

ESIG has finalised its 2020 solvent volatile organic compounds (VOC) emission inventories and results is in line with previous numbers: Solvent VOC emissions have stabilized in the EU28 (EU27+UK) since 2008 staying around 2000 ktonnes.

- Overall trend (ktonnes)

year	ESIG VOC emissions	ESIG VOC emissions with ethanol	EEA inventories*	EEA vs ESIG difference
2008	2159	na	3311	35%
2009	1917	na	2950	35%
2013	1978	na	2612	24%
2015	1981	na	2562	23%
2016	1628	1968	2549	23%
2017	1613	1946	2603	25%
2018	1813	2113	2589	18%
2019	1765	2073	2570	19%
2020	1538	2217		

* based on reporting in 2021

Both ESIG and EEA data show relatively stabilized emission level in the 2010s, with a difference between the two datasets being around 25%. In 2018 reporting however, the difference decreased to ~20% and in 2019 the difference was similar. In 2020, the ESIG VOC emissions decreased, which may be attributed to lower production/sales given the Covid-19 crisis. On the other hand, ethanol consumption increased given the use in hand sanitizer. Overall, this results in a 7% increase in VOC emissions from solvents in EU27+UK.

This paper presents the final numbers. The ESIG solvents emission inventories have been conducted with the support of TNO.

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ESIG Solvent VOC Emissions Numbers 2020 per country

Summary of results for aggregated country groups applied by ESIG 2020			
Countries	TOTAL EMISSIONS BY COUNTRY OF PRODUCTION Hydrocarbon+Oxygenated solvents (ktonne/country)	IMPORT/EXPORT Corrections	Emissions NMVOC in ktonne/country
Austria	32.55	22.36	54.91
Belgium + Luxembourg	122.02	-93.56	28.46
Bulgaria + Romania	9.52	51.27	60.79
Croatia	1.53	18.91	20.44
Cyprus + Greece + Malta	18.82	16.89	35.71
Czech Republic	13.20	45.61	58.81
Denmark	21.37	-0.52	20.85
Estonia + Latvia + Lithuania	4.32	8.77	13.09
Finland	15.10	20.86	35.97
France	367.92	-8.68	359.24
Germany	576.95	-346.89	230.06
Hungary	9.06	20.99	30.05
Ireland	14.03	5.67	19.70
Italy	279.04	157.58	436.62
Netherlands	181.39	-102.37	79.03
Poland	85.30	61.97	147.27
Portugal	9.28	9.20	18.48
Slovakia	3.66	8.27	11.93
Slovenia	16.68	-5.98	10.70
Spain	175.24	96.76	272.00
Sweden	31.18	17.30	48.47
United Kingdom	228.47	-4.42	224.05
Total EU-28	2216.64	0.00	2216.64

Data on import/export are taken from J. Pearson for 2016 & 2017, based on adjusted 2015 import/export. For 2018 and 2019, import/export estimates are based on the import and export estimates from the year before which are adjusted for the increase/decrease in VOC emissions.

For 2020, import and export estimates have been revised for 2020 as well as for the years before. This does not affect EU28 totals but at country level adjustments have been made. All of this will be made available as soon as possible And will include the updated datasets from 2016 onwards.

Once the EEA data is available we will add the comparison table

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ESIG Solvent VOC Inventories for the EU – a top down approach¹

In summary, ESIG's top-down approach consists of three operations:

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

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1. All companies which are part of ESIG are invited to submit their solvent sales volumes by end-use sector for each European country (EU-27+ UK).

Notes:

- The sales numbers are about 90% of all oxygenated and hydrocarbon VOC solvents² manufactured and then sold in the European Union hence highly confidential. There are collated by Cefic, and carefully and confidentially analyzed.
 - No data from chlorinated/halogenated solvents are included anymore as all uses are in closed system, meaning no emission to air.
 - Excluded from ESIG's portfolio is also any substance which main use is not as solvent such as
 - Toluene, Benzene and Xylene - DMF, NMP, THF - Propylene Glycols - Methanol
 - The end-use sector 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
2. The emissions factors (see table below) 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.

¹ For more information on the method used, former technical papers can be consulted: https://www.esig.org/wp-content/uploads/2018/03/201802_ESVOC_techncial-paper-solvent-VOC-emisissions-2015_final-1.pdf
<https://www.esig.org/wp-content/uploads/2019/03/Atmospheric-Environment-John-VOC-article-201903.pdf>

² 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"



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 generic exposure scenarios (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 (2010).

Not all solvents are VOC and not all VOC's are solvents. Their respective properties such as boiling point range, 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.

3. 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 has to be made. Cefic (with as source Eurostat) has data for overall chemicals exports and imports for each country so that the net chemical transfer can be calculated for each 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 for 2015, which has been extrapolated to the later years. These calculations assume that there is no net import or export to or from the EU. These data show that Belgium, Germany and Netherlands are substantial exporters of solvents and downstream products (as such "exporting" VOC emissions) within the EU. The UK and France are effectively in balance as we assume is 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 apportion is made based on population data. For the 2020 ESIG emissions, the import and export assumptions have been reassessed, where especially for smaller countries adjustments were made.

How to access and use ESIG data?

The ESIG inventories are an accepted Tier 2a method according to the EMPE/EEA air pollutant emission inventory guidebook, however, the top down approach using REACH end uses and confidentiality considerations make it difficult to use the data when establishing the country inventories.

Due to the high confidentiality of sales data Cefic statistics impose certain rules. When there are fewer than 5 original entries there is no show of data for a category. In few cases countries are grouped together to allow to display at least some numbers. Here again population numbers could serve to split between countries to get some results.

Thanks to efforts done by the UK a table is added as an annex to the EMEP/EEA air pollutant emission inventory guidebook 2019, chapter 2.D.3.a. Domestic solvent use mapping the NFR categories against Reach end use sectors showing where and when ESIG data can be used (see table below). For instance for



INDUSTRIAL CLEANING : 100% is attributed to 2D3e, so in case of no own activity data the ESIG number can be used instead.

Since ESIG data are based on real data from EU solvents manufacturers, the ESIG emission inventories remain a valuable source of information and can also be used for comparisons.

Member States can obtain more information 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 data can also be used for comparison.

REACH end use categories & Emission Factors

	End-use	Release to air	Remarks
1	Agrochemical uses	100%	assumed to be completely released to the atmosphere and utilize solvents that are VOC
2	Blowing Agents	100%	
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 (inc.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

Table annexed to the EMEP/EEA air pollutant emission inventory guidebook 2019 , chapter 2.D.3.a.Domestic solvent use

REACH end-use sector	2D3a	2D3b	2D3c	2D3d	2D3e	2D3f	2D3g	2D3h	2D3i
Agrochemical uses	100 %								
Blowing agents									100 %
De-icing	50 %								50 %
Binder and release agents									100 %
Cleaning industrial and leather treatment					100 %				
Cleaning — professional consumer	100 %								
Coatings — industrial and adhesives, inks				80 %				15 %	5 %
Coatings — professional/consumer and thinners, paint industry	30 %			70 %					
Functional solvents (including solvents used in chemical processes, e.g. process aids, intermediates, extraction, dewaxing agents)							100 %		
Metal working/rolling oils/lubricant uses									100 %
Oil field chemicals, drilling, mining, extraction									100 %
Polymers processing (including rubber-tyre production) and industrial resins, synthetic rubber, process							100 %		
Road and construction		100 %							
Use as fuel/combustion and fuel additives									100 %
Water treatment									100 %
Other consumer uses (household, aerosols, cosmetics)	100 %								
Pharmaceuticals manufacturing							100 %		
Others — please specify below									100 %

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