

Category		Title
NFR:	3.D.2	Domestic solvent use including fungicides
SNAP:	060408	Domestic solvent use (other than paint application)
ISIC:		
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1 Overview

This chapter addresses non-methane volatile organic compound (NMVOC) emissions from the use of solvent-containing products by members of the public in their homes. However, many of these products are also used in industry and commerce. In many cases it will be difficult or impossible to separate total sales into domestic and industrial parts. This section does not include the use of decorative paints, which is covered by source category 3.A.1.

2 Description of sources

2.1 Process description

NMVOCs are used in a large number of products sold for use by the public. These can be divided into a number of categories:

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

A further distinction can be made between aerosol and non-aerosol products.

Pesticides such as garden herbicides and insecticides and household insecticide sprays may be considered as consumer products. Most agrochemicals, however, are produced for agricultural use and fall outside the scope of this section.

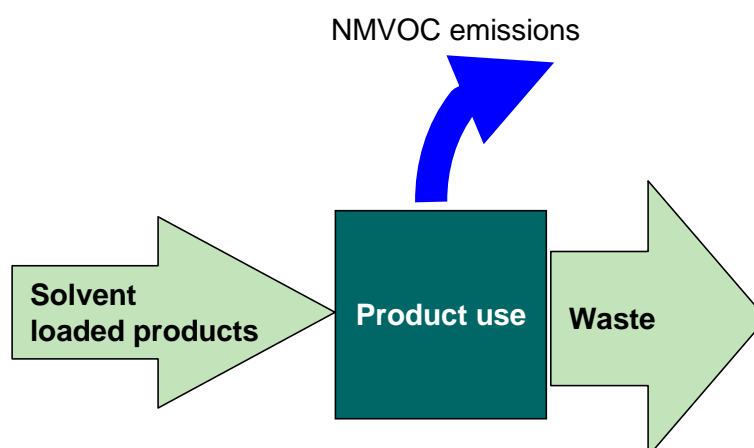


Figure 2-1 Process scheme for source category 3.D.2 Domestic solvent use

2.2 Techniques

NMVOCs in consumer products are mainly there as solvents. In aerosols, NMVOCs such as butane and propane are also used as propellants. Propellants generally act as solvents as well. Switching from an aerosol to a non-aerosol form of product will not necessarily reduce the proportion of solvent used in the product.

2.3 Emissions

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

There are few data on the NMVOC species present in consumer products. A breakdown of NMVOC emissions from all consumer products has been given by a Swiss study (ATAL, 1992).

Table 2-1 Breakdown of NMVOC emissions from all consumer products

VOC compound class	Total emission (t/a)	% of total emission
Aliphatic hydrocarbons	3 200	22
Alcohols	7 300	50
Amines	210	1
Ketones	70	1
Esters	140	1
Ethers	2 780	19
Aromatic hydrocarbons	450	3
Chlorinated hydrocarbons	190	1
Organic acids	190	1

The NMVOCs used are stated to include propane butane ethanol isopropanol ethyl acetate and butyl acetate. The following breakdown for emissions due to the use of aerosols is given in Passant (1993):

Table 2-2 Breakdown for emissions due to the use of aerosols

Compound	% wt
Alkanes	60
Alcohols	35
111-trichloroethane	2
Esters and ketones	1
Dimethylether	2

The alkanes present in emissions will be predominantly butane and propane propellants. Ethanol is likely to be the most commonly used alcohol. The most widely used solvent in cosmetics and toiletries is ethanol and in the absence of more detailed information it is recommended that all emissions from non-aerosol cosmetics and toiletries are assumed to be ethanol. No data have been found for solvent types used in household and car-care non-aerosol products.

2.4 Controls

Control of emissions from use of consumer products can only be achieved through reformulation of products to contain less NMVOC or measures to promote the use of lower boiling NMVOC products.

3 Methods

3.1 Choice of method

Figure 3-1 presents the procedure to select the methods for estimating emissions from the domestic use of solvents. The basic idea is:

- if detailed information is available, use it. For this source category, however, facility-level data will not be available. Therefore, the Tier 3 method using facility data cannot be used for this chapter;
- if the source category is a key category, a Tier 2 method must be applied and detailed input data must be collected. The decision tree directs the user in such cases to the Tier 2 method.

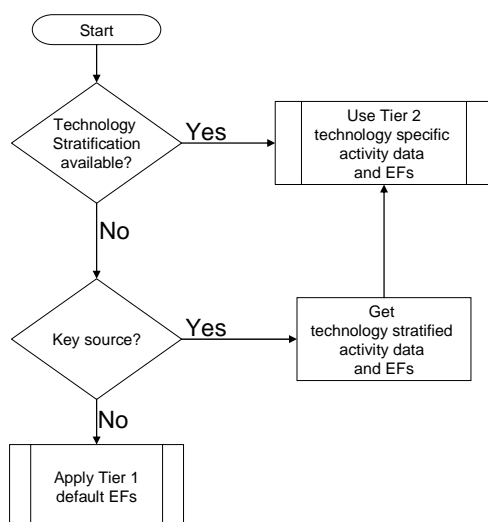


Figure 3-1 Decision tree for source category 3.D.2 Domestic solvent use

3.2 Tier 1 default approach

3.2.1 Algorithm

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

The Tier 1 emission factors assume an averaged or typical technology and abatement implementation in the country and integrate all different sub-processes within the source category. It is applied at a national level, using the national total domestic solvent use.

In cases where specific abatement options are to be taken into account a Tier 1 method is not applicable and a Tier 2 or Tier 3 approach must be used.

3.2.2 Default emission Factors

Table 3-1 presents the default emission factor for this source category. It has been derived from an assessment of the emission factors presented in the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model (International Institute for Applied Systems Analysis (IIASA), 2008). It represents a weighted average of the emission factor from this model for all the countries considered in 2000.

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

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

3.2.3 Activity data

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

3.3 Tier 2 technology-specific approach

3.3.1 Algorithm

The Tier 2 approach is similar to the Tier 1 approach. To apply the Tier 2 approach, both the activity data and the emission factors need to be stratified according to the different domestic products with solvents that may be used in the country. A list of different products (regarded here as ‘techniques’) is listed in subsection 3.3.2 of the present chapter.

The Tier 2 algorithm is as follows.

Stratify the domestic use of products in the country to model the different products occurring in this sector into the inventory by

- defining the products used in this sector (called ‘technologies’ in the formulae below) separately; and
- applying technology-specific emission factors for each product:

$$E_{\text{pollutant}} = \sum_{\text{technologies}} AR_{\text{product,technology}} \times EF_{\text{technology,pollutant}} \quad (2)$$

If, however, no direct activity data are available, penetration of different technologies within the domestic use of solvents could be estimated from other data that might reflect the relative size of each product.

A country where only one technology is implemented is basically a special case of the above approaches. The penetration of this technology in such a case is 100 % and the algorithm in equation (3) reduces to:

$$E_{\text{pollutant}} = AR_{\text{product}} \times EF_{\text{technology,pollutant}} \quad (3)$$

3.3.2 Technology-specific emission factors

Studies such as those carried out in the US are useful in providing an extensive list of consumer products which contain NMVOC. However, the bulk of NMVOC emissions will be due to the use of a relatively small number of consumer products and it is good practice to give these products priority in developing detailed estimates. Based on the US and UK data, the following products may contribute significantly to emissions (Guidebook, 2006):

Cosmetics and toiletries

Aerosols, all types
Styling aids, pumps
Styling gels
Other hair care, pumps
Antiperspirants/deodorants, pumps
Perfumes
After shave
Nail-polish remover
Astringent
Healthcare products, external
Rubbing alcohol

Car care products

Aerosols, all types
Antifreeze
Brake fluids
Car waxes and polishes
De-icer pumps
Engine degreasers
Windscreen washing fluid

Household products

Aerosols, all types
General purpose cleaners
Glass cleaner
Air freshener, slow release
Toilet blocks
Disinfectants
Waxes and polishes

DIY/buildings

Carpet/tile adhesives
Pipe cements
Construction adhesives
Paint thinners
Paint remover
Solvents

Also cooling liquid (ethylene glycol) may be an important contributor to the national total emissions from this source category.

The proportion of solvent contained in a product which is actually emitted to atmosphere will vary depending upon the manner in which it is used. The US and UK surveys assumed 100 % NMVOC emitted to atmosphere except in the case of products which are either used diluted in water (i.e. dishwasher detergents, fabric detergents, bleach, etc.), in which case 1 % was generally assumed,

or products which are removed with water after performing their function (i.e. shampoos, soaps, toothpaste, household cleaners, etc.), which were assigned factors of between 5 % and 50 % NMVOC emitted to atmosphere. The data quality of estimates made using the detailed method will depend upon the quality and quantity of data used. In theory it may be possible to obtain estimates deserving of an A rating (refer the General Guidance, Chapter 5, Uncertainties, for an explanation of the quality ratings).

The following per-person emission factors have been derived from data for the UK, Canada and the United States.

3.3.2.1 Cosmetics and toiletries

Table 3-2 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Cosmetics and toiletries

Tier 2 emission factors					
NFR Source Category	Code	Name			
	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Cosmetics and toiletries				
Region or regional conditions	USA				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	1	kg/person/year	0.5	1.5	US EPA (1995)

Table 3-3 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Cosmetics and toiletries, Non aerosol

Tier 2 emission factors					
NFR Source Category	Code	Name			
	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Cosmetics and toiletries, non aerosol				
Region or regional conditions	UK				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.2	kg/person/year	0.1	0.3	Atlantic (1995)

Table 3-4 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Cosmetics and toiletries, Non aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Cosmetics and toiletries, non aerosol				
Region or regional conditions	Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.4	kg/person/year	0.2	0.6	UNECE (1990)

Table 3-5 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Cosmetics and toiletries, Aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Cosmetics and toiletries, Aerosol				
Region or regional conditions	UK				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.5	kg/person/year	0.2	0.8	Atlantic (1995)

Table 3-6 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Cosmetics and toiletries, Aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Cosmetics and toiletries, Aerosol				
Region or regional conditions	Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.4	kg/person/year	0.2	0.6	UNECE (1990)

3.3.2.2 Household products

Table 3-7 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Household products

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Household products				
Region or regional conditions	USA				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.4	kg/person/year	0.2	0.6	US EPA (1995)

Table 3-8 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Household products, Non aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Household products, Non aerosol				
Region or regional conditions	UK, Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.2	kg/person/year	0.1	0.3	UNECE (1990); Atlantic (1995)

Table 3-9 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Household products, Aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Household products, Aerosol				
Region or regional conditions	UK				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.05	kg/person/year	0.03	0.1	Atlantic (1995)

Table 3-10 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Household products, Aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Household products, Aerosol				
Region or regional conditions	Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.3	kg/person/year	0.2	0.5	Atlantic (1995)

3.3.2.3 Car care products**Table 3-11 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Car care products**

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Car care products				
Region or regional conditions	USA				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.6	kg/person/year	0.3	1	US EPA (1995)

Table 3-12 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Car care products, Non aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Car care products, Non aerosol				
Region or regional conditions	UK				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.3	kg/person/year	0.2	0.5	Atlantic (1995)

Table 3-13 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Car care products, Non aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Car care products, Non aerosol				
Region or regional conditions	Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.6	kg/person/year	0.4	1	UNECE (1990)

Table 3-14 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Car care products, Aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Car care products, Aerosol				
Region or regional conditions	UK				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.1	kg/person/year	0.05	0.2	Atlantic (1995)

Table 3-15 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Car care products, Aerosol

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	Car care products, Aerosol				
Region or regional conditions	Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.3	kg/person/year	0.2	0.5	UNECE (1990)

Instead of the default NMVOC emission factors for car care, given in mass flow per year per person, it is also possible to estimate the emissions based on the ownership of cars. This may even be a more accurate activity statistic than the population, if the number of vehicles is known. The emission factor to be used with this activity statistic is 0.8 kg (NM)VOC per vehicle per year (Guidebook, 2006).

3.3.2.4 DIY/buildings

Table 3-16 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, DIY/buildings, Adhesives

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	DIY/buildings, Adhesives				
Region or regional conditions	UK				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	0.07	kg/person/year	0.04	0.1	Atlantic (1995)

Table 3-17 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, DIY/buildings, Adhesives

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	DIY/buildings, Adhesives				
Region or regional conditions	Canada				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.05	kg/person/year	0.03	0.1	UNECE (1990)

Table 3-18 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, DIY/buildings, Adhesives

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	DIY/buildings, Adhesives				
Region or regional conditions	USA				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.3	kg/person/year	0.1	0.5	US EPA (1995)

Table 3-19 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, DIY/buildings, Other

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.2	Domestic solvent use including fungicides			
Fuel	NA				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/Practices	DIY/buildings, Other				
Region or regional conditions	USA				
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Not estimated	PM2.5				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.2	kg/person/year	0.1	0.4	US EPA (1995)

3.3.2.5 Aerosol propellant

Table 3-20 Tier 2 emission factors for source category 3.D.2 Domestic solvent use including fungicides, Aerosol propellant

Tier 2 emission factors					
		Code	Name		
NFR Source Category		3.D.2	Domestic solvent use including fungicides		
Fuel		NA			
SNAP (if applicable)		060408	Domestic solvent use (other than paint application)		
Technologies/Practices		Aerosol propellant			
Region or regional conditions		UK			
Abatement technologies					
Not applicable		NOx, CO, SOx, NH3, TSP, PM10, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP			
Not estimated		PM2.5			
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	0.8	kg/person/year	0.4	2	Atlantic (1995)

The US survey (US Environmental Protection Agency (US EPA), 1995) is comprehensive and for many product categories includes formulation data for practically all products sold within that category. There is likely to be greater uncertainty over the proportion of solvent lost to atmosphere from such products; however, the overall quality of the US emission factors is likely to be good. A data quality B rating is probably realistic. The UK factors for non-aerosol products are based on a smaller set of formulation data; however the results have been discussed with industry who were in broad agreement with the estimates. A data quality B rating was given to these estimates. Emissions from aerosols are based on a survey by the UK aerosol manufacturers. These estimates are assigned a C data quality. The methods used to calculate the Canadian figures are not known and so no data quality rating can be given. The application of per-person emission factors to other countries does increase the uncertainties in emission estimates; however a data quality C rating seems justified for emission estimates calculated using the simpler method.

3.3.3 Abatement

Abatement options are not available for this source category.

3.3.4 Activity data

Basic activity statistics are solvent consumption for the simpler methodology and quantity of material cleaned per machine type for the detailed methodology.

3.4 Tier 3 emission modelling and use of facility data

Tier 3 is not applicable for this source.

4 Data quality

4.1 Completeness

Care should be taken to include all emissions from solvent use. There could be overlapping with other NFR source categories. It is good practice to check that indeed all emissions are included.

4.2 Avoiding double counting with other sectors

Care should be taken not to double count emissions from solvent use. There could be overlapping with other NFR source categories. It is good practice to check that indeed no emissions are double counted.

4.3 Verification

Verification of emission estimates can be carried out in a number of ways. It is good practice to carry out the most detailed methods in co-operation with product manufacturers who may be able to provide formulation data and production statistics. Estimates derived using the detailed method could be cross checked against estimates made for other countries. It is good practice to keep in mind, however, that there may be significant differences in the use of NMVOCs in consumer products from country to country. Estimates may also be compared with estimates of the quantity of solvent sold to manufacturers of consumer products derived perhaps in consultation with solvent suppliers. Formulation data where obtained from manufacturers could be verified through analysis of products.

In 2002, a study for the European Commission identified many products and emissions that are important for this source category (European Commission, 2002). This report can be very useful to verify the emissions.

4.3.1 *Best Available Technique emission factors*

The Best Available Techniques are available from the BREF STS document (European Commission, 2007).

4.4 Developing a consistent time series and recalculation

Temporal allocation of emissions can be derived from monthly consumption statistics and from information on operating schedule, work-shifts, weekend interval ,etc. If these data are not available, it is good practice to assume constant operation.

4.5 Uncertainty assessment

4.5.1 *Emission factor uncertainties*

It is good practice to note that the per capita emission factor is likely to vary considerably between countries, particularly Western and Eastern European countries.

The simple method relies upon a per person emission factor. This was derived from emissions estimates for the US, UK and Canada. The estimates for the US and UK are likely to be quite accurate, perhaps +/- 20 %. In the case of the US, since data on the NMVOC content was obtained

for products representing most of the US market, the largest uncertainty will be the proportion of NMVOC in some products which is actually emitted to air. There are likely to be differences in the per person consumption of products as the formulations used from country to country vary due to economic geographical and cultural reasons. The overall uncertainty of estimates may therefore be high perhaps as much as +/- 50 %.

The use of the detailed method will remove one uncertainty which is present in the simpler method, namely whether per person consumption of products is the same in each country. Depending upon the quantity of data relating to formulations which can be obtained, there is no reason why the detailed method should not give an accuracy of perhaps +/- 20 %. As with the US data, the largest uncertainty may be the proportion of NMVOC which is emitted to air.

4.5.2 Activity data uncertainties

No specific issues

4.6 Inventory quality assurance/quality control QA/QC

The weakest aspect of the Tier 1 method is the use of per person emission factors. There are likely to be differences in the use of consumer products in different countries due to, for instance, differences in car ownership, household size, wealth, lifestyle, product formulation and climate. It is good practice to feed back emission estimates from other countries derived using the Tier 2 or Tier 3 method into the Tier 1 method to improve the emission factors. The adoption of a range of factors to reflect geographical and economic factors could be considered.

The Tier 2 method should provide reasonably accurate estimates depending upon the quantity of data on product NMVOC content which is available. More information is required on the NMVOC contents of consumer products, especially those products which contribute most to emissions. If the formulations used are comparable in different countries, then default emission factors could be developed for use in the detailed method. The proportion of NMVOC in a product actually emitted to atmosphere may be considerably less than 100 % for some products. Further research may be necessary to determine the fate of NMVOCs contained in such products.

Better speciated data are required, especially for household and car-care non-aerosol products.

4.7 Gridding

It is good practice to disaggregate national emissions by population.

4.8 Reporting and documentation

No specific issues.

5 Glossary

Consumption	Refers to sales of products in the country concerned.
Decorative paints	Paints applied to internal walls, ceilings, woodwork, etc. As well as being decorative, they also provide protection against moisture penetration and consequent damage.
DIY	'Do It Yourself', i.e. home decoration by the general public.
Domestic	Refers to the use of products by members of the public in their own homes. These products will usually have been purchased from retail stores.
Formulation	The substances from which the product is manufactured. For aerosols this includes the propellant and solvent. Does not include the packaging materials.
Industrial use	Refers to the use of products by firms engaged in business. Includes products used for cleaning and maintaining buildings and vehicles as well as those used in the production process itself. Many products are used in industry and by households. In the construction industry there is almost a complete overlap with most of the products used by the industry also sold to the DIY market.
Production	Refers to the amount of product manufactured in the country concerned. In many cases production statistics have to be used instead of consumption statistics. They are, however, less appropriate and, if they are used, the resulting emission will have to be assigned a lower data quality.
Propellant	A compressed gas present in the headspace of an aerosol can. Until recently, CFCs were used for this purpose, but now hydrocarbons such as butane are often used. Propellants are chosen to be liquid under pressure, so that when propellant vapour is lost from the headspace on discharge of the aerosol, it is replenished by evaporation of the liquid. The liquid propellant is intimately mixed with the active ingredients and can also act as a solvent, thereby blurring the distinction between propellant and solvent. If the propellant were replaced by a mechanical pump, extra solvent would be needed.
Solvent	A liquid present in an aerosol can to dissolve solid active ingredients.
NMVOC content	The NMVOC content of a product such as a coating can be inferred from its formulation or measured by evaporation tests. The latter are more accurate, but such data are unlikely to be available.

6 References

ATAL (1992). Amt für technische Anlagen und Lufthygiene NMVOC Emissionen aus Haushaltprodukten, Zurich, February 1992.

Atlantic Consulting (1995). Emissions of Volatile Organic Compounds from Non Aerosol Consumer Products in the UK. Unpublished report commissioned by AEA Technology on behalf of the UK Department of the Environment, March 1995.

European Commission (2002). Screening study to identify reductions in VOC emissions due to the restrictions in the VOC content of products. Final report, available via http://ec.europa.eu/environment/air/pdf/paint_solvents/2002_02_bipro_final_report.pdf.

European Commission (2007). Integrated Pollution Prevention and Control (IPPC). Reference document on Best Available Technologies on Surface Treatment using Organic Solvents, August 2007.

Guidebook (2006). EMEP/Corinair Emission Inventory Guidebook, version 4 (2006 edition), published by the European Environmental Agency. Technical report No 11/2006. Available via <http://reports.eea.europa.eu/EMEPCORINAIR4/>.

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

Passant N.R. (1993). Emissions of Volatile Organic Compounds from Stationary Sources in the United Kingdom, Warren Spring Laboratory Report No LR990.

UN ECE (1990). United Nations Economic Commission for Europe, Emissions of Volatile Organic Compounds (VOC) from Stationary Sources and Possibilities for their Control, University of Karlsruhe, July 1990.

US EPA (1995). EPA consumer products survey 1995 (draft only).

7 Point of enquiry

Enquiries concerning this chapter should be directed to the relevant leader(s) of the Task Force on Emission Inventories and Projection's expert panel on combustion and industry. Please refer to the TFEIP website (www.tfeip-secretariat.org/) for the contact details of the current expert panel leaders.