Category		Title
NFR:	2.D.3.i, 2.G	Other solvent and product use
SNAP:	0604	Other use of solvents and related activities
	060401	Glass wool enduction
	060402	Mineral wool enduction
	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
	060412	Other
	0605	Use of HFC, N_2O, NH_3, PFC & SF6
	060508	Other
	0606	Other product use
	060601	Use of fireworks
	060602	Use of tobacco
	060603	Use of shoes
	060604	Other
ISIC:		
Version	Guidebook 2019	

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Contents

1 Overview

This chapter describes and gives guidance on estimating emissions from ‘Other solvent and product use’. The list of SNAP codes associated with this NFR defines the detailed activities that are included in this source category. Two different NFR source categories are described in this chapter:

- NFR 2D3i (SNAP 0604): Other solvent use (solvent use not covered by NFR categories 2D3a, 2D3d-h);
- NFR 2G (SNAP 0605 and 0606): Other product use (non-solvent)

In estimating emissions from this source category, it is recommended to use country specific data wherever possible. In the present chapter, priority has been given to compiling emission factors from national inventories that are based on high quality data characterised by a high degree of completeness, accuracy and transparency and have country specific estimates that are independent from other inventories or previous Guidebook data. These countries represent western European countries, which have detailed mass balances relying on e.g. national production, import and export statistics and information from industries and trade organisations. Methods used by the different countries vary greatly, reasons being that the category comprises a large number of products and pollutants that are categorized as NMVOCs, and that usage patterns vary considerably. Furthermore model estimates from IIASA and detailed studies by US EPA, for US conditions, and UNECE for Canadian conditions, have been used.

The ideal approach when estimating emissions would be to have access to activity data as ‘used amount of product’, as well as to know the solvent content in products, and measurements and/or estimates of emission factors for solvent species under the given conditions of product use. Realising that not all data is available and that assumptions and simplifications are necessary, emission factors are given in the following way:

- Tier 1: g/g product on an aggregated level
- Tier 2: g/g product and/or g/g solvent in product. In the ideal case the one can be derived from the other. Preference should be given to g/(kg solvent in product) when both units are stated in a table

Emission factors are uncertain parameters and are represented by one number (mean value) with 95%-confidence interval limits. When only one or two figures define an emission factor the uncertainty was assessed from expert judgment, typically representing the 95% confidence interval as (- mean value/(2 to 10); + mean value *(2 to 10)), unless more reliable information was available. When more than two figures defined an emission factor, the mean value and 95% confidence interval was calculated from these. In some cases the upper and lower intervals were set to the minimum and maximum values, respectively, from the available dataset.

It was not always possible to differentiate domestic and industrial/professional use in the SNAP categories 060412 Other and 060604 Other product use-other, but whenever possible this differentiation should be emphasised in the reporting. The fraction of domestic use arising from application described in this chapter should be reported under ‘Domestic solvent use’.

2 Description of sources

2.1 Process description

2.1.1 Fat, edible and non-edible oil extraction

This activity includes solvent extraction of edible oils from oilseeds and drying of leftover seeds before resale as animal feed. The extraction of oil from oil seeds is performed either mechanically or through the use of solvents, or both. Where solvent is used, it is generally recovered and cleaned for reuse. The seed may be subjected to solvent treatment many times before all the oil is extracted. The remaining seed residue is then dried and may be used as an animal feed.

2.1.2 Preservation of wood

This activity considers industrial processes for the impregnation with, or immersion of timber to protect it against fungal and insect attack and also against weathering. There are three main types of preservative: creosote, organic solvent-based (often referred to as 'light organic solvent-based preservatives (LOSP)') and water-borne. Wood preservatives may be supplied for both industrial and domestic use. This activity only covers industrial use and does not include domestic use of wood preservatives, which is covered under NFR source category 'Domestic solvent use'. Most of the information currently available on emissions relates to the industrial use of wood preservatives. This section is not intended to cover the surface coating of timber with paints, varnishes or lacquer (see the chapter 'Paint application').

Creosote preservatives

Creosote is an oil prepared from coal tar distillation. Creosote contains a high proportion of aromatic compounds such as polycyclic aromatic hydrocarbons (PAHs).

Levels of benzo[a]pyrene in some types of creosote are restricted in the EU to 500 ppm for industrial use (14th amendment to the Marketing and Use Directive — Creosote (96/60/EEC)).

Creosote is the oldest form of wood preservative and is used for external applications such as telegraph poles and railway sleepers. Creosote is gradually being replaced by water-borne preservatives.

Creosote may be mixed with petroleum fractions to produce carbolinium. This can be brushed onto the surface of the wood and is mainly for private use.

Water-borne preservatives

Water-borne preservatives consist of solutions of inorganic salts in water. Copper, chromium and arsenic (CCA) types are the most widely used. These are usually based on copper oxide, chromium trioxide and arsenic pentoxide. In the UK, CCA formulations are supplied only to industry.

Organic solvent-borne preservatives

These consist of approximately 10 % active ingredient including insecticides and fungicides such as dinitrophenol, pentachlorophenol, chloronaphthalenes, chlorobenzenes, lindane, dieldrin, organophosphorous and carbamate compounds, and copper/zinc naphthenates, (Giddings et al

1991). The preservatives also have 90 % organic solvent, usually white spirit or other petroleum-based hydrocarbons.

2.1.3 Underseal treatment

This category addresses the application of protective coatings to the undersides of cars. This is only a very small source of emissions and can nowadays be considered negligible. The following description of the processes and controls is based on discussions with the Society of Motor Manufacturers and Traders (SMMT) (SMMT, 1997), the Association of European Automobile Manufacturers (ACEA) (ACEA, 1997) and Ford Europe (Ford Europe, 1997).

The application of coatings to the underside of car bodies can be divided into the original equipment manufacture (OEM) sector and the aftermarket (repair) sector. For the OEM sector a coating of PVC plastisol (1) is applied during manufacture to the underneath of car bodies at the same time as the primer. The body is then heated in an oven at 135 °C for about five minutes to cure both the primer and the PVC coating. This coating is applied for protection from stone chips and for sound deadening. The PVC coating is 97 %–99 % solids and is an integral part of the vehicle's coating 'package'. Any emission during manufacture will be included in any estimate of the emission from painting during vehicle manufacture (SNAP 060101 Paint application: manufacture of automobiles, included in chapter 3.A, Paint application).

In the aftermarket sector, coatings are applied to the underside of cars only during repair of damaged bodywork. This coating is the same type as in the OEM sector. These emissions will be included in car repairing (chapter 3.A, Paint application).

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

2.1.4 Vehicle dewaxing

This category considers the removal from cars of temporary coverings that are applied to protect the car's paint work during transport. This is only a very small source of emissions and nowadays can be considered negligible. The following description of the processes and controls is based on discussions with SMMT (SMMT, 1997), ACEA (ACEA, 1997) and Ford Europe (Ford Europe, 1997).

Some new cars have a protective covering applied to their bodies after painting to provide protection during transport. In the UK, this is usually done only on cars destined for export. Removal of the coating is usually done only at import centres. Cars produced for the home market are not usually given a protective covering unless there is a specific reason, for example problems at their storage location. In continental Europe, cars are transported long distances on land as well as being imported from overseas, so the driving forces affecting the use of such coatings may be different.

Transport protection coverings are not applied to the whole car body, but only to regions of the body considered vulnerable to damage during transport. The pattern of application varies from one

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(1) A colloidal suspension of fine PVC particles in a liquid plasticizer which solidifies on heating to give a rubbery material.

manufacturer to another. Some manufacturers do only the bumper, some do only the drivers door, some do the horizontal surfaces and some do the sides as well.

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

Consequently, it is recommended that the volatile organic compounds (VOC) emission from this source is assumed to be rapidly approaching zero.

2.1.5 Lubricant use

This category considers the use of lubricants covering the use phase including the process stages of input, use and output but not the production of lubricants nor end-of-life treatment / waste disposal.

The products or lubricants concerned can be divided into lubricants for automotive and industrial use with a further differentiation into different lubricant types:

- Automotive lubricants:
    - engine oil
    - gear oil inc. ATF oil (Automatic Transmission Fluid);
- Industrial lubricants:
    - gear oil
    - compressor oil
    - turbine oil
    - hydraulic oil
    - electro insulating oil
    - machine oil
    - process oil
    - other industrial oils not for lubricating purposes
    - metal working fluids
    - greases
    - base oil
    - extracts from lubricant refining.

Emissions from the use of lubricants in 2-stroke engines should be considered in the Energy Sector and 2-stroke engine oils must be excluded from the activity data here.

2.1.6 Application of adhesives

Sectors using adhesives are very diverse (Peters et al., 2002; the Expert Group on Techno-economic Issues (EGTEI, 2003). Production processes and application techniques are also very different.

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

In Germany, the shares of the different market segments were as follows in 2000 (Peters et al., 2002):

34 % for the non-industrial sector (DIY and construction industry), 35 % for the paper and packaging industry, 15 % for the wood and furniture industry, 5 % for transportation, 3 % for the footwear and leather industry and 8 % for others.

The following shares are given for UK in 1992 (Entec, 1999):

34 % for packaging (1 % of total solvent-based adhesives), 16 % for non-industrial application of adhesives (24 % of solvent-based adhesives), 14 % for tapes and labels (46 % of solvent-based adhesives), 7 % for wood and furniture industry (4 % of solvent-based adhesives), 3 % for book binding (0 % of solvent-based adhesives), 2 % for transportation (3 % of solvent-based adhesives), 2 % for lamination (3 % of solvent-based adhesives), 2 % for disposables (0 % of solvent-based adhesives), 1 % for footwear (5 % of solvent-based adhesives), 9 % for other (6 % of solvent-based adhesives) and 9 % for sealants (7 % of solvent-based adhesives).

2.1.7 Adhesive tapes

Adhesive tape consists of a substrate, a coupling agent, a pressure-sensitive adhesive and releasing agents.

The selection of the adhesive system depends on the technical application of the adhesive tape. At a European level, packaging adhesive tapes have a proportion of 74 % and coating adhesive tapes only 10 %.

Solvent-based adhesives (acrylate for double-sided adhesive tapes, natural rubber for packaging and cover adhesive tapes) have a proportion of 49 % in the European adhesive-tape production. Hot melts (acrylate for double-sided adhesive tapes and synthetic rubber for packaging, cover and double-sided tapes) have a proportion of 33 % and dispersions (acrylate for double-sided and packaging adhesive tapes), 18 %.

2.1.8 Tobacco combustion

This category comprises emissions arising from the combustion (smoking) of tobacco.

2.1.9 Aircraft de-icing

This category comprises emissions of NMVOC arising from the deicing of aircraft at airports.

2.2 Techniques

2.2.1 Fat, edible and non-edible oil extraction

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

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

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

2.2.2 Preservation of wood

Wood preservation is a major industry, with 6 million m3 of timber treated annually in the EU alone (Hein et al. 1994). Wood impregnation may be carried out at large plants, where control of emissions may be practical, or smaller plants, where add-on abatement systems could be prohibitively expensive.

The application of the preservative may be via vacuum processes, dipping, spraying or brushing. Vacuum processes are used widely in the UK, The Netherlands and Denmark, but in other countries dipping, spraying and brushing techniques are more common (Hein et al. 1994).

The vacuum process may vary slightly, depending on the type of preservative: creosote preservatives, water-borne preservatives and organic solvent-borne preservatives.

Creosote preservatives: timber is treated in a chamber which may be pressurised with air. The chamber is flooded with hot creosote for one to three hours. After draining, a vacuum is applied to draw off excess creosote. The timber is then left to dry in the open air.

Water-borne preservatives: these are applied in the same way as creosote.

Organic solvent-borne preservatives: timber is treated in a chamber which is subsequently evacuated. The chamber is flooded with preservative and pressurised for 5 to 20 minutes. After draining the chamber, a final vacuum is applied to draw off excess preservative. The timber is left to dry in the open air. About 15–25 % of the solvent remains in the wood which leaves the treatment plant. A large part of this residual solvent is likely to evaporate over the life of the product. The application efficiency of the vacuum process, dipping and brushing is close to 90 %. Spraying has a much lower efficiency of around 50 % (Giddings et al 1991).

2.2.3 Underseal treatment and conservation of vehicles and vehicle dewaxing

The techniques used in the activities are described in subsections 2.1.3 and 2.1.4.

2.2.4 Adhesive tapes

Three main steps can be described in the production of adhesive tapes:

- surface treatment of substrate and coating of adhesive onto the sheet-like substrate:
  - ✓ for processing of solvent-based adhesives, doctor-knife systems, accugravure- or reverse-roll-coater are used,

  - ✓ for adhesive dispersions, doctor-knife systems, reverse-roll-coater or roll-doctor-knife systems are appropriate,
  - ✓ hot melts are applied by doctor-knife systems, slot-die systems or extrusion techniques,
  - ✓ spraying techniques are rarely used;
- drying, cross-linking and cooling (for the hot melts) of the adhesive:
  - ✓ air circulation dryers, infrared dryers and radiation systems (UV radiation or electron beams for cross-linking only) are predominantly used in industrial production,
  - ✓ solvent-based adhesives and dispersions are dried thermally;
- Coiling up, cutting, etc.

2.2.5 Aircraft de-icing

De-icing agents for aircraft in Europe are typically based on propylene glycol. The total consumption and exact type of deicing fluid used is strongly dependent on actual weather situation. The key steps in the process are:

- washing off ice and snow which cannot be removed mechanically, for which the de-icing liquid contains a high proportion of propylene glycol diluted with warm water;
- applying a spray containing 50-60% propylene glycol and an additional thickener in snowy conditions, to prevent re-freezing for approximately 30-80 minutes.

2.3 Emissions

2.3.1 Fat, edible and non-edible oil extraction

Solvent recovery is an integral part of solvent extraction plant. The economics of a plant may be finely balanced on the proportion of solvent which is recovered. The efficiency of recovery is usually high, but is dictated by economic considerations, and will be limited to recovery plant on which the capital investment can be paid for by reduction in expenditure on new solvent.

The only solvent identified is hexane (Rentz et al., 1990), and any solvent which fails to be recycled will eventually be emitted. Hexane is therefore suggested as the major species emitted. Aldehydes and fatty acids are liberated during steam treatment (Swannell et al., 1991).

Emissions of non-methane volatile organic compounds (NMVOC) will also arise from the drying of spent oil seeds.

Particulate emissions can arise from transport and related mechanical handling of seed materials; in addition the material is mechanically processed (for example dehulled, flaked and milled) which can give rise to particulate matter (PM) emissions.

2.3.2 Preservation of wood

NMVOCs result from the evaporation of organic solvents and the volatile components of creosote.

White spirit, other petroleum distillates and creosote are the most common solvents used. They are complex mixtures of hydrocarbons, ranging in mass from isomers of hexane to isomers of dodecane, aromatics such as toluene and xylene, and some C6 to C12 alkenes.

The evaporation of creosote is likely to be a significant source of PAHs. In addition, the use of certain organic solvent-borne wood preservatives is a potential source of other persistent organic pollutants (POPs) such as lindane and pentachlorophenol.

These emissions may be fugitive (un-captured emissions) or captured and vented via a stack. Stack emissions may be controlled using waste gas cleaning (e.g. carbon adsorption, incineration, etc.).

Fugitive emissions can occur throughout the handling, application and drying stages of the processes. Timber impregnation using the closed double-vacuum process minimises the fugitive loss from the application process. However, the majority of the emissions occur during the drying process (Chem Systems Ltd / ERM 1996).

2.3.3 Underseal treatment and conservation of vehicles and vehicle dewaxing

Emissions from this activity can be assumed negligible. In some circumstances it may be necessary to calculate an emission estimate for previous years, where the Tier 2 emission factor for this source can be used.

2.3.4 Lubricant use

Different kinds of losses occur along the life cycles of different lubricant types,. Relevant loss mechanisms comprise leaking, drop losses, combustion, adherence to parts/ products, exports of filled vehicles (relevant for engine and gear oil), etc. Only some types of losses are of relevance with regard to air emissions and the different lubricants types differ significantly from each other. While emissions can be completely ruled out for some lubricant types (e.g. process oils), relevant emissions result from the application of other lubricant types (e.g. engine oils, metal working fluids).

Relevant emitted pollutants identified for lubricants are NMVOC and CO_2. However, only for engine oils used in machinery and in vehicle emissions could emissions of both pollutants occur and require accounting for, due to combustion of a small fraction of lubricating oils.

2.3.5 Aircraft de-icing

NMVOC emissions occur from the use of aircraft deicing fluid, resulting from the propylene glycol content.

2.4 Controls

2.4.1 Fat, edible and non-edible oil extraction

NMVOC emissions may be controlled by improving the efficiency of the solvent extraction plant and by adding abatement equipment such as water scrubbers to the drying plant.

Particulate emission controls include cyclones and fabric filters.

2.4.2 Preservation of wood

Emissions from drying can be reduced by enclosing the drying process so that air can be extracted through abatement equipment (e.g. condensation or incineration).

In addition, some reduction in emissions from the handling and application process can be made by good solvent management, housekeeping-type controls, measures to reduce spillages, enclosing the process wherever possible, and using alternative low solvent coatings where possible.

A separate abatement option for some processes which use creosote or organic solvent-borne preservative is substitution with water-borne preservatives. This abatement option would be nearly 100 % efficient for NMVOCs, but in many processes organic solvent-borne preservatives are still used where they offer substantial technical advantages (e.g. some organic solvent-borne preservatives give greater durability and are more likely to be used for wood which will be subjected to difficult environments). Many processes are therefore unlikely to substitute the preservatives they use. The applicability of this substitution option will therefore vary between countries.

Where a spraying process is used, a reduction in NMVOC emissions could be achieved (depending on the existing level of abatement) by changing the process to, for example, the vacuum process, which would improve the application efficiency from 50 to 90 %.

2.4.3 Underseal treatment and conservation of vehicles and vehicle dewaxing

Aftermarket underseal treatment of vehicles using bituminous coatings is no longer common for modern cars in much of Western Europe. It may still occur in Eastern Europe, in countries having cold climatic conditions and during the restoration and maintenance of vintage cars. This market is thus considered small. Where it is carried out emissions could be reduced by:

- using alternative non-solvent containing materials;
- carrying out the coating operation in a cabin with an extract system leading to abatement plant.

Atmospheric emissions from the application of transport protective coverings can be eliminated by the use of non-solvent containing products such as self-adhesive plastic film. The major European car manufacturers are already changing over to this method and within a few years it is expected that all will have done so.

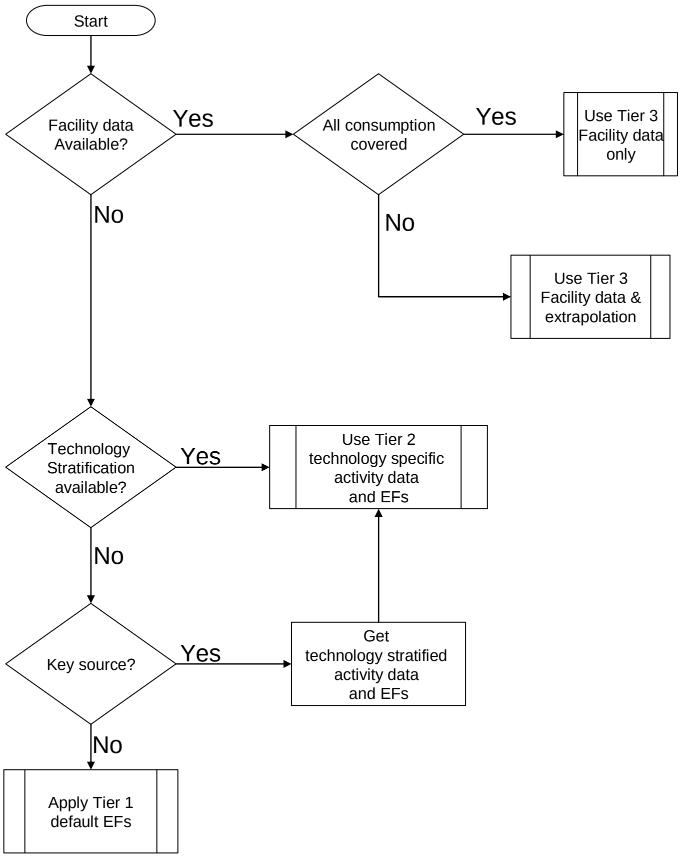
3 Methods

3.1 Choice of method

Figure 3-1 presents the procedure to select the methods for estimating emissions from this source category. The basic idea is:

- if detailed information is available, use it;
- if the source category is a key category, a Tier 2 or better 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, since it is expected that it is more easy to obtain the necessary input data for this approach than to collect facility level data needed for a Tier 3 estimate;
- the alternative of applying a Tier 3 method, using detailed process modelling, is not explicitly included in this decision tree. However, detailed modelling will always be done at facility level and results of such modelling could be seen as ‘facility data’ in the decision tree.

Figure 3-1 Decision tree for source category 2.D.3.i, 2.G Other solvent and product use



3.2 Tier 1 default approach

3.2.1 Algorithm

The Tier 1 approach for emissions from Other solvent and product use uses the general equation:

$$E_{pollutant} = AR_{production} \times EF_{pollutant} \quad (1)$$

This equation is applied at the national level, using annual totals of product use.

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.

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 provides the Tier 1 default emission factor for NMVOC emissions from source category 2.D.3.i, 2.G, Other solvent and product use. This factor has been derived from the Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model (International Institute for Applied Systems Analysis (IIASA), 2008). An assessment of the available emissions for this source category has shown that the main emission sources are the categories GLUE_INT/GLUE_INH (industrial application of adhesives) and IND_OS (other industrial use of solvents, source not covered by any other sector in GAINS), as these are defined in the GAINS model. Also, the category FATOIL (fat, edible and non-edible oil extraction) has been considered in this analysis, since it is expressed in the same activity units. A weighted average over these sources (together accounting for 66 % of the NMVOC emissions) has been calculated and is taken as the Tier 1 estimate here. Since other sources use very different activity statistics, the emission factors are not directly comparable. Therefore, care must be taken when applying this emission factor. It is recommended to use the Tier 2 (product-specific) approach wherever possible. The uncertainty is estimated to be one order of magnitude because of the variety in processes considered in this chapter.

More information with regards to the IIASA model and background information regarding this model is available via the website http://gains.iiasa.ac.at/, including more information on which activities are covered by each GAINS category.

Table 3-1 Tier 1 emission factors for source category 2.D.3.i, 2.G Other solvent and product use

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	2	kg/Mg product used	2	200	IIASA (2008)

3.2.3 Activity data

The Tier 1 emission factor requires knowledge about the total mass of solvent/product used.

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 products that may be used in the country.

The Tier 2 algorithm is as follows.

Stratify the ‘other’ 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:

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

If, however, no direct activity data are available, penetration of different technologies within the 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 (2) reduces to:

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

3.3.2 Technology-specific emission factors

This section provides Tier 2 technology-specific emission factors for the different activities (SNAP codes) within this source category.

Table 3-2 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Glass Wool Enduction

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060401	Glass Wool Enduction			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies					
Not applicable					
Not estimated	NOx, CO, SOx, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	850	g/t glass wool	400	1600	N=2 (Swiss IIR, 2012; Italian IIR, 2012)
NMVOC	250	g/kg solvent	100	500	N=1 (Norwegian IIR, 2012). This value is given preference

Table 3-3 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Mineral Wool Enduction

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060402	Mineral Wool Enduction			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies					
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	300	g/t mineral wool	150	600	N=1 (Swiss IIR, 2012)
NMVOC	250	g/kg solvent	120	500	N=1 (Norwegian IIR, 2012). This value is given preference

Fat, edible and non-edible oil extraction

The Tier 2 methodology for this activity combines an activity statistic with an appropriate emission factor for processing of the materials.

A more detailed methodology would combine activity statistics and emission factors for different vegetable oil types and for the production of different VOC and particulate species. It might also consider other stages within the oil extraction process.

The emission factor for NMVOC in Table 3-4 is taken from the EGTEI background document on fat, edible and non-edible oil extraction (EGTEI, 2003) and country specific inventories in the UK (UK IIR, 2012) and Italy (Italian IIR, 2012).

The total suspended particulates (TSP) data represent the sum of US Environmental Protection Agency (USEPA) dehulling, hull grinding, conditioning, flaking rolls, flake cooler, meal grinder/sizing and loadout emission factors with either cyclone abatement or no controls. Some of these activities may not be appropriate for a particular process and differing degrees of abatement may be applied. PM_{10} and $PM_{2.5}$ estimates are 'expert judgment'. Estimates of PM emissions from grain handling processes are provided by USEPA in AP-42 Chapter 9.9.1, Grain Elevators and Processes (US EPA, 1995).

Table 3-4 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Fat, edible and non-edible oil extraction

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060404	Fat, edible and non-edible oil extraction			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies	Traditional desolventiser without hexane recovery				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	1.57	g/kg seed	0.33	2.81	N=3 (EGTEI, 2003; UK IIR, 2012; Italian IIR, 2012)
TSP	1.1	g/kg seed	0.1	10	N=1 (US EPA, 1995)
PM10	0.9	g/kg seed	0.1	9	N=1 (US EPA, 1995)
PM2.5	0.6	g/kg seed	0.1	6	N=1 (US EPA, 1995)

Preservation of wood

For this activity, Tier 2 involves the combination of emission factors (e.g. mass of NMVOC emitted per kg of wood preservative used) with activity statistics (e.g. kg of wood preservative used), resulting in a baseline (uncontrolled) emission factor. When controls are in effect, it is good practice to use the abatement efficiencies provided in subsection 3.3.3 of the present chapter.

If preservative consumption data is not available then it can be calculated by using the 'quantity of wood preserved' combined with the following assumptions (estimated from Giddings et al., 1991) and equation by using:

- quantity of preservative used = [Volume of wood impregnated (m^3)] x [kg of wood preservative per m^3];
- 1 m^3 of wood requires 75 kg of creosote;
- 1 m^3 of wood requires 24 kg of solvent borne preservative;
- 1 m^3 of wood is approximately 1 Mg.

The NMVOC emission factors in the following tables are derived from IIASA (2008), recalculated in terms of g/kg creosote used using the above figure of 75 kg creosote/m^3 wood and from selected countries. The emission factors for PAHs are from Berdowski (1995) and from the UK inventory.

Table 3-5 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Wood preservation, Creosote preservative type

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	Creosote preservative type				
Region or regional conditions	Western Europe				
Abatement technologies	Uncontrolled				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	105	g/kg creosote	70	160	N=2 (IIASA, 2008; UK IIR, 2012)
Benzo(a)pyrene	1,05	mg/kg creosote	0.2	5	N=2 (Berdowski, 1995; UK IIR, 2012)
Benzo(b)fluoranthene	0.53	mg/kg creosote	0.1	2.5	N=2 (Berdowski, 1995; UK IIR, 2012)
Benzo(k)fluoranthene	0.53	mg/kg creosote	0,1	2.5	N=2 (Berdowski, 1995; UK IIR, 2012)
Indeno(1,2,3-cd)pyrene	0.53	mg/kg creosote	0,1	2.5	N=2 (Berdowski, 1995; UK IIR, 2012)

In addition, emission factors for acenaphthene, acenaphthylene, anthracene, benz(a)anthracene, benz(ghi)perylene, chrysene, dibenz(ah)anthracene, fluoranthene, fluorine, naphthalene, phenanthrene and pyrene can be found in UK IIK (2012).

Table 3-6 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Wood preservation, Organic solvent-borne preservative

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	Organic solvent-borne preservative				
Region or regional conditions	European Union				
Abatement technologies	Uncontrolled				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	

NMVOC	945	g/kg preservative	900	1000	N=4 (EGTEI, 2004; Austrian IIR, 2012; UK IIR, 2012; Giddings, 1991)

Table 3-7 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Wood preservation, Water-borne preservative

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	Waterborne preservative				
Region or regional conditions	European Union				
Abatement technologies	Uncontrolled				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	5	g/kg preservative	0.5	7	N=2 (EGTEI, 2004; Giddings, 1991)

Table 3-8 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Wood Preservatives, General

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	General				
Region or regional conditions	European Union				
Abatement technologies	Uncontrolled				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCB, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
Dioxins and furans	0.0016	gTEQ/t PCP applied	0.0003	0.008	N=1 (UK IIR, 2012)
PCP	0.033	g/g PCP applied	0.007	0.17	N=1 (UK IIR, 2012)
ɣ-HCH	0.5	g/g ɣ-HCH applied	0.1	2.5	N=1 (UK IIR, 2012)

Underseal treatment and conservation of vehicles and vehicle dewaxing

The current emission from the sources covered by this chapter can be assumed to be negligible.

In some circumstances it may be necessary to calculate an emission estimate for previous years, for example, in assessing emission reductions under the United Nations Economic Commission for Europe (UNECE) VOC protocol. To estimate an emission for vehicle dewaxing for previous years when the process was still being carried out, an emission factor is given in Table 3-9. It is good practice to apply this emission factor only to a proportion of the cars sold in the country in question. It assumes that 3 kg of solvent is used per car, with 2 kg of solvent recycled and based on Van der Most (pers. comm.).

Table 3-10 gives the NMVOC emission factors to be used with vehicle treatment. The factors are in different units; kg/person, g/kg used underseal agent and g/kg used solvent in underseal agent. The factor should be selected according to the most reliable activity data available, and the IIASA factor should only be used when no activity data is available.

Table 3-9 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Vehicles dewaxing

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060409	Vehicles dewaxing			
Technologies/Practices	Dewaxing of new vehicles following storage/transport				
Region or regional conditions	Netherlands				
Abatement technologies					
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	1	kg/car	0,1	10	Van der Most (1980)

Table 3-10 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Treatment of vehicles

Tier 2 emission factors		
	Code	Name
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use
Fuel	NA	
SNAP (if applicable)	060407	Underseal treatment and conservation of vehicles
Technologies/Practices	Treatment of vehicles	
Region or regional conditions	European Union	

Abatement technologies					
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	0.2	kg/person	0.01	0.2	IIASA (2008)
NMVOC	636	g/kg underseal agent	300	900	N=2 (Austrian IIR, 2012; Swiss IIR, 2012)
NMVOC	950	g/kg solvent	900	1000	N=1 (Norwegian, 2012). This value is given preference

The IIASA weighted average emission factor employs a unit of kg/person rather than the more expected kg/vehicle.

Table 3-11 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Industrial application of adhesives, Use of traditional solvent-based adhesives

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060405	Application of glues and adhesives			
Technologies/Practices	Industrial application of adhesives				
Region or regional conditions	European Union				
Abatement technologies	Traditional solvent-based adhesives (65% solvent, 35% solid) No secondary measure				
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	522	g/kg adhesives	200	900	N=3 (EGTEI, 2003; Austrian IIR, 2012; UK IIR 2012)
NMVOC	562	g/kg solvent	350	900	N=2 (Norwegian IIR, 2012; Swiss IIR, 2012). This value is given preference

Aircraft de-icing

Table 3-12 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Aircraft de-icing

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Aircraft deicing				
Region or regional conditions	European Union				
Abatement technologies					
Not applicable	All except NMVOC				
Not estimated					
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	53	Kg/ton deicing fluid used	27	106	KBP (2018)

Other use of solvents and related activities - Other

This category comprises various other uses of solvents. It must not replace other categories, but should be used in addition when some uses are not covered elsewhere.

Table 3-13 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Other

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060412	Other			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies					
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NMVOC	342	g/kg product	100	700	N=2 (Austrian IIR, 2012; Danish IIR, 2012)

Table 3-14 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Other, Use of Fireworks

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060601	Other, Use of Fireworks			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies					
Not applicable					
Not estimated	NH3, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
SO$_2$	3020	g/t product	1500	4500	N=2 (NNWB, 2008; Swiss IIR, 2012)
CO	7150	g/t product	6800	7500	N=2 (NNWB, 2008; Swiss IIR, 2012)
NO$_x$	260	g/t product	130	520	N=1 (Swiss IIR, 2012)
TSP	109,830	g/t product	50,000	170,000	N=2 (Klimont et al., 2002; Swiss IIR, 2012)
PM10	99,920	g/t product	40,000	160,000	N=2 (Klimont et al., 2002; Swiss IIR, 2012)
PM2.5	51,940	g/t product	10,000	90,000	N=2 (Klimont et al., 2002; Swiss IIR, 2012)
As	1.33	g/t product	0.1	13	N=1 (Passant et al., 2003)
Cd	1.48	g/t product	0.1	14	N=2 (Passant et al., 2003; Swiss IIR, 2012)
Cr	15.6	g/t product	0.1	150	N=1 (Passant et al., 2003)
Cu	444	g/t product	100	2000	N=1 (Passant et al., 2003)
Hg	0.057	g/t product	0.005	0.5	N=2 (Fyrv. Miljö, 1999, Swiss IIR, 2012)
Ni	30	g/t product	0.6	150	N=1 (Fyrv. Miljö, 1999)
Pb	784	g/t product	200	3000	N=2 (Passant et al., 2003; Swiss IIR, 2012)
Zn	260	g/t product	26	2000	N=1 (Fyrv. Miljö, 1999)

Table 3-15 Tier 2 emission factors for source category 2.D.3.i, 2.G Other solvent and product use, Tobacco combustion

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060602	Tobacco combustion			
Technologies/Practices					
Region or regional conditions					
Abatement technologies					
Not applicable					
Not estimated	SO$_2$, Pb, Hg, As, Cr, Se , As, PCBs, HCB, HCH				
Pollutant	**Value**	**Unit**	**95% confidence interval**		**Reference**
			Lower	**Upper**	
NO$_x$	1.80	kg/Mg tobacco	1.7	1.9	Martin et al., 1997
CO	55.1	kg/Mg tobacco	53	57	Martin et al., 1997

NMVOC	4.84	kg/Mg tobacco	2.4	9.7	Sandmo, 2011
NH_3	4.15	kg/Mg tobacco	3.9	4.4	Martin et al., 1997
TSP	27.0	mg/cigarette	25	30	Schauer et al., 1998. PM2.5
PM_{10}	27.0	mg/cigarette	25	30	Schauer et al., 1998. PM2.5
$PM_{2.5}$	27.0	mg/cigarette	25	30	Schauer et al., 1998. PM2.5
BC (2)	0.45	% of $PM_{1.8}$	0.30	0.67	Schauer et al., 1998. It is assumed that EC equals BC for tobacco smoking
Cd	5.4	µg/cigarette	1.4	22	Schauer et al., 1998. EFs are calculated from 0.01 % and 0.02 % of $PM_{1.8}$
Ni	2.7	µg/cigarette	0.7	11	Schauer et al., 1998. EFs are calculated from 0.01 % and 0.02 % of $PM_{1.8}$
Zn	2.7	µg/cigarette	0.7	11	Schauer et al., 1998. EFs are calculated from 0.01 % and 0.02 % of $PM_{1.8}$
Cu	5.4	µg/cigarette	2.4	12	Schauer et al., 1998. EFs are calculated from 0.01 % and 0.02 % of $PM_{1.8}$
PCDD/F	0.1	µg I-TEQ/Mg tobacco	0.05	0.2	UNEP toolkit, 2005
Benzo(a)pyrene	0.111	g/Mg tobacco	0.06	0.22	Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2
Benzo(b)fluoranthene	0.045	g/Mg tobacco	0.023	0.09	Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2
Benzo(k)fluoranthene	0.045	g/Mg tobacco	0.023	0.09	Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2
Indeno(1,2,3-cd)pyrene	0.045	g/Mg tobacco	0.023	0.09	Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2

Note: One cigarette contains 1 g of tobacco and one cigar contains 5 g of tobacco.

Both Schauer et al. (1998) and Martin et al., (1997) provide standard errors for the emission factor, a log-normal distribution is assumed in the calculation of lower and upper 95 % confidence intervals.

For pollutants where no default emission factor is provided, emissions can be estimated by using emission factors for a one-year crop like straw or wood for residential plants.

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(2) For the purposes of this guidance, BC emission factors are assumed to equal those for elemental carbon (EC). For further information please refer to Chapter 1.A.1 Energy Industries.

Table 3-16 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Other, Use of Shoes

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060603	Other, Use of Shoes			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies					
Not applicable					
Not estimated	NOx, CO, SOx, NH3, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, HCH , PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC	60	g/pair	30	120	N=1 (EGTEI, 2003a)

Other solvent and product use

This category comprises various other uses of solvent containing products. It must not replace other categories, but should be used in addition when some uses are not covered elsewhere.

Table 3-17 Tier 2 emission factor for source category 2.D.3.i, 2.G Other solvent and product use, Other, Other

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060604	Other, Other			
Technologies/Practices					
Region or regional conditions	European Union				
Abatement technologies					
Not applicable					
Not estimated	NH3, Cu, HCH , PCB, HCB				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NMVOC (concrete additive)	915	g/t product	450	1800	N=1 (Swiss IIR, 2012)
NMVOC (cooling lubricant)	1,000	g/t product	500	2,000	N=1 (Swiss IIR, 2012)
NMVOC (lubricant)	28,000	g/t product	14,000	56,000	N=1 (Swiss IIR, 2012)
NMVOC (pesticide)	69,000	g/t product	35,000	140,000	N=1 (Swiss IIR, 2012)

NMVOC (other industrial application)	110	g/kg solvent in products	50	250	N=1 (Norwegian IIR, 2012)

3.3.3 *Abatement*

A number of add-on technologies exist that are aimed at reducing the emissions of specific pollutants. The resulting emission can be calculated by replacing the technology-specific emission factor with an abated emission factor as given in the formula:

$$EF_{technology,abated} = (1 - \eta_{abatement}) \times EF_{technology,unabated} \qquad (4)$$

Wood preservation

This section presents default abatement efficiencies for controlled emissions from wood preservation. The unabated emission factors for this activity can be found in Section 0. The efficiencies are calculated from abated emission factors (Chem Systems Ltd / ERM, 1996) and EGTEI (2004).

Table 3-18 Abatement efficiencies ($\eta_{abatement}$) for source category 2.D.3.i, 2.G Other solvent and product use, Wood preservation, Creosote preservative type

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	Creosote preservative type				
Abatement technology	**Pollutant**	**Efficiency**	**95% conf. interval**		**Reference**
		Default value	**Lower**	**Upper**	
Solvent management plan; good housekeeping – type controls	NMVOC	3%	0%	70%	Chem Systems Ltd / ERM (1996)
Enclosure of drying and other areas and venting through end-of-pipe controls such as condensation or incineration[1]	NMVOC	67%	0%	90%	Chem Systems Ltd / ERM (1996)

[1] Assumes that solvent management plan/good housekeeping-type measures are also used.

Table 3-19 **Abatement efficiencies ($\eta_{abatement}$) for source category 2.D.3.i, 2.G Other solvent and product use, Wood preservation, Organic solvent-borne preservative type**

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	Organic solvent-borne preservative type				
Abatement technology	**Pollutant**	**Efficiency**	**95% conf. interval**		**Reference**
		Default value	**Lower**	**Upper**	
Solvent management plan; good housekeeping – type controls	NMVOC	5%	0%	90%	Chem Systems Ltd / ERM (1996)
Enclosure of drying and other areas and venting through end-of-pipe controls such as condensation or incineration[1]	NMVOC	69%	10%	70%	Chem Systems Ltd / ERM (1996)
100% solvent based preservatives. Improved application technique. (Vacuum impregnation system).	NMVOC	16.2%	5%	40%	EGTEI (2004)
Process optimisation. 100% more concentrated solvent based preservatives. Improved application technique. (Vacuum impregnation system).	NMVOC	44.4%	20%	70%	EGTEI (2004)

[1] Assumes that solvent management plan/good housekeeping-type measures are also used.

Table 3-20 **Abatement efficiencies ($\eta_{abatement}$) for source category 2.D.3.i, 2.G Other solvent and product use, Wood preservation, Water based preservative type**

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060406	Preservation of wood			
Technologies/Practices	Water based preservative type				
Abatement technology	**Pollutant**	**Efficiency**	**95% conf. interval**		**Reference**
		Default value	**Lower**	**Upper**	
100% water based preservatives. Improved application technique. (Vacuum impregnation system).	NMVOC	40%	20%	60%	EGTEI (2004)

Fat, edible and non-edible oil extraction

The table below shows reduction efficiencies for NMVOC emissions from this source. They are calculated with respect to the Tier 2 emission factors as given in Table 3-4.

Table 3-21 Abatement efficiencies ($\eta_{abatement}$) for source category 2.D.3.i, 2.G Other solvent and product use, Fat, edible and non-edible oil extraction

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060404	Fat, edible and non-edible oil extraction			
Abatement technology	**Pollutant**	**Efficiency**	**95% conf. interval**		**Reference**
		Default value	**Lower**	**Upper**	
Traditional desolventiser with old hexane recovery section	NMVOC	73%	60%	80%	EGTEI (2003)
Schumacher type desolventiser-toaster-dryer-cooler with old hexane recovery section	NMVOC	80%	70%	90%	EGTEI (2003)
Schumacher type desolventiser-toaster-dryer-cooler with new hexane recovery section and process optimisations	NMVOC	83%	70%	90%	EGTEI (2003)

Industrial application of adhesives

The table below shows reduction efficiencies for NMVOC emissions from this source. They are calculated with respect to the Tier 2 emission factors as given in Table 3-11.

Table 3-22 Abatement efficiencies ($\eta_{abatement}$) for source category 2.D.3.i, 2.G Other solvent and product use, Industrial application of adhesives

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060405	Application of glues and adhesives			
Technologies/Practices	Industrial application of adhesives				
Abatement technology	**Pollutant**	**Efficiency**	**95% conf. interval**		**Reference**
		Default value	**Lower**	**Upper**	
Traditional solvent based adhesives (65% solvent, 35% solid) with activated carbon adsorption or condensation	NMVOC	76%	70%	80%	EGTEI (2003)
Traditional solvent based adhesives (65% solvent, 35% solid) with thermal or catalytic incineration	NMVOC	76%	70%	80%	EGTEI (2003)
Emulsions (2% solvent, 50% solid) without secondary abatement	NMVOC	98%	96%	100%	EGTEI (2003)
Hot melts or UV cross-linking acrylates or electron beam curing systems (100% solid) without secondary abatement	NMVOC	100%	100%	100%	EGTEI (2003)

Other solvent and product use, Use of shoes

The table below shows reduction efficiencies for NMVOC emissions from this source. They are calculated with respect to the Tier 2 emission factors as given in Table 3-16.

Table 3-23 Abatement efficiencies ($\eta_{abatement}$) for source category 2.D.3.i, 2.G Other solvent and product use, Other, Use of shoes

Tier 2 Abatement efficiencies					
	Code	Name			
NFR Source Category	2.D.3.i, 2.G	Other solvent and product use			
Fuel	NA				
SNAP (if applicable)	060603	Use of shoes			
Abatement technology	**Pollutant**	**Efficiency**	**95% conf. interval**		**Reference**
		Default value	**Lower**	**Upper**	
90% solvent based/10% water based adhesives. Incineration	NMVOC	71%	55%	85%	EGTEI (2003a)
90% solvent based/10% water based adhesives. Biofiltration	NMVOC	71%	55%	85%	EGTEI (2003a)
60% solvent based adhesives/40% water based, good housekeeping No secondary end-of-pipe device	NMVOC	48%	35%	65%	EGTEI (2003a)
60% solvent based adhesives/40% water based, good housekeeping Incineration	NMVOC	85%	70%	95%	EGTEI (2003a)
60% solvent based adhesives/40% water based, good housekeeping Biofiltration	NMVOC	85%	70%	95%	EGTEI (2003a)
60% solvent based adhesives/40% water based, good housekeeping/automatic application No secondary end-of-pipe device	NMVOC	62%	50%	75%	EGTEI (2003a)

3.3.4 Activity data

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

Fat, edible and non-edible oil extraction

For applying the Tier 2 emission factors, the relevant activity statistics are the quantities of oil extracted and seed used in units of tonnes (Mg) per year. In addition, the total solvent consumption by the industry is a measure of the solvent required to replace that loss during the recovery process.

A more detailed methodology would require the activity for the different oil types and the different NMVOC species, but this is outside the scope of this Guidebook.

Preservation of wood

Estimating Tier 2 emission factors for the preservation of wood requires knowledge about the mass production or consumption by industry (for solvent-borne and creosote wood preservatives), or about the mass/volume of wood by industry.

In addition, the simpler methodology requires some knowledge of the type, efficiency and applicability of existing abatement.

The detailed methodology requires the following activity statistics for each plant, but this is not within the scope of this Guidebook.

Underseal treatment and conservation of vehicles and vehicle dewaxing

For vehicle dewaxing in previous years when the process was still carried out on a large scale, emission estimation required knowledge of the number of vehicles dewaxed in a year. This can be ascertained from local motor industry representatives. In the UK, for example, it would apply only to those vehicles imported into the country from overseas. In continental Europe it may apply only to those vehicles transported over longer distances.

For treatment of vehicles, the emission factor is related to population figures.

Industrial application of adhesives

The relevant activity statistics for this source is the amount of adhesives consumed per year.

Lubricant use

For applying the Tier 2 emission factors, data on lubricant use are required to estimate emissions, with activity data expressed in tonnes. Lubricant use can be estimated based on amounts of lubricant placed on the market per year. It can be assumed that the amount of lubricants placed on the market per year equals the lubricant use (consumption) in the same year.

The quantities of lubricants placed on the market are either directly available from respective statistics or calculated based on production statistics and import-export statistics. Associations such as UEIL can also provide statistics on lubricant amounts placed on the market.

3.4 Tier 3 emission modelling and use of facility data

Tier 3 is not available 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

Fat, edible and non-edible oil extraction

Emission estimates based on emission factors may be compared with data on the total solvent consumption of this industrial sector. Additionally, it is good practice to verify emission factors through measurements if possible.

Preservation of wood

For the simpler methodology, verification is through the solvent auditing of selected plants and comparison of this data with estimates based on emission factors. For the detailed methodology, inter-comparison of plants and a comparison with data from other countries is recommended.

For verification, it might be good to compare the emissions from wood preservation to the data in the IIASA GAINS model. This model estimates the average NMVOC emission factor from creosote wood preservation at 4 600 g/m^3 wood preserved (range 200–19000 g/m^3). However, since no speciation is given on the preservative type for this figure, it has not been included in the Guidebook.

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

No specific issues.

4.5 Uncertainty assessment

4.5.1 Emission factor uncertainties

Fat, edible and non-edible oil extraction

The range of emission factors available suggests that there is considerable variation from plant to plant on the efficiency of the solvent recovery systems, with older plant being considerably less efficient than new plant. If this is not taken into account then the emission estimate may vary by a factor of 20.

There is only one reference emission factor for the drying of seed. This may not be expected to vary as much as the efficiency of solvent recovery plants. Nevertheless, an uncertainty estimate of 100 % cannot be ruled out.

Underseal treatment and conservation of vehicles and vehicle dewaxing

There is probably a small amount of bituminous coating still used in the restoration and maintenance of vintage cars. This activity is usually carried out by small firms or by amateurs, so reliable statistics are difficult to obtain. The extent to which the practice is still continued is likely to represent only a small deviation from zero.

The emission factor for vehicle dewaxing of 1 kg/car is subject to a number of uncertainties. These are:

- manufacturers do not coat the whole car surface and the pattern of application varies from one manufacturer to another — consequently, the smaller the amount of coated surface, the less emission there will be from removing it;
- the factor itself was not based on actual measurements but rather on ‘engineering judgement’.

Also, not all cars sold in a country are dewaxed. It is necessary to obtain an estimate of how many cars are dewaxed and this estimate may also be subject to considerable uncertainty.

Preservation of wood

There is considerable uncertainty in estimating fugitive emissions of NMVOCs and the quantity that can be captured. Uncertainty in the emission factor estimates for NMVOCs is greater than a factor of 2. There is significantly greater uncertainty in the emission factors for PAHs (a factor of approximately 10).

There is also much uncertainty in the significance of this source with respect to emissions of PAHs and other POPs. Only the more volatile PAHs are likely to be emitted in significant quantities from creosote use. Additional uncertainty arises because of the potential for double counting of these PAH emissions and the NMVOC emissions.

4.5.2 Activity data uncertainties

No specific issues.

4.6 Inventory quality assurance/quality control QA/QC

4.6.1 Fat, edible and non-edible oil extraction

The range of emission factors available suggests that there is considerable variation from plant to plant on the efficiency of the solvent recovery systems, with older plant being considerably less efficient than new plant. If this is not taken into account then the emission estimate may vary by a factor of 20.

There is only one reference emission factor for the drying of seed. This may not be expected to vary as much as the efficiency of solvent recovery plants. Nevertheless, an uncertainty estimate of 100 % cannot be ruled out.

The weakest aspect of the methodology is the application of general emission factors to different types of plant and different types of feedstock. The methodology would be considerably improved if emission factors could be established for old and modern plants and for the different types of seed, e.g. corn, cotton seed, sunflower, rape, soya-bean, peanut.

4.6.2 Preservation of wood

There is considerable uncertainty in estimating fugitive emissions of NMVOCs and the quantity that can be captured. Uncertainty in the emission factor estimates for NM VOCs is greater than a factor of 2. There is significantly greater uncertainty in the emission factors for PAHs (a factor of approximately 10).

There is also much uncertainty in the significance of this source with respect to emissions of PAHs and other POPs. Only the more volatile PAHs are likely to be emitted in significant quantities from creosote use. Additional uncertainty arises because of the potential for double counting of these PAH emissions and the NMVOC emissions.

The weakest aspect of the methodology is the accuracy of the emission factors and the lack of field-based emission data.

It is good practice to improve the recommended emission factors through on-site measurements, particularly from the controlled (abated) use of creosote and solvent-borne preservatives. PAHs and other POPs should be covered by these measurements as well as NMVOCs.

In addition, the issue of evaporation of solvent after the treated wood has left the site of the application process should be reviewed.

4.6.3 Underseal treatment and conservation of vehicles and vehicle dewaxing

There is probably a small amount of bituminous coating still used in the restoration and maintenance of vintage cars. This activity is usually carried out by small firms or by amateurs, so reliable statistics are difficult to obtain. The extent to which the practice is still continued is likely to represent only a small deviation from zero.

The emission factor for vehicle dewaxing of 1 kg/car is subject to a number of uncertainties. These are:

- manufacturers do not coat the whole car surface and the pattern of application varies from one manufacturer to another — consequently the smaller the amount of coated surface, the less emission there will be from removing it.
- the factor itself was not based on actual measurements but rather on 'engineering judgement'

Also, not all cars sold in a country are dewaxed. It is necessary to obtain an estimate of how many cars are dewaxed and this estimate may also be subject to considerable uncertainty.

Underseal treatment and dewaxing activities which are within the coverage of this chapter are rapidly declining or are not carried out by major manufacturers across Western Europe. This needs to be confirmed for all countries with manufacturing plant.

A lack of data makes it difficult to reliably estimate emissions in previous years, if required. It should be kept in mind, though, that emissions were likely to be low compared to other NMVOC sources.

These activities, however, could be widespread in Eastern European countries and, if this is the case, then emission factors need to be developed, particularly for underseal (aftermarket) treatment.

4.7 Gridding

As for fat, edible and non-edible oil extraction, it is good practice to consider plants as point sources if possible.

4.7.1 Preservation of wood

Emissions from wood impregnation may be considered to be distributed according to population. However, given that industrial wood preservation is unlikely to be an urban business, a significant improvement in the spatial disaggregation would be made if the main territorial units where wood preserving takes place could be identified.

Further information is required on spatial disaggregation for wood preservation processes.

4.8 Reporting and documentation

No specific issues.

5 Glossary

Aftermarket	Products and services supplied to vehicle owners in connection with their vehicle, but not as part of the vehicle manufacture itself (see chapter 3.A, Paint application).
CCA	Copper, chromium and arsenic water-borne preservatives.
Creosote	The oldest form of wood preservative. Creosote is an oil prepared from coal tar distillation; contains a high proportion of aromatics.
Carbolinium	A mix of creosote and petroleum fractions.
NMVOC	Non-methane volatile organic compounds.
PAH	Polycyclic aromatic hydrocarbons.
PCB	Polychlorinated biphenyls.
PCDD/F	Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzo furans — a series of chlorinated aromatic compounds, commonly known as 'dioxins'.
PCP	Pentachlorophenol.
POPs	Persistent organic pollutants.
SBP	Specific boiling point.
Vacuum process	Process for the application of wood preservative, making use of an evacuated chamber.
White spirit	A petroleum fraction intermediate between gasoline and kerosene. White spirit or other petroleum distillates are commonly used as organic solvents in wood preservatives.
Vehicle refinishing	The repair of vehicles damaged in accidents and also the repainting of old vehicles to improve their appearance (see chapter 3.A, Paint application).
OEM	Original equipment manufacture — refers in this context to the manufacture of new vehicles.
UEIL	Union of the European Lubricants Industry

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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.