

Task 3: Updates to Domestic and Other Solvent Use (3D2 & 3D3)

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Introduction

This report comprises updates and suggestions for improvements for the emission estimation methods, emission factors (EFs), activity data (AD) and uncertainties for the use of solvents in the sectors 3D2 Domestic Solvent Use and 3D3 Other Product Use.

Improved inventory methods require; comparability between countries, transparency, reflection of developments in the legislation, and quantification of uncertainties. Methods used by the different countries vary greatly, one reason being that especially categories 3D2 (Domestic Solvent Use) and 3D3 (Other Product Use) comprise a large number of products and pollutants that are categorized as NMVOCs. Hardly any specific methodologies exist in the Guidebook (GB) for these categories even though they appear to be major source categories in many countries. Some countries use a detailed mass balance relying on national production, import and export statistics while others use a simple approach of multiplying default AD and EFs based on e.g. population number. While being comparable between countries the simple method may lack considerable precision and reliability. To perform an inventory that fulfils these criteria requires high quality databases and methodological principles that utilises available data in an optimum way.

The pollutant composition and use pattern of products can vary considerably meaning that AD and EFs may not be directly extrapolated between countries. To improve the precision of the inventories an improved general methodological procedure that facilitates the implementation of EU and national product use and compositions will be assessed. This implies screening member countries methodologies and data and in more detail investigating selected countries country specific methodologies and data. In particular the improvements will build on the recent activities of the TFEIP Combustion and Industry Expert Panel and representatives from Norway who are working on a more accurate, reliable and simple method compared to the existing GB methodology, based on the Norwegian method where statistics are available for all products. The GB's EFs database will be updated with potential changes in EFs to ensure it is consistent

1 with the contents of the updated chapters. The update is done in close cooperation with the TFEIP expert
2 panel co-chairs.

3

4 Procedure

5 The updates to the GB will include compiling, analysing and aggregating information and data used by
6 countries with high quality and relatively detailed emission inventories. Many country specific information
7 and data are not inherently included in the GB and this information, primarily on EFs, may be beneficial for
8 other countries to use.

9 Priority will be given to sources, and pollutants if available, that have high emissions for countries with
10 detailed inventories. This implies that not all sources described in 3D2 and 3D3 will be given equal
11 attention. Exceptions are sources where the EF is not appropriately representative of the source, e.g.
12 underseal treatment and conservation of vehicles has a NMVOC EF with the unit kg/person/year. This
13 should be expressed pr. car rather than pr. person. Improved EF estimates will be assessed for these
14 sources.

15 The existing EFs will be assessed by investigating selected countries inventories that are based on country
16 specific EFs and AD. Countries that use GB values or other countries EFs are not included here, e.g. Spain
17 and Greece, as these will not contribute with any new information. Tier 1 EFs will be quantified as mean
18 values with respect to a representative indicator. For 3D2 persons will be used and for 3D3 used amount of
19 products will be used, if data are available.

20 AD and EFs are uncertain parameters that vary due to uncertainties in use quantities, variations in solvent
21 content in products, uncertainties in estimation (and measurement) of EFs from the different use patterns
22 of the product groups. Accordingly a final EF for any category will be defined by a mean value and 95%
23 confidence intervals representing the variations in country specific data. When only one figure defines an
24 EF this will be apparent by missing uncertainty ranges. It is important to note that such a figure may be
25 associated with considerable uncertainty, which is, however, not possible to quantify. No shape of
26 probability distribution function (DF) is stated for GB values. It can be argued that log-normal DFs are most
27 appropriate for EFs as these often exhibit large probability ranges, which are not properly assigned to
28 normal DFs, due to the possibility for negative values. Log-normal 95% confidence intervals will therefore
29 be assigned to EFs unless otherwise stated.

30 The ideal case would be to have access to AD as used amount of product. Furthermore to know solvent
31 content in product, and measurements and/or estimates of EF for solvent species under the given
32 conditions of product use, thus; $(g \text{ emitted solvent}) / (g \text{ used product})$. A challenge is always to obtain such
33 data. For products that are used in aqueous solutions and released to waste water, such as household
34 cleaning products, EF are derived from the total flow path of solvent; i.e. use of product, transport in
35 sewerage, degradation in waste water treatment plant and release to recipient. Such comprehensive
36 studies are not available for the group of solvents considered here. Simplifications must be made. For
37 product that are used in open air the path of emissions is more straightforward, however data on accurate
38 measurements are sparse.

39 Realising that not all data is available and that assumptions are necessary, countries have different ways of
40 expressing EFs:

41 1) g solvent/g used product

1 2) g solvent/g used solvent in product

2 3) g solvent/person

3 In the ideal case 1) can be derived from 2) and vice versa. With respect to 3D3 where the activities are
4 associated to specific processes and activities 1) and 2) are most appropriate to use. For domestic use all
5 three may be appropriate, however, for products and activities that are not directly associated with
6 number of persons, such as car care, 1) and 2) are best to use. In this work all three EFs are stated when
7 possible.

8 We suggest that an appropriate way of presenting EFs and AD for the categories in a Tier 2 approach will be
9 by one number for each sub-category with 95%-confidence interval limits. This differs from the present
10 version of the GB where all data, e.g. from different countries or studies, are presented. We believe that it
11 is more transparent and user-friendly to evaluate and relate to data in this way. Exception will be made
12 when data are not comparable, e.g. due to different units, and can not be aggregated in one number.

13 It is appropriate to define EFs representing the entire 3D2 and 3D3 categories. In the present GB Tier 1 EFs,
14 i.e. overall EFs that cover the entire 3D2 and 3D3, respectively are:

15 3D2: 1kg (-0.5; +3) NMVOC/person/år (IIASA, 2008)

16 3D3: 2kg (-2; +200) NMVOC/Mg product/år

17 Explanation of these numbers from GB? These can be used when no detailed information on use amounts
18 and/or EFs are available. However, large variations may be inherent in the underlying data on sub-category
19 consumption amounts, chemical composition of products, use patterns and abatement techniques.

20 When the source category is a key category and a more detailed and differentiated inventory, i.e. Tier 2, is
21 called for it is necessary to have sub-categories that represent relatively high use amounts and emissions.
22 When these sub-categories are predefined the best possibilities for comparing and sharing of data between
23 countries are available.

24 In the present GB some categories are addressed with respect to assigning Tier 2 EFs. The categories, and
25 associated SNAP numbers, in 3D3 are:

26 060404 Fat, edible and non-edible oil extraction

27 060405 Application of glues and adhesives

28 060406 Preservation of wood

29 060407 Underseal treatment and conservation of vehicles

30 060409 Vehicles dewaxing

31 060602 Use of tobacco

32
33 The GB EFs and AD will be evaluated relative to selected countries EFs and AD.

34 Some categories in 3D3 are not addressed in the GB, these are:

35 060401 Glass wool enduction

36 060402 Mineral wool enduction

37 060411 Domestic use of pharmaceutical products

38 060412 Other (preservation of seeds, etc.)

39 060508 Other

- 1 0606 Other
- 2 060601 Use of fireworks
- 3 060603 Use of shoes
- 4 060604 Other other

5
6 For these categories EFs and AD from selected countries inventories will be presented.

7 It is not always possible to differentiate domestic and industrial/professional use in the category 060604
8 Other-other in 3D3, but whenever possible this differentiation should be emphasised in the reporting.
9 Accordingly it is not always possible to assign the fraction of domestic use of this 3D3 category in 3D2
10 where it belongs. It is not clear why 060411 Domestic use of pharmaceutical products is placed in 3D3
11 when it would be most transparent to include all domestic use in 060408 Domestic solvent use (other than
12 paint application) in 3D2.

13 Based on US and UK data, the following domestic use categories and products may contribute significantly
14 to emissions (Guidebook, 2006). Some are specifically addressed in the GB with EFs:

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

Household products

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

Car care products

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

DIY/buildings

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

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

17 Some of these categories will be investigated further by assessing selected countries inventories and the
18 scientific literature for use amounts and EFs. Additional categories (products) may be considered.

19 Generally, no sub categories in 3D3 will be removed if rendered insignificant and poorly described, as they
20 may already be inherent in some countries inventories. Some new significant categories may be added and
21 the most accurate EFs will be supplemented in the GB. This is most relevant for 3D2 where there is only one
22 subcategory.

1 Country specific inventories

2 Methods

3 Ten countries have been selected for supplying input for background data on EFs and AD. The country
4 inventories are characterised by a high degree of completeness, accuracy and transparency and have
5 country specific estimates that are not directly associated with GB values. The additional information
6 compared to the existing GB is therefore high which enables an optimum basis for improving EFs and AD.

7 *Norway:* The Norwegian model is based on a mass balance per substance. The substance list is based on the
8 Swedish substance list (Skårman et al., 2006) and comprises 678 substances. AD for 355 of these are found
9 from the Norwegian Product Register where import, export and manufacture have to be declared for any
10 dangerous chemical for professional or private use. The only exception is for products that are placed on
11 the market by a given importer/producer in less than 100 kg per year. The information from the product
12 register is analysed on a substance level for different product types (UCN codes), industrial sectors (NACE
13 codes). EFs are specific for combinations of product types and industrial sector and take into account
14 different application techniques, abatement measures and alternative pathways of release (e.g. waste or
15 water). These country specific EFs apply to 12 different industries or activities that are sub-divisions of the
16 four source categories in the solvent sector. Swedish EFs are representative for Norway with respect to
17 product types, use patterns and abatement measures and save a few adjustments (Holmgren & Kittilsen,
18 2009) the Swedish EFs are used. EFs are set to zero for products where solvents are completely converted
19 through combustion processes, such as EP-additives, soldering agents and welding auxiliaries. Amounts
20 that are not registered to industrial sector or product type are given EF 0.98 (maximum). Although EFs
21 change over time all EFs are constant for all years. Cosmetics are not declared in the product register and
22 annual use amount of different cosmetic groups are obtained from the Norwegian Association of Cosmetics
23 and Toiletries and Fragrance Suppliers (KLF, <http://www.klf.no/?itemID=1448>). EFs and solvent content are
24 mainly taken from a study in the Netherlands (IVAM, 2005 se Norsk IIR s. 114?) with some country specific
25 supplements.

26 The Norwegian data for EF and AD are prepared for application in a selected group of activities and
27 products that are assessed to be most significant, with respect to emission amount, in 3D2 and 3D3. This is
28 based on work with TFEIP following the solvent expert meeting in Utrecht in 2010 where it was suggested
29 that the detailed and high quality Norwegian inventory was to be used for assisting countries with less
30 available data in improving their inventories. EFs for Norway are expressed as g solvent/g used solvent in
31 products and g solvent/person. The information for deriving EF = g solvent/g used product is available, but
32 requires extra effort in data analysis.

33 *Denmark:*

34 *Sweden:* Sold quantities of 382 substances (VOCs) and substance based products reported to the Product
35 Register at the Swedish Chemicals Agency are calculated from Production + import – export. Due to
36 confidentiality data cannot be delivered on substance level, but on product and industrial category level.
37 Product Register data are differentiated in product codes and industry categories and the amount of
38 substance in products and as raw material is determined. Country specific EFs are calculated based on
39 emission time series (1988-2001), which is based on country specific information. The EFs also consider
40 application techniques and information from industries. EFs for raw materials are set low since only a small
41 amount of the solvents will be emitted during production compared to use of products. 3D2 is included in
42 3D3 as it is not estimated separately in the Swedish model.

1 *Austria:* A combination of a top down and a bottom up approach is used. The top down approach provides
2 total amounts of solvents used based on import-export-production statistics (statistics Austria), a survey on
3 non-solvent-applications in companies (Windsperger et al., 2004; Windsperger et al., 2008) and a survey on
4 the solvent content in products and preparations at producers and retailers (Windsperger et al., 2002;
5 Windsperger et al., 2008). The bottom up approach provides the share of solvents used for the different
6 applications. The solvent EFs have been calculated on the basis of the bottom up approach. The bottom up
7 approach is based on an extensive survey on solvent use in the year 2000 in 1300 Austrian companies
8 (Windsperger et al., 2002). Information on solvent content in paints, cleaning agents and solvents used
9 (both substances and substance categories) like acetone and alcohols, type of application (cleaning,
10 product preparation). The bottom up approach also constitutes a survey in 1800 households (Windsperger
11 et al., 2002) for estimating the domestic solvent use dividing 37 categories in 5 main groups (cosmetics, DIY,
12 household cleaning, car care, fauna and flora). Moonlighting is also estimated.

13 *Netherlands:*

14 *Germany:*

15 *UK:* NMVOC emissions are assumed equal to solvents consumed in products. For consumer products and
16 smaller industrial processes, e.g. vehicle refinishing processes, the use of recovery devices such as thermal
17 oxidisers would be expensive and abatement strategies therefore concentrate on minimising the solvent
18 consumption. Solvent recovery and destruction can be ignored for these processes and uses. For larger
19 industrial solvent users, e.g. flexible packaging print works, car manufacturing plants and special coating
20 processes thermal oxidisers and other devices to capture and destroy solvent emissions are used. Emissions
21 occur due to incomplete destruction but also because some solvents avoid capture. Other uses of solvents,
22 e.g. publication gravure printing, seed oil extraction and dry cleaning, do not rely upon the solvent being
23 evaporated at some stage, and in these processes recovery and re-use of solvent is performed.
24 Manufacturers of paints, inks and other coatings wish to minimise solvent losses but here the solvent is not
25 recovered and re-used but instead contained in products, which are used elsewhere. In some applications,
26 e.g. wood treatments and bitumen, where the solvent is not entirely released to the atmosphere, the
27 methodology is based on consumption data and allows for estimating solvent not released. The
28 methodology relies on solvent consumption data for the sectors assuming that little or no solvent is
29 recovered or destroyed for aerosol and non-aerosol products used in car care, cosmetics & toiletries,
30 household products, domestic adhesives and paint thinner. Solvent consumption data at individual site
31 level with adjustment for abatement at each site are used for industrial use and EFs with assumed
32 percentage loss of solvents are assumed for activities such as wood impregnation and creosote use (UK
33 NIR, 2012).

34 *France:*

35 *Switzerland:* EFs for NMVOC are country specific based on data from industry and services and industry
36 associations. German studies on NMVOC from solvent use (Theloke et al., 2000 and Theloke, 2005) and
37 expert estimates, documented in the EMIS database (EMIS 2012/3D). The EFs for 3D2 cleaning of
38 households, the most important single source, is 900 gNMVOC/inhabitant in 2010 and remained constant
39 in the recent years. The value is based both on information from the Swiss association of cosmetics and
40 detergents and Theloke (2005). There were neither significant improvements/changes in the formulas and
41 solvent compositions of the domestic products nor a shift in individual product use, hence the increase in
42 NMVOC emissions is attributed to the increase in population only. All emissions related to domestic use of
43 solvents in 3D2 and 3D3 (domestic use of pharmaceuticals) are calculated proportional to the Swiss

1 population. 3D1 and 3D3 categories are calculated based on the basis of production volumes or number of
2 employees. AD are annual production volumes, consumption of solvents and agents, number of employees
3 and population, These data are originate from industry, services, industry associations and expert estimates
4 documented in the EMIS database (EMIS 2012/3D).

5 *Italy:* Solvents in household cleaning, car care products and cosmetics are included in 3D2. EFs have been
6 reconstructed on the basis of information provided by the European Commission (EC, 2002). For 3D3 EFs
7 are up to 2004 provided by industrial associations. After 2004 EFs are considered constant due to missing
8 new information. For 060404 default EFs do not change over the period. For 3D2 AD for solvents in
9 household cleaning and car care products are obtained from Sectoral Association of the Italian Federation
10 of the Chemical Industry (Assocasa) and Italian Association of Aerosol Producers (AIA), and cosmetics from
11 AIA, National Institute of Statistics and Industrial Associations (ISTAT) and UNIPRO.

12 **NM VOC Tier 2 data**

13 EFs and AD will be calculated as mean (\pm 95% conf interval) from countries data, given that the units are
14 the same.

15

16

17 **Comment regarding tables: Reference will be given for all numbers (some are from countries IIR) EF must**
18 **be harmonised to have same units when the summary table is made. X: specific data is required from the**
19 **countries. Request also for uncertainty estimates for EFs and AD. Final summary tables consist of one, e.g.**
20 **EF, value with \pm 95% conf. interval for each category and pollutant. Uncertainties are based on variations in**
21 **countries EFs and AD and on variations in solvent content in products.**

22

1 **Emission factors**

2 Table 1 NMVOC Emission factors for 3D2 and SNAP sub-categories.

3

Category			Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy (2010)
NFR:	3.D.2	Domestic solvent use including fungicides				3D2 is included in 3D3							
SNAP:	060408	Domestic solvent use (other than paint application)	No aggregated tier 2 EF				841,174 g/t						52,275 g/Mg product 1,810 g/person
	Sub-categories	Household (cleaning) products	<p>Household products (kg/person/year): 0.4 (±0.2)¹⁾ 0.2 (±0.1) (non aerosol)^{2),3)} 0.05 (0.03;0.1) (aerosol)²⁾ 0.3 (0.2;0.5) (aerosol)²⁾</p>	<p>Household cleaning products (all): 0.95 g solvent/g solvent in product & 522 g solvent/person Polishing agents: 0.95 & 55 Degreasers & Drain Cleaners & floor wash & basic cleaning & Auto shampoo: 0.95 & 96 Glass- and window cleaner (window polish): 0.95 & 194 Washing agents for textile (detergents) & Optical whiteners & Other cleaning/washing agents: 0.95 & 170 Other cleaning products: 0.95 & 8</p>			Household cleaning: X			Household products (t per?): 16.3 (aerosol) 7.25 (non aerosol)		Household cleaning agents (g/person): 900	<p>Household cleaning (all): 727 g/person Soaps and detergents (all): 496 g/person Laundry soaps: 0.005 g solvent/g used product & 0.92 g solvent/person Laundry soaps (powder): 0.05 & 192 Laundry soaps (liquid): 0.01 & 70 Washing aids: 0.001 & - Softeners: 0.04 & 205 Dish-washing detergents (hand): 0.005 & 24 Dish-washing agents (machine): 0.003 & 1.7 Detergents for hard surfaces: 0.002 & 7.2 Abrasives: 0.005 & - Cleaning and maintenance products (all): 230 g/person Leather, shoes, wood, pavement and metal: 0.167 g solvent/g used product & 47 g solvent/person Air fresheners: 0.4 & 117 Insecticides (domestic): 0.45 & 52 Disinfectants (domestic): 0.124 & - Hypochlorites, hypobromites etc.: 0.001 & 2.9</p>

1 Table 1 (continued)

Category		Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy (2010)
	Car care products	Car care products (kg/person/year): 0.6 (0.3;1) ¹⁾ 0.3 (0.2;0.5) (non aerosol) ²⁾ 0.6 (0.4;1) (non aerosol) ³⁾ 0.1 (0.05;0.2) (aerosol) ²⁾ 0.3 (0.2;0.5) (aerosol) ³⁾	Car care/maintenance products (all): 0.95 g solvent/g solvent in product & 319 g solvent/person Lubricants: 0.95 & 25 Wind screen washing agents: 0.95 & 294			Car care: X			Car care products t (per?): 30.5 (aerosol) 246.93 (non-aerosol)			Car maintenance products: 0.143 g solvent/g used product & 12 g solvent/person
	Cosmetics (and toiletries)	Cosmetics and toiletries (kg/person/year): 1 (±0.5) ¹⁾ 0.2 (±0.1) (non-aerosol) ²⁾ 0.4 (±0.2) (non aerosol) ³⁾ 0.5 (±0.3) (aerosol) ²⁾ 0.4 (±0.2) (aerosol) ³⁾	Cosmetics (all): 368 g/person Unit all below g/g used product: Hand & body care: 0.043 Face care: 0.13 Sun cosmetics: 0.085 Shampoo/conditioner: 0.0005 Hair styling products: 0.26 Hair dye: 0.034 Make-up: 0.019 Perfume: 0.68 Deodorant: 0.66 Tooth paste: 0.0015 Mouth wash: 0.67 Shaving products: 0.075 Soap, bath and shower products: 0.0025			Cosmetics: X			Cosmetics and toiletries (t per?): 44.6 (aerosol) 49.5 (non-aerosol)			Cosmetics, personal care products (all): 0.13 g solvent/g used product & 1083 g solvent/person: 0.27 & 252 (aerosol) 0.12 & 831 (non-aerosol)
	DIY/buildings	DIY/buildings (kg/person/year): 0.07 (±0.03) (adhesives) ²⁾ 0.05 (0.03;0.1) (adhesives) ³⁾ 0.3 (±0.2) (adhesives) ¹⁾ 0.2 (0.1;0.4) (other) ¹⁾	DIY/buildings (all): 0.95 g solvent/g solvent in product & 223 g solvent/person Colouring agents: 0.96 & 11 Impregnation agents: 0.95 & 16 Adhesives: 0.95 & 18 Paint and varnish removers: 0.95 & 12 Solvents: 0.95 & 154 Filling agents: 0.95 & 13			DIY: X			DIY/buildings (t per?): 2869 (domestic adhesives) 205 (paint thinner)		Removal of paint and lacquer (g/person): 38	

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Table 1 (continued)

Category			Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy (2010)
	Various		Aerosol propellant (kg/person/year): 0.8 (0.4;2) ²⁾	Anti-freezing agents (all): 0.95 g solvent/g solvent in product & 327 g solvent/person Cooling agents: 0.95 & 309 De-icing agents & Other anti-freezing agents: 0.95 & 19 Biocides (all): 0.80 g solvent/ g solvent in product & 89 g solvent/person Wood preservatives: 0.80 & 35 Antifouling: 0.80 & 11 Other disinfectants and biocidal products: 0.80 & 5 Other preservatives and pesticides: 0.80 & 38			Flora & fauna: X			Agrochemicals use (t per?): 146.48 (active ingredient)		Domestic use of spray cans (g/person): 225	
ISIC:													
Version	Guidebook 2009												

4 ¹⁾ US EPA (1995) derived for US conditions
5 ²⁾ Atlantic (1995) derived for UK conditions
6 ³⁾ UNECE (1990) derived for Canada conditions
7
8
9

1 Table 2 NMVOC (implied) emission factors for 3D3 and SNAP sub-categories.

Category			Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria (2008)	Netherlands	Germany	UK	France	Switzerland	Italy (2009)
NFR:	3.D.3	Other product use				3D2 is included in 3D3 (where?) as it is not estimated separately in the Swedish model							
SNAP:	060401	Glass wool enduction	No	0.25 g solvent/g solvent & 14 g solvent/person		No	No					900 g/t glass wool	800 g/Mg product
	060402	Mineral wool enduction	No	0.25 g solvent/g solvent & 5 g solvent/person		No	No					300 g/t rock wool	No
	060403	Printing Industry	Not in 3D2 or 3D3 but included in this draft	Included elsewhere		Raw material: 0.001 (unit solvent?) Remaining (of the solvent content in product?): 0.55 (unit solvent?)	669,293 g/t (same unit as AD?)					295 kg/t ink	174,227 g/Mg ink
	060404	Fat, edible and non-edible oil extraction	Yes (indsæt tal fra GB)	No		No	200,885 g/t			0.949 t (per?)		No	754 g/Mg product
	060405	Application of glues and adhesives	Yes	Other industrial application: 0.40 g solvent/g solvent & 63 g solvent/person		No	659,418 g/t			126.83 kt (per?) (industrial adhesives) 84.3 t (per?) (pressure sensitive tapes)		724 kg/t solvent	84,190 g/Mg product
	060406	Preservation of wood	Yes	Wood preservatives: 0.20 g solvent/g solvent & 5 g solvent/person Wood impregnation agents, wood preserving agents: 0.22 g solvent/g solvent & 11 g solvent/person		Raw material: 0.001 Remaining: 0.15	991,284 g/t			100 t (per?) (creosote) 900 t (per?) (LOSP)		110 kg/t preservative	No

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1 Table 2 (continued)

Category		Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria (2008)	Netherlands	Germany	UK	France	Switzerland	Italy (2009)
060407	Underseal treatment and conservation of vehicles	Yes	Wholesale and retail trade and repair of motor vehicles and motorcycles (all): 0.95 g solvent/g solvent & 500 g solvent/person Cleaning products: 0.95 & 349 Solvents: 0.95 & 66 Anti-corrosion materials: 0.95 & 35 Car care products: 0.95 & 17 Lubricants: 0.95 & 14 Polishing agents: 0.95 & 14 Metal surface treatment: 0.95 & 2 Binding agents: 0.95 & 3		No	850,000 g/t					422 kg/t underseal agent	No
060409	Vehicles dewaxing	Yes	No		No	No					No	1000 g/vehicles
060411	Domestic use of pharmaceutical products	No	No		No	940,864 g/t					36 g/person	No
060412	Other (preservation of seeds, etc.)	No	No			579,376 g/t						No

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Table 2 (continued)

Category		Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria (2008)	Netherlands	Germany	UK	France	Switzerland	Italy (2009)
	060508	Other	No	No		No						No
	0606 060601	Other Use of fireworks	No	No		No					No	No
	060602	Use of tobacco	Yes	No		No					9 kg/mio cigarette eq.	No
	060603	Use of shoes	No	No		No					No	No
	060604	Other	No	Other industrial application (all): 0.11 g solvent/g solvent & 4439 g solvent/person Biocides, except wood preservatives: 0.51 & 1045 Cleaning products: 0.16 & 507 Solvents: 0.23 & 539 Raw materials: 0.18 & 284 Anti-freezing agents: 0.35 & 415 Binding agents: 0.28 & 278 Construction materials: 0.36 & 154 Insulation materials: 0.27 & 127 Paint and varnish removers: 0.06 & 32 Metal surface treatment: 0.31 & 46 Sanitation agents: 0.94 & 27 Lubricants: 0.57 & 24 Anti-corrosion materials: 0.02 & 15 Polishing agents: 0.62 & 27 Car care products: 0.13 & 4 Other products: 0.04 & 913		Including 3D2? Raw material: 0.95 Remaining: 0.95 De-icer: Raw material: 0.001 Remaining: 0.1	No		Confidential (other solvent use)		Use of concrete additives: 915 g/t additive Use of cooling lubricants: 1 kg/t lubricant Use of lubricants: 28 kg/t lubricant Use of pesticides: 69 kg/t pesticide Commercial and industrial use of cleaning agents: 477 g/employee Cosmetic institutions: 26 kg/employee De-icing of airplanes: 246 kg/t de-icing agent Hairdressers: 14 kg/employee Health care, other: 3 kg/employee Medical practices: 12 kg/employee Scientific laboratories: 15 kg/employee	No
ISIC:												
Version	Guidebook 2009											

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1 **Activity data**

2 Table 3 NMVOC activity data for 3D2 and SNAP sub-categories.

Category			Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy
NFR:	3.D.2	Domestic solvent use including fungicides				Not in IIR							
SNAP:	060408	Domestic solvent use (other than paint application)	Basic activity statistics are solvent consumption for tier 1 and amount of material cleaned per machine for tier 2 (ref GB)				26,931 Mg solvent						2,099,131 Mg product
	Sub-categories	Household (cleaning) products		Household cleaning products (all): 2580 t Polishing agents: 274 t Degreasers & Drain Cleaners & floor wash & basic cleaning & Auto shampoo: 478 t Glass- and window cleaner (window polish): 960 t Washing agents for textile (detergents) & Optical whiteners & Other cleaning/washing agents: 830 t Other cleaning products: 38 t			Household cleaning: X			Household products: 576.46 mill units (aerosol) 1725.8 kt (non aerosol)		Household cleaning agents: 7,870,000 inhabitants	Household cleaning (all): 1607 kt: Soaps and detergents (all): 1213 kt: Laundry soaps: 11.2 Laundry soaps (powder): 232.6 Laundry soaps (liquid): 426.8 Washing aids: - Softeners: 311.4 Dish-washing detergents (hand): 291.2 Dish-washing agents (machine): 33.5 Detergents for hard surfaces: 219.4 Abrasives: - Cleaning and maintenance products (all): 395 kt: Leather, shoes, wood, pavement and metal: 17.2 Air fresheners: 17.7 Insecticides (domestic): 7.0 Disinfectants (domestic): - Hypochlorites, hypobromites etc.: 347.9

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1 Table 3 (continued)

Category		Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy
	Car care products		Car care/maintenance products (all): 1598 t Lubricants: 126 t Wind screen washing agents: 1472 t			Car care: X			Car care products: 576.46 mill units (aerosol) 127.0 kt (non-aerosol)			Car maintenance products: 5.0 kt
	Cosmetics (and toiletries)		Cosmetics (all): X? Unit all below ?: Hand & body care: X all below Face care: Sun cosmetics: Shampoo/conditioner: Hair styling products: Hair dye: Make-up: Perfume: Deodorant: Tooth paste: Mouth wash: Shaving products: Soap, bath and shower products:			Cosmetics: X			Cosmetics and toiletries: 576.46 mill units (aerosol) 317.0 kt (non-aerosol)			Cosmetics (all): 492 t: 56,679 (aerosol) 434,979 (non-aerosol)
	DIY/buildings		DIY/buildings (all): 1105 t Colouring agents: 54 t Impregnation agents: 78 t Adhesives: 89 t Paint and varnish removers: 60 t Solvents: 760 t Filling agents: 64 t			DIY X			DIY/buildings: 244.25 kt (domestic adhesives) 62.262 mill people (paint thinner)		Removal of paint and lacquer: 7,870,000 inhabitants	

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1 Table 3 (continued)

Category		Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria (2008)	Netherlands	Germany	UK	France	Switzerland	Italy
	Various		Anti-freezing agents (all): 1634 t Cooling agents: 1542 t De-icing agents & Other anti-freezing agents: 92 t Biocides (all): 518 t Wood preservatives: 205 t Antifouling: 62 t Other disinfectants and biocidal products: 30 t Other preservatives and pesticides: 221 t			Flora & fauna: X			Agrochemicals use: 26.352 kt (active ingredient)		Domestic use of spray cans: 7,870,000 inhabitants	
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2 Table 4 NMVOC activity data for 3D3 and SNAP sub-categories.

Category			Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy
NFR:	3.D.3	Other product use				Not in IIR							
SNAP:	060401	Glass wool enduction	No	269 t			No					35,698 t	68,228 Mg product
	060402	Mineral wool enduction	No	588 t			No					56,376 t	No
	060403	Printing Industry	Not in 3D2 or 3D3 but included in this draft	Included elsewhere			12,247 Mg solvent					15,154 t	111,550 Mg ink
	060404	Fat, edible and non-edible oil extraction	Yes (indsæt tal fra GB)	No			175 Mg solvent			2282 kt (per?)		0 t	7,683,754 Mg product
	060405	Application of glues and adhesives	Yes	Other industrial application: 732 t			412 Mg solvent			244.25 kt (per?) (industrial adhesives) 4.0595 kt (per?) (pressure sensitive tapes)		1,212 t solvent	278,495 Mg product
	060406	Preservation of wood	Yes	Wood preservatives: 798 t Wood impregnation agents, wood preserving agents: 284 t			818 Mg solvent			12.324 kt (per?) (creosote) 3.332 kt (per?) (LOSP)		7,615 t	No

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1 Table 4 (continued)

Category		Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy
060407	Underseal treatment and conservation of vehicles	Yes	Wholesale and retail trade and repair of motor vehicles and motorcycles (all): 2473 t Cleaning products: 1724 t Solvents: 328 t Anti-corrosion materials: 171 t Car care products: 86 t Lubricants: 67 t Polishing agents: 68 t Metal surface treatment: 11 t Binding agents: 17 t			223 Mg solvent					30 t	No
060409	Vehicles dewaxing	Yes	No			No					0 employees	2,177,601 g/vehicles
060411	Domestic use of pharmaceutical products	No	No			7,459 Mg solvent					7,870,000 inhabitants	No
060412	Other (preservation of seeds, etc.)	No	No			17,019 Mg solvent					No	No

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Table 4 (continued)

Category			Guidebook (2009)	Norway (average 2005-10)	Denmark	Sweden	Austria	Netherlands	Germany	UK	France	Switzerland	Italy
	060508	Other	No	No			No						No
	0606 060601	Other Use of fireworks	No	No			No					1,400 t	No
	060602	Use of tobacco	Yes	No			No					13,531 mio cigarette eq.	No
	060603	Use of shoes	No	No			No					No	No
	060604	Other	No	Other industrial application (all): 196,321 t Biocides, except wood preservatives: 10,633 t Cleaning products: 16657 t Solvents: 12493 t Raw materials: 7709 t Anti-freezing agents: 5450 t Binding agents: 4726 t Construction materials: 2311 t Insulation materials: 2259 t Paint and varnish removers: 2950 t Metal surface treatment: 768 t Sanitation agents: 137 t Lubricants: 181 t Anti-corrosion materials: 5449 t Polishing agents: 177 t Car care products: 1810 t Other products: 122,649 t			No			Confidential (other solvent use)	Use of concrete additives: 34,231 t Use of cooling lubricants: 8,038 t Use of lubricants: 4,462 t Use of pesticides: 1,385 t Commercial and industrial use of cleaning agents: 4,300,769 employees Cosmetic institutions: 3,923 employees De-icing of airplanes: 1,700 t Hairdressers: 22,846 employees Health care, other: 167,308 employees Medical practices: 50,769 employees Scientific laboratories: 23,462 employees	No	
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Version	Guidebook 2009												

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2 **Other pollutants**

3 **Same tables as above but now with other pollutants:**

4 *Norway:* Use of N₂O in anaesthesia 3D? is based on sales for 2000 and number of births and bednights,
5 which are taken from the Statistical yearbook each year. No EFs are applied since sales data are used (IIR
6 page 119). Use of N₂O as a propellant 3D? is based on sales volumes reported by the plants to Statistics
7 Norway. All propellant is assumed released to air. Emission estimates from mercury containing products
8 3D? are based on annual reports from the Climate and Pollution Agency

9 *Denmark:*

10 *Sweden:* Sweden reports NO_x, CO, NMVOC, Pb, Cd, Hg, As, Cr, Cu, dioxin and PAH for tobacco smoking and
11 fireworks. EFs for tobacco smoking are from the GB, and EFs for fireworks are from CEPMEIP
12 (http://www.air.sk/tno/cepmeip/em_factors_detail.php?cat_code=750000&fuel_code=DUM&snap=0605).
13 AD are from official statistics on sale. Tax free and cross-border trading of tobacco is not included. For
14 fireworks AD for 1980-1987 are based on data from after 1987.

15 *Austria:* PAHs, dioxins and HCB from 3D3 Preservation of wood, PM from 3D3 Other: Fireworks and
16 Tobacco smoking. EF and AD are not stated in IIR. Waiting for data..

17 *Netherlands:*

18 *Germany:*

19 *UK:* NH₃ from 3D2 use of household non aerosol products (confidential data), γ -HCH from 3D3 wood
20 impregnation, dioxins from 3D3 wood impregnation-PCP treatment, PCP from 3D3 wood impregnation-PCP
21 treatment, previously treated wood & wood imports, PAHs from 3D3 creosote use.

22 *France:*

23 *Switzerland:* NH₃ from 3D3 glass wool enduction. Cd, CO, Hg, NO_x, Pb, PM, PM₁₀, PM_{2.5}, SO₂ from 3D3
24 use of fireworks. BaP, BbF, BkF, IcdP, NH₃, PM, PM₁₀ and PM_{2.5} from 3D3 use of tobacco

25 *Italy:* PAHs in 3D3. EF and AD not stated in IIR

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27 **Other data from literature and IIASA and Nordic PRTR group**

28 Data from Nordic PRTR group will arrive late 2012.

29

30 **Revised EFs and AD for 3D2 and 3D3**

31 Based on the country specific data and other data, aggregated EFs and AD with associated uncertainties are
32 compiled in the tables below for NMVOC and other pollutants. Sub-categorisation of 3D2 and 3D3 Other
33 has been made to a level corresponding to those used by the countries.

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1 **Emission factors**

2 Table 5 Emission factors for 3D2 and SNAP sub-categories for all pollutants. Mean values ± 95% confidence intervals, n is number of numbers included in mean
3 estimate
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Category			NMVOC	SO2	NOx	NH3	TSP, PM10, PM2.5	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	dioxin	PAH (BaP, BbF, BkF, IcdP)	HCB	HCH	PCB	PCP	
NFR:	3.D.2	Domestic solvent use including fungicides																				
SNAP:	060408	Domestic solvent use (other than paint application)																				
	Sub-categories	Household (cleaning) products																				
		Car care products																				
		Cosmetics (and toiletries)																				
		DIY/buildings																				
		Various																				
ISIC:																						
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1 Table 6 Emission factors for 3D3 and SNAP sub-categories for all pollutants. Mean values ± 95% confidence intervals, n is number of numbers included in mean
2 estimate

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Category			NMVOC	SO2	NOx	NH3	TSP, PM10, PM2.5	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	dioxin	PAH (BaP, BbF, BkF, IcdP)	HCB	HCH	PCB	PCP	
NFR:	3.D.3	Other product use																				
SNAP:	060401	Glass wool enduction																				
	060402	Mineral wool enduction																				
	060403	Printing Industry																				
	060404	Fat, edible and non-edible oil extraction																				
	060405	Application of glues and adhesives																				
	060406	Preservation of wood																				
	060407	Underseal treatment and conservation of vehicles																				
	060409	Vehicles dewaxing																				
	060411	Domestic use of pharmaceutical products																				
	060412	Other (preservation of seeds, etc.)																				
	060508	Other																				
	0606	Other																				
	060601	Use of fireworks																				
	060602	Use of tobacco																				
	060603	Use of shoes																				
	060604	Other																				
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1 **Activity data**

2 Table 7 Activity data for 3D2 and SNAP sub-categories for all pollutants. Mean values \pm 95% confidence intervals, n is number of numbers included in mean
3 estimate
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Category			NMVOC	SO2	NOx	NH3	TSP, PM10, PM2.5	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	dioxin	PAH (BaP, BbF, BkF, IcdP)	HCB	HCH	PCB	PCP	
NFR:	3.D.2	Domestic solvent use including fungicides																				
SNAP:	060408	Domestic solvent use (other than paint application)																				
	Sub-categories	Household (cleaning) products																				
		Car care products																				
		Cosmetics (and toiletries)																				
		DIY/buildings																				
		Various																				
ISIC:																						
Version	Guidebook																					

1 Table 8 Activity data for 3D3 and SNAP sub-categories for all pollutants. Mean values ± 95% confidence intervals, n is number of numbers included in mean
2 estimate

Category			NMVOc	SO2	NOx	NH3	TSP, PM10, PM2.5	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	dioxin	PAH (BaP, BbF, BkF, IcdP)	HCb	HCH	PCB	4P	
NFR:	3.D.3	Other product use																				3 5
SNAP:	060401	Glass wool enduction																				
	060402	Mineral wool enduction																				
	060403	Printing Industry																				
	060404	Fat, edible and non-edible oil extraction																				
	060405	Application of glues and adhesives																				
	060406	Preservation of wood																				
	060407	Underseal treatment and conservation of vehicles																				
	060409	Vehicles dewaxing																				
	060411	Domestic use of pharmaceutical products																				
	060412	Other (preservation of seeds, etc.)																				
	060508	Other																				
	0606 060601	Other Use of fireworks																				
	060602	Use of tobacco																				
	060603	Use of shoes																				
	060604	Other																				
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2 **Suggestions for future work**

3 Interesting possibilities of including and utilising results from a recent work on compiling data on product
4 ingredient concentrations for seven chemical categories sponsored by the American cleaning Institute in
5 Voluntary HPV Chemical Challenge Programs, for soaps and detergents. These data are obtained from the
6 industry and comprise more than 95% of the total production and use of soaps and detergents in US (and
7 world-wide, not sure). Many of these data have not been available before due to confidentiality. However,
8 EFs are not directly deducible but must be estimated based on volatilities in aqueous solutions, which can
9 be derived from risk assessments, e.g. available from the HERA project <http://www.heraproject.com/>.
10 Furthermore use amounts can be obtained from chemical economics handbook (expensive!). This is
11 however beyond the scope of this study.

12

13 **References**

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