



EMEP/EEA Guidebook, Additional Guidance: 2D3 Solvent and Product Use

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Contents

1	2
2	2
3	3
4	4
5	5
6	5
6.1	5
6.2	5
6.3	6
6.4	8
6.5	8
7	9
8	10
8.1	10
A1 APPENDIX I: NFR 2D3 Solvent & Product use - EFs and Activity Data	14

1 Introduction

NFR 2D3 Solvent and Product Use primarily covers NMVOC emissions that occur from processes and products that use solvents and other volatile organic chemicals (such as propellants used in aerosols). Emissions of other pollutants such as particulate matter do also occur, but these are relatively trivial and will therefore not be discussed further. Instead, this document will provide some general guidance on the estimation of NMVOC emissions and, wherever possible, give some detailed examples of methods being used in Europe to estimate emissions. NFR 2D3 has nine sub-divisions, but much of the guidance is equally applicable across all or many of those sub-divisions. Therefore, to avoid duplication of information, this section starts with some cross-cutting information, followed by sections dealing with selected sub-parts of 2D3.

In the following sections, we will use the term 'solvent' to refer to all volatile organic chemicals that are used in the sectors covered by 2D3. Inventory compilers should bear this in mind and should ensure that their estimates do actually cover all NMVOC emissions. Information obtained from industrial sources may have a strictly limited definition for the term 'solvent' and any data that industries supply could therefore underestimate NMVOC emissions if it excludes chemicals that are volatile but not considered as solvents by industry.

2 Characteristics of NFR 2D3

NFR 2D3 can be a very challenging part of the national inventory. This is because of a somewhat unique set of characteristics which are described below.

NFR 2D3 arguably covers the widest range of any NFR category. It includes emissions that occur when the general public use any of a huge range of consumer products, and it also extends to a wide range of processes that are carried out in practically every branch of industry. Solvents can also be used by other institutions such as those in the public and commercial sectors. This diversity of sources is a particular challenge for the inventory compiler, who must estimate emissions for numerous different types of source in order to have a complete inventory.

As well as the many types of sources, there are also numerous individual locations where emissions occur. Obviously, consumer products will be used by practically everyone so there will be millions of individual emission sources in many countries. But there will also be very large numbers of individual emission locations within industry and other institutions. Indeed, those institutions will themselves use consumer products to clean and maintain premises. And even where institutions are using solvents in industrial processes, those processes could be so widespread that the number of locations of emissions in a large country runs into thousands. For example, there are numerous types of coating processes that employ solvents including the application of adhesives, inks, and paints, and it is likely that there are tens of thousands of sites that use at least some solvents in coatings. Many would have relatively trivial emissions, but the large number of sites does mean that, generally speaking, the use of facility-level emissions data (i.e. a Tier 3 approach) is not possible. There are exceptions, which will be discussed below, but facility-level data should be used carefully, and the issue of completeness given due attention. Facility-level data are available in E-PRTR (and probably in national datasets as well) but it is very likely that, in most or all countries, relatively few sites using solvents meet the requirements for reporting emissions in these datasets, so an inventory based on those data alone would be very incomplete. For example, an examination of 2012-2017 E-PRTR data for an example country shows that up to 100 solvent-using sites report each year, which represents a small fraction of the many thousand industrial sites where solvents are used.

A further difficulty is that use of solvents is often a relatively minor element of the activity carried out by a business. For example, solvents are used in the paints for motor vehicles, but manufacturers will probably think of that solvent use as a very minor aspect of their business activity. The car manufacturing sector in a country will probably have a very good understanding of how many vehicles are made but they may have far less idea how much solvent is used. Equally, governments may collect statistics on the number of vehicles made but are less likely to collect data specifically relating to solvents or coatings used in the manufacturing process. Even in a sector such as printing, where the solvent use is part of the central activity, industry representatives may not always have a clear understanding of overall solvent use.

Solvents are not only used in a large number of sectors and applications, but even for a given application, there can be a wide variation in solvent use. For example, printing is not a single technology but a range of technologies some of which require high levels of organic solvents, while others do not. There will be variation even for a particular printing technology since the ink technology and solvent content of inks can differ from process to process. Industry and government statistics may not provide enough granularity to allow accurate estimates: activity data in the form of total ink use, for example, can only be used to generate highly uncertain emission estimates because of the variation in solvent content between different ink types.

Within a sector, the fate of any NMVOC emissions will also be site-specific because there are a range of control strategies available. Taking the example of printing again, two sites might use the same printing technique, use similar inks but have very different emission characteristics if one site abates emissions and the other does not. The main strategies include reducing solvent usage, for example by reformulating products, and using end-of-pipe abatement technologies such as thermal oxidation to either destroy or recover NMVOC emissions. For some sectors, it is likely that a common strategy is adopted at all sites, or all regulated sites at least, but for other sectors, the choice will differ from site to site.

The issues described above can cause difficulties both in terms of collecting suitable activity data and in terms of deciding on suitable emission factors. What would be a good methodology for one country might not work for another due to differences in the level and type of data available. In comparison to some other sectors (such as NFR 1A for example) we therefore consider that a greater degree of flexibility is necessary for NFR 2D3 when considering what is a 'good' method. The sectoral guidance chapters of the EMEP/EEA Guidebook set out recommended methods for each part of 2D3. However, it is likely that some countries will not have the data that is needed for those methodologies. If that is the case, then there are alternative methods that could provide similarly reliable estimates, and countries should adopt methods that make best use of their local information. The guidance that follows discusses approaches that can be used and gives some detailed examples of methods from national inventories.

3 Use of per-capita emission factors

The EMEP/EEA Guidebook presents per-capita emission factors for 2D3a and 2D3f, as Tier 1 methods to be used in the absence of better data. Table 1 below indicates per-capita emission factors for other sub-categories of 2D3, based on data reported by European countries. These per-capita factors are presented as a fallback method, to be used in the absence of any better data.

Table 1: Tier 1 per capita emission factors for 2D3

NFR Source	Factor (kg per capita)
2D3d	2.4
2D3e	0.4
2D3g	0.9
2D3h	0.6
2D3i	0.9

4 Use of country-specific emission factors

The combination of industrial production or consumption data with emission factors is a well-established way to estimate pollutant emissions. For emission sources such as NFR 1A (Energy), all or practically all countries will collect the type of activity data needed for the methods and emission factors given within inventory guidance. There is usually no barrier to most countries using the exact same methods and same emission factors for these sources.

The EMEP/EEA Guidebook does provide emission factors that can be used for 2D3 and some countries will be able to use these factors without any problems. However, some inventory compilers may find that the EMEP/EEA Guidebook factors require activity data that are not collected for their country. Difficulties obtaining activity data have already been mentioned and many of the activities that involve use of solvents are not necessarily things for which Governments will collect data. Any statistics that do exist may be insufficiently granular to allow good estimates to be made. For example, statistics regarding the total consumption of coatings would not allow separate estimates to be made for 2D3d Coating applications, 2D3h Printing and 2D3i Other solvent use, let alone allow the selection of emission factors that took account of the range of process technologies within each of these NFR categories.

Compared with some other parts of the emission inventory, the collection of activity data can be a major task for 2D3, and something that can severely limit the accuracy of the estimates. Conversely, countries may have activity data that are more detailed and therefore want emission factors that would allow these more detailed activity data to be used. Inventory compilers are therefore encouraged to generate country-specific emission factors which both match the available activity data but also can reflect any unique characteristics of a sector in that country, for example, any differences in abatement or process technologies compared with other countries.

5 Estimates based on quantities of solvent consumed

Many emission factors are expressed in terms of products used: paint or ink consumed, or similar. But it isn't always necessary to think in terms of the quantities of products containing solvent, if instead there is good information on the supply of solvent to a sector. Thinking about the quantities of solvent itself rather than the quantities of products does solve one problem – there can be hundreds of different products used within a sector, each needing to be quantified whereas it may be simpler to instead try to quantify the solvent supplied to, or consumed by, that sector. Solvents will often pass through several different businesses before they ultimately are released as NMVOC emissions, for example:

- Solvent made and sold by solvent manufacturer
- Solvent incorporated into a product by a manufacturer
- Product used by another manufacturer.

This also means that there may also be more than one industrial group that can help establish the quantities of solvent being used.

As mentioned previously, care needs to be taken that emission inventories include all NMVOC emissions. Industries can have very specific definitions for what is a solvent and can even have different ideas about what is a solvent in a particular type of product. The scope of any data must therefore be understood: does it include all volatile chemicals that could be included within 2D3? A good example concerns aerosols, where some industry representatives may not consider propane/butane propellants as solvent. Nonetheless, these propellants will be emitted as NMVOC when the aerosols are used. Data from industry on solvents supplied for use in aerosols therefore might not include propellants so it is important to check the detail of the input data.

6 Use of ESIG estimates

6.1 Introduction

The European Solvent Industry Group (ESIG) have generated solvent emission estimates for the countries of the EU-27 plus the UK. In the absence of other data, these estimates may be useful for compilers of national emission inventories.

ESIG's approach to generating the estimates consists of three operations:

1. Collecting the solvent sales volumes in each EU country according to REACH end use sector
2. Applying an air emission factor for each use sector & calculating VOC emissions
3. Applying import/export corrections.

6.2 Step 1: Sales volumes

All companies which are part of ESIG are invited to submit their solvent sales volumes by end-use sector for each European country in the EU-27 and the UK.

These sales represent about 90% of all oxygenated and hydrocarbon VOC solvents¹ manufactured and then sold in the European Union, hence they are highly confidential. They are collated and carefully and confidentially analysed. Data are not collected for chlorinated/halogenated solvents on the basis that ESIG considers that all uses are in closed systems meaning that there are no emissions to air. Note though that this assumption is not consistent with the EMEP/EEA Guidebook, which suggests that there will still be some small emissions from enclosed systems.

The figures only cover ESIG's portfolio, which means that certain substances whose main use is not as a solvent are excluded, such as:

- Toluene, benzene, & xylene
- Dimethylformamide (DMF)
- N-methyl-2-pyrrolidone (NMP)
- Tetrahydrofuran (THF)
- Propylene glycols
- Methanol
- Propane, butane, and similar aerosol propellants.

The end-use sectors are the same market sectors as defined for the Generic Exposure Scenario (GES) of the Registration, Evaluation and Authorisation of Chemicals Regulation (REACH). For the estimation of environmental exposure, ESIG has developed Specific Environmental Release Categories (SpERCS), which provide sector-specific release fractions, associated operational conditions and risk management measures

6.3 Step 2: Emission factors

The emissions factors have been assessed by using the GES approach, and estimate the percentage of VOCs emitted into the air. The solvent VOC emissions per sector are then calculated by multiplying the solvent volumes by the emission factor for that sector.

These emissions factors depend on two parameters: the final end-use of the solvent and the type of solvent. As each of these end-uses is associated with one or more GES where the release-to-air percentages have been determined from the environmental safety assessment based on realistic data and/or assumptions for particular uses. Not all solvents are VOC and not all VOC's are solvents. Their respective properties such as boiling point range and molecular weight make them VOC or not. For example, a C₆ hydrocarbon solvent (hexane) will be a VOC whereas a heavier C₁₄-C₁₉ hydrocarbon solvent is not a VOC.

The REACH categories and the emission factors applied for each category are shown in Table 2.

¹ Members are asked to report only solvent sales for VOC solvents according to the definition given in the Industrial Emissions Directive : 'volatile organic compound' means any organic compound (...), having at 293.15 K a vapour pressure of 0.01 kPa or more, or having a corresponding volatility under the particular conditions of use"

Table 2: REACH sectors and emission factors used in the ESIG method

No	End-use	Release to air	Remarks
1	Agrochemical uses	100%	Assumed to be completely released to the atmosphere
2	Blowing Agents	100%	and utilize solvents that are VOC
3	De-Icing	100%	
4	Binder and Release Agents	100%	
5	Industrial Cleaning	70%	Cleaning agents used industrially are mostly handled in a closed system and are partially released to atmosphere
6	Professional & Consumer Cleaning	50%	There are two types of products in this category: dry cleaning agents used by professionals that have very low release percentage and the other cleaning agents used by consumers that are completely released to atmosphere. Therefore, an average 50% emission factor is applied
7	Industrial, Professional and Consumer Coatings	75%	The emission factor of the entire coatings industry is a combination of consumer and professional paint for the decorative market which has an emission factor of 100% and the industrial paints where the solvents are mostly regenerated resulting in an emission factor assumed to be 10%. Therefore, a conservative emissions factor of 75% is applied.
8	Functional Solvents	10%	Include solvents used in chemical processes including intermediates, polymerization and extraction resulting in a low emission factor of 10%.
9	Metal working/Rolling Oils/Lubricant uses	0%	Taken over from ATIEL, the technical Association of the European Lubricants Industry
10	Oil field chemicals-Drilling-Mining-Extraction	0%	Solvents used are mostly heavy and non-VOC
11	Polymers Processing (including rubber-tyre production)	10%	Value from ESIG GES/SpERCS
12	Road and Construction	95%	Value from ESIG GES/SpERCS
13	Use as Fuel/Combustion	0.25%	Combustion solvents are burnt, generating water and carbon dioxide and therefore do not produce any VOC in the atmosphere. A conservative emission factor of 0.25% has been applied to take into account possible leaks.
14	Water Treatment	5%	Value from ESIG GES/SpERCS
15	Other Consumer uses (household, aerosols, cosmetics)	90%	Solvents used by consumer in household and aerosol applications are completely released to the atmosphere. Solvents used in cosmetic applications are heavy and non-VOC products. Therefore, an estimated 90% emission factor has been applied.
16	Pharmaceuticals Manufacturing	30%	Value from ESIG GES/SpERCS

6.4 Step 3: Import/export corrections

Step 1 generates data on the sales of solvents to countries. Some of that solvent will then be exported to other countries, typically after being incorporated into a product and so this final step aims to account for that. Due to the free flow of goods in the European Union, there are no direct data for import and export of solvents within the EU member states and so an estimate must be made. ESIG use data for overall chemicals exports and imports for each country so that the net chemical transfer can be calculated for each EU Member State. By assuming this percentage of chemical transfer is directly proportional to percentage of solvent movements, an estimate of solvent import/export related to solvent downstream activities has been made for each country. These calculations assume that there is no net import or export into or from the EU. The import/export data suggest that Belgium, Germany and Netherlands are substantial exporters of solvents and downstream products within the EU. The UK and France are effectively in balance (and the same is assumed for Ireland), and it is further assumed that there is no net import or export of solvents for these three countries. The remaining EU Member States are net importers of solvents, and although they export and import to one another, their total net imports are assumed to equal the exports from Belgium, Germany and the Netherlands. An apportionment is then made based on population data.

6.5 Using and accessing the ESIG data

The ESIG data are suitable for use in national inventories, although with some limitations. For 2D3a, ESIG estimates are considered a Tier 2a method according to the EMEP/EEA Guidebook. However, it is important to note the limits of the ESIG estimates and to account for VOCs used in consumer products that are not within the scope of the data e.g. propellants in aerosols, and methanol in products such as vehicle de-icing products. These would need to be added to the ESIG numbers in order to have a complete VOC inventory.

ESIG cannot always provide data for each individual country. Due to the high confidentiality of sales data, certain rules are imposed on the statistics. These statistics originate from CEFIC – the European Chemical Industry Council. When there are fewer than 3 original entries there is no show of data for a category. In a few cases, countries are grouped together to allow display of at least some numbers. Here, population numbers could serve to generate a split between countries.

REACH categories used in the ESIG inventory do not always map to NFR categories in a simple way. ESIG have worked with national inventory experts over the past few years to understand how the two systems compare and the result was a proposed mapping of REACH to NFR. This mapping relied partially on data from the UK inventory, and is published in the Annex to the 2019 EMEP/EEA Guidebook chapter for 2D3a. In some cases, there is a simple mapping of a REACH category to a single NFR category, for instance Industrial Cleaning can be 100% attributed to 2D3e. When this simple mapping occurs, the ESIG data could be incorporated directly into national inventories, however note that the ESIG figures only cover the solvents within ESIG's brief and assume zero emissions of chlorinated solvents, so it would also be necessary for inventory compilers to consider whether additional estimates need to be made for sources that are outside the scope of the ESIG data. In other cases, a REACH category can map to multiple NFRs, which may limit the extent to which those data can be used.

Since ESIG data are based on real data from EU solvents manufacturers, and cover all uses of these solvents, the ESIG emission inventories remain a valuable source of information. As well as being useful for populating national inventories, the data can also be used for comparisons. For example, the UK has carried out a cross-comparison of ESIG and UK inventory data for multiple years. This has shown that, although the UK inventory mostly relies on alternative sources of data, the emissions in both the

ESIG and UK inventories are very similar. It was vital when doing this comparison to identify all VOC emissions reported in the UK inventory that were outside the scope of the ESIG numbers, such as the chemicals listed at the start of this section, and to then subtract those emissions from the UK inventory before doing the comparison, so that the scope of both sets of numbers was consistent. In the case of the UK, this meant that roughly a third of the VOC emissions were discounted as being outside the scope of the ESIG figures.

EU Member States can obtain more information from ESIG upon request for full details per REACH category, provided data is not confidential. Additionally, based on the mapping, ESIG can derive per capita emission factors per country for domestic solvent emissions based on its data. ESIG publishes data each year for the overall emissions per country and for the EU. More detailed data can be requested by contacting the ESIG secretariat.

7 Facility-level data

Regulation of industry often results in the provision of facility-level emissions data to regulators, and this can then become available to inventory compilers. As has already been mentioned, NFR 2D3 covers a wide range of industrial processes, with the potential also for differences from site to site in the way that process operators meet the requirements of legislation. Processes within the same sector might choose very different strategies for reducing NMVOC emissions: for example, product reformation or end-of-pipe abatement might be viable alternatives for an industrial coating process. The use of facility-level emissions data allows inventory compilers to reflect the abatement strategy choices at each site, providing that the emissions data are high quality. Use of facility-level data has the potential to therefore be a preferred method for some sub-sectors of NFR 2D3.

Despite this potential, there are some limits to the use of facility-level data. Most importantly, if an emission estimate is to be generated by adding up emissions for individual facilities, then it follows that the estimate will be incomplete unless data are available for all facilities. This is actually a major problem for NFR 2D3, since solvent tends to be used by businesses of all sizes, including many that are too small to be regulated under the Industrial Emissions Directive (IED), for example. If emissions data are only available for those larger facilities that are regulated under IED, then simply summing those emissions will result in an underestimate of national emissions. It is therefore essential to consider if emission estimates based on facility-level data can be made complete.

Within NFR 2D3, there are many different sub-sectors, and the characteristics of those sub-sectors do vary. Some types of solvent-using process are almost always carried out on a large scale, for example the coating of new cars, or the coating of steel coil. So, there may be sub-sectors within NFR 2D3 where all processes are regulated and present in the facility-level dataset. Consultation with regulators and industry can help to identify any such sectors in each country, and the use of facility-level data is then the ideal method for estimating emissions from those sectors.

If facility-level data are only available for a proportion of a sector, it may be much more difficult to use the data to generate national estimates. In theory, an inventory compiler could scale up the emission estimates to account for non-reporting sites, but this requires that the inventory compiler know what proportion of the sector is reporting. Regulators may not collect the data that allow this to be done: they will ask for emissions, but may not ask for production data or other activity data. Without this context, it becomes difficult to know how to scale up to cover non-reporting sites. Industry, or regulators, may be able to supply estimates of the fraction of a sector covered by regulation.

A second problem with facility-level data is that emissions may cover all activities at a site and thus not be specific to a single part of NFR 2D3. For example, a site may use solvents for surface cleaning as well

as for coating with industrial paint, in which case emissions will be from both 2D3e Degreasing and 2D3d Coating Applications. This can complicate the use of the data and care is needed to avoid duplication of emissions.

One way to overcome many of these issues is to set up a system that specifically collects data on solvent use, such as the French GEREP system. This system is described in Section A2.1.8.1

8 Examples of Inventory practice

8.1 French GEREP system and solvent management plans

The implementation of a Solvent Management Plan (SMP) comes from the Solvent Directive 1999/13/CE (also the IED Directive 2010/75/EU) which is transposed in the French regulation. In this way, in France, it is required that industrial sites consuming more than one ton of solvent per year establish a SMP.

A solvent management plan is a mass balance allowing to estimate VOC emissions of an industrial site. The following definitions come from the IED Directive.

The inputs of organic solvents (I):

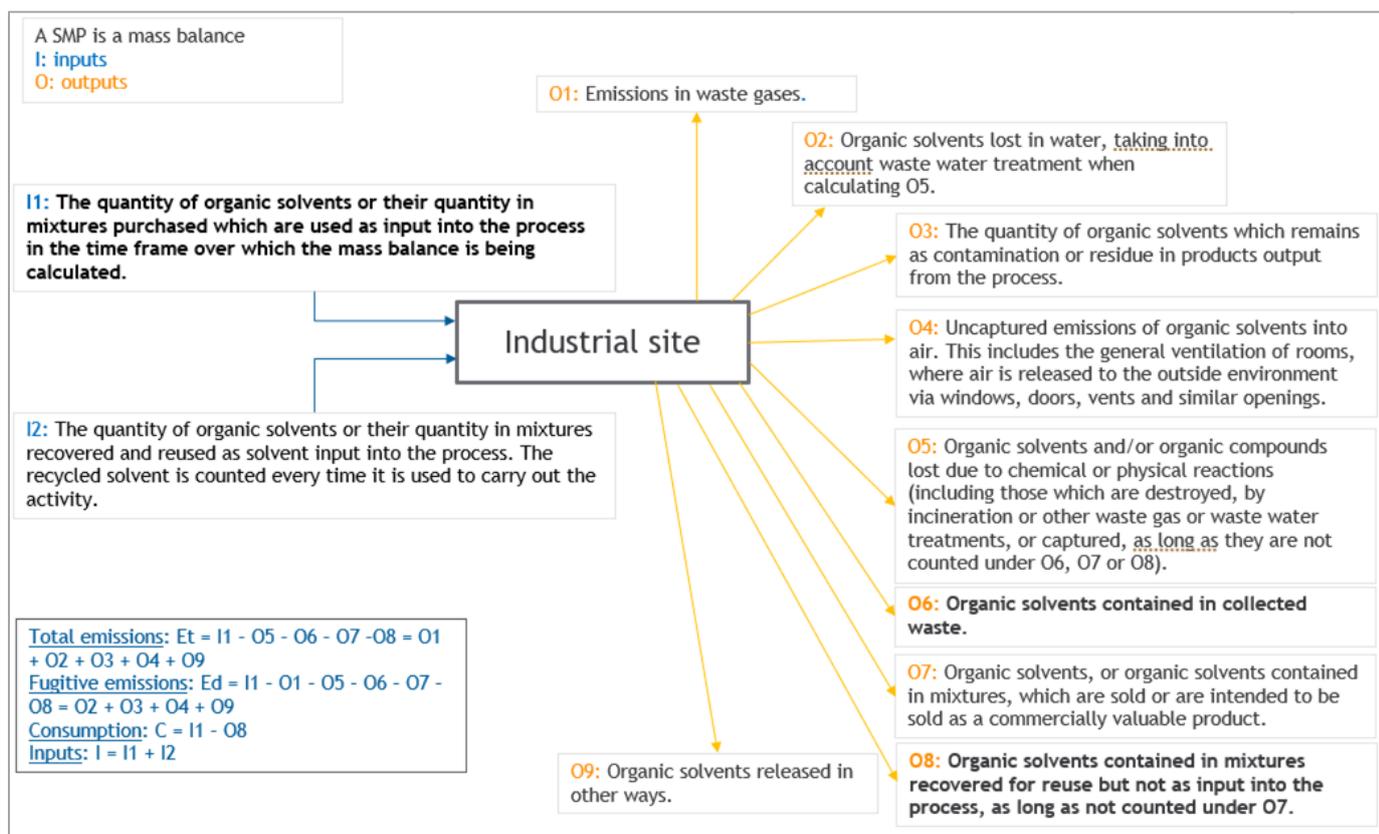
- I1: The quantity of organic solvents or their quantity in mixtures purchased which are used as input into the process in the time frame over which the mass balance is being calculated.
- I2: The quantity of organic solvents or their quantity in mixtures recovered and reused as solvent input into the process. The recycled solvent is counted every time it is used to carry out the activity.

The outputs of organic solvents (O):

- O1: Emissions in waste gases.
- O2: Organic solvents lost in water, taking into account wastewater treatment when calculating O5.
- O3: The quantity of organic solvents which remains as contamination or residue in products output from the process.
- O4: Uncaptured emissions of organic solvents into air. This includes the general ventilation of rooms, where air is released to the outside environment via windows, doors, vents and similar openings.
- O5: Organic solvents and/or organic compounds lost due to chemical or physical reactions (including those which are destroyed, by incineration or other waste gas or wastewater treatments, or captured, as long as they are not counted under O6, O7 or O8).
- O6: Organic solvents contained in collected waste.
- O7: Organic solvents, or organic solvents contained in mixtures, which are sold or are intended to be sold as a commercially valuable product.
- O8: Organic solvents contained in mixtures recovered for reuse but not as input into the process, as long as not counted under O7.
- O9: Organic solvents released in other ways.

Figure 1 shows a solvent management plan, with the sources and fates of solvents.

Figure 1. A Solvent Management Plan



GEREP – The French emission registry web platform

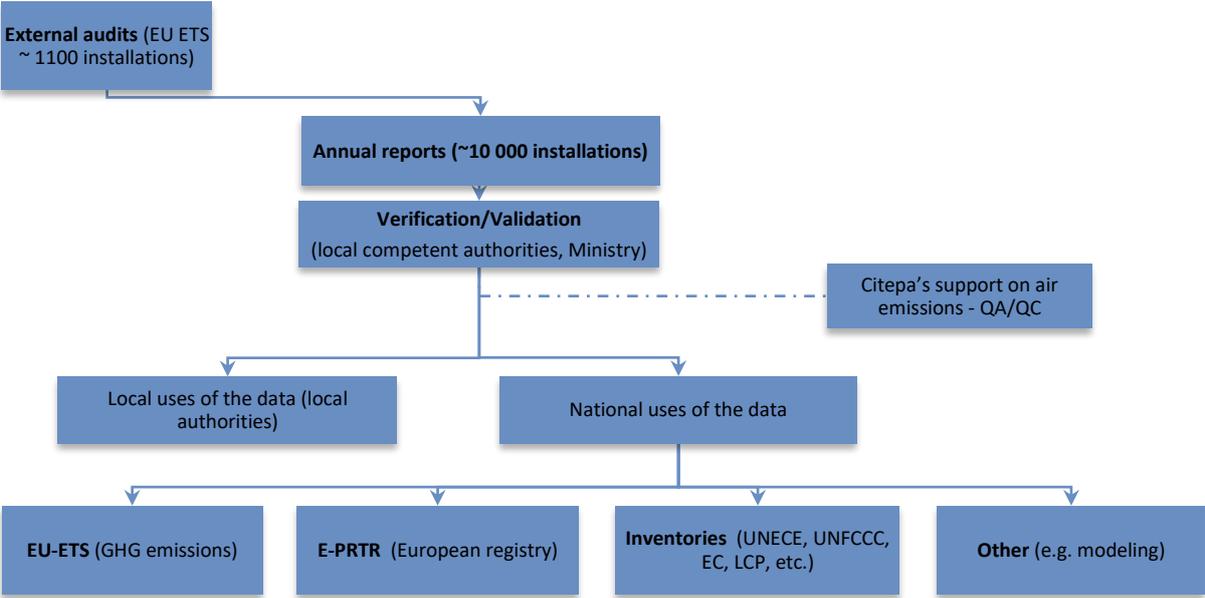
In order to increase the accuracy of the French inventory, plant specific data are used (bottom-up approach). In France, the national emission registry GEREP is used for the purpose of the preparation of the inventory for a lot of IPPU sectors (thanks to a contract between Citepa (the French Inventory compiler) and the Ministry of Environment). GEREP is the French centralized web platform on which French facilities report their activity data and annual emissions.

Automatic quality checks are implemented in the platform, so that operators can check and correct their data while reporting online, before the submission deadline. Quality checks cover, for example, the interannual variation of emissions (emissions trends), the emission factors (ranges of values are defined for fuels), the identification of missing pollutant or missing data, units check, etc.

Then the local competent authorities validate the reports, with the support of Citepa. The French Environment Ministry also conducts secondary-level checks. When errors are detected, the operator is contacted by the local competent authority, Citepa or the ministry. Then the report is corrected in the platform.

Figure 2 shows a schematic of GEREP. This is the French web platform where facilities report their activity data and annual emissions.

Figure 2: A schematic of GEREP (the French web platform where facilities report their activity data and annual emissions)



Operators also report their solvent management plan (SMP). An average of 845 facilities reports their SMP and emissions each year in GEREP. If the VOC emissions of a facility are higher than 30 tons/year, then the operator must report its VOC emissions in the solvent section (“Solvants / PGS”). The form that must be filled in, shows the inputs and outputs of the SMP. VOC emissions, solvent consumptions and the solvent use are automatically calculated in the web platform.

Table 3 below shows the solvent consumption reported in GEREP and the total national solvent consumption. The solvent consumption reported in GEREP represent an average of 1.3% of the national solvent consumption. In 2019, the platform was fully remade, and some operators did not report their data in the correct solvent section. Citepa had to analyse the data and to add them manually for the estimate.

Table 3: Solvent emissions reporting in GEREP

Year	Solvent consumption reported in GEREP (kt)	Total national solvent consumption (kt)	%
2016	957.09	70 187.06	1.4%
2017	985.13	70 856.34	1.4%
2018	986.75	70 383.06	1.4%
2019	710.08	70 924.19	1.0%

This percentage varies according to the sectors (example: in coating application, the consumption of solvent in manufacturing of automobile is totally covered by the annual reports in GEREP).

Plant with a solvent consumption of less than 1 tonne are included in national statistics.

The methodologies for the following NFR source sectors are detailed in Appendix I with accompanying EFs and where relevant information that allows the calculation of activity data:

2D3a Domestic solvent use including fungicides

- non-aerosol personal-care products
- non-aerosol household products
- non-aerosol consumer products

2D3d Coating Applications

- Manufacture of automobiles
- Coil coating (SNAP 060105)
- Car repairing (SNAP 060102)
- Construction, building and corrosion protection (SNAP 060103)
- Domestic use (SNAP 060104)
- Boat building (SNAP 060106)
- Other industrial paint application (SNAP 060108)
- Paint manufacturing (SNAP 060307)

2D3g Chemical Products

- Polyester processing (SNAP 060301)
- Polyvinylchloride processing (SNAP 060302)
- Polyurethane foam processing (SNAP 060303)
- Polystyrene foam processing (SNAP 060304)
- Rubber processing (SNAP 060305)
- Pharmaceutical products manufacturing (SNAP 060306)
- Adhesive, magnetic tapes, films and photographs manufacturing (SNAP 060311)

2D3h Printing

rotogravure printing:

- Publication rotogravure (Publication)
- Publication (Heat set web offset, Cold set web offset, Sheet fed, Additive)
- Decorating packaging (Ink, varnish decoration, packaging, Pigment preparation)
- Metal packaging (Offset metal ink, Varnish)

A1 APPENDIX I: NFR 2D3 Solvent & Product use - EFs and Activity Data

The following tables and accompanying text present the emission factors and activity data for estimating emissions of NMVOCs from a range of difference sources within 2D3 Solvent and Product Use.

2D3a Domestic solvent use including fungicides

Table 4: UK emission factors for non-aerosol personal-care products

Product Group	Product Type	VOC content (%)	% VOC emitted	Emission factor (g/kg product)
AP/Deodorants	Roll-on	5%	100%	50
AP/Deodorants	Stick	25%	100%	250
AP/Deodorants	Pump (non-aerosol type)	75%	100%	750
Bath/Shower	Bath/Shower oil & gel	2%	5%	1
Beauty Aids: Eye	Eye makeup	1%	100%	10
Beauty Aids: Face/skin	Cleansers	5%	100%	50
Beauty Aids: Face/skin	Astringent / Toner	30%	100%	300
Beauty Aids: Face/skin	Foundation / Concealer	5%	100%	50
Beauty Aids: Lip	Lipstick / Lip Gloss	1%	100%	5
Beauty Aids: Nail	Nail polish remover	90%	100%	900
Beauty Aids: Nail	Nail polish	70%	100%	700
Beauty Aids: Nail	Nail treatments/strengthener	66%	100%	660
Creams	All types	1%	100%	10
Fragrances	Fine	85%	100%	850
Fragrances	Mass market	70%	100%	700
Hair Care	Styling aids	48%	100%	475
Hair Care	Conditioners, colouring & treatments	1%	100%	10
Hair Care	Shampoo	1%	5%	0.5
Oral Care	Mouthwash	20%	5%	10
Oral Care	Toothpaste	1%	100%	10
Oral Care	Denture fixatives	2%	100%	20
Powders	All types	4%	100%	35
Soaps	All types	3%	5%	1.5
Sun Care	Sun-protection, after-sun & self-tanning	4%	100%	40

Table 5: UK emission factors for non-aerosol household products

Product Group	Product Type	VOC content (%)	% VOC emitted	Emission factor (g/kg product)
Air freshener	Gels	80%	100%	800
Air freshener	Electric	20%	100%	200
Air freshener	Car	80%	100%	800
Air freshener	Liquid (wick) Type	25%	100%	250
Air freshener	Scented Candles	4%	100%	40
Carpet / Cleaners/Freshener	Textile All types	1%	100%	10
Dishwashing	Hand liquid	5%	5%	2.5
Dishwashing	Automatic, all types and additives	1%	5%	0.5
Hygiene products	Disinfectant	4%	100%	40
Hygiene products	Toilet liquid	10%	5%	5
Hygiene products	Toilet block	10%	50%	50
Other	Starch/Ironing Aids	5%	100%	50
Polish	Furniture polish	20%	100%	200
Polish	Floor polish	30%	100%	300
Polish	Shoe polish	20%	100%	200
Polish	Metal polish	15%	100%	150
Surface cleaners	General purpose surface cleaners	1%	50%	5
Surface cleaners	Glass/window cleaner	4%	100%	40
Surface cleaners	Oven cleaner	5%	25%	12.5
Surface cleaners	Floor cleaner	3%	100%	30
Textile	Stain removers	2%	100%	17.5
Textile	Liquid detergents	3%	10%	2.5
Textile	Powder detergents	1%	10%	0.5
Textile	Fabric softener	3%	5%	1.5

2D3a Non-aerosol consumer products

The UK has developed a detailed methodology for certain non-aerosol consumer products that takes advantage of activity data that can be obtained from market research organisations. UK inventory compilers have been unable to identify any government statistics for personal-care and household consumer products so instead purchased data from a market research company. Consultation with industry over a period of years has allowed emission factors for both non-aerosol personal-care products and non-aerosol household products to be developed. These are presented in Table 47 and Table 5 above. These EFs can be combined with the activity data to produce emission estimates for part of 2D3a.

In the French inventory, the implied emission factor in g/capita is recalculated using the emissions and the French population for the following categories: household products, cosmetic and toiletries, car care product. Emissions from Domestic use of paints are considered in the coating application sector.

VOC emissions are calculated using the following equations:

$$\text{Equation 1 : VOC emissions [t] = VOC content [\%] x consumption [t]}$$

The consumption is estimated based on the national production from PRODFRA and imports / exports that come from customs data:

$$\text{Equation 2: Consumption [t] = Production [t] + Imports [t] – Exports [t]}$$

The different VOC contents used in the French inventory and the references are listed in the following table.

Table 6: VOC contents used in the French inventory with accompanying references

Categories	Prodfra subcategories	Solvent contents (%)	References
Soap	Perfumes and toilet soaps: Bar of soap, liquid, or pasty	3.5	Netherlands Institute for Public Health and the Environment (RIVM 2006) German solvent contents
	Products and organic preparations surfactant for washing skin, containing soap packed for retail.	0.5	Netherlands Institute for Public Health and the Environment (RIVM 2006)
	Soaps in flakes, granular, powder form	0.5	Netherlands Institute for Public Health and the Environment (RIVM 2006)
	Preparations for detergents and cleaning, packed for retail	1.6	
	Soaps, products, and organic surfactant preparations other than toiletries, in bars (industrial and household)	1.6	
	Other soaps in other forms (including hand wash of mechanics)	1.6	
Washing, cleaning, rinse	Preparations for detergents and cleaning, packed for retail	1.6	EMEP/EEA Guidebook
	Anionic organic surface-active agents, packed for retail	1.6	
	Cationic organic surface-active agents, packed for retail	1.6	
	Non-ionic organic surface-active agents, packed for retail	1.6	
	Organic surface-active agents, packed for retail	1.6	
Deodorizers	Preparations for perfuming or deodorising rooms: aerosols, liquids, paradichlorobenzene, gels, evaporators	28.9	1/ German solvent contents 2/ Study from ARCADIS Belgique (NMVOC emissions through domestic solvent use and the use of paints in the Brussels Capital)

Leather shoes products	and care	Polish, creams and similar preparations for shoes and leather (grease, products for suede, white, dyeing)	31.4	Average determined with: Netherlands Institute for Public Health and the Environment (RIVM 2006) European Commission
Furniture floor products	and care	Polish for wood furniture, floor and woodwork	60.7	Netherlands Institute for Public Health and the Environment (RIVM 2006)
		Other polish, creams and similar preparations: not classified elsewhere: products for modern floors, carpets	27.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
Polish abrasive	and	Metal cleanser	49.6	Netherlands Institute for Public Health and the Environment (RIVM 2006)
		Pastes, powders et other abrasive cleaning products	4.0	German solvent contents
Car care products		Polish and similar preparations for car bodywork (other than metals polish)	18	EMEP/EEA Guidebook
		Antifreeze preparations and liquids prepared for defrost	20.0	German solvent contents
		Perfumes	82.5	Netherlands Institute for Public Health and the Environment (RIVM 2006)
		Eau de parfum	82.5	Netherlands Institute for Public Health and the Environment (RIVM 2006)
Perfumes		Toilet waters	76.3	Netherlands Institute for Public Health and the Environment (RIVM 2006)
		Pre-shave, shaving and after shave lotions (excluding beard bar soaps)	45.0	German solvent contents Study from ARCADIS Belgique (NMVOC emissions through domestic solvent use and the use of paints in the Brussels Capital)
		Make-up products for lips	30.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
Make-up products		Make-up products for eyes	5.0	German solvent contents
		Powders, foundation	1.0	German solvent contents
		Other beauty products: other facial make-up products	12.7	EMEP/EEA Guidebook
		Preparations for manicure or pedicure: hands and foot care products	81.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)

Hand care and foot treatment products	Preparations for manicure or pedicure: products for nails (including nail polish remover)	81.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
Other beauty products	Beauty products and skin care (including sun preparation)	12.7	EMEP/EEA Guidebook
	Liquid shampoos and other forms	3.2	Netherlands Institute for Public Health and the Environment (RIVM 2006)
Hair wash and hair care products	Preparations for waving and straightening	13.5	Netherlands Institute for Public Health and the Environment (RIVM 2006)
	Hair spray	95.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
	Hair preparations other than shampoos, hair spray and for perm	3.1	German solvent contents Study from ARCADIS Belgique (NMVOC emissions through domestic solvent use and the use of paints in the Brussels Capital)
	Pre-shave, shaving and after shave foams and gels (excluding beard bar soaps)	5.0	German solvent contents
Shaving products, olfaction products, personal hygiene and beauty products	Deodorizing body spray and antiperspirants	67.5	Study from ARCADIS Belgique (NMVOC emissions through domestic solvent use and the use of paints in the Brussels Capital)
	Salt bath and other bath preparations	1.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
	Other body care products (perfumes, toiletries products, depilatory products, etc.)	12.7	EMEP/EEA Guidebook
	Toothpaste	5.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
	Other preparations for oral hygiene, dental hygiene or for dentures	5.0	Netherlands Institute for Public Health and the Environment (RIVM 2006)
Essential oils	Essential oils and natural aromatic products	0.13	French centralized platform (GEREP)

2D3d Coating Applications

The methods used in the French emissions inventory for 2D3d are summarised below:

Manufacture of automobiles

In the French inventory, activity data and emissions come from the French centralized platform (GEREP) on which French facilities report their activity data, emissions and also their solvent management plan (SMP).

As all the industrial sites of this subsector report their solvent consumption and emissions on the platform, the methodology applied is 100% bottom-up.

Note: the consumption corresponds to I1, one of the inputs in a solvent management plan. Refer to the part 2 of this report for more details on a SMP.

Table 7 shows solvent use and EFs in the manufacture of automobiles.

Table 7: Solvent use and EFs in the manufacture of automobiles

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
2000	29 643	19 385	653 950
2005	21 475	14 459	673 296
2010	12 054	7 066	586 242
2019	10 820	6 444	595 626

French data - IIR 2021

SNAP 060105 – Coil coating

As well as SNAP 060101 - Manufacture of automobile, the methodology applied is 100% bottom-up.

Table 8 shows solvent use and EFs in coil coating.

Table 8: Solvent use and EFs in coil coating

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	10 726	1 374	128 119
2000	11 381	862	75 702
2010	11 549	839	72 658
2019	10 602	447	42 058

French data - IIR 2021

SNAP 060102 – Car repairing

In the French inventory, the activity data come from national statistics (PRODFRA) and sector specific activity data and solvent contents from the French paint federation. The activity data is equal to the VOC emissions.

Figure 3 shows the methodology for calculating the VOC emissions from car repairing.

Figure 3: Calculating the VOC emissions from car repairing

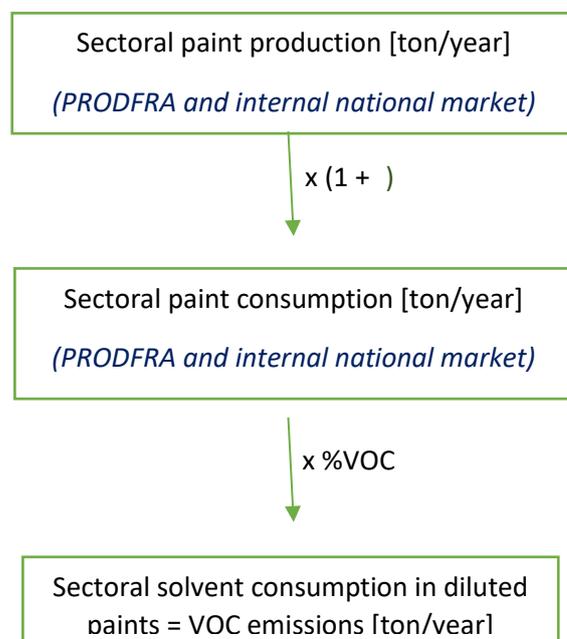


Table 9 presents the emission factors for solvent use in car repairing from the French inventory.

Table 9: Solvent use and EFs in car repairing

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	13 384	13 384	1 000 000
2000	13 330	13 330	1 000 000
2010	4 154	4 154	1 000 000
2019	2 519	2 519	1 000 000

French data - IIR 2021

SNAP 060103 – Construction, building and corrosion protection

The activity data of this subsector is determined applying the same methodology as for SNAP 060102 – Car repairing. The solvent content for construction and building comes from the EGTEI study (see below).

Table 10: The following data were given by the European Council of the Paint, Printing Ink, and Artist's Colours Industry (CEPE) throughout work carried out in 2003 and 2004 (EGTEI study).

Weighted VOC content of WB and SLV paints used in DECO_P sector (1990), [g/kg]																				
		Belgium	Denmark	Germany	Greece	Spain	France	Italy	Lux	Netherlands	Norway	Austria	Portugal	Swiss	Finland	Sweden	UK	ACC-1	ACC-2	Other
Interior walls and ceilings	Water	20.7	26.5	27.5	26.4	27.1	12.5	26.4	18.5	23.0	17.1	26.4	26.4	26.0	22.0	26.5	27.2	26.7	30.0	25.0
	Solvent	19.2	13.1	24.8	13.0	11.5	86.3	13.0	5.8	5.4	34.2	13.0	13.0	51.8	7.3	13.1	11.1	22.6	23.1	26.9
Exterior walls and ceilings	Water	4.9	8.9	5.1	8.9	6.0	11.4	8.9	12.7	8.6	1.7	8.9	8.9	5.1	6.2	1.8	4.2	7.6	7.6	12.6
	Solvent	1.8	1.8	28.6	1.8	10.7	20.1	1.8	1.8	1.8	0.0	1.8	1.8	19.9	16.8	51.8	9.9	11.7	7.1	7.1
Interior/exterior trim and cladding paint wood/metal	Water	4.6	5.8	2.4	1.2	1.2	0.4	2.3	4.7	8.8	0.7	2.3	1.2	0.0	9.8	5.8	2.6	2.7	0.6	0.6
	Solvent	51.3	20.9	20.6	37.7	87.0	15.3	33.4	53.2	67.1	56.1	33.4	37.7	0.0	49.1	20.9	53.7	38.6	30.4	26.1
Interior/exterior trim varnish and wood stains	Water	2.9	5.3	5.0	0.5	0.5	1.4	1.1	1.5	5.3	3.2	1.1	0.5	1.5	7.1	6.4	11.7	2.4	1.2	1.2
	Solvent	42.9	26.4	16.3	50.3	30.0	33.2	47.8	34.4	32.6	180.6	47.8	50.3	20.8	54.6	21.0	24.9	19.0	15.0	15.0
Primers	Water	1.3	0.1	0.4	0.3	0.0	0.5	0.3	0.6	0.0	0.1	0.3	0.3	0.6	0.1	0.3	0.0	0.2	0.2	0.2
	Solvent	7.8	5.2	1.0	3.1	0.8	5.7	3.1	3.1	1.6	5.2	3.1	3.1	4.3	1.4	3.1	2.4	2.6	2.6	2.6
Binding primers	Water	1.3	0.1	0.4	0.3	0.0	0.5	0.3	0.6	0.0	0.1	0.3	0.3	0.6	0.1	0.3	0.0	0.2	0.2	0.2
	Solvent	10.4	7.0	1.4	4.2	1.0	7.7	4.2	4.2	2.1	7.0	4.2	4.2	5.8	1.9	4.2	3.2	3.5	3.5	3.5
One pack performance coating	Water	1.4	0.2	1.1	0.7	0.1	1.4	0.7	1.8	0.1	0.2	0.7	0.7	1.8	0.2	0.7	0.1	0.6	0.6	0.6
	Solvent	28.2	5.2	1.0	3.1	0.8	5.7	3.1	3.1	1.6	5.2	3.1	3.1	4.3	1.4	3.1	2.4	2.6	2.6	2.6
Two pack performance coating	Water	0.6	0.2	1.1	0.7	0.1	1.4	0.7	1.8	0.1	0.2	0.7	0.7	1.8	0.2	0.7	0.1	0.6	0.6	0.6
	Solvent	1.0	5.2	1.0	3.1	0.8	5.7	3.1	3.1	1.6	5.2	3.1	3.1	4.3	1.4	3.1	2.4	2.6	2.6	2.6
Multi-coloured coatings	Water	0.5	0.3	1.2	0.8	0.1	1.5	0.8	1.9	0.1	0.3	0.8	0.8	1.9	0.2	0.8	0.1	0.6	0.6	0.6
	Solvent	1.6	5.2	1.0	3.1	0.8	5.7	3.1	3.1	1.6	5.2	3.1	3.1	4.3	1.4	3.1	2.4	2.6	2.6	2.6
Decorative effect coatings	Water	1.0	0.5	2.3	1.5	0.3	3.0	1.5	3.8	0.3	0.5	1.5	1.5	3.8	0.4	1.5	0.2	1.3	1.3	1.3
	Solvent	1.6	5.2	1.0	3.1	0.8	5.7	3.1	3.1	1.6	5.2	3.1	3.1	4.3	1.4	3.1	2.4	2.6	2.6	2.6
	TOTAL	205.1	142.9	143.3	163.8	179.6	225.2	158.7	162.9	163.2	328.1	158.7	163.8	163.1	183.0	171.1	161.0	151.3	135.0	134.5
TOTAL paint plus cleaning solvent		205.1	175.8	176.3	201.5	242.1	291.0	195.2	200.4	200.7	403.6	195.2	201.5	200.6	225.1	210.4	198.0	186.1	166.0	165.5

Weighted VOC content of WB and SLV paints used in DECO_P sector (2000), [g/kg]																				
		Belgium	Denmark	Germany	Greece	Spain	France	Italy	Lux	Netherlands	Norway	Austria	Portugal	Swiss	Finland	Sweden	UK	ACC-1	ACC-2	Other
Interior walls and ceilings	Water	12.7	16.3	18.9	16.3	19.8	7.7	16.3	11.4	14.2	10.5	16.3	16.3	16.0	13.5	16.3	16.8	16.4	18.5	15.4
	Solvent	16.3	11.1	0.0	11.1	4.3	73.4	11.1	5.0	4.6	29.1	11.1	11.1	44.1	6.2	11.1	9.4	19.2	19.6	22.9
Exterior walls and ceilings	Water	3.7	6.7	6.7	6.7	6.5	8.6	6.7	9.5	6.5	1.3	6.7	6.7	3.8	4.7	1.4	3.1	5.7	5.7	9.5
	Solvent	1.5	1.7	1.4	1.7	3.1	19.1	1.7	1.7	1.7	0.0	1.7	1.7	18.9	15.9	49.2	9.4	11.1	6.8	6.8
Interior/exterior trim and cladding paint wood/metal	Water	4.4	5.6	2.4	1.2	2.1	0.4	2.2	4.6	8.6	0.7	2.2	1.2	0.0	9.6	5.6	2.5	2.7	0.6	0.6
	Solvent	47.2	19.2	19.0	34.7	41.2	14.1	30.8	49.0	61.7	51.6	30.8	34.7	0.0	45.2	19.2	49.4	35.5	28.0	24.0
Interior/exterior trim varnish and wood stains	Water	3.0	5.3	5.0	0.5	0.2	1.4	1.1	1.5	5.3	3.2	1.1	0.5	1.5	7.1	6.4	3.9	2.4	1.2	1.2
	Solvent	39.6	24.2	15.0	46.1	16.0	30.4	43.8	31.6	29.9	165.6	43.8	46.1	19.1	50.1	19.3	22.8	17.4	13.8	13.8
Primers	Water	1.3	0.1	0.4	0.3	0.0	0.5	0.3	0.6	0.0	0.1	0.3	0.3	0.6	0.1	0.3	0.0	0.2	0.2	0.2
	Solvent	6.5	4.3	0.9	2.6	0.3	4.8	2.6	2.6	1.3	4.3	2.6	2.6	3.6	1.2	2.6	2.0	2.2	2.2	2.2
Binding primers	Water	1.3	0.1	0.4	0.3	0.0	0.5	0.3	0.6	0.0	0.1	0.3	0.3	0.6	0.1	0.3	0.0	0.2	0.2	0.2
	Solvent	10.4	7.0	1.4	4.2	0.6	7.7	4.2	4.2	2.1	7.0	4.2	4.2	5.8	1.9	4.2	3.2	3.5	3.5	3.5
One pack performance coating	Water	1.4	0.2	1.1	0.7	0.1	1.4	0.7	1.8	0.1	0.2	0.7	0.7	1.8	0.2	0.7	0.1	0.6	0.6	0.6
	Solvent	25.8	4.8	1.0	2.9	0.4	5.3	2.9	2.9	1.4	4.8	2.9	2.9	4.0	1.3	2.9	2.2	2.4	2.4	2.4
Two pack performance coating	Water	0.6	0.2	1.1	0.7	0.1	1.4	0.7	1.8	0.1	0.2	0.7	0.7	1.8	0.2	0.7	0.1	0.6	0.6	0.6
	Solvent	1.0	4.8	1.0	2.9	0.4	5.3	2.9	2.9	1.4	4.8	2.9	2.9	4.0	1.3	2.9	2.2	2.4	2.4	2.4
Multi-coloured coatings	Water	0.4	0.2	0.9	0.6	0.1	1.2	0.6	1.5	0.1	0.2	0.6	0.6	1.5	0.2	0.6	0.1	0.5	0.5	0.5
	Solvent	1.3	4.3	0.9	2.6	0.3	4.8	2.6	2.6	1.3	4.3	2.6	2.6	3.6	1.2	2.6	2.0	2.2	2.2	2.2
Decorative effect coatings	Water	0.7	0.4	1.7	1.1	0.2	2.2	1.1	2.8	0.2	0.4	1.1	1.1	2.8	0.3	1.1	0.1	0.9	0.9	0.9
	Solvent	1.3	4.3	0.9	2.6	0.3	4.8	2.6	2.6	1.3	4.3	2.6	2.6	3.6	1.2	2.6	2.0	2.2	2.2	2.2
	TOTAL	180.7	120.8	79.8	139.5	96.1	194.7	134.9	141.0	141.8	292.8	134.9	139.5	137.0	161.2	149.7	131.4	128.2	111.9	111.9
TOTAL paint plus cleaning solvent		180.7	148.6	98.1	171.6	146.1	236.5	166.0	173.4	174.5	360.1	166.0	171.6	168.6	198.3	184.1	161.6	157.7	137.6	137.6

Weighted VOC content of WB and SLV paints used in DECO_P sector (2007), [g/kg]																				
		Belgium	Denmark	Germany	Greece	Spain	France	Italy	Lux	Netherlands	Norway	Austria	Portugal	Swiss	Finland	Sweden	UK	ACC-1	ACC-2	Other
Interior walls and ceilings	Water	7.1	8.7	7.1	10.8	12.6	20.0	10.8	7.4	7.3	6.6	6.5	10.8	10.1	7.1	8.7	11.0	11.4	12.7	11.0
	Solvent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior walls and ceilings	Water	2.0	4.3	4.3	4.3	4.3	9.6	4.3	6.1	4.1	0.8	4.3	4.3	3.7	4.0	4.3	2.5	4.3	4.0	6.4
	Solvent	1.4	1.0	1.0	1.0	1.0	16.1	1.0	1.5	1.0	0.0	1.0	1.0	0.9	1.0	1.0	1.9	1.0	1.0	1.5
Int/ext trim and cladding paint wood/metal	Water	10.2	5.0	3.5	5.0	6.3	2.1	5.0	8.4	8.5	7.0	5.0	5.0	0.0	10.2	5.0	7.6	5.8	3.9	3.4
	Solvent	12.9	11.3	7.9	11.4	14.2	5.0	11.3	19.0	26.7	16.0	11.3	11.4	0.0	22.9	11.3	17.0	13.1	8.8	7.6
Int/ext trim varnish and wood stains	Water	7.1	6.3	4.9	6.3	2.2	6.1	6.4	5.0	5.3	23.6	6.4	6.3	3.4	10.8	6.3	4.2	3.7	2.5	2.5
	Solvent	14.6	13.2	10.3	13.2	4.6	18.8	13.3	10.5	14.8	49.1	13.3	13.2	7.1	22.5	13.2	13.1	7.8	5.3	5.3
Primers	Water	0.8	0.0	0.2	0.1	0.0	0.5	0.1	0.3	0.0	0.0	0.1	0.1	0.3	0.0	0.1	0.0	0.1	0.1	0.1
	Solvent	2.8	2.8	0.6	1.7	0.2	4.3	1.7	1.7	0.8	2.8	1.7	1.7	2.3	0.8	1.7	1.3	1.4	1.4	1.4
Binding primers	Water	0.7	0.0	0.2	0.1	0.0	0.5	0.1	0.3	0.0	0.0	0.1	0.1	0.3	0.0	0.1	0.0	0.1	0.1	0.1
	Solvent	9.1	6.1	1.2	3.7	0.5	7.2	3.7	3.7	1.8	6.1	3.7	3.7	5.1	1.6	3.7	2.8	3.0	3.0	3.0
One pack performance coating	Water	1.2	0.2	0.9	0.6	0.1	1.4	0.6	1.5	0.1	0.2	0.6	0.6	1.5	0.2	0.6	0.1	0.5	0.5	0.5
	Solvent	22.3	4.1	0.8	2.5	0.3	5.7	2.5	2.5	1.2	4.1	2.5	2.5	3.4	1.1	2.5	1.9	2.1	2.1	2.1
Two pack performance coating	Water	0.5	0.2	1.0	0.7	0.1	1.4	0.7	1.6	0.1	0.2	0.7	0.7	1.6	0.2	0.7	0.1	0.5	0.5	0.5
	Solvent	0.8	3.9	0.8	2.3	0.3	5.3	2.3	2.3	1.2	3.9	2.3	2.3	3.2	1.1	2.3	1.8	2.0	2.0	2.0
Multi-coloured coatings	Water	0.5	0.2	0.7	0.5	0.1	1.5	0.5	1.1	0.1	0.2	0.5	0.5	1.1	0.1	0.5	0.1	0.4	0.4	0.4

	Solvent	0.0	0.8	0.2	0.5	0.1	3.8	0.5	0.5	0.2	0.8	0.5	0.5	0.6	0.2	0.5	0.4	0.4	0.4	0.4
Decorative effect coatings	Water	1.0	0.3	1.4	0.9	0.1	3.0	0.9	2.2	0.1	0.3	0.9	0.9	2.2	0.2	0.9	0.1	0.7	0.7	0.7
	Solvent	0.0	1.5	0.3	0.9	0.1	4.8	0.9	0.9	0.5	1.5	0.9	0.9	1.3	0.4	0.9	0.7	0.8	0.8	0.8
	TOTAL	95.2	70.0	47.4	66.4	47.2	117.2	66.5	76.5	74.1	123.4	62.1	66.4	48.3	84.4	64.2	66.6	59.2	50.2	49.7
TOTAL paint plus cleaning solvent		95.2	86.1	58.2	81.7	75.4	140.1	81.7	94.1	91.1	151.7	76.4	81.7	59.5	103.8	78.9	81.9	72.8	61.7	61.1

Weighted VOC content of WB and SLV paints used in DECO_P sector (2010), [g/kg]																				
		Belgium	Denmark	Germany	Greece	Spain	France	Italy	Lux	Netherlands	Norway	Austria	Portugal	Swiss	Finland	Sweden	UK	ACC-1	ACC-2	Other
Interior walls and ceilings	Water	7.2	6.5	4.7	8.7	10.1	7.3	8.7	5.9	5.5	5.0	6.5	8.7	7.6	5.3	6.5	6.6	9.1	10.2	8.8
	Solvent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exterior walls and ceilings	Water	2.0	4.3	4.3	4.3	4.3	6.1	4.3	6.1	4.2	0.8	4.3	4.3	3.7	4.1	4.3	2.6	4.4	4.1	6.5
	Solvent	1.5	0.5	0.5	0.5	0.5	8.6	0.5	0.7	0.5	0.0	0.5	0.5	0.4	0.5	0.5	0.6	0.5	0.5	0.8
Interior/exterior trim and cladding paint wood/metal	Water	9.3	4.3	3.0	6.1	7.6	2.4	6.0	7.3	10.2	6.1	4.3	6.1	0.0	8.8	4.3	6.5	7.0	4.7	4.1
	Solvent	6.0	9.0	6.4	9.1	11.4	3.6	9.0	15.2	21.4	12.7	9.0	9.1	0.0	18.3	9.0	13.6	10.5	7.0	6.1
Interior/exterior trim varnish and wood stains	Water	5.8	7.9	6.2	7.9	2.7	6.1	8.0	6.3	6.7	29.5	8.0	7.9	4.3	13.5	7.9	4.4	4.7	3.2	3.2
	Solvent	12.9	8.3	6.4	8.2	2.9	6.3	8.3	6.5	9.2	30.8	8.3	8.2	4.4	14.1	8.3	10.5	4.8	3.3	3.3
Primers	Water	0.8	0.0	0.2	0.1	0.0	0.3	0.1	0.3	0.0	0.0	0.1	0.1	0.3	0.0	0.1	0.0	0.1	0.1	0.1
	Solvent	2.9	2.8	0.6	1.7	0.2	3.1	1.7	1.7	0.8	2.8	1.7	1.7	2.3	0.8	1.7	1.3	1.4	1.4	1.4
Binding primers	Water	0.7	0.0	0.2	0.1	0.0	0.3	0.1	0.3	0.0	0.0	0.1	0.1	0.3	0.0	0.1	0.0	0.1	0.1	0.1
	Solvent	9.4	6.1	1.2	3.7	0.5	6.7	3.7	3.7	1.8	6.1	3.7	3.7	5.1	1.6	3.7	2.8	3.0	3.0	3.0
One pack performance coating	Water	3.6	0.2	0.9	0.6	0.1	1.2	0.6	1.5	0.1	0.2	0.6	0.6	1.5	0.2	0.6	0.1	0.5	0.5	0.5

	Solvent	12.6	4.1	0.8	2.5	0.3	4.5	2.5	2.5	1.2	4.1	2.5	2.5	3.4	1.1	2.5	1.9	2.1	2.1	2.1
Two pack performance coating	Water	0.5	0.2	1.0	0.7	0.1	1.3	0.7	1.6	0.1	0.2	0.7	0.7	1.6	0.2	0.7	0.1	0.5	0.5	0.5
	Solvent	0.8	3.9	0.8	2.3	0.3	4.3	2.3	2.3	1.2	3.9	2.3	2.3	3.2	1.1	2.3	1.8	2.0	2.0	2.0
Multi-coloured coatings	Water	0.5	0.2	0.7	0.5	0.1	0.9	0.5	1.1	0.1	0.2	0.5	0.5	1.1	0.1	0.5	0.1	0.4	0.4	0.4
	Solvent	0.0	0.8	0.2	0.5	0.1	0.9	0.5	0.5	0.2	0.8	0.5	0.5	0.6	0.2	0.5	0.4	0.4	0.4	0.4
Decorative effect coatings	Water	1.0	0.3	1.4	0.9	0.1	1.8	0.9	2.2	0.1	0.3	0.9	0.9	2.2	0.2	0.9	0.1	0.7	0.7	0.7
	Solvent	0.0	1.5	0.3	0.9	0.1	1.7	0.9	0.9	0.5	1.5	0.9	0.9	1.3	0.4	0.9	0.7	0.8	0.8	0.8
	TOTAL	77.4	61.0	39.8	59.1	41.5	67.1	59.2	66.7	63.9	105.0	55.3	59.1	43.6	70.5	55.2	54.2	53.0	44.8	44.6
TOTAL paint plus cleaning solvent		77.4	75.1	49.0	72.8	57.1	90.1	72.8	82.1	78.6	129.2	68.1	72.8	53.6	86.7	67.9	66.6	65.2	55.2	54.8

Since 2010 the weighted VOC content used is equal to 90.1 g VOC/kg of consumed paints for France. The activity data is also equal to the VOC emissions.

The solvent content for corrosion protection is recalculated annually. Table 11 presents the emission factors for solvent use from construction, building and corrosion protection from the French inventory.

Table 11: Solvent use and EFs in construction, building and corrosion protection

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	90 131	90 131	1 000 000
2000	78 539	78 539	1 000 000
2010	45 433	45 433	1 000 000
2019	40 949	40 949	1 000 000

French data - IIR 2021

SNAP 060104 – Domestic use

The activity data of this subsector is determined using the same methodology as the one for the SNAP 060103 – Construction, building and corrosion protection. The solvent content for the domestic use comes from the EGTEI study (see SNAP 060103 above). Since 2010 the weighted VOC content used is equal to 90.1 g VOC/kg of consumed paint for France. The activity data is also equal to the VOC emissions.

Table 12 provides the activity data, emissions and emission factors for domestic solvent use from the French inventory.

Table 12: Domestic solvent use and EFs

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	29 938	29938	1 000 000
2000	35 546	35 546	1 000 000
2010	13 710	13 710	1 000 000
2019	13 281	13 281	1 000 000

French data - IIR 2021

SNAP 060106 – Boat building

The activity data of this subsector is determined using the same methodology as the one for the SNAP 060102 – Car repairing.

Table 13 presents the activity data, emissions and emission factors for boat building from the French Inventory.

Table 13: Solvent use and EFs in boat building

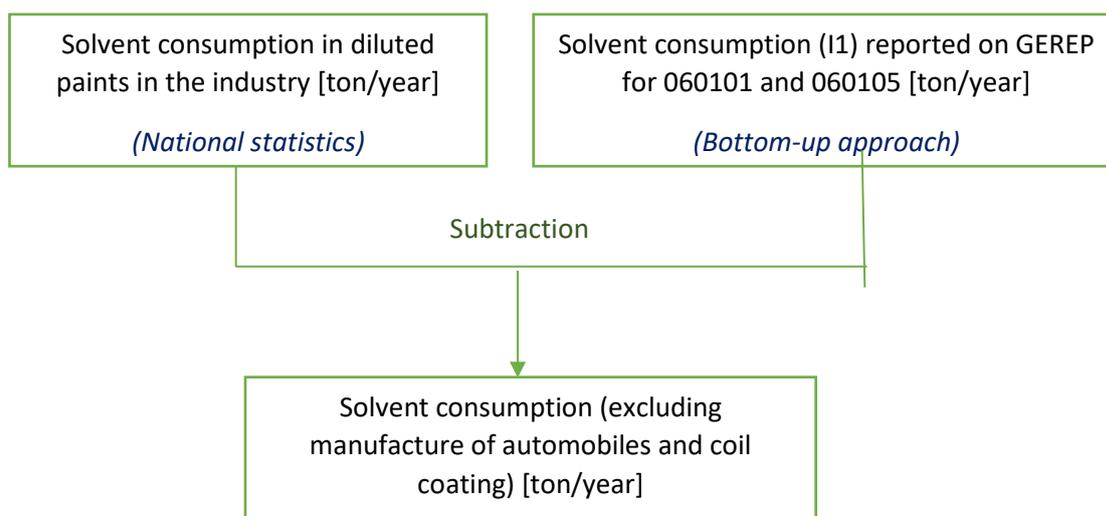
Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	2 854	2854	1 000 000
2000	2 059	2 059	1 000 000
2010	1 737	1 737	1 000 000
2019	1 182	1 182	1 000 000

French data - IIR 2021

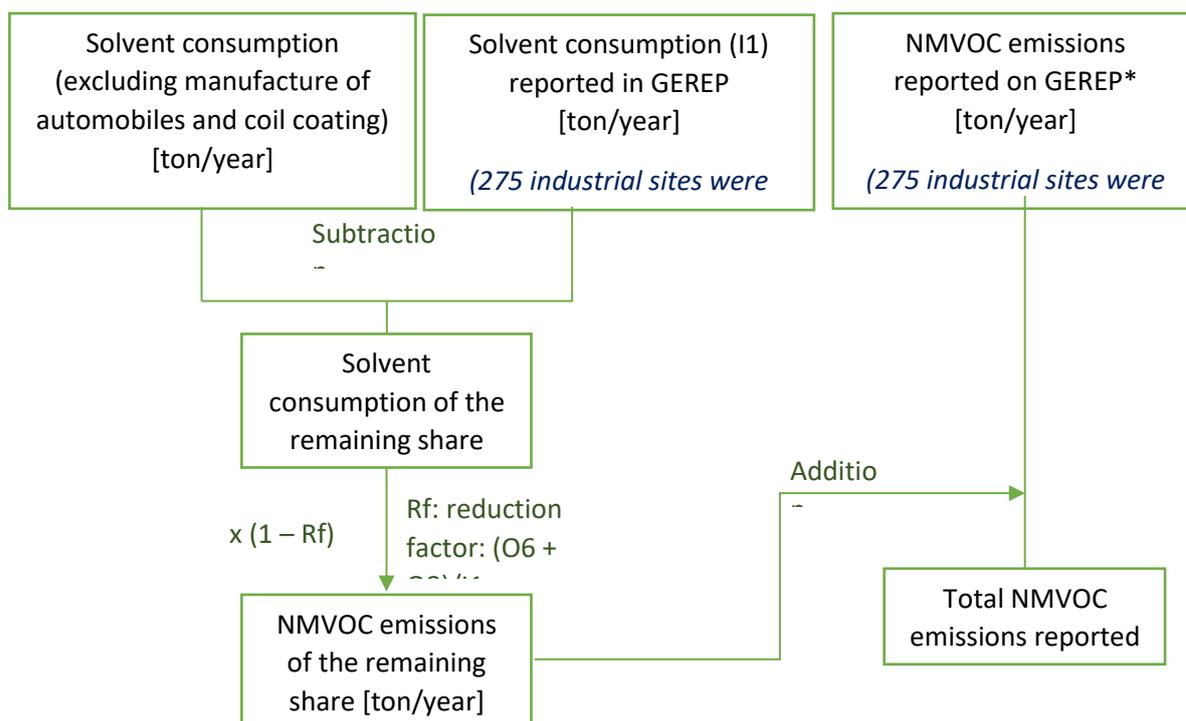
SNAP 060108 – Other industrial paint application

The activity data is based of national statistics and data from the bottom-up approach. Figure 4 presents the methodology for calculating the VOC emissions from other industrial paint application.

Figure 4: Calculating the VOC emissions from other industrial paint application



The emissions are estimated using the data extracted from GEREP:



I1, O6 and O8 correspond to input and outputs of the management plan (SMP). Refer to the chapter 5 of this report to have more details on an SMP.

Table 14 provides the activity data, emissions and emission factors used in the French inventory for other industrial paint applications.

Table 14: Solvent use and EFs in other industrial paint applications

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	97 747	97 747	1 000 000
2000	96 389	84 822	880 000
2010	58 410	36 529	625 394
2019	32 054	17 516	546 447

French data - IIR 2021

SNAP 060307 – Paint manufacturing

The total quantity of paint manufactured comes from national statistics. The activity data, which corresponds to the quantity of solvents contained in the paints manufactured is equal to the sum of the solvents contained in the paint produced in the different subsectors.

Emissions are determined applying an emission factor that is calculated with data reported by paint manufacturers in GEREP. In 2019, the emission factor estimated was equal to 1.2 % of solvents used in the paints.

Table 15 provides the activity data, emissions and emission factors used in the French inventory for paint manufacture.

Table 15: Solvent use and EFs in paint manufacture

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	214 343	9397	43 841
2000	232 474	8 138	35 006
2010	147 047	2 054	13 970
2019	111 407	1 464	13 139

French data - IIR 2021

2D3g Chemical Products

French methods for estimating emissions from 2D3g Chemical Products are summarised below:

SNAP 060301 – Polyester processing

This activity data of this subsector corresponds to the national consumption of polyester. The data comes from customs data. The emission factor is calculated with data that given by the Association of Plastic Manufacturers (SPMP) and is constant during the entire time series.

Table 16 provides the activity data, emissions and emission factors used in the French inventory for polyester processing.

Table 16: Solvent use and EFs in polyester processing

Year	Activity data	Emissions	Emission factor
	Mg of polyester	Mg VOC	g VOC / Mg polyester
1990	70 031	2 272	32 438
2000	86 000	2 790	32 438
2010	116 000	3 763	32 438
2019	105 144	3 411	32 438

French data - IIR 2021

SNAP 060302 – Polyvinylchloride processing

The activity data of this subsector is the national sale of polyvinylchloride given by Plastics Europe, which is a European plastic manufacturers association. The emission factor is constant during the entire time series. It is determined by taking assumptions.

Table 17 provides the activity data, emissions and emission factors used in the French inventory for polyvinylchloride processing.

Table 17: Solvent use and EFs in polyvinylchloride processing

Year	Activity data	Emissions	Emission factor
	Mg of polyvinylchloride	Mg VOC	g VOC / Mg manufactured product
1990	760 725	3 328	4 375
2000	751 000	3 286	4 375
2010	551 000	2 411	4 375
2019	496 268	2 171	4 375

French data - IIR 2021

SNAP 060303 – Polyurethane foam processing

The activity data of this subsector is the quantity of polyurethane used. The emission factor is constant during the entire time series; it is determined with data that come from two industrial facilities that use polyurethane.

Table 18 provides the activity data, emissions and emission factors used in the French inventory for polyurethane foam processing.

Table 18: Solvent use and EFs in polyurethane foam processing

Year	Activity data	Emissions	Emission factor
	Mg of polyurethane	Mg VOC	g VOC / Mg consumed product
1990	139 266	372	2 673
2000	153 000	409	2 673
2010	128 182	343	2 673
2019	160 909	430	2 673

French data - IIR 2021

SNAP 060304 – Polystyrene foam processing

The activity data is the quantity of transformed polystyrene. This quantity is based on the national production and the share of the transformed quantity in the total production, which is estimated at 66%. These data are given by the French Association of Polystyrene insulation Expanded in the building and Plastics Europe.

Table 19 provides the activity data, emissions and emission factors used in the French inventory for polystyrene foam processing.

Table 19: Solvent use and EFs in polystyrene foam processing

Year	Activity data	Emissions	Emission factor
	Mg of transformed polystyrene	Mg VOC	g VOC / Mg VOC
1990	93 000	5 580	60 000
2000	121 000	7 260	60 000
2010	91 866	5 319	57 900
2019	85 741	4 853	56 600

French data - IIR 2021

SNAP 060305 – Rubber processing

This subsector covers the manufacture of industrial rubber and tyre production. The methodology applied is 100% bottom-up.

Table 20 provides the activity data, emissions and emission factors used in the French inventory for tyre production.

Table 20: Solvent use and EFs in tyre production

Year	Activity data	Emissions	Emission factor	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent	g VOC / Mg tyre
1990	6 741	6 741	1 000 000	10.0
2000	4722	4722	1 000 000	5.7
2010	1556	969	623 058	1.9
2019	917	483	526 862	1.5

French data - IIR 2021

Table 21 provides the activity data, emissions and emission factors used in the French inventory for industrial rubber manufacture.

Table 21: Solvent use and EFs in industrial rubber manufacture

Year	Activity data	Emissions	Emission factor	Emission factor
	Mg of solvent	Mg VOC	g VOC/Mg solvent	g VOC / Mg rubber
1990	3 290	3 290	1 000 000	13.8
2000	1 718	1 718	1 000 000	3.9
2010	1 087	390	359 230	1.0
2019	1 099	1 099	309 057	1.1

French data - IIR 2021

[SNAP 060306 – Pharmaceutical products manufacturing](#)

The methodology applied is 100% bottom-up.

Table 22 provides the activity data, emissions and emission factors used in the French inventory for pharmaceutical product manufacture.

Table 22: Solvent use and EFs in pharmaceutical product manufacture

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	117 454	10 878	92 614
2000	154 420	12 303	79 672
2010	130 474	5 167	39 599
2019	138 193	4 074	29 484

French data - IIR 2021

[SNAP 060311 – Adhesive, magnetic tapes, films and photographs manufacturing](#)

The methodology applied is 100% bottom-up.

Table 23 provides the activity data, emissions and emission factors used in the French inventory for the manufacture of adhesives, magnetic tapes, films and photographs.

Table 23: Solvent use and EFs in the manufacture of adhesives, magnetic tapes, films and photographs

Year	Activity data	Emissions	Emission factor
	Mg of solvent	Mg VOC	g VOC / Mg solvent
1990	22 925	13 000	567 066
2000	18 079	4 907	271 419
2010	9 786	1 228	125 485
2019	11 991	1 160	96 739

French data - IIR 2021

2D3h Printing

French methods for 2D3h are summarised below.

The SNAP 060403 – printing industry, covers publication rotogravure, publication (including heat set web offset, cold set web offset, sheet fed and additive), decorating packaging and metal packaging.

The methodology for publication rotogravure only is 100% bottom up. Table 24 provides the activity data, emissions and emission factors used in the French inventory for solvent use in rotogravure printing.

Table 24: Solvent use and EFs in rotogravure printing

Publication rotogravure

Year	Activity (Mg solvent)	Emissions (Mg VOC)	Emission factor (g VOC / Mg solvent)
1990	19 321	1 747	90 401
2000	23 457	4 113	175 338
2010	9 963	2 007	201 393
2019	5 744	842	146 604

French data - IIR 2021

The ratios between the ink consumption per type of ink and the total ink consumption are given in Table 25 below.

Table 25: Ink consumption by type in printing

Printing Type	Sub Type	Ink Consumption Ratio			
		1990	2000	2010	2019
Publication rotogravure	Publication	15%	11%	6%	4%
Publication	Heat set web offset	15%	12%	8%	5%
	Cold set web offset	12%	9%	6%	4%
	Sheet fed	9%	7%	5%	3%
	Additive	9%	8%	6%	4%
Decorating packaging	Ink, varnish decoration, packaging	33%	45%	62%	74%
	Pigment preparation	2%			
Metal packaging	Offset metal ink	1%	1%	1%	1%
	Varnish	3%	6%	6%	4%

French data - IIR 2021

The emission factors for printing are given in Table 26 below.

Table 26: EFs for printing

Year	Emission factor g VOC / Mg solvent	Emission factor g VOC / Mg ink
1990	797 524	872 447
2000	728 676	709 526
2010	529 260	508 191
2019	356 068	355 647

French data - IIR 2021

The solvent contents for printing in 1990, 2010 and 2019 are given in the tables below:

Table 27: Solvent contents used in printing (1990)

Group product	%VOC in inks		Water based ink rate (%)
	Solvent based inks (kg VOC/kg ink)	Water based inks (kg VOC/kg ink)	
Publication rotogravure	Publication rotogravure	1.5	
Publication including	Total		
	Heatset web offset	0.61	
	Coldset web offset	0.35	
	Sheet fed	1.345	
	Additive	0.2	
Decorating packaging including	Total		
	Ink. varnish decoration. packaging	1.8	0.1
			22
Metal packaging including	Total		
	Offset metal ink	0.03	
	Varnish	1.5	

French data

Table 28: Solvent contents used in printing (2010)

Group product		%VOC in inks		Water based ink rate (%)
		Solvent based inks (kg VOC/kg ink)	Water based inks (kg VOC/kg ink)	
Publication rotogravure	Publication rotogravure	1.5		
Publication including	Total			
	Heatset web offset	0.51		
	Coldset web offset	0.15		
	Sheet fed	0.615		
	Additive	0.2		
Decorating packaging including	Total			
	Ink. varnish decoration. packaging	1.8	5	38.5
Metal packaging including	Total			
	Offset metal ink	0.03		
including	Varnish	1.5	5	42

French data

Table 29: Solvent contents used in printing (2019)

Group product		%VOC in inks		Water based ink rate (%)
		Solvent based inks (kg VOC/kg ink)	Water based inks (kg VOC/kg ink)	
Publication rotogravure	Publication rotogravure	1.5		
Publication including	Total			
	Heatset web offset	0.51		
	Coldset web offset	0.15		
	Sheet fed	0.615		
	Additive	0.2		
Decorating packaging including	Total			
	Ink. varnish decoration. packaging	1.8	5	38.5
Metal packaging including	Total			
	Offset metal ink	0.03		
including	Varnish	1.5	5	42

French data