676 million m^3.

b) Emission factor
The emission factor for degassing groundwater has been calculated for the year 1990 by dividing the estimated methane emissions (2000 tons) by the amount of extracted groundwater (810 million m^3), as reported by van den Born (1990).

Substance	EF	Unit
CH_4	2469	kg/ million m^3 groundwater

17.3 Uncertainty and Quality checks

The activity data for the degassing of drink water from ground water is derived from the statistics of VeWin (Dutch association for water win companies). It's estimated that the uncertainty is at most 10%, based on expert judgement.
The uncertainty of the emission factor for methane is derived from '*Olivier, 2009*' and is reported as 50%.

Quality codes

Substance	Activity data	Emission factor	Emission
CH_4	A	D	C

Quality checks

There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

17.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on population density. Although this might not be completely correct, it's probably the best assumption.

Emission source/process	Allocation-parameter
Degassing of groundwater	Population density

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

17.5 References

Born, G.J. van den, A.F. Bouwman, J.G.J. Olivier, R.J. Swart, 1991, The emission of greenhouse gases in the Netherlands, RIVM-rapport 222901003.

VeWin, vereniging voor waterwinbedrijven. http://www.vewin.nl/

17.6 Version, dates and sources

Version: 1.2
Date: May 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

18 Fireworks (CRF 2.G.4)

In this paragraph the emissions from fireworks are described. This refers only to consumer fireworks lighted on new year's eve, since only professional fireworks is allowed on other occasions. Other amounts are considered negligible.

Process description	Emk_code	CRF_code	NFR_code	Sector
Fireworks	0801700	2.G.4	2D3i	CON

18.1 Description emission source

On new year's eve, inhabitants of the Netherlands are allowed to light up fireworks. These fireworks consist of both 'firecrackers' and 'ornamental' types of firework, with an estimated 15% / 85% ratio. When lighting fireworks, various gasses and metal substances are emitted, dependent on the type of fireworks.

Contribution to the national emission
For the greenhouse gases this emission source is not a key source.

The contribution of fireworks to the total national emission of particulate matter was <5% in 2009.
However, the emission of some metal components contributes considerably to the national total. Fireworks may contain, among other substances, antimony, barium and strontium. For these metals, fireworks are the main source of process emissions, emissions to the soil and emissions to the sewer system.

18.2 Calculation

The emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of fireworks lighted in kg
Emission factor = Average emission per kg fireworks

This is a tier 1 methodology. The methodology is not provided within the IPCC 2006 Guidelines.

a) Activity data
In 2009, an estimated 17.3 million kg of fireworks was lighted at new year.
In order to calculate the amount of fireworks, the difference between import and export each year is taken into account. These statistics are derived from the national statistics agency (CBS). As the difference of imported and exported fireworks doesn't need to be lighted up the same year, consecutive years are averaged. This is done according to the following rule:
Year2 = (Year1 + 2 * Year2 + Year3) / 4
There is a bias in the statistics since smaller companies are not included in the statistics and the import of illegal fireworks is not accounted. To

compensate for this bias, the amount calculated from the statistics is multiplied by a factor 1.7. This factor is based on expert judgement (estimated total fireworks divided by the CBS reported amount). Prior to 1996 the CBS provided also information on the smaller companies, therefore the statistics where only multiplied by 1.316 to correct for illegal fireworks only.

b) Emission factor
The emission factors for all gaseous substances caused by fireworks are from Brouwer et al. (1995). This includes; CO_2, CO, CH_4, H_2S, SO_2, N_2O and PM_{10}.

Substance	EF	Unit	
CO_2	43250	kg/ million kg fireworks	Brouwer et al, 1995
CO	6900	kg/ million kg fireworks	Brouwer et al, 1995
CH_4	825	kg/ million kg fireworks	Brouwer et al, 1995
H_2S	1195	kg/ million kg fireworks	Brouwer et al, 1995
SO_2	1935	kg/ million kg fireworks	Brouwer et al, 1995
N_2O	1935	kg/ million kg fireworks	Brouwer et al, 1995
PM_{10}	14244	kg/ million kg fireworks	Brouwer et al, 1995

For the emissions of heavy metals, the studies of Brouwer et al. (1995), Plinke et al. (2001), both for Germany and Sweden, and Croteau et al. (2010) are combined to retrieve an average emission factor. The metal content in Plink et al (2001) is a metal content per kg pyrotechnic mixture. To calculate a metal content per kg fireworks, it is assumed that fireworks consist of 40% pyrotechnic ingredients (comparable with Brouwer et al.).

The following table shows the metal emission factors of 'ornamental fireworks' from the several studies, and the emission factor that is currently used for emissions from 'ornamental fireworks' in the Netherlands. The values in this table are based on the metal content of the fireworks (in g/kg fireworks) and is an emission factor for pollutants to all compartments (atmosphere, surface water, sewer and soil).

Pollutant	Brouwer 1995	Plinke 2001 (Germany)	Plinke 2001 (Sweden)	Croteau 2010	EF used in NL
Strontium	7.74	2.48	1.16	5.96	4.33
Barium	22.61	6.71	15.60	8,85	13.44
Copper	7.43	0.34	3.08	16,30	6.79
Antimony	0.92	0.01		2,34	1.09
Zinc			0.52	0.84	0.68

There is a difference between the 'fire crackers' and the rest of the fireworks in emissions. The uncoloured 'fire crackers' don't contain the reported heavy metals and have a different emission profile. Therefore, the emission factors are weighted for the contribution of the different types of fireworks, with a ratio of 15% 'fire crackers' and 85% of the 'ornamental fireworks'.

The emission of particulate matter is calculated by the sum of the emitted metals and the other particulate matter forming components as reported by Brouwer et al. (1995). According to Brouwer (1995) only 10% of particulate matter (and likewise the heavy metals) is emitted to air. This is in line with Croteau et al. (2010), where both the composition of the fireworks and the emissions to air are reported, giving around 10% of the ingredients as emissions to air. However, if we exclude the non-combusted residue from fireworks, then the fraction to air is much higher (between 20% and 48%). Other information sources suggest that the atmospheric emissions could be 3 times higher, which means that 30% of the emissions would emit to the air.
The atmospheric emissions will be updated next year. This year, a fraction of 10% of the emissions is used.

The remaining 70% of the emissions are emitted to sewer and soil. It is assumed that 14% is emitted to the sewer system and 56% is emitted to the soil.

The amount of metals that enter the sewer system is estimated based on the amount of paved area and the amount of precipitation entering the sewer system. In 2012, the amount of paved and sewed area was $4.29 * 10^9$ m^2. This includes built-up area and traffic area in the Netherlands. As fireworks is mainly used in built-up areas and on the streets in cities during new years' eve, it is assumed that the emissions from fireworks are released in the built-up area and the traffic area. With an average amount of precipitation of 850 mm per year, this would result in $3.65 * 10^9$ m^3 precipitation on paved area. In 2015, the sewer system received an influent of $0.58 * 10^9$ m^3 of precipitation (estimation by Liefting et al, 2017). This implies that only a fraction (0.58 / 3.65 = 16%) of the precipitation on paved area enters the sewer system. In the study by Liefting (2017) approximately 20% of the influent of waste water treatment plants is not accounted for by waste water from companies and households and by precipitation. This fraction could enter the sewer system via other routes, but it is also possible that the estimation of the amount of precipitation in the sewer system is too low. If we would assume that 10% of the water that is not accounted for is also precipitation, then $0.58 * 10^9 + 0.20 * 10^9 = 0.78 * 10^9$ m^3 precipitation enters the sewer system. This would result in a fraction of 0.78 / 3.65 = 21% of the precipitation on paved area that enters the sewer system.

On average, we assume that 20% of the precipitation on paved area enters the sewer system. Most of the fireworks is used in built-up areas and on traffic areas in cities, which means that the main part of the emissions also falls on the paved area. We assume that the fraction of fireworks that enter the sewer system is equal to the amount of precipitation that enter the sewer system. Thus 20% of the emissions on the ground is assumed to enter the sewer system. The remaining 80% of the emissions that falls on the ground is assumed to emit to soil.

This result in an emission fraction of 70% * 20% = 14% to sewer system and 70% * 80% = 56% to soil.

This results in the following emission factors to the several compartments (kg/million kg fireworks):

Substance	Atmosphere	Sewer system	Soil
CO_2	43250		
CO	6900		
CH_4	825		
H_2S	1195		
SO_2	1935		
N_2O	1935		
PM_{10}	14244		
$PM_{2.5}$	14244		
Strontium*	433	606	2425
Barium*	1344	1882	7526
Copper*	679	951	3802
Antimony*	109	153	610
Zinc*	68	95	381

18.3 Uncertainty and Quality checks

Within the Netherlands the emissions of fireworks and candles are reported on a aggregated level under CRF 2G. For this aggregated level, Olivier (2009) reported uncertainties for CO_2 (20%), CH_4 (50%) and N_2O (50%). The uncertainty in activity data for fireworks is estimated to be 50% (Olivier, 2009).

The uncertainty of the emissions of other substances have not been studied. Instead, the reliability of the data is qualitatively indicated in the table below with codes A-E (see Appendix A). The codes are based on expert judgement.

Quality codes

Substance	Activity data	Emission factor	Emission
CO_2	D	D	D
CO	D	D	D
CH_4	D	D	D
H_2S	D	D	D
SO_2	D	D	D
N_2O	D	D	D
Strontium	D	C	D
Barium	D	C	D
Copper	D	C	D
Antimony	D	C	D
Zinc	D	C	D
PM_{10}	D	D	D
$PM_{2.5}$	D	D	D

Quality checks

There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

18.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on population density.

Emission source/process	Allocation-parameter
Fireworks	Population density

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

18.5 References

Brouwer J.G.H., J.H.J. Hulskotte, J.A. Annema, 1995, Afsteken van vuurwerk, WESP rapportnr C3, RIVM rapportnr 772414005.

Noordijk, H., 1994, Luchtverontreiniging door vuurwerk tijdens de jaarwisseling 1993 - 1994, RIVM-rapport 722101007.

Plinke, E., Wolff, G. en von Arx, U., 2001. Feuerwerkskörper. Umweltauswirkungenand Sicherheitsaspekte. Umwelt-Materialien nr 140. Bunderamt für Umwelt, Wlt und Landschaft (BUWAL).

Croteau, G., Dills, R., Beaudreau, M. en Davis, M., 2010. Emission factors and exposures from ground-level pyrotechnics. Atmospheric Environment 44, 3295-3303.

National Bureau of Statistics, www.statline.CBS.nl

Olivier, J.G.J., Brandes, L.J. and te Molder, R.A.B., 2009, Uncertainty in the Netherlands' greenhouse gas emissions inventory, PBL publication 500080013

Liefting, E. and de Man, H., 2017. EmissieRegistratie Afvalwaterketen. Achtergrondrapport bij de in 2017 geactualiseerde factsheet 'Effluenten RWZIs, regenwaterriolen, niet aangesloten riolen, overstorten en IBA's'. 15 juni 2017.

18.6 Version, dates and sources

Version: 1.2
Date: May 2015
Responsibility manager task group WESP:

Administrator	**Organisation**	**E-mail address**
B.I. Jansen	TNO	bart.jansen@tno.nl

19 Human ammonia emissions from transpiration and breathing

In this paragraph the emissions of NH_3 from human transpiration and breathing are described.

Process description	Emk_code	NFR_code	Sector
Human transpiration and breathing	0801600	6A	Consumers

19.1 Description emission source

This emission source describes the ammonia emissions from humans by sweating and breathing. Through the consumption of food, nitrogen (N) is introduced in our system and afterwards is disposed again. Most nitrogen is released into the sewer system, the ammonia released through sweating and breathing is calculated within this emission source.

Contribution to the national emission
The contribution of this source to the total national NH_3 emission is around 1% (based on 2014).

19.2 Calculation

For the complete time series, the emissions are calculated as follows.
Emission = Activity data x Emission factor

Activity data = the amount of Dutch inhabitants
Emission factor = kg emission per inhabitant

a) Activity data
The amount of inhabitants in the Netherlands is derived from CBS Statline on annual basis. The amount of people living in the Netherlands at the end of June in a specific year is taken as activity data for that year.

b) Emission factor
With the food humans consume, also nitrogen (N) is consumed. It is estimated that a human excretes though different ways (urine, sweat, faeces etc.) 5 kg N (NH_3) per year (Battye et al 1994). Most N or NH_3 is released with the urine (and faeces) and is supposed to go through the sewer system.
The first emission factor used by the Dutch emission inventory was based on van der Hoek 1994. This report mentioned a total emission factor of 0.7 kg NH_3 per inhabitant per year, combining 0.3 kg NH3 from sweating and breathing, use of ammonia as cleaning product (1 litre of ammonia solution per household) and the ammonia emissions of cats and dogs.
Another report (Bouwman et al 1997) mentions an emission factor of the same magnitude for human emission of NH_3. In this study the emissions calculated are used for a global emission inventory. The

author mentions that it’s difficult to come to a well estimated emission factor, but describes that this source should not be neglected. Therefore he assumes 0.5 kg NH_3 per person per year, independent of sanitary arrangements and including domestic pets (cats/dogs). Since the Dutch standard includes a good sewer system and the Netherlands reports the emissions of domestic pets separately, this emission factor is considered to too high for the Netherlands.
In Joshua Fu et al 2010 is mentioned that, perspiration, respiration, untreated waste, cigarettes, household ammonia use, diapers and homeless people are sources of ammonia emissions directly caused by humans. Joshua Fu et al 2010 reports an emission factor of 0.44 kg NH3 per person per year for all these emission sources combined. No separate emission factors are presented, though de distribution of the emission on the different sources is reported. Both perspiration and respiration are reported to contribute about 40% each. The emissions of untreated waste, household ammonia use and homeless people contribute about 4-6% each. Cigarettes, (untreated) waste and household ammonia are sources that are included as separate sources in the Dutch emission inventory. Also other studies report that the emissions of breathing are less than the emissions of sweating. Therefore the emissions in this document could be too high for the Netherlands.
In Battye et al 1994 different references are considered, varying from 0.25-1.3 kg NH_3/human/year from breathing and sweating. Although it’s mentioned that further research is needed, it’s recommended to use the emission factor of 0.25 kg NH_3 p.p.p.y. and that this emission factor is retrieved from a NAPAP report. Most interesting aspect is the reference to a measurement of NH_3 in a home. It is mentioned that an emission factor of 1 kg NH_3 should result in a concentration of about 431 µg/m^3, while the concentrations measured are between 32 and 39 µg/m^3. It might be concluded, although this is not done within this study, that the emission factor should be around 0.1 kg NH_3 per person and per year.
One of the most comprehensive studies on the emissions of ammonia from non-agricultural sources, is conducted by Sutton et al 2000. In this report the emissions of sweating are calculated with a range of emission factors from 2.08 g NH_3 till 74.88 g NH_3 (as g N per person and year). For breathing the range is 1.0-7.7 g NH3 (as N per person per year). Sutton et al 2000 references to a number of other reports and explains his assumptions. One of the most important assumptions made is the amount of NH_3 that volatilizes from sweat (10-30%). If no volatilisation is assumed the high end emission factor is about 0.25 kg NH_3 per person and per year. This is equal to Battye et al 1994 and a reference used by Sutton et al 2000.
Furthermore some studies (Chang 2014, Zheng et al 2012 and Klimont&Brink 2004) found on ammonia emissions, all use the emission factors presented by Sutton et al 2000.
Some countries other than the Netherlands also report the emissions of human sweating and breathing, for example Switzerland, Canada and the UK (in the past). The three countries mentioned used the ‘best’ emission factors provided by Sutton et al 2000 of 0.017 kg NH_3 p.p.p. This is less than the ammonia emission factor in the guidebook 2013 of 0.05 kg NH_3 per person and year.
Only one study found (Sutton et al 2000) reports an emission factor for the ammonia emissions from diapers. Depending on the age and some

assumptions made, the emission factor ranges from 2.4-68 g NH_3 per infant and per year. A first estimate for children (age 0-3 year) in the Netherlands gives an emission of 2 till 50 tonnes NH_3 a year. Since this is only one reference and a relative low contribution to the national total, the decision is made not to include this emission (separately) in the Dutch emission inventory.

Emission factor used in the Netherlands emissions inventory:
The high end emission factors of Sutton et al 2000 are used, resulting in a total emission factor of 0.0826 kg NH_3-N per person per year (sum of 74.88 and 7.7 gram p.p.p.y. for sweating and respiration respectively). For the Dutch national emission inventory this is recalculated to 0.1004 kg NH3 per person per year. Because the emission factors in other reports are higher, it is decided to choose the high end emission factors of Sutton et al 2000, instead of the 'best' emission factors. This way the risk of underestimating the human ammonia emissions is reduced and emission sources not calculated (homeless people and diapers) can be neglected.

19.3 Uncertainty and Quality checks

The uncertainty in the number of inhabitants in the Netherlands is considered to be very small, therefore the uncertainty is qualified as A. The uncertainty in the emission factor is estimated to be relative high, since emission factors vary between different sources and the amount of ammonia volatilized is based on an assumption. Hence the uncertainty is qualified as D.

Quality codes

Substance	Activity data	Emission factor	Emission
NH_3	A	D	C

Quality checks
There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

19.4 Spatial allocation

The ammonia emissions of humans are spatially allocated in the Netherlands based on the inhabitants.

Emission source/process	Allocation-parameter
Human ammonia emission; sweating and breathing	inhabitants

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

19.5 References

Dutch Bureau of Statistics, Statline, annual data on the number of inhabitants

Sutton M.A. et al, 1999, Ammonia emissions from non-agricultural sources in the UK, Atmospheric Environment 34 (2000) 855-869

EMEP/EEA emission inventory guidebook 2013, other sources and sinks activities 110701 – 110703

Battye R. et al, 1994, Development and selection of ammonia emission factors, EC/R Incorporated, Durham, North Carolina 27707

Joshua Fu et al, 2010, Quality Improvement for Ammonia Emission Inventory, Department of Civil and Environmental Engineering, University of Tennessee, Knoxville, TN 37996-2010

Bouwman et al, 1997, A global high-resolution emission inventory for ammonia, global biochemical cycles, Vol. 11, No. 4, pages 561-587

Chang Y.H., 2014, Non-agricultural ammonia emissions in urban China, Atmos. Chem. Phys. Discuss., 14, 8495–8531, retrieved 2016 from http://www.atmos-chem-phys-discuss.net/14/8495/2014/acpd-14-8495-2014.pdf

Zheng J.Y. et al, 2012, Development and uncertainty analysis of a high-resolution NH3 emissions inventory and its implications with precipitation over the Pearl River Delta region China, Atmos. Chem. Phys., 12, 7041–7058, retrieved 2016 from http://www.atmos-chem-phys.net/12/7041/2012/acp-12-7041-2012.pdf

Klimont Z. and Brink C., 2004, Modelling of Emissions of Air Pollutants and Greenhouse Gases from Agricultural Sources in Europe, International Institute for Applied Systems Analysis, Austria, Interim Report IR-04-048

Van der Hoek K.W., 1994, Berekeningsmethodiek ammoniakemissie in Nederland voor de jaren 1990, 1991 en 1992, RIVM report 773004003

19.6 Version, dates and sources

Version: 1.2
Date: May 2017
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

20 Leather maintenance products and office supplies

This paragraph describes the emissions of NMVOC from office supplies and leather maintenance products.

Process description	Emk_code	NFR_code	Target group
Leather maintenance products	0802800	2D3a	Consumers
Office supplies	0820600	2D3a	Consumers
Office supplies	0820601	2D3i	Trade and services

20.1 Description emission source

All emissions from leather maintenance products are ascribed to consumers. The emissions from office supplies are ascribed to consumers (50%) and trade and surfaces (50%). Leather maintenance products consist of polishing wax, furniture polish, furniture cleaners, shoe polish, etc. Office supplies consist of tip-ex, ballpoints, fibre- tip pens, text markers, etc. All these products contain NMVOC which emits after use to the air.

Contribution to the national emission
The contribution to the national total is less than 1% for both the consumers and trade and services groups.

20.2 Calculation

The market share of VOC containing products was monitored on a regular basis monitored in the project KWS2000 by InfoMil. They performed producer and supplier surveys. The surveys however, were performed a long time ago: leather maintenance products in 2000 and for office supplies in 1997 and surveys.
The NMVOC total is split up into the individual substances, using an average profile, established by TNO and Association in 1992.

20.3 Quality codes

Substance	Activity data	Emission factors	Emission
NMVOC	D	Not relevant	D

20.4 Spatial allocation

Details are available at:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

The emissions NMVOC are allocated in the Netherlands based on:

Emissiesource/proces	Allocation-parameter	Source data

Office supplies	Floor area commercial and industrial buildings	LISA
Office supplies	Population density	Bridgris (ACN)
Leather maintenance products	Population density	Bridgris (ACN)

20.5 References

KWS2000/InfoMil, 1999, Jaarverslagen 1996-2000, InfoMil, Den Haag.

20.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

21 Meat preparation and charcoal use (CRF 1.A.4.b)

In this paragraph the emissions of charcoal use on the barbecue and meat preparation are described.

Process description	Emk_code	CRF_code	NFR_code	Sector
Meat preparation	0801800	1A4bi	1A4bi	CON
Charcoal use	0801801	1A4bi	1A4bi	CON

21.1 Description emission source

During meat preparation, NMVOC are produced as result of the heating and burning of grease.
During the burning of charcoal on the barbecue, various compounds are emitted, for example particulate matter, CH_4 and NMVOC.

Contribution to the national emission
For the greenhouse gases this emission source is not a key source.

The contribution of NMVOC emissions from meat preparation to the total national NMVOC emission was 0.5% in 2009.

The emission of CO_2 is booked as memo item under the Kyoto protocol, since charcoal is considered as biomass. The amount of CO_2 emissions caused by charcoal burning is negligible in relation to the national total CO_2 emissions from biomass burning.
The contribution to national emissions of PM_{10}, $PM_{2.5}$, CO, CH_4, NO_X, N_2O, SO_2 and NMVOC as a result of charcoal burning are negligible.

21.2 Calculation

Emissions are calculated as follows:
Emission = Activity data x Emission factor

This is a tier 1 methodology. The methodology is consistent with the IPCC 2006 Guidelines.

a) Activity data
Since no actual data is available for the use of charcoal in Dutch households, all emissions are calculated based on the amount of meat used. Data on the number of inhabitants and the amount of meat consumed annually per inhabitant were gathered from the national statistics bureau. Combined, these result in a total amount of meat consumed in the Netherlands.
Estimated is that 0.3% of the meat is prepared on the barbeque and about 80% is fried, roasted or grilled.

Charcoal use is estimated by multiplying the amount of meat consumed by 0.194 TJ charcoal/kton meat. This is based on 1.5 kg charcoal per 1 kg meat prepared on the barbeque.

For the year 2009 this results in 1,430 kton meat consumed and 278 TJ charcoal used on the barbecue

b) Emission factor
The emission factors for NMVOC, particulate matter, SO_2, NO_X and CO are derived from Brouwer et al. (1994). The emission factor for CO_2 (memo item), CH_4 and N_2O are derived from the 2006 IPCC guidelines, the default emission factors are used.

Substance	**EF**	**Unit**
Meat preparation		
NMVOC	0.5	g/kg meat
Barbecuing		
NMVOC	250	kg/TJ charcoal
SO_2	10	kg/TJ charcoal
N_2O	1	kg/TJ charcoal
NO_X	50	kg/TJ charcoal
CO	6000	kg/TJ charcoal
CH_4	200	kg/TJ charcoal
PM_{10}	150	kg/TJ charcoal
$PM_{2.5}$	75	kg/TJ charcoal
CO_2 (memo item)	112	ton/TJ charcoal

21.3 Uncertainty and Quality checks

The activity data for the burning of charcoal in households is estimated on the amount of meat consumed yearly. This is based on the assumption that only barbecuing is responsible for charcoal usage in households. Since the amount of charcoal used in the Dutch households is based on meat consumption combined with estimated charcoal sales, the uncertainty is estimated at 50%, based on expert judgement.
The emission factors (and corresponding uncertainties) used for charcoal burning are derived from '*IPCC guidelines 2006*'. Therefore the uncertainty bandwidth is for N_2O -62.5% till 275%. For CH_4 the uncertainty bandwidth is -66.6% till 200%. The corresponding uncertainty of CO_2 (memo-item) is reported as 20%.

The other emission factors are estimated based on a single report from the US. Therefore those emission factors are not very reliable;
The reliability of the data is qualitatively indicated in the table below with codes A-E (see Appendix A). The valuations are based on expert judgement.

Quality codes

Substance	Activity data	Emission factor	Emission
NMVOC (meat)	B	C	C
NMVOC (BBQ)	B	C	C
SO_2	B	C	C
N_2O	B	B	B
NO_X	B	C	C
CO	B	C	C
CH_4	B	B	B
PM	B	C	C
CO_2	B	B	B

Quality checks
There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

21.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on population density.

Emission source/process	Allocation-parameter
Meat preparation	Population density
Charcoal use in barbecue	Population density

Details available via:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

21.5 References

ER, 2009. Netherlands Emission Registry. Data on 2009 available from www.emissieregistratie.nl

Brouwer J.G.H., J.H.J. Hulskotte, C.H.A. Quarles van Ufford, 1994, Vleesbereiding, inclusief gebruik barbecue, WESP-rapport C-2, RIVM-rapportnr 773009003.

CBS statline

IPCC 2006 guidelines. http://www.ipcc-nggip.iges.or.jp/public/index.html

21.6 Version, dates and sources

Version: 1.2
Date: May 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

22 Paint

This paragraph describes the non-methane volatile organic compounds (NMVOC) emission from paint.

Process description	Emkcode	NFR code	Sector
Car paint – use of paint and lacquer	8920800	2D3d	Trade and services
Paint - construction	0802200	2D3d	Construction
Paint - consumers	0802201	2D3d	Consumers
Road paint	0119800/ 0129800	2D3d	Construction

22.1 Description emission source

Paint may contain NMVOC which evaporates to the air during and after use. Paint includes products like coating, (wall) paint, lacquer, varnish, plaster, glue, stripper and filler and thinner. Annually the Netherlands Association of Paint Producers (Vereniging Van Verf en drukinkt Fabrikanten (VVVF)) provides sales data for the calculation of NMVOC emission.

Contribution to the national emission and sector totals
An overview of the contribution of NMVOC by paints to the target group and the national total can be found in the next table.

Sub market VVVF	Target group	Contribution to Target group (%)	Contribution to national total (%)
Car repair lacquer	Trade and services	10	1.3
Construction	Construction	94	3.7
Consumers	Consumers	7	1.5

22.2 Calculation

The annual national paint sales, including information on NMVOC content, are provided by the annual paint sales statistics of the VVVF, representing about 95% of the Dutch total market. The remaining 5% consists of directly imported paint. The VVVF divides different sub markets as seen in the table below. The task force ENINA covers the target group industry and therefore will not be addressed in this report.

Sub market VVVF	Target group
Car repair lacquer	Trade and services
Construction (including steel preservation and road marking)	Construction
Consumers	Consumers
Industry and carpentry factories	Industry
Ship building	Industry

Car repair lacquer
The total NMVOC emission from this source is calculated as follows:

$EM_{totalcrl}$ = EmN + EmI
EmN = NMVOC content national paint sales
EmI = NMVOC content directly imported paint

It is assumed that:
- all paint sold will be used the same year and that the NMVOC emitted is 100% and the
 imported paint has the same NMVOC percentage as the paint sold by VVVF,
- 5% is directly imported paint.

Construction (including steel preservation and road marking)
The total NMVOC emission from this source is calculated as follows:

$Em_{totalconstruction}$ = EmN-C + EmI-C + EmN-SP + EmI-SP
EmN-C = NMVOC content national paint sales of construction
EmI-C = NMVOC content directly imported paint of construction.
EmN-SP = NMVOC content national paint sales of steel preservation
EmI-SP = NMVOC content directly imported paint of steel preservation

It is assumed that:
- all paint sold will be used the same year and that the NMVOC emitted is 100%,
- the NMVOC percentage of the imported construction paint is 2%,
- the imported paint of steel preservation has the same NMVOC percentage as the paint sold by VVVF,
- for construction 35% is directly imported paint is and for steel perservation 10% is directly imported paint.

The total NMVOC emission from the construction sector must be split up into road markings and others based on the amount of road markings.

Consumers
The total NMVOC emission from this source is calculated as follows:

$EM_{totalconsumers}$ = EmN + EmI
EmN = NMVOC content of national paint sales
EmI = NMVOC content of directly imported paint

It is assumed that:
- all paint sold will be used the same year and that the NMVOC emitted is 100% and the imported paint contains the same amount of NMVOCs as the paint sold by VVVF,
- 0% is directly imported paint.

a) Activity data
Total NMVOC emission is subdivided into individual substances based on paint profile statistics as provided by the VVVF (VVVF 1997).

Substance in paint profile	Factor*
Additional Nonhalogenated volatile hydrocarbons	0,119
Additional Alif nonhalogenated hydrocarbons	0,264
Additional Aromatic nonhalogenated hydrocarbons	0,045
Methylenechloride	0,004
Ethanol	0,015
Esters boiling point <150◦C	0,224
Ketone	0,075
Propyleneglycomethylether	0,045
Propyleneglycomethylether acet	0,045
Toluene	0,030
Xylene	0,134

*Based on VVVF statistics 1997

22.3 Uncertainty

The uncertainties of the emission calculation are quantified by the Utrecht University (J. vd Sluys) in 2002.

Quality codes

Substance	Activity data	Emission factor	Emission
NMVOC			C

22.4 Spatial allocation

The emissions of consumers and trade and services are allocated in the Netherlands based on population density. The emission of road paint is allocated based on road density.

22.5 References

Annually reports VVVF on www.vvvf.nl

Ministerie van VROM 2005. Nationaal Reductieplan NMVOS industrie, HDO en bouw, bijdrage van de sectoren aan het realiseren van het NEC-plafond in 2010.

Staatsblad 2005/632. Besluit organische oplosmiddelen in verven en vernissen (BOOVV).

Sluijs vd J., et al., 2002. Uncertainty assessment of VOC emissions from paint in the Netherlands. Utrecht University, NW&S E-2002-13.

Instituut voor toegepaste milieu-economie (TME) 2003.Kosteneffectiviteit VOS maatregelen 2010. eindrapportage.

Instituut voor toegepaste milieu-economie (TME) 2003. Kosteneffectiviteit VOS maatregelen 2010. achtergronddocument verf, bouw en doe het zelf.

Vereniging Van Verf en drukinktFabrikanten (VVVF) 1999. Grondstoffenverbruik in 1997 in de Nederlandse verfindustrie.

Vereniging Van Verf en drukinktFabrikanten (VVVF) 2002.VOS-reductieplan 2010 voor de verf-en drukinktindustrie.

22.6 Version, dates and sources

Version: 1.1
Date: March 2015
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

23 PCP pressure treated wood

This paragraph describes the emissions of PCP and dioxins from resident façade boarding treated with PCP. The paragraph does not describe the emission NMVOC.

Process description	Emk_code	NFR_code	Target group
PCP pressure treated wood	0010300	2D3i	Consumers

23.1 Description emission source

In the past wooden façade boarding of residences were treated with PCP (pentachlorophenol). Overtime PCP and dioxins emit from the wood to the air. The dioxin emissions occur because the wood was treated with contaminated paint.

Contribution to the national emission
PCP from façade boarding is within the ER the only source.
The contribution of dioxin is ~46% of the national total.

23.2 Calculation

Dioxin
In 1990 Bremmer at al. estimated the dioxin emission from façade boarding in the RIVM report 'emissies van dioxines in Nederland' (Bremmer et al 1993). The use of PCP is prohibited in 1989 and therefore, it's assumed that there is linear decrease of the emission. Bremmer et al. estimated emission of ~25 g I-TEQ (1990), ~20 g I-TEQ (2000) and ~10 g I-TEQ in 2020.

Pentachlorophenol
Slooff et al. (1990) calculated in a PCP base document an emission of 35 tons in 1987. For the year 1990 the PCP emission was set to 34 tons. According to Slooff et al and Bremmer et al. in both these documents it is stated that within 15 years the emission will be reduced to 50%. Therefore, an emission of 3.3% per year is assumed.

The emission of PCP and dioxin is also reduced because façade boarding are been replaced. The total amount of façade boarding is assumed to be reduced with 1% each year between the years 10 to 20, 2% for each year between 20 to 30 years, 3% for each year between 30 to 40 years and 4% for each year after 40 years.

The emission values for PCP and dioxin presented by Slooff et al and Bremmer et al are including the reduction of the amount façade boarding reduction after 10 years.

Measures influencing the calculation
The use of PCP was prohibited in 1989.

23.3 Uncertainty

The uncertainties of the emission calculation are quantified within the reports of Bremmer et al and Slooff et al.

Bremmer calculated an average of 16 g I-TEQ dioxin in 1990 and stated in the report that the maximum could not exceed 25 g I-TEQ dioxin. For 1990 the ER assumed an emission of 25 g I-TEQ. This would mean that there is only uncertainty in the low tail of the value. The 95% confidence interval is skewed. Within the ER, as a rule, the highest uncertainty value is used and also that the 95% confidence interval is normally distributed around the 25 g I-TEQ.

For PCP Slooff et al reported the average PCP emission. The 95% confidence interval is normally distributed around the average.

Quality codes

Substance	Activity data	Emission factors	Emission
Dioxins	D	Not relevant	D
PCP	D	Not relevant	E

23.4 Spatial allocation

The emissions dioxin and PCP are allocated in the Netherlands based on population density. Details are available at:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

23.5 References

Bremmer, H.J., L.M. Troost, G. Kuipers, J. de Koning, A.A. Sein, 1993, Emissies van dioxinen in Nederland, RIVM rapportnummer 770501003.

Slooff et.al, Basisdocument PCP, RIVM, november 1990.

23.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

24 Petrol stations

This paragraph describes the NMVOC emissions from petrol stations.

Process description	Emk_code	NFR_code	Target group
NACE 47.3: gas stations, spills tank refill	8920900	1B2aiv	Trade and service
NACE 47.3: gas stations, vapour expel - tank refill	8920901	1B2aiv	Trade and services
NACE 47.3: gas stations, vapour expel - storage tanks	8920902	1B2aiv	Trade and services

24.1 Description emission source

Petrol stations not only include the distributions points for road traffic, but also include petrol stations on company grounds (meant for company cars). The NMVOC emissions of petrol and LPG are reported. LPG is reported as butane and propane (50/50). Emission occurs during the filling of tanks and result from two sources. The first is the loss due to leakages of the fuel (petrol) and the second is due to expulsion while filling car tanks and storage tanks (petrol and LPG). In the Netherlands there are between 40 and 45 filling stations for car using natural gas as fuel. However it is assumed that the losses occurring during filling of natural gas are negligible. Before disconnecting the filling pistol, the natural gas in the dead space between pistol and tank, is recovered, no gas is emitted into the air.

Contribution to the national emission
The contribution of NMVOC from petrol station is around 5.5% of the national total NMVOC emission and circa 18% of the target group trade and services (ER, 2009).

24.2 Calculation

Emissions are calculated as follows:
Emission = Activity data x Emission factor

Activity data = amount of fuel used in the Netherlands for road transportation
Emission factor = emission per litre fuel used

a) Activity data

<u>Leakage losses</u>

During filling of car tanks spilling of petrol drops can occur.

On average it’s assumed that the minimal spillage is at least 1-2 ml and the average tank amount per filling is 40 litres. The density of petrol is 0.72 kg/litre. It’s assumed that a million litres petrol produces 720 tons of VOC.

The last decade the Netherlands used 5.5 billion litres petrol for transportation by road (statline.CBS.nl). Based on these assumption and official data we calculated a VOC emission of around 300,000 kg. Since the amount of petrol is constant over the years, the VOC emission due petrol spillage has not changed.

After disconnecting the LPG filling pistol, LPG (a mixture of butane and propane 50/50) will be-emitted into the air. The average dead volume of the pistol and connection nipple of the tank is 12.5 ml (personal communication LPG installation branch).
It’s assumed that on average the tank is filled with 40 litres LPG. CBS (statline.CBS.nl) in the Netherlands provides data for amounts LPG used for transportation by road. Based on these assumptions and the official data we calculated LPG spillage of 97 tons.

Expulsion losses car tanks
At the start of refuelling with petrol the tank is filled with petrol vapour. When petrol flows in the tank, the petrol vapour comes out (Bernouille-principal). Therefore, during refuelling petrol is emitted into the air. In the Netherlands measures were implemented to reduce the emission of petrol. These measures called stage 1 and stage 2 have been implemented since 2000 and 2005 respectively. Since 2005 the expulsion losses have been settled to 1.27 kt. Because the amount of petrol for transportation has not changed (5.5 billion litres according to statline.CBS.nl) the expulsion losses have been constant for years now.

Measures influencing the calculation
Although both the stage 1 and the stage 2 measures are implemented since 2005, a rest emission of 25% of pre-implementation emission will remain. No further emission reduction measures are foreseen. Although the mobility increases, the sale of petrol remains constant. The sale of diesel however did increase.

b) Emission factors
The factors for the emission by petrol leakage are unknown.

NMVOC (kT)	**Amount Petrol**	**Expulsion losses**		**Spillage**	**Total**	**Realization**
year	(billion litre)	storage	car's	refueling car's	losses	Stage I and II
1980	?	5.1	4.9	0.6	10.6	
1990	?	4.9	4.9	0.6	10.4	
2001	5.5	0.0	1.9	0.4	2.5	Stage 1
2005	5.5	0.0	1.3	0.3	1.6	Stage II
2011	5.7	0.0	1.3	0.3	1.6	
2012	5.4	0.0	1.3	0.3	1.6	

Substance in LPG	**Emission factor**
propane	0.5
butane	0.5

Butane/propane (kT)	Amount Petrol	Losses	Spillage refueling car's (kT)		
year	(billion litres)	storage	LPG total	wv butane	wv propane
1985	1.5	0.0	0.26	0.13	0.13
1990	1.5	0.0	0.24	0.12	0.12
2001	1.0	0.0	0.16	0.08	0.08
2005	0.7	0.0	0.11	0.06	0.06
2011	0.5	0.0	0.09	0.045	0.045

24.3 Uncertainty

The uncertainties of the emission calculation are not quantified.

Quality codes

Substance	Activity data	Emission factor	Emission
NMVOC	B	C	C

24.4 Spatial allocation

The emissions of the petrol stations are assigned to the locations of the petrol stations (SBI 47.3) in the Netherlands according the ratio of employees at the petrol stations point. Details are available at: http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation).

24.5 References

ER, 2009. Netherlands Emission Registry. Data on 2009 available www.emissieregistratie.nl

VROM, Besluit ‘tankstations en milieubeheer’ en ‘herstelinrichtingen voor motorvoertuigen en milieubeheer’ en het wijzigingsbesluit daarop (Stb 1996, 228).

Comprimo (briefrapport 18 november1994) over schattingen voor lekverliezen van benzine.

www.statline.CBS.nl

24.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

25 Residential combustion, Wood stoves and Fire places (CRF 1.A.4.b)

In this paragraph the emissions from wood combustion by consumers are described.

Process description	Emk_code	CRF_code	NFR_code	Sector
Residential wood combustion	T012200	1A4bi	1A4bi	CON

25.1 Description emission source

In the Netherlands residential combustion of wood is mainly done to create a cosy atmosphere. Although wood combustion in stoves is sometimes considered more environmentally friendly, there are hardly any houses in the Netherlands that use wood combustion as their main heat source.
The wood combustion in stoves and fire places leads to various emissions. The emissions of CO_2 are the result of biomass burning and therefore reported as such. Besides CO_2, also CH_4, N_2O, NO_X, particulate matter, VOC's and other compounds are emitted.

Contribution to the national emission
For the greenhouse gases this emission source is not a key source.

Wood stoves and fire places contribute relatively the most to the emissions of particulate matter. The contribution to particulate matter is about 6% of the national total. Although this is the particulate matter without condensables. If the condensables are included in the particulate matter emissions, the contribution increases to about 14% of the national total.

All contributions to the national emissions are related to the emissions in the year 2009.

25.2 Calculation

The emissions of fire places and different types of woodstoves are calculated with a model. This model is described in Jansen (2010) and Jansen (2014).

The emissions are calculated as follows for each type of stove;
Emission = Activity data x Emission factor

For the greenhouse gases this is a tier 1 methodology, since there is no differences in the emission factors for the greenhouse gases. The methodology is consistent with the IPCC 2006 Guidelines.

a) Activity data
For the year 2009 this results in a total wood use of about 1200 million kilograms in all stoves and the fire places. This is the equivalent of

17000 TJ wood burned in the stoves and fire places. The amount of wood is based on Segers (2013) (and earlier studies on wood burning in stoves for the Netherlands) and modelled in the emission model (for more details see Jansen 2010).

b) Emission factor
All emission factors are reported in the 2010 and 2014 reports about the emission model for woodstoves (Jansen 2010; 2016).
The emission factors for some substances are listed in the next table.

	EF (type of stove)				
Substance	**Fire place**	**conventional**	**approved**	**DINplus**	**unit**
CO_2	112	112	112	112	kg/GJ
CH_4	0,3	0,3	0,3	0,3	kg/GJ
N_2O	4	4	4	4	g/GJ
PM_{10}	161	194	97	52	g/GJ
Condensables	484	323	129	80	g/GJ

For the greenhouse gas emission factors, the default emission factors from the IPCC 2006 guidelines are used.

25.3 Uncertainty and Quality checks

The activity data for wood burning is calculated yearly, based on 5-yearly questionnaires. The uncertainty might therefore fluctuate over time and is estimated on 35% (ND) based on expert judgement in combination with the data in *Segers, 2010*.
The emission factors for the greenhouse gases are based on the '*IPCC guidelines 2006*', the corresponding uncertainties are reported as; 20% for CO_2 (reported as memo-item), -62.5% till 275% for N_2O and -66.6% till 200% for CH_4.

For the other substances the uncertainty in the emission factors has not been specifically determined. Based on expert judgment the uncertainty is estimated to be rated as C (see Appendix A).

Quality checks
There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

25.4 Spatial allocation

The emissions of consumers are spatially allocated in the Netherlands based on the inhabitant distribution.

Emission source/process	Allocation-parameter
Burning wood in Stoves	Population density

Details available via
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

25.5 References

Segers R., 2010, Houtverbruik huishoudens, CBS, The Netherlands

Segers R., 2013, Houtverbruik huishoudens WoOn 2012, CBS, The Netherlands

Jansen B.I., 2010, Emissiemodel houtkachels, TNO, The Netherlands

Jansen B.I., 2016, Emissiemodel houtkachels update, TNO, The Netherlands

Oldenburger et al., 2012, Houtstromenstudie, Probos, The Netherlands

25.6 Version, dates and sources

Version: 1.2
Date: March 2016
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

26 Shooting

This paragraph describes the emissions of lead to the soil by shooting.

Process description	Emk_code	Target group
Shooting	E800200	Trade and services

26.1 Description emission source

The emission source involves clay-pigeon shooting. Hunting and traditional (folklor(ist)ic) shooting is not included. Since 2008, the use of lead is in both disciplines prohibited. Lead has been replaced by steel. The emission of steel (iron) is reported by the agriculture group. Only official clay-pigeon shooters (match) have an exemption from the minister until 2016 to shoot with lead, but will probably be continued because in the international competition the shooters still use lead. Clay-pigeon shooting is only performed at one location in the Netherlands, in Emmen. Currently the number off match shooters is very small.

Contribution to the national emission
The lead emission contribution from clay-pigeon shooting to the national total is ~3%.(ER 2012).

26.2 Calculation

Since December 2004, lead shots aren't allowed anymore. According to the information from the KNSA (Koninklijke Nederlandse Schutters Associatie) there are presently only 3 clay-pigeon match shooters. Only official clay-pigeon shooters (match) have exemption release from the minister until 2016 to shoot with lead. A match shooter trains on a regular basis and shoots 14000 times per year. A shell contains 24 grams lead. Thus, a shooter uses 336 kg lead. In 2012 there were 3 match shooters in the Netherlands, thus, the emission of lead due to clay-pigeon shooting was ~1 ton. According to the KNSA the lead is, afterwards, not removed from the shooting range. In 2013 the Minister of State signed an exemption until end 2016, granting the Olympic competitive shooters another four years. However, the KNSA is invited to come up with proposal, at latest date of 1 January 2014, to avoid emission of to the environment (soil and groundwater).

26.3 Quality codes

Substance	Activity data	Emission factors	Emission
Lead	B	A	C

26.4 Spatial allocation

There is only one location in the Netherlands, Schietsportcentrum Emmen in Emmer-Compascuum.

26.5 References

Reference	Titel
Staatscourant 2004/ 237	*Besluit kleiduivenschieten WMS, 19 mei 2004*
De straat, 1996	*De Straat Milieu-adviseurs, 1996*, Beperking van de milieubelasting bij kleiduivenschieten, Projectnummer B2112, De Straat Milieu-adviseurs, Delft.
Bon, 1988	*Bon, J. van en J.J. Boersema, feb 1988,* Metallisch lood bij de jacht, de schietsport en de sportvisserij, IVEM rapport nr 24, Groningen.
VROM, 1995	*VROM/DGM, dir. Stoffen, Veiligheid, Straling, afd. Stoffen, 1995,* Circulaire Beperking loodbelasting van de bodem bij traditioneel schieten, VROM/DGM, Den Haag.
Booij, 1993	*Booij, H ,et al, sept 1993*, Alternatieven onder schot, RIVM rapport nr 710401026, RIVM, Bilthoven.
VROM, 1999	*Traditioneel Schieten, Circulaire, VROM/DGM/SVS, 1 november 1999*
KNSA, 2011/2013	*Telefonisch onderhoud met Dhr. Duisterhof van de KNSA. http://www.knsa.nl*
Staatscourant 2013	*Beschikking van 11 juni 2013, Ontheffing verbod op gebruik van loodhagel bij het kleiduivenschieten voor topsporters. Staatscourant nr 17795*

26.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

27 Wholesale Business in fuel and remaining mineral oil products

This paragraph describes NMVOC emissions from Wholesale business in fuel and remaining mineral oil products. Before 2010 this emission source was addressed with the terms "petrol distribution points" or petrol distribution chain".

Process description	Emk_code	NFR code	Sector
Wholesale business in fuel and remaining mineral oil products.	8921100	1B2aiv	Trade and services

27.1 Description emission source

The petrol distribution points are looked upon as the link between petrol stations and refinery. In the KWS2000 project it was called "petrol distribution chain". The emissions resulting from the loading of tank Lorries at refineries and filling of large storage tanks are incorporated within the emission trend of the distribution chain. Since 2001 the expulsions losses during filling of Lorries and storage tanks are no longer reported individually, but reported summed up and imply the emission resulting from petrol only.

Contribution to the national emission
The NMVOC emissions from petrol distribution chain decreased after a light increase in 1996. The decrease is mainly due to decreased NMVOC emission from storage tanks.

The contribution of NMVOC from the wholesale business and remaining mineral oil products is <1% of the total national NMVOC emission and circa 7% from the NMVOC emission from HDO (ER, 2009).

27.2 Calculation

Until 1999, emission data is based on data for 1997 and overall estimates of branch developments in the years after. In 2001 the petrol storage facilities have been interviewed through questionnaires in order to provide information about the implementation of measures and the residual emissions in 2000. Since the response to this questionnaire was limited, it was not possible to use this questionnaire in order to obtain a good picture of the VOC emissions and the implementation degree. The individual companies have not gained insight in their VOC emissions. With regard to the implementation degree of measures the questionnaire data show that in any case the major petrol storage facilities have implemented these measures, but the situation of the smaller storage facilities remains unclear (KWS 2000, 2002).

In 2004 the VPNI (Vereniging Nederlandse Petroleum Industrie: Association Dutch Petrol Indusrty) developed a reduction plan VOC emissions for the years 2000-2010. The VPNI produced emission calculations based on measures mentioned in KWS 2000.

Measure affecting the calculation
Due to the KWS2000 the following precautions were undertaken for the distribution chain:
storage tanks with internal floating deck
treatment of expulsion air
These measures were established in the departmental regulation "Storage, transfer and distribution of petrol environmental management" December 1995. There were no further reductions presented in the reduction plan VOS 2000-2010 for petrol distribution (VPNI).
Since 2003 the emissions from distribution points are kept constant.

27.3 Uncertainty

The uncertainties of the emission calculation are not quantified.
There were two general measures enforced (labelling and environmental car). The effect of these measures are unknown.

Quality codes

Substance	Activity data	Emission factor	Emission
NMVOC	C	C	C

27.4 Spatial allocation

The emissions of the Wholesale Business in fuel and remaining mineral oil products are assigned to the locations of the petrol distribution points (SBI 46.71) in the Netherlands according ratio of employees at the distribution point. Details are available at:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation).

27.5 References

ER, 2009. Netherlands Emission Registry. Data on 2009 available from www.emissieregistratie.nl

VROM Ministeriele regeling Op-, overslag en distributie benzine milieubeheer, 27 december 1995.

VNPI, P.Houtman, mrt 2004 Reductieplan VOS 2000-2010 voor de aardolieketen.

27.6 Version, dates and sources

Version: 1.1
Date: November 2013
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
J. Meesters	RIVM	Joris.Meesters@rivm.nl

Note: Since 1999 no new data is available on emission variables and emission factors. Therefore, the used data might be outdated.

28 Smoking of cigarettes and cigars

In this paragraph the emissions caused by the smoking of cigars and cigarettes are described.

Process description	Emk_code	NFR_code	Sector
Smoking of cigars	0801001	2D3i	CON
Smoking of cigarettes	0801002	2D3i	CON

28.1 Description emission source

When tobacco products are burned, the fumes contain a mix of different substances. These substances are inhaled and exhaled by the smoker or emitted to the air directly. Since smoking is found to be unhealthy, the number of people smoking declines almost yearly and the amount of tobacco products consumed is reduced.

Contribution to the national emission
The contribution of particulate matter for smoking to the total national PM10 emission is <5%.
For other important (PRTR) substances the contribution to the national total emission is <0.5%.

28.2 Calculation

Emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Number of cigars (or cigarettes) smoked
Emission factor = kg emission per number of cigars (or cigarettes) smoked

a) Activity data
Cigarettes
For the number of cigarettes most data is provided by the branch organisation for the cigarette industry (Stichting Sigaretteninductrie). The data retrieved covers the years 2005-2014 for only the number of cigarettes. For rolling tobacco, the information is retrieved from the branch organisation rolling tobacco ‘VNK’ (Vereniging Nederlandse Kerftabakindustrie). For rolling tobacco the VNK presents information for the years 2003-2013.
For the years 1990-2010 the Dutch Centre for Statics (CBS) provided information for the total amount of rolling tobacco and cigarettes. All of the above data is matching for the years that are covered by multiple data sources, however it seems like the data is not independent, but comes from the same source.
The most recent years, starting with 2014, are covered by the Trimbos institute, a research organization on mental health and addiction.

Cigars
For the years 1990 until 2006 the Dutch Centre for Statics (CBS) presented information on the consumption of cigars in the Netherlands. This information was the average number of cigars smoked per inhabitant. However since 2006 the information was no longer provided by the CBS, in 2014 contact was made with the Dutch Cigar Manufacturers Association (NVS). The NVS was willing to provide data annually starting with the data for the year 2013. The number of cigars consumed in the years between 2006 and 2013 are interpolated.

b) Emission factor
The emission factors for smoking are based on Brouwer et al 1994, written specifically for the taskforce WESP. For cigars the emission factors of are also based on a report from the American National Cancer Institute.

Substance	**Cigarettes**		**Cigars**	
	EF	**Unit**	**EF**	**Unit**
Acetaldehyde	4507	kg/ milliard pieces	2	mg/ piece
NOx	2552	kg/ milliard pieces	0.5	mg/ piece
Hydrogen cyanide	199	kg/ milliard pieces	2	mg/ piece
NH_3	9478	kg/ milliard pieces	0.07	mg/ piece
CO (till 2001) Starting 2002	64389 10000	kg/ milliard pieces	119 161	mg/ piece
CO_2 (memo)	294242	kg/ milliard pieces	305	mg/ piece
PM_{10}	52293	kg/ milliard pieces	63	mg/ piece
$PM_{2.5}$	52293	kg/ milliard pieces	63	mg/ piece
NMVOC	22767	kg/ milliard pieces	Not reported	
Acetone	663	kg/ milliard pieces	Not reported	
Acrylonitrile	57	kg/ milliard pieces	Not reported	
Acrolein	Not reported		0.13	mg/ piece
Acetic acid	Not reported		0.70	mg/ piece
Formic acid	Not reported		0.26	mg/ piece
Benzene	Not reported		0.39	mg/ piece
Phenol	Not reported		0.15	mg/ piece
Pyridine	Not reported		0.23	mg/ piece
Anthracene	Not reported		0.27	µg/ piece
Fluoranthene	Not reported		0.46	µg/ piece
Pyrene	Not reported		0.40	µg/ piece
Benzo(a)anthracene	Not reported		0.15	µg/ piece
Benzo(a)pyrene	Not reported		0.09	µg/ piece
Cadmium	Not reported		0.05	µg/ piece
Copper	Not reported		0.23	µg/ piece
Lead	Not reported		0.50	µg/ piece
Nickel	Not reported		11	µg/ piece
Zinc	Not reported		3.3	µg/ piece

28.3 Uncertainty

The activity data is reported by reliable 3rd parties. However due to inconsistency between years, the uncertainty in illegal imported tobacco products and data from branch organisations, the activity data is rated with an B.
The emission factors are based on older reports, for the cigars and cigarettes an average weight is assumed. Therefore the emission factors are rated with an C.
Overall the emissions are rated with an C.

Substance	**Activity data**	**Emission factors**	**Emission**
All	B	C	C

28.4 Spatial allocation

The emissions of consumers are regionalized in the Netherlands based on population density.

Source	Allocation-parameter
Smoking	Population density

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

28.5 Reference

Brouwer J.G.H., J.H.J. Hulskotte, H. Booij, 1994, Roken van tabaksproducten, WESP Rapportnr. C4, RIVM-rapportnr. 773009006.

28.6 Version, dates and sources

Version 1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

29 Service stations, anti-corrosive treatment

In this paragraph the emissions caused by the anti-corrosive treatment of cars are described.

Process description	Emk_code	NFR_code	Sector
Service stations, anti-corrosive treatment	8920700	2D3i	Trade and Services

29.1 Description emission source

When old cars lose their corrosive protection, they are treated with anti-corrosive products. This is mainly the case for older cars, because the newly produced cars are generally equipped with a chassis of anti-corrosive materials such as plastics or galvanized steel. This treatment is mainly done by specialized service stations (garages), due to decreasing demands, the number of workshops providing this service are decreasing. The anti-corrosive products used are a source of NMVOC, the NMVOC emissions are released in a short period after the product is applied.

Contribution to the national emission
The contribution of NMVOC from anti-corrosive treatment to the total national NMVOC emission is <1%.

29.2 Calculation

Between 1990 and 1999 the sales of anti-corrosive products is estimated by the company with the largest market share of the anti-corrosive product (KWS2000).

Starting with the year 2000 the emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of cars treated
Emission factor = kg emission per treated car

a) Activity data
It is assumed that only cars produced in 1985 or earlier need an anti-corrosive treatment. The number of old cars in the Netherlands is based on the statistics created by Statistics Netherlands (CBS). They provide the number of cars that are still in use in the Netherlands which are built before 1986. Not all those cars have to be treated each year. Under normal circumstances the treatment is only needed once every ten year. However it’s estimated that most old-timers are treated more frequent, hence it’s assumed that the cars are treated each eight year, or 12.5% of the old-timers is treated.

b) Emission factor
For each car treated the emission of NMVOC is estimated at 8 kilograms. This is based on the EMEP/EEA air pollutant emission inventory guidebook (2.D.3.d. table 3-6). However this emission factor is not specific for this type of treatment, but for a general coating application. The emission of NMVOC is distributed to individual substances based on an emission profile created by TNO in 1992.

29.3 Uncertainty

Up until 1999 the amount of NMVOC emission was estimated by expert judgement. This results in an uncertainty qualified with an C.
The total number of cars is reported by a reliable 3rd party starting with the year 2000. However the number of cars treated is based on literature study combined with expert judgement. Therefore the activity data should be rated with an B.
The emission factor for NMVOC is based on the EMEP/EEA guidebook, with the concession that the used emission factor is not specific for this type of treatment. Therefore the emission factor is rated with an D.
Overall the emissions for the whole time series are rated with an C.

Substance	Activity data	Emission factors	Emission
NMVOC	B	D	C

29.4 Spatial allocation

The emissions of consumers are regionalized in the Netherlands based on the amounts of employees within the service stations (SBI 50: garages).

Source	Allocation-parameter
Anti-corrosive treatment	Employee density within SBI 50

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

29.5 Reference

KWS2000, multiple years, Annual reports. InfoMil, Den Hague.

CBS statline. https://opendata.cbs.nl/statline/#/CBS/nl/

Dutch Emission Inventory.
http://emissieregistratie.nl/erpubliek/bumper.en.aspx

European Environment Agency.
https://www.eea.europa.eu/publications/emep-eea-guidebook-2016

29.6 Version, dates and sources

Version 1.1

Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

30 Manure of Domestic animals

In this paragraph the emissions of NH3 caused by domestic animals are described.

Process description	Emk_code	NFR_code	Sector
Manure of domestic animals	0802000	6A	Consumers

30.1 Description emission source

Within this emission source the emissions of domestic animals are calculated. Domestic animals are defined as animals not used as livestock in the agricultural industry, with the exception of horses and ponies, which are calculated by the taskforce agriculture and nature. When animals consume food, the nitrogen (N) from the food is (partly) released again. Most N is released through the excretion of faeces and urine, which results in the emission of ammonia. Emissions of other substances caused by domestic animals are considered irrelevant and therefore are not calculated.

Contribution to the national emission
The contribution of this source to the total national NH3 emission is >5%.

30.2 Calculation

For the complete time series, the emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of households
Emission factor = kg NH3 per household

a) Activity data
The number of households is derived from Statistics Netherlands.

b) Emission factor
The emission factor used by the Dutch emission inventory is based on Booij 1995, who calculated a total emission of 1220 tonne NH3 from domestic animals (cats, dogs, rabbits and birds) for the year 1990. The emission factors for cats and dogs calculated by Booij 1995 are respectively 0.18 and 0.36 kg NH3 per animal and per year. The emission calculated for cats and dogs by Booij 1995 is about 70% from the total NH3 emission from pets. With the total emission in 1990 and the number of households in 1990 an emission factor of 0.2 kg NH3 per household was calculated.

Some other authors, Joshua Fu et al 2010 and Bouwman et al 1997, report emission factors of around 0.7 kg NH3 per year for cats and around 2 kg NH3 per year for dogs. This seems high compared to Booij 1995. Furthermore most other reports seem to base their emission factor on the work of Sutton et al 2000. The presented emission factor in Sutton et al 2000 is 0.61 kg NH3 for dogs and 0.11 kg NH3 for cats each per animal and per year.

30.3 Uncertainty and Quality checks

The number of cats and dogs could be based on a survey conducted by order of DIBEVO. A sample survey generally has a relatively high uncertainty due to the number of respondents and because not all animals are taken into account. Since the data is not yearly available and not complete, the data is only used as a check.
Combining the data from the survey of DIBEVO with the emission factors in Sutton et al (2000) results in a NH3 emission that is approximately 20% lower than the NH3 emission calculated with the emission factor of 0.2 kg per household. However the survey by DIBEVO includes only cats and dogs and the emission factors are from Sutton et al 2000.

In Sutton et al 2000 the uncertainty range provided is 50%. However the emission factors according to the other studies can be higher than that.

The uncertainty in the activity data is small, rated as an A.

The emission factor is depended on the share of different domestic animals, which will vary in time. Besides that, the emission factor is probably uncertain. Therefore the emission factor is qualified with an E

The uncertainty of the total emissions is about the same as the uncertainty in the emission factor. Therefore the uncertainty in the total emission is qualified as an E.

Quality codes

Substance	Activity data	Emission factor	Emission
NH_3	A	E	E

Quality checks
There are no sector specific quality checks performed. For the general QA/QC, see chapter 2.

30.4 Spatial allocation

The emissions of ammonia from the manure of domestic animals are spatially allocated in the Netherlands based on inhabitants.

Emission source/process	Allocation-parameter
Manure of domestic animals	Inhabitants

Details available via:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

30.5 References

Booij H., 1995, Gezelschapsdieren, WESP-rapport C6, RIVM-rapport 772414003.

Feiten en cijfers gezelschapsdierensector 2015, August 2015, HAS Hogeschool

DiBeVo, https://dibevo.nl/

Neijenhuis F. and Niekerk T., 2015, 'Als de kat van huis is…', WUR report 316

http://www.nu.nl/algemeen/699151/nederlanders-houden-steeds-meer-huisdieren.html, 2006, viewed May 2015.

Joshua Fu et al, 2010, Quality Improvement for Ammonia Emission Inventory, Department of Civil and Environmental Engineering, University of Tennessee, Knoxville, TN 37996-2010

Bouwman et al, 1997, A global high-resolution emission inventory for ammonia, global biochemical cycles, Vol. 11, No. 4, pages 561-587

Sutton M.A. et al, 2000, Ammonia emissions from non-agricultural sources in the UK, Atmospheric Environment 34 (2000) 855-869

30.6 Version, dates and sources

Version: 1.0
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

31 Pesticides, domestic and not agricultural use

In this paragraph the emissions caused by pesticides used domestic or not agricultural are described.

Process description	Emk_code	NFR_code	Sector
Domestic pesticides	0802400	2D3a	Consumers
Pesticides (not agricultural usage)	0812400	2D3i	Trade and Services

31.1 Description emission source

During the domestic usage of pesticides emissions of NMVOC occur as a result of the propelling agent and/or other additives. Those are needed to distribute the pesticides in the right dosage. Domestic pesticides are mainly used against unwanted indoor bugs (flies, mosquito's, ants etc.). The non-agricultural usage of pesticides is mainly subscribed to the professional abetment of woodworm. The active pesticides are mixed with additives, those additives contain volatile organic compounds (NMVOC) which are emitted.
Pesticides used for agricultural purposes are reported by the taskforce Agriculture.

Contribution to the national emission
The contribution of NMVOC for non-agricultural and domestic pesticides usage to the total national NMVOC emission is <1%.

31.2 Calculation

During the KWS2000 project both the domestic and non-agricultural usage of pesticides have been estimated yearly for the period 1990-2000. Starting with 2001 the emissions are not updated anymore.
For the pesticides used for the pest control of woodworm, the estimate was based on the information of the largest seller of the product.
For the domestic pesticides the emission estimation was based on the information provided by four companies (resulting in the majority of market for those products).
In the year 2017 TNO researched possibilities to improve the NMVOC emissions within the taskforce WESP. However within the project no easy solution could be found to improve the emissions for domestic and non-agricultural pesticide usage due to lack of activity data. Therefore, the emissions are still based on data from the KWS2000 project.

The NMVOC is divided into single substances according to emission profiles. For domestic pesticides the NMVOC profile is based on composition of propellant agents in aerosol cans. For the non-agricultural (woodworm) pesticides the NMVOC emission profile is based on the 'Toelatingsregistratie Bestrijdingsmiddelen' (Klein, 1996), meaning 'allowance registration pesticides'.

31.3 Uncertainty

Since the data is outdated, it's not sure what the uncertainty is for the current emissions and the emission profiles. Therefore up until 2000 the emission data and emission factors could be rated with an C. However currently the emission data and emission factor should be rated with an E.

Substance	**Activity data**	**Emission factors**	**Emission**
NMVOS	B	C	C

31.4 Spatial allocation

The emissions of non-agricultural and domestic pesticides are regionalized in the Netherlands based on population density.

Source	Allocation-parameter
Domestic pesticides	Population density
Non-agricultural pesticides	Population density

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

31.5 Reference

KWS2000, multiple years, Annual reports. InfoMil, Den Hague.

Dutch Emission Inventory.
http://emissieregistratie.nl/erpubliek/bumper.en.aspx

Klein A.E. 1996, Risico-evaluatie van hulpstoffen in niet-landbouwbestrijdingsmiddelen, TNO rapport R 96/319.

31.6 Version, dates and sources

Version 1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

32 Dry cleaning of clothing and textile

In this paragraph the emissions caused by the dry cleaning of cloths and textiles are described. This paragraph includes the smaller companies (<10 employees) for consumers. Industrial cleaning of clothing and textile is covered in another paragraph.

Process description	Emk_code	NFR_code	Sector
Chemical cleaning of clothing and textile	8922200	2D3f	Trade and Services

32.1 Description emission source

The dry cleaning of clothing and textiles leads to emissions from solvents. A couple of hundred smaller companies (<10 employees) provide dry cleaning of clothing and textile as service to consumers. The emissions calculated in this chapter only contain the emissions of perchloroethylene (PER). Although in recent years the amount of dry cleaning installations using PER is reducing, no alternative emission substances have been identified and/or calculated. Alternative solvents used are for example CO2, petroleum based hydrocarbons or specialized detergents in water.
When the dry cleaning process is started, the clothing is put in a special washing machine, containing PER and detergents. The PER is heated and vaporized, after the cleaning the clean PER vapours are cooled and reused. A part of the PER forms a residue with the detergents and is wasted. A part of the PER vapour is emitted to the air. Another part of the PER goes into the ‘contact’ water, this contact water is filtered with active carbon filters and released to the sewage system.

Contribution to the national emission
The contribution of NMVOC for dry cleaning to the total national NMVOC emission to is <0.1%.
The contribution of PER for dry cleaning to the national total emission is about 20%.

32.2 Calculation

Emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Tonne of clothing and textile cleaned with PER
Emission factor = kg emission per tonne dry cleaned

a) Activity data
Between 1994 and 1998 the amount of clothing was estimated based on inhabitants and the amount of clothing and textiles each inhabitant needed to get dry cleaned.
It is assumed that the activity data for 1990-1993 is equal to 1994.

From 1999 onwards the amount of clothing cleaned is based on the statistics from NETEX, a branch organisation for dry cleaning in the Netherlands. In their annually reports the distribution of the turn-over and the percentage of PER cleaning is mentioned, although not all years give insight in the percentage of PER used as cleaning method. The use of PER as a cleaning method is declining over time. The turnover distribution is corrected for inflation, using the data from Statistics Netherlands. For the years that no percentage of PER cleaning is mentioned in the NETEX annual report, the emissions are calculated with an interpolated value of the percentage PER that is used.

b) Emission factor
Since 1980 there is a constant push to reduce the emissions of PER from dry cleaning. First the machines had to be closed, later the vapours cooled and filtered. Therefore the emission factor is decreasing over time. In 1990, the emission factor started with 40 kilograms PER for each tonne clothing and textiles cleaned. Between 2000 and 2007 the emission factor decreased from 40 kg PER to 20kg PER for each tonne cleaned product. From 2007 onwards the emission factor has been kept constant. Communication with NETEX in 2014 suggested that the emission factor could be as low as 10 kilogram. However there was no reference to support this lower emission factor. Both the 40 kilogram PER and 20 kilogram PER for each tonne of clothing and textiles match the EMEP Guidebook emission factors.

32.3 Uncertainty

The activity data is calculated by using data from different sources, therefore the activity data is rated with an E.
The emission factors are based on reliable reports, but the market share of the technique used is not known. Also the NETEX doubts the emission factor used. Therefore the emission factors are rated with an D.
Overall the emissions are rated with an E.

Substance	Activity data	Emission factors	Emission
NMVOC/PER	E	D	E

32.4 Spatial allocation

The emissions of consumers are regionalized in the Netherlands based on population density.

Source	Allocation-parameter
Dry cleaning	Companies within SBI 93.01 (empl. <10)

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

32.5 Reference

NETEX annual reports, multiple years. https://www.netex.nl/

EMEP/EEA air pollutant emission inventory guidebook 2016, 2.D.3.f Dry cleaning.

32.6 Version, dates and sources

Version 1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

33 Industrial cleaning of clothing and textile

In this paragraph the emissions caused by the cleaning of cloths and textiles are described. This paragraph includes the industrial cleaning companies (>10 employees). Dry cleaning of clothing and textile for consumers is covered in another paragraph.

Process description	Emk_code	NFR_code	Sector
Chemical cleaning of clothing and textile	8922100	2D3f	Trade and Services

33.1 Description emission source

The industrial dry cleaning of clothing and textiles leads to emissions from solvents. The bigger companies considered for this emission source are cleaning for example company clothing and cleaning cloths. The emissions calculated in this chapter contain the emissions of perchloroethylene (PER) and trichloroethene (TRI). Although in recent years the amount of installations using PER and TRI are probably reducing, no alternative emission substances have been identified and/or calculated. Alternative solvents used are for example CO_2, petroleum based hydrocarbons or specialized detergents in water.
When the dry cleaning process is started, the clothing is put in a special washing machine, containing solvents (PER or TRI) and detergents. The PER is heated and vaporized, after the cleaning the clean PER vapours are cooled and reused. A part of the PER or TRI forms a residue with the detergents and is wasted. A part of the vapour is emitted to the air. Another part of the solvent goes into the ‘contact’ water, this contact water is filtered with active carbon filters and released to the sewage system.

Contribution to the national emission
The contribution of NMVOC for industrial cleaning to the total national NMVOC emission to is <0.1%.

33.2 Calculation

Emissions are calculated as follows.
For the year 1991 the emissions of PER were calculated by the amount of PER sold to the market for cleaning purposes. This was (according to VHCP) an amount of 1690 ton. The amount of chemical waste containing PER was 600 ton, containing about 225 ton PER. This resulted in a total emission of 1690 – 225 = 1465 ton PER (for industrial cleaning and dry cleaning for consumers together). In the year 1991 the PER emissions caused by dry cleaning for consumers, was estimated at 965 ton. Resulting in an emission of 500 ton PER from the industrial cleaning of textiles and clothing.

All other estimates for this emission source have been made based on expert judgement by H. vd Berg from TNO (industrial cleaning

techniques). For the year 1995 the PER emission of industrial cleaning was estimated to be 400 ton. The emissions of TRI have been estimated at 11.9 ton in 1991 and 9.5 ton in 1995. Afterwards no new estimates are available. So the amount of emissions of both PER and TRI is assumed constant from 1995 onwards.
Most of the PER and TRI are emitted to the atmosphere. The extra emissions to water are estimated to be about 0.015% of the emissions to air.

The emission estimates for industrial cleaning of clothing and textiles are outdated. The expectation is that the amount of PER and TRI used for cleaning is reduced. It's also possible that the washing techniques are improved, resulting in less emissions.

33.3 Uncertainty

Since the data is outdated and based on expert judgement, the uncertainty is qualified with an E.

Substance	Activity data	Emission factors	Emission
All	E	E	E

33.4 Spatial allocation

The emissions of industrial cleaning companies are regionalized in the Netherlands based on company location.

Source	Allocation-parameter
Dry cleaning	Companies within SBI 93.01 (empl. >10)

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

33.5 Reference

CFK-project centre, 1991-1995, Tilburg

Berg H. van den, expert judgement by oral communication, TNO Cleaning techniques, Delft

Dutch emission inventory,
http://emissieregistratie.nl/erpubliek/bumper.en.aspx

33.6 Version, dates and sources

Version 1.0
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

34 Fumigation of transports

In this paragraph the emissions caused by fumigation of transports are described.

Process description	Emk_code	NFR_code	Sector
Fumigation of transports	E800000	2D3i	Trade and Services

34.1 Description emission source

Until 2008 containers and some bulk cargo ships were treated with methyl bromide for overseas transport. Treatment of overseas transport occurs in order to be compliant with the import legislations. For the Dutch market this is mainly done for grains, rice, cacao, nuts and animal feed. Fumigation occurs by putting pellets or tablets within the cargo container, during transport the humidity and oxygen react with the pellet to form toxic fumes containing methyl bromide. During the transport and at the port, the methyl bromide is released to air.

Contribution to the national emission
The last years of reporting, the fumigation of transports was the only source of methyl bromide.

34.2 Calculation

The emissions till 2004 are based on numbers provided by the inspection of VROM (Ministry of housing, spatial planning and environment) called the 'Inspectie Milieuhygiëne' (IMH, stands for inspection environmental hygiene). The IMH needs to check incoming transports which have been chemically treated, in order to supervise the safely degassing of the transport. However this is only the case for bulk transport. Container transport is not monitored, since it's not mandatory to report incoming containers which have been fumigated. So only the bulk transport was reported by IMH.
Between 2004 and 2008 no new data could be obtained from IMH. Since 2008 the usage of methyl bromide is prohibited. Although it's expected other substance are used, no information is found regarding amounts and substances used.
KPMG used to monitor the use of methyl bromide by questioning relevant companies in order of the CFK action program. The data KPMG used to obtain was higher then the data IMH could provide. This is caused by illegal usage, not reporting actual consumption to IMH, but also lack of control by IMH. However the data provided by IMH are considered more consistent in time, so the data of KPMG has not been used.

34.3 Uncertainty

Since this emission source is outdated, it's hard to quantify the uncertainty.

However due to the difference between the KPMG data and the IMH data, it's assumed the uncertainty is high, rated with an E.

34.4 Spatial allocation

The emissions caused by the fumigation of transports were regionalized in the Netherlands based on the location where they take place.

Source	Allocation-parameter
Fumigation of transports	Location of activity

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

34.5 Reference

VROM, IMH, department pest control, written and oral communication.

Dutch emission inventory,
http://emissieregistratie.nl/erpubliek/bumper.en.aspx

34.6 Version, dates and sources

Version 1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

35 Preserved wood

This paragraph describes the emission from preserved wood.

Process description	Emkcode	NFR code	Sector
Solvent and other product use: creosote pressure treated wood, new	0804000	2D3i	Consumers
Solvent and other product use: creosote pressure treated wood, new	0804001	2D3i	Trade and services
Solvent and other product use: creosote pressure treated wood, new	0804002	2D3i	Agriculture
Solvent and other product use: creosote pressure treated wood, new	0804003	2D3i	Transport
Solvent and other product use: creosote pressure treated wood, stock	0804100	2D3i	Consumers
Solvent and other product use: creosote pressure treated wood, stock	0804101	2D3i	Trade and services
Solvent and other product use: creosote pressure treated wood, stock	0804102	2D3i	Agriculture
Solvent and other product use: creosote pressure treated wood, stock	0804103	2D3i	Transport
CCA pressure treated wood: constructions	0804200	-	
CCA pressure treated wood: garden funiture	0804201	-	
Leaching CCA pressure treated wood at waterline boarders, stock	0804300	-	

35.1 Description emission source

Emissions from preserved wood originate from three types of preserved wood:

- wood treated with Wolman's salt (CCA pressure treated wood)
- wood treated with creosote (creosote pressure treated wood)

Wolman's salts can cause emissions of arsenic, chromium and copper. Creosote preserved wood is a source of emissions of polycyclic aromatic hydrocarbons (PAH).

35.2 Calculation

Emissions are calculated for each substance by multiplying an activity rate (AR), in this case the quantity of preserved wood, by an emission factor (EF) expressed in kg of the specific substance per m^2 of preserved wood. This method of calculation is explained in the 'Handreiking Regionale aanpak diffuse bronnen'[1]. For creosote treated wood, this is calculated using the following equation.

$$\text{Emission} = AR_l \times EF_l + \Sigma\,(AR)_s + EF_s$$

Where:
AR_l = Creosote treated wood (added last year) (m^2),
EF_l = Emission factor creosote treated wood added last year (kg/m^2) AR_s = Creosote treated wood (standing from previous years) (m^2)
EF_s = Emission factor creosote treated wood standing from previous years (kg/m^2)

Here a distinction is made between new application of creosote treated wood and standing quantities of creosote treated wood. "New application" refers to the amount of wood placed in the past year. "Standing" creosote treated wood refers to the amount of creosote treated wood placed in previous years and which is still a source of emissions.

For wood treated with Wolman's salt, the emissions caused by standing wood from past years is calculated and totaled separately, as with the following formula:

$$\text{Emission} = \Sigma\,(AR_J * EF_J)$$

Where:
AR_J = Amount of wood treated with Wolman's salt placed in year J (m^3)
EF_J = Emission factor for wood treated with Wolman's salt placed in year J (kg/m^3) The emission calculated in this way is referred to as the total emission.

a) Activity data

The activity data is the amount of preserved wood. The activity data for creosote treated wood, wood treated with Wolman's salt and carbolized wood are determined by different methods.

Creosote treated wood

For creosote treated wood, the assumption is that the emissions in the first year are higher than those in the years thereafter. This is why there are separate calculations for the new application (placed in the past year) and the standing (placed in previous years) wood.

The activity data are determined in the following manner:
The new application in 1985 and 1992 is determined by Hulskotte [2]. The quantities in 1990, 1995 and 2000 are interpolated. From 2001 on, no new

creosote treated wood was placed, pursuant to the governmental regulation called PAK-besluit [3].
The standing wood in 1992 is calculated by multiplying the new application from 1980 (500,000 m^2) by the lifetime (25 years) minus 10 years and then adding the new application of 1992 (250,000 m^2) times 10 years [2]. Because we do not count the new application from the last year with the standing wood, we subtract the 1992 figure for new application from the standing wood calculated. This results in a figure of 9,750,000 m^2 for standing wood 1992. This figure is used for the further calculation of the standing wood in the other years. Figures for standing wood in other years is calculated in the same manner:

$$\text{Standing Wood}_{\text{reporting year}} = \text{Standing Wood}_{1992} - a * \text{New App}_{1980} + \text{New App}_{1992\text{ - reporting year}}$$

Where:
$\text{Standing Wood}_{\text{reporting year}}$ = Standing Wood in 1985, 1990, 1995, 2000, 2004 or 2005, (m^2)
$\text{Standing Wood}_{1992}$ = Standing Wood in 1992, (9,750,000 m^2)
a = Number of years between reporting year and 1992
New App_{1980} = New Application in 1980, (500,000 m^2)
$\text{New App}_{1992 - \text{reporting year}}$ = Sum of the new application in the years 1992 until reporting year, (m^2)

Wood treated with Wolman's salt
Calculating the emissions by wood treated with wolman salt requires knowing how much wood was placed in previous years. These quantities are based on [4]. Because the emission factor decreases as the wood ages, counting up the total amount of standing wood will not lead to a correct result. Instead, the emission per year of new application must be determined.

Wood treated with Wolman's salt has only been used since 1979. In the years prior to that, creosote treated wood was most commonly used. For the years before 1979, the amount of wolman treated wood placed is set at 0 m^3. Its lifetime is set at 40 years [4]. From 2001 on, no new wood treated with wolman salt was used in bank revetments, because no further WVO permits (permits under the Act on Water Pollution) were issued for the product after that time.

b) Emission factors

The emission factor is the emission per quantity of preserved wood in bank revetments. The emission factors for creosote treated and wood treated with wolman salt are determined by different methods.

Creosote treated wood

For creosote treated wood, emission factors are formulated to be higher in the first year than in the years thereafter. This is why different emission factors are used for the new application of creosote treated wood and standing creosote treated wood. First, the emission factor for fluoranthene is determined. The emission factors for other substances are determined using a substance profile at leaching of the PAH.
For new application of creosote treated wood, the emission factor for fluoranthene is calculated using the following assumptions:

Emission is highest for the first 31 days. For pine wood, the assumed emission factor is 4.0 * 10^{-6} kg fluoranthene/m^2/day, and for fir, the assumed emission factor is 1.9 * 10^{-6} kg fluoranthene/m^2/day [5]. For days 32-365 of the first year, the assumed emission factor is 0.9 * 10^{-6} kg fluoranthene/m^2/day for both woods [5]. Additionally, it is assumed that pine makes up approximately 75% of the wood used, with 25% being fir [6]. When combined, this information results in an emission factor of 4.1 * 10^{-4} kg fluoranthene/m^2/year.
For calculating the emission factor for fluoranthene for standing creosote treated wood, the assumption is that this emission factor is the same as the emission factor for days 32-365 in the first year. This is an emission factor of 0.9 * 10^{-6} kg fluoranthene/m^2/day for both woods [5]. This results in an emission factor of 3.3 * 10^{-4} kg fluoranthene/m^2/year.
The emission factors for phenanthrene, anthracene and pyrene are determined using data from a report by TNO [7]. This report presents the substance profile in the leaching fluids from two reports [5, 8]. Based on the substance profile, we estimate the ratios at leaching for phenanthrene, anthracene, fluoranthene and pyrene at 65%, 5%, 15% and 15%.
The emission factor for naphthalene is taken from [9], in which the quantity of naphthalene is equal to the quantity of phenanthrene. This is why the same emission factor is used for these two substances.

Table 3: Emission factors for PAH-compounds from creosote treated wood, (10^{-3} kg/m^2) [5].

	New application	Standing
Phenanthrene	1.78	1.43
Anthracene	0.14	0.11
Fluoranthene	0.41	0.33
Pyrene	0.41	0.33
Naphthalene	1.78	1.43

Wood treated with wolman salt

The emission factors for wood treated with wolman salt depend on the type of preservative compound used to treat the wood and the leaching over the lifetime of the wood. More details about the calculation of the emission factors is available in [4]. Tables 4-6 show the emission factors for arsenic, chromium and copper, depending on the year of placement of the wood.

Table 4: Emission factors for arsenic from wood treated with wolman salt based on [4], (10^{-3} kg/m^3)

	Emission factor in reported year															
Year of new application	1985	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1979	8.19	7.61	7.15	6.83	6.44	6.44	6.4	6.3	6.2	6.2	6.1	6.0	6.0	5.9	5.9	5.9

1980	8.11	7.48	7.04	6.66	6.28	6.22	6.2	6.2	6.1	6.03	5.97	5.91	5.84	5.78	5.72	5.72
1981	7.95	7.28	6.86	6.49	6.13	6.07	6.0	6.0	5.9	5.88	5.82	5.76	5.70	5.64	5.58	5.52
1982	7.9	7.14	6.67	6.32	5.97	5.91	5.9	5.8	5.8	5.73	5.67	5.62	5.56	5.50	5.44	5.38
1983	7.83	6.99	6.53	6.14	5.8	5.75	5.7	5.6	5.6	5.58	5.52	5.46	5.41	5.35	5.30	5.24
1984	7.85	6.83	6.34	5.96	5.69	5.58	5.5	5.5	5.4	5.36	5.36	5.31	5.25	5.20	5.15	5.09
1985	8.37	6.71	6.19	5.82	5.51	5.46	5.4	5.3	5.3	5.20	5.15	5.15	5.10	5.04	4.99	4.94
1986		6.81	6.24	5.88	5.56	5.51	5.5	5.4	5.3	5.25	5.20	5.15	5.15	5.10	5.04	4.99
1987		7.02	6.34	5.93	5.62	5.56	5.5	5.5	5.4	5.30	5.25	5.20	5.15	5.15	5.10	5.04
1988		7.23	6.45	6.03	5.67	5.62	5.6	5.5	5.5	5.36	5.30	5.25	5.20	5.15	5.15	5.10
1989		7.54	6.55	6.08	5.72	5.67	5.6	5.6	5.5	5.46	5.36	5.30	5.25	5.20	5.15	5.15
1990		4.51	3.61	3.33	3.14	3.08	3.1	3.0	3.0	2.97	2.94	2.88	2.86	2.83	2.80	2.77
1991			3.67	3.36	3.16	3.14	3.1	3.1	3.0	3.00	2.97	2.94	2.88	2.86	2.83	2.80
1992			3.78	3.42	3.19	3.16	3.1	3.1	3.1	3.02	3.00	2.97	2.94	2.88	2.86	2.83
1993			3.89	3.47	3.25	3.19	3.2	3.1	3.1	3.05	3.02	3.00	2.97	2.94	2.88	2.86
1994			3.05	2.65	2.46	2.44	2.4	2.4	2.4	2.31	2.29	2.27	2.25	2.23	2.21	2.16
1995			3.1	2.48	2.29	2.25	2.2	2.2	2.2	2.16	2.12	2.10	2.08	2.06	2.04	2.02
1996				2.29	2.1	2.08	2.0	2.0	2.0	1.98	1.96	1.93	1.91	1.89	1.87	1.86
1997				2.13	1.92	1.89	1.9	1.8	1.8	1.80	1.78	1.76	1.73	1.72	1.70	1.69
1998				1.95	1.74	1.71	1.7	1.7	1.6	1.62	1.60	1.58	1.57	1.54	1.53	1.51
1999				1.69	1.47	1.45	1.4	1.4	1.4	1.37	1.35	1.33	1.32	1.31	1.28	1.27
2000				1.5	1.2	1.18	1.2	1.1	1.1	1.11	1.09	1.08	1.06	1.05	1.05	1.03
2001-2016					0	0	0	0	0	0	0	0	0	0	0	0

Table 5: Emission factors for chromium from wood treated with wolman salt based on [4], (10^{-3} kg/m^3)

	1985	1990	1995	2000	2005	2006	2007	2008 - 2017
Year of new application								
1979	0.20	0	0	0	0	0		

	0							
1980	0.202	0	0	0	0	0		
1981	0.204	0	0	0	0	0		
1982	0.206	0	0	0	0	0		
1983	0.208	0.208	0	0	0	0		
1984	0.420	0.210	0	0	0	0		
1985	1.855	0.212	0	0	0	0		
1986		0.212	0	0	0	0		
1987		0.212	0	0	0	0		
1988		0.212	0.212	0	0	0		
1989		0.424	0.212	0	0	0		
1990		2.065	0.236	0	0	0		
1991			0.236	0	0	0		
1992			0.236	0.000	0	0		
1993			0.236	0.236	0	0		
1994			0.432	0.216	0	0		
1995			1.523	0.218	0	0		
1996				0.219	0	0		
1997				0.221	0	0		
1998				0.222	0.222	0		
1999				0.431	0.215	0.215		
2000				1.461	0.209	0.209	0.209	0
2001-2016					0	0	0	0

Table 6: Emission factors for copper from wood treated with wolman salt (10^{-3} kg/m^3) based on [4].

	Emission factor in reported year															
Year of new application	1985	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1979	2.0	1.2	0.8	0.6	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1980	2.2	1.4	0.8	0.6	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1981	2.4	1.4	1.0	0.6	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1982	2.6	1.6	1.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

			0	6	4	4	4	4	4	4	2	2	2	2	2	2
1983	2.8	1.8	1.2	0.8	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2	0.2
1984	3.4	2.0	1.2	0.8	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2	0.2
1985	22.0	2.2	1.4	0.8	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.2	0.2
1986		2.4	1.4	1.0	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.2	0.2
1987		2.6	1.6	1.0	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.2
1988		2.8	1.8	1.2	0.8	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4	0.4
1989		3.4	2.0	1.2	0.8	0.8	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.4	0.4	0.4
1990		17.6	1.8	1.1	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.3
1991			1.9	1.1	0.8	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.3	0.3	0.3
1992			2.1	1.3	0.8	0.8	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.3	0.3
1993			2.2	1.4	1.0	0.8	0.8	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.3
1994			2.6	1.5	0.9	0.9	0.8	0.8	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5
1995			5.2	1.8	1.1	1.0	1.0	0.8	0.8	0.6	0.6	0.6	0.5	0.5	0.5	0.5
1996				2.0	1.2	1.2	1.0	1.0	0.8	0.8	0.7	0.7	0.6	0.5	0.5	0.5
1997				2.2	1.3	1.2	1.2	1.0	1.0	0.8	0.8	0.7	0.7	0.7	0.5	0.5
1998				2.5	1.5	1.4	1.2	1.2	1.0	1.0	0.8	0.8	0.7	0.7	0.7	0.5
1999				3.2	1.7	1.5	1.4	1.2	1.2	1.0	1.0	0.8	0.8	0.7	0.7	0.7
2000				6.4	1.9	1.7	1.5	1.4	1.2	1.2	1.0	1.0	0.8	0.8	0.7	0.7
2001-2016					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Until 1989, treatment compound CCA type B was used. In 1990, this was replaced by preservative type C [4] (see appendix 1). Preservative CCA type C contains less arsenic than CCA type B. The replacement of Type B with Type C resulted in an emission reduction of arsenic.

From 2001 on, no new creosote treated wood was placed, pursuant to the governmental regulation called PAK-besluit [3]. Likewise, from 2001 on no new wood treated with wolman salt was used in bank revetments, because no further WVO permits (permits under the Act on Water Pollution) were issued for the product after that time. Application of preserved wood in, along or above water is obliged to obtain a WVO permit. One consideration in any permitting procedure is that creosote treated wood and wood treated with wolman salt are a source of

environmental problems even though alternatives are available. Consequently, these wood preservatives are no longer be allowed in bank revetments.
From 2001 on, only emission occurs from preserved wood that was placed prior to that year.

Release into environmental compartments

The assumption for wood treated with wolman salt is that all emissions go directly to surface water [4]. For creosote treated wood, the assumption is that half of the wood comes into direct contact with water, and consequently that half of the emissions go to the soil and half to the surface water [5].

35.3 Uncertainty

The activity data for creosote treated wood, wood treated with wolman salt are both based on extrapolation of estimates. This is assigned a classification of D. The emission factors are determined using measurements supplemented with assumptions and estimates. This is assigned a classification of C (for creosote treated, wood treated with wolman salt).

35.4 Spatial allocation

The emissions of preserved wood are allocated in the Netherlands based on length of banks. Details are available at http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

35.5 References

CIW/CUWVO werkgroep VI, februari 1997. Handreiking Regionale aanpak diffuse bronnen. Bijlage 1, par 2.2.

Hulskotte, J.J.H., 1995. Diffuse bodembelasting met PAK in de provincie Zuid-Holland. TNO- rapport R95-036, Apeldoorn.

Besluit PAK-houdende coatings, Wet milieugevaarlijke stoffen. Besluit van 4 juni 1996, houdende regelen met betrekking tot het beperken van het gehalte polycyclische aromatische koolwaterstoffen (PAK) in coatings (Besluit PAKhoudende coatings Wet milieugevaarlijke stoffen [Versie geldig vanaf: 26-05-1998])

Zee, M.E. van der, 2002. Emissies van koper, chroom en arseen uit verduurzaamd hout. SHR rapport 1.513, Wageningen.

Berbee, R., 1989. Onderzoek naar uitloging in oppervlaktewater van PAK en koper, chroom, arseen uit geïmpregneerd hout. RIZA notanr. 89.049.

Bentum, F. van, e.a., 1996. Doelgroepstudie Bouwmaterialen, een analyse van de problematiek in aquatisch milieu. Project Watersysteemverkenningen. RIZA, notanr. 96.023.

TNO rapport B-91-0082, Evaluatie van onderzoek naar de uitloogkarakteristieken van verduurzaamd hout, 1991

J.F. Rijsdijk en J.D.P. de Ruiter. Uitloging van gecreosoteerd hout. VHN, rapport 1,2 en 3.

Dortland, R.J., 1986. Creosootolie en milieu. Milieutechniek 4, 65-66

Molder, R. te, 2007. Notitie ruimtelijke verdeling binnen de emissieregistratie. Een overzicht.

Most, P.F.J. van der, van Loon, M.M.J., Aulbers, J.A.W. en van Daelen, H.J.A.M., juli 1998. Methoden voor de bepaling van emissies naar lucht en water. Publicatiereeks Emissieregistratie, nr. 44.

35.6 Version, date and sources

Version: 1.0
Contact:

Emission expert	Organization	E-mail adress
J. Meesters	RIVM	joris.meesters@rivm.nl

36 Refrigerator foam

In this paragraph the emissions caused by CFC in refrigerator foam are described.

Process description	Emk_code	NFR_code	Sector
Diffuse emission isolation foam refrigerator	0890400	2D3i	Waste disposal
Diffuse emission isolation foam refrigerator	0890401	2D3a	Consumers

36.1 Description emission source

When refrigerator foam is made with CFC's as blowing agent, the CFC's are released during the use and waste of the refrigerator. Hence the Montreal protocol prohibits the use of CFC's, the production of foam with CFC-11 has ceased. Since 1995 no new refrigerators with CFC-11 isolation foam are produced for the Dutch market. The emissions are distributed evenly to the sectors consumers and waste disposal. Since 2013 the emissions are supposed to have reduced to zero.

Contribution to the national emission
The contribution is not relevant anymore, since there's no emission left.

36.2 Calculation

Emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Amount of refrigerators
Emission factor = kg emission per refrigerator

a) Activity data
The number of refrigerators is based on the year 1992, in which a total of 6.35 million refrigerators was estimated. Since 1994 the number of refrigerators containing CFC's is reduced by 350.000 each year. This results in zero refrigerators in 2013.

b) Emission factor
The emission factor is based on the year 1992. The emission calculated for this year was divided by the total amount of refrigerators. This results in an emission to air of 17 grams trichlorofluoromethane per refrigerator. This emission factor was distributed between both emission sources, giving an emission factor of 8.5 gram trichlorofluoromethane per refrigerator per emission source.

36.3 Uncertainty

The activity data is based on a single report from the year 1995. Making the uncertainty high, especially for later years, resulting in an E

The emission factor is also based on the same report. With the amount of CFC diffusing from the foam reducing over time. Those reasons make that the uncertainty should be considered high, rating it with an E.

Substance	Activity data	Emission factors	Emission
All	E	E	E

36.4 Spatial allocation

The diffuse emissions of refrigerators are regionalized in the Netherlands based on population density.

Source	Allocation-parameter
Refrigerator diffuse emissions from isolation foam	Population density

Details are available via:
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

36.5 Reference

Brouwer J.G.H. et al, 1995, Verwerking afgedankte koelapparatuur, WESP-report H-2, RIVM report 772414004, Bilthoven.

36.6 Version, dates and sources

Version 1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

37 Tanker truck cleansing

This document describes the emissions of substances from tanker truck cleansing.

Process description	EMK code	Target group	NFR category
Tanker truck cleansing	0811200	Trades and services	2D3i

37.1 Description emission source

The process is defined as the cleansing of tanker trucks by specialized cleaning companies (20 in number) united in the ATCN. There is a large variation in the loads carried by tanker trucks, e.g. orange juice, chalk powder, formaldehyde, glycol, phosphoric acid, natron leach, kerosene, wine, etc. In many cases the tanks still contain a vapor or a rest load of volatile substances, which are released during the cleaning activity. This was the case for 41,000 tanker trucks in 1999.

37.2 Calculation

Emission from cleaning tanker trucks were measured by TNO in the year 1999 and reported in the year 2000 (TNO, 2000). All annual emissions after the year 1999 have been set equal to these measured emissions. Annual emission estimations for the years earlierthan 1999 are based on estimation from the tanker truck branch and the KWS project (Infomil, 2002).

There was a meeting in 2000 with the tanker truck branch about mthat were to be taken. The outcome of the meeting led to some intervention to reduce emissions that are reported in the NIR of 2001. However, it is unknown to what extent these interventions have been incorporated. A letter has been send to the ATCN in 2005, but without any reaction. For now, emissions are assumed to be equal to those of the year 2000.

37.3 Uncertainty

Substance	Activity data	Emission factors	Emission
NMVOC			D

37.4 Spatial allocation

Spatial allocation of emissions is based on population density.

37.5 References

Infomil, 2002. KWS 2000 eindrapportage, Infomil, Den Haag 52
TNO. 2000. Vervolgonderzoek naar emissies van VOS bij tankautoreiniging in Nederland, sept 2000, TNO-MEP r2000/280, Apeldoorn

37.6 Version, date and sources

Version: 1.0
Contact:

Emission expert	Organization	E-mail adress
J. Meesters	RIVM	joris.meesters@rivm.nl

38 Accidental fires

In this paragraph the emissions caused by the accidental fires of cars and houses are described.

Process description	Emk_code	NFR_code	Sector
Accidental fires, houses	0801200	5E	Consumers
Accidental fires, cars	0801300	5E	Consumers

38.1 Description emission source

Due to accidents or sometimes on purpose, cars and houses are lost in a fire. The smoke caused by the fire is the source of the emissions. When a house or car burns, the amount of material lost in the fire is dependent on the response time of (professional) fire fighters.

Contribution to the national emission
The contribution of particulate matter for accidental fires to the total national PM_{10} emission is <0.1%.

38.2 Calculation

Emissions are calculated as follows
Emission = Activity data x Emission factor

Activity data = Number of accidental fires (house or car)
Emission factor = kg emission per accidental fire

a) Activity data
The number of houses and cars exposed to fire, was reported yearly by CBS statline, until the year 2013. Those numbers are used for the timeseries 1990-2013.
For the house fires in the years 2014 and later, an assumption was made that 0.2% of the houses is exposed to a fire.
For car fires a news article was found, giving numbers of car fires for 2015 and 2016. This article refers to 'alarmeringen.nl' and seems to be legitim. The year 2014 was interpolated from 2013 and 2015.

b) Emission factor
For the car fires the emission factors have been derived from the EMEP/EEA guidebook (EMEP/EEA, 2016) (chapter 5.E. table 3.2).
The emission factor of house fires in the EMEP/EEA guidebook (chapter 5.E. table 3.3 till 3.5) seem impropriate for the Dutch situation. The emission factor in the guidebook is based on a Norwegian study. However the houses built in Norway contain more wood and Norway is more rural.
To get an estimate for the Dutch situation, a study on the Dutch house stock by TNO is used to get an amount of combustible materials, leaving out the 95% non-combustible materials like concrete and bricks. Without the interior of the house, this results in about 10.3 tonne. Based on expert judgement the interior is estimated on 3 tonne, making

a total of 13.3 tonne. According to statistics of the fire fighters in the Netherlands (brandweerstatistiek 2013), about 90% of the fires are regarded as small and 10% as big. To correct for the amount of material destructed in the fire, for small fires it's assumed 25% of the materials is combusted and for big fires 100% of the materials is combusted. So on average 32.5% of the house is lost in a fire, resulting in about 4.3 tonne of materials burned. An emission factor of 2.5 g PM_{10}/kg was applied (based on open wood burning), resulting in 10.8 kg PM_{10}/fire. The PM_{10} emission factor was converted to a $PM_{2.5}$ and EC emission factor based on expert judgement.
The PCDD/F emission factor is based on the relation of PCDD/F and PM_{10} emission factors presented in the EMEP/EEA guidebook.
The emission factors of heavy metals presented for house fires in the guidebook are considered irrelevant for the Dutch situation, since the amounts released are very low (<<0.1%).

Substance	Houses		Cars	
	EF	Unit	EF	Unit
PM_{10}	10.8	kg/ fire	2.3	kg/ fire
$PM_{2.5}$	10.3	kg/ fire	2.3	kg/ fire
EC	2.1	kg/ fire	1.15	kg/ fire
PCDD/F (i-TEQ)	108	µg/ fire	48	µg/ fire

38.3 Uncertainty and quality checks

The uncertainty in the activity data for the years before 2014 is relatively low, since the data is reported by a reliable source. Starting with the year 2014 the activity data is not yearly reported or had to be estimated. Therefore the uncertainty is rated with a C.

The emission factor for car fires is reported within the guidebook, with a relatively high bandwidth and only 1 source mentioned. Therefore the emission factor is rated with a B.

For house fires the emission factors are based on expert judgment in combination with reliable sources. Therefore the emission factor should be rated with an D.

Source	Activity data	Emission factors	Emission
House fires	C	D	D
Car fire	C	B	C

Quality checks

The number of house fires reported by the CBS is not in line with the number of house fires reported within a report from the Dutch association for insurance companies. The insurance companies report about 7 times more house fires. However it's believed that the insurance companies report all fire related incidents. So also for example an incident with burn stains in a kitchen.

38.4 Spatial allocation

The emissions of consumers are regionalized in the Netherlands based on population density.

Source	Allocation-parameter
Accidental fires, houses and cars	Population density

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

38.5 Reference

https://www.verzekeraars.nl/publicaties/actueel/risicomonitor-woningbranden-2017

EMEP/EEA air pollutants emission inventory guidebook, 2016,
https://www.eea.europa.eu/publications/emep-eea-guidebook-2016

CBS statline
https://opendata.cbs.nl/statline/#/CBS/en/

Brandweerstatistiek 2013

38.6 Version, dates and sources

Version 1.1
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

39 Degreasing new vehicles

In this paragraph the emissions caused by the degreasing of new vehicles are described. These emissions occurred till 1999.

Process description	Emk_code	Sector
Degreasing of new vehicles	8920701	Trade and Services

39.1 Description emission source

Till 1998 cars were sometimes protected with a paraffin coating (wax) to protect them during transport. At the dealer the protective coating was removed with a solvent, resulting in emissions of NMVOC. Nowadays the cars are protected by a plastic film or a water solvable coating. However some car producers don't apply protection or only in certain means of transport.

Contribution to the national emission
This emission source is no longer occurring.

39.2 Calculation

a) Activity data
Before 1999 the emissions were calculated based on the number of imported cars (of certain brands) that were paraffin coated and dewaxed at the dealer. Most car brands had central depots with adequate air cleaning installations, so no significant emissions occurred. Between 1990 and 1993 there is a trend of less cars getting a dewaxing treatment. As mentioned other options (centralized cleaning, other coatings) reduced the need to dewax a new car.
Between 1994 and 1998 there was only one car brand left that used decentralized dewaxing.

b) Emission factors
An emission factor to air of 0.64 kilogram NMVOC per cleaned car was applied for all years. The emission factor to the sewer system was about 4.5 gram NMVOC and the direct emissions to water were estimated to be 0.3 gram NMVOC per treated car. These emission factors were estimated by TNO based on the reference year 1992. Also an emission profile for the NMVOC was determined by TNO, the NMVOC emissions were supposed to be non-aromatic hydrocarbons.

39.3 Uncertainty

Hence this method is no longer used, it's hard to quantify the uncertainty. The TNO report on the emission profile is not (publicly) available, hence the value of the emission factors is hard to judge.
If the uncertainty had to be rated, it should be qualified with an E.

39.4 Spatial allocation

The emissions of consumers are regionalized in the Netherlands based on population density.

Source	Allocation-parameter
Degreasing of new vehicles	Car maintenance companies

Details are available via :
http://www.emissieregistratie.nl/erpubliek/misc/documenten.aspx?ROOT=Algemeen (General)\Ruimtelijke toedeling (Spatial allocation)

39.5 Reference

InfoMil, KWS2000 Annual reports, multiple years, Den Hague.

CREM, November 1998, 'Monitoring VOS-emissie van 9 sectoren 1997', Amsterdam (not publicly available).

39.6 Version, dates and sources

Version 1.0
Date: February 2018
Responsibility manager task group WESP:

Administrator	Organisation	E-mail address
B.I. Jansen	TNO	bart.jansen@tno.nl

A Quality indication

The quality and reliability of the emission data is expressed in a coding system using A, B, C, D and E scores. This corresponds to the method used in EPA emission inventories in the light of EMEP/CORINAIR. The quality scores are defined as follows:

A: The data are gathered from very accurate (high precision) measurements.
B: The data are gathered from accurate measurements.
C: The data are gathered from a published source such as government statistics or industrial trade figures.
D: The data are derived from extrapolation of other measured activities.
E: The data are derived from extrapolation of foreign data.
N: Not applicable or no data available.

The reliability of the emission factors can vary substantially over years and between substances. Therefore, no confidence interval can be linked to the quality indications used. However, it can be assumed that, for a specific substance, the relative confidence decreases along the data quality classifications (A to E).