

IMPROVEMENTS IN NMVOC EMISSION ESTIMATION

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› **OUTLINE**

IMPROVEMENTS IN NMVOC EMISSION ESTIMATION

- › Introduction & main sources of NMVOC emissions
- › Focus area: NMVOCs from product/solvent use
- › Challenges for Member States
- › How to progress? Role of the TFEIP and Way forward
- › Conclusions

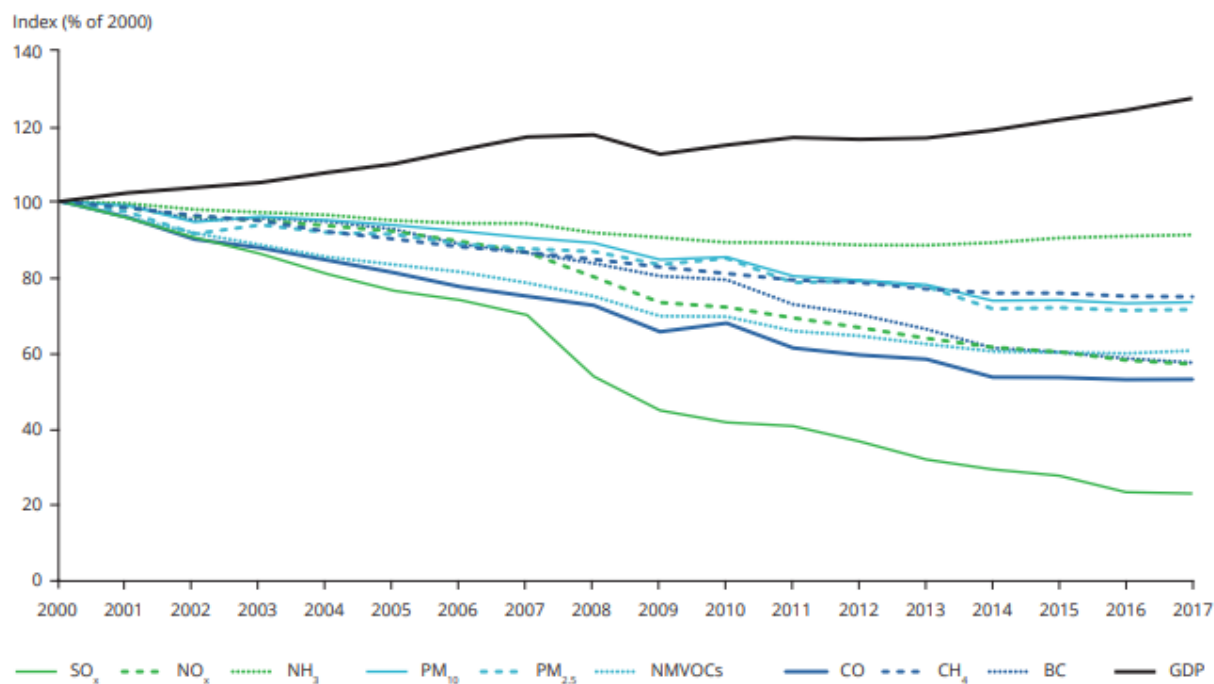
T F E I P

Task Force on Emission Inventories and Projections

A group established under the UNECE Convention on Long-range Transboundary Air Pollution.

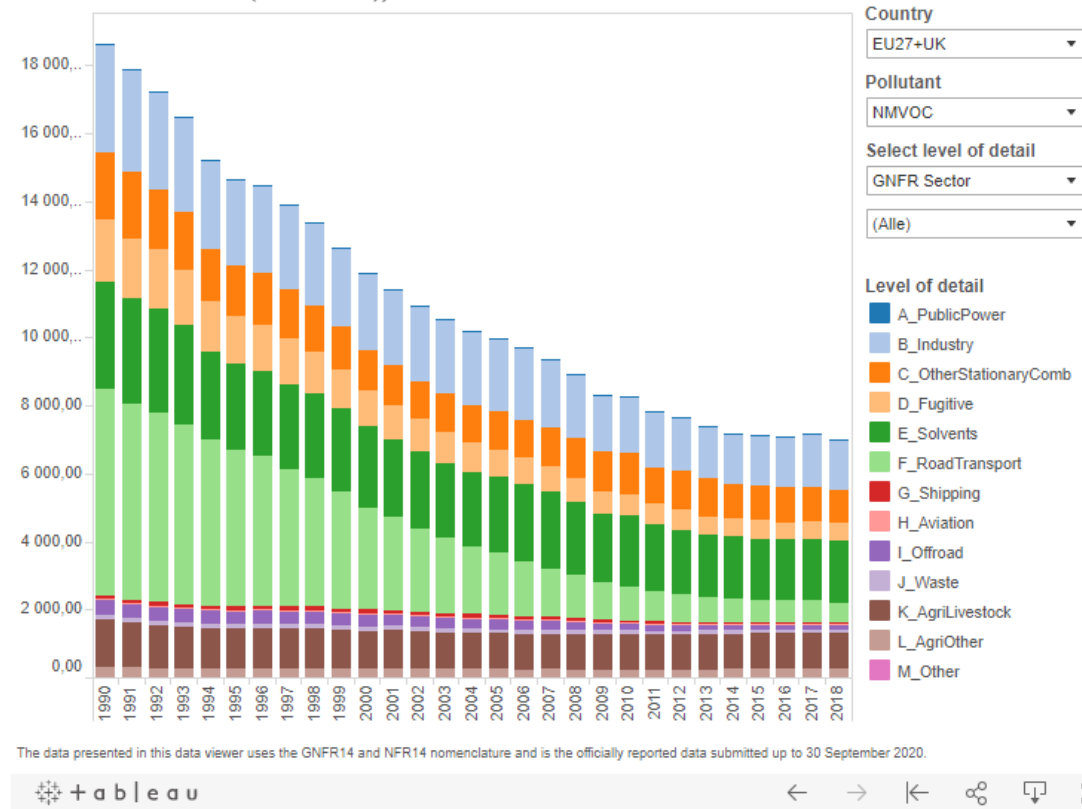
INTRODUCTION

FIGURE 8.1 Trends in the main air pollutant emissions and in gross domestic product in the EU-28



Source: EEA State of the Environment 2020

Emissions of NMVOC (kilotonnes), EU27+UK

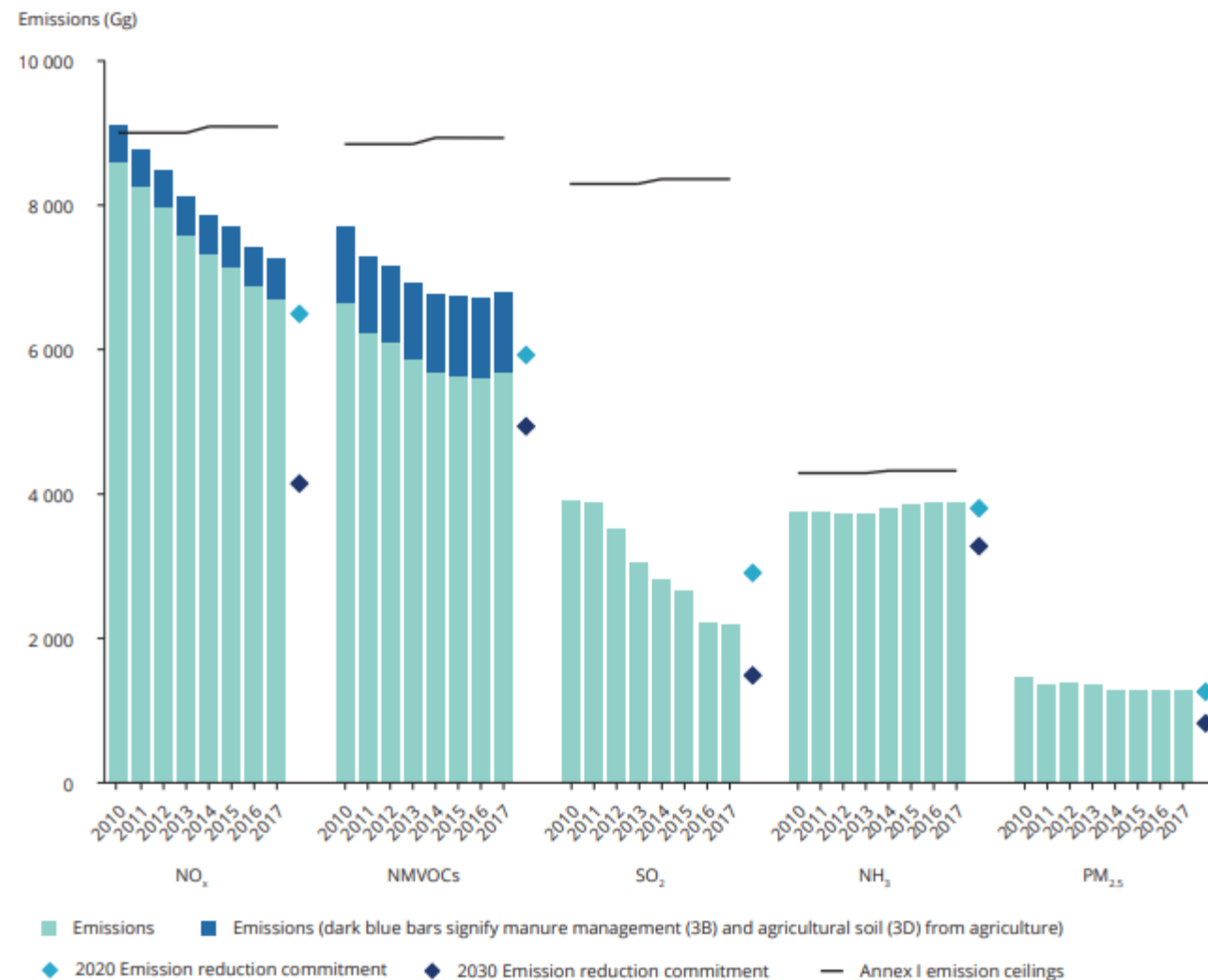


Source: www.ceip.at

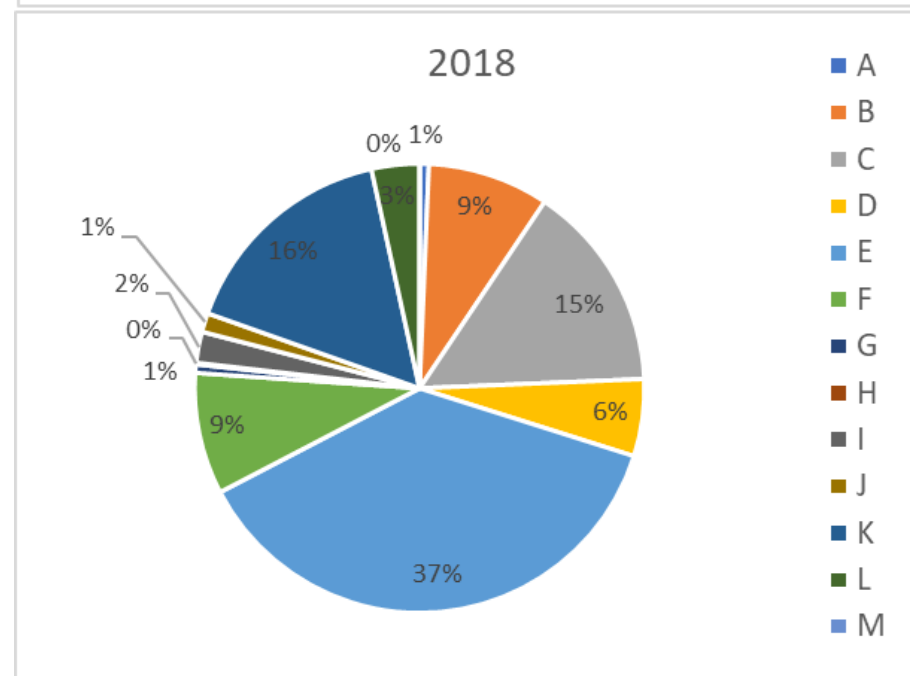
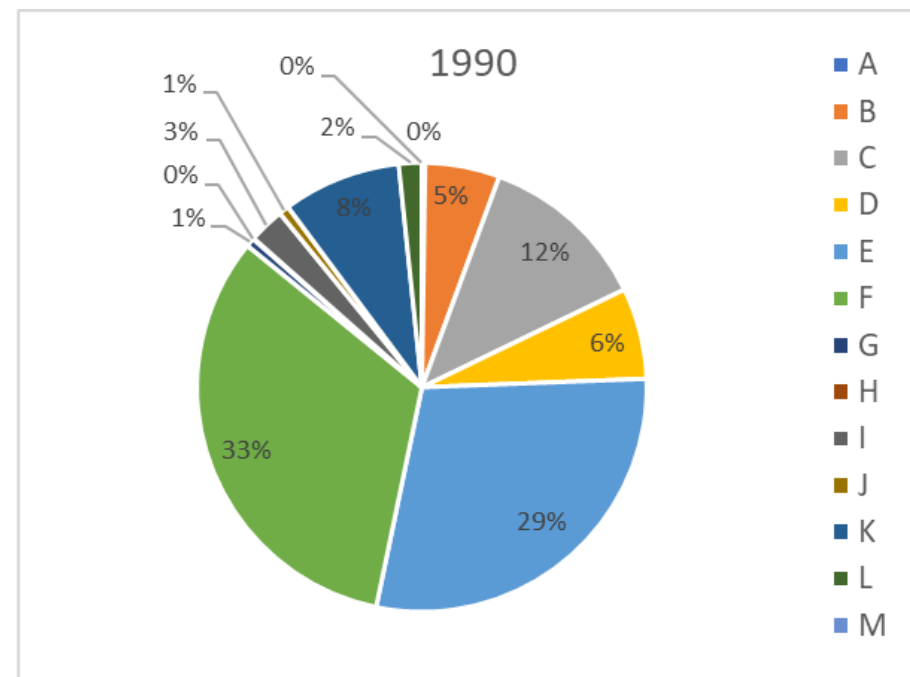
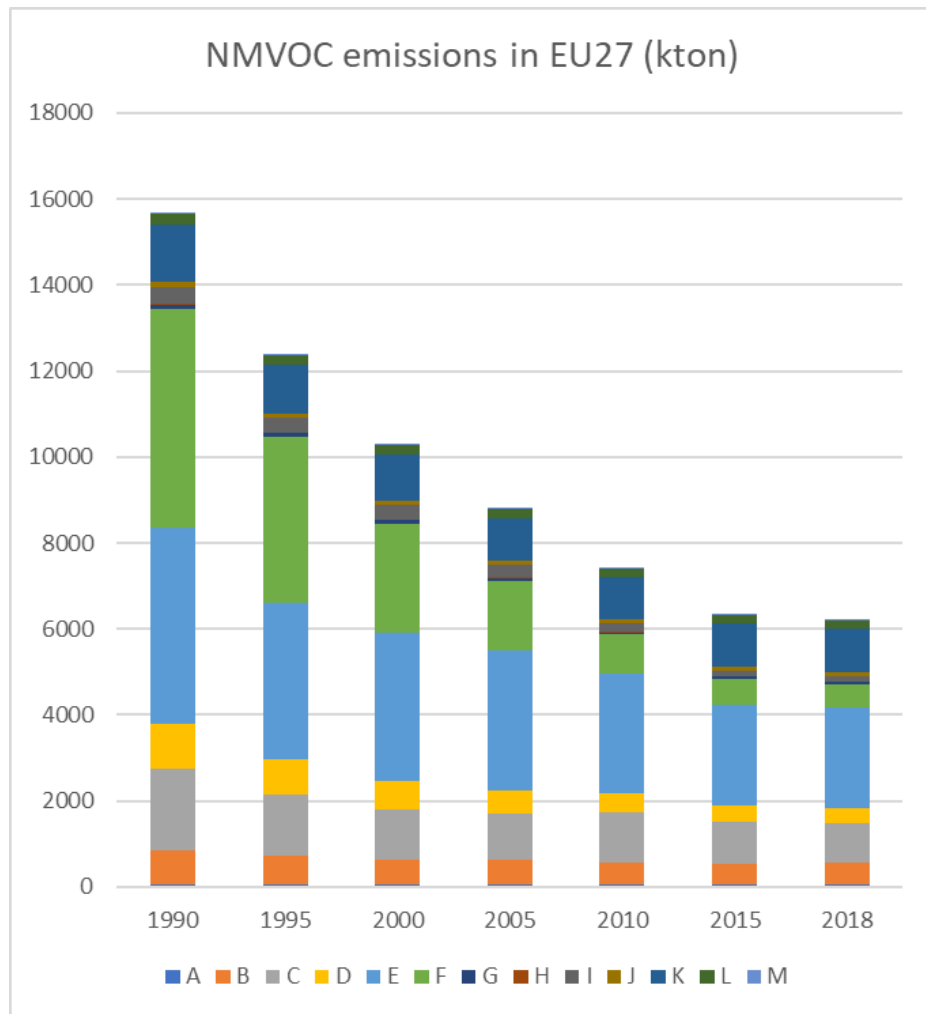
› FUTURE EMISSION TARGETS

- › Large reductions achieved... but further reduction needed
- › For NMVOC
 - › 2010 & 2020 ceilings achieved
 - › For 2030 ceiling more is needed!
- › Emission inventory needs to be set up such that these changes can be taken into account and reductions can be monitored

FIGURE 8.2 EU progress towards meeting the 2010 emission ceilings set out in the NEC Directive and the 2020/2030 reduction commitments



MAIN SOURCES OF NMVOC

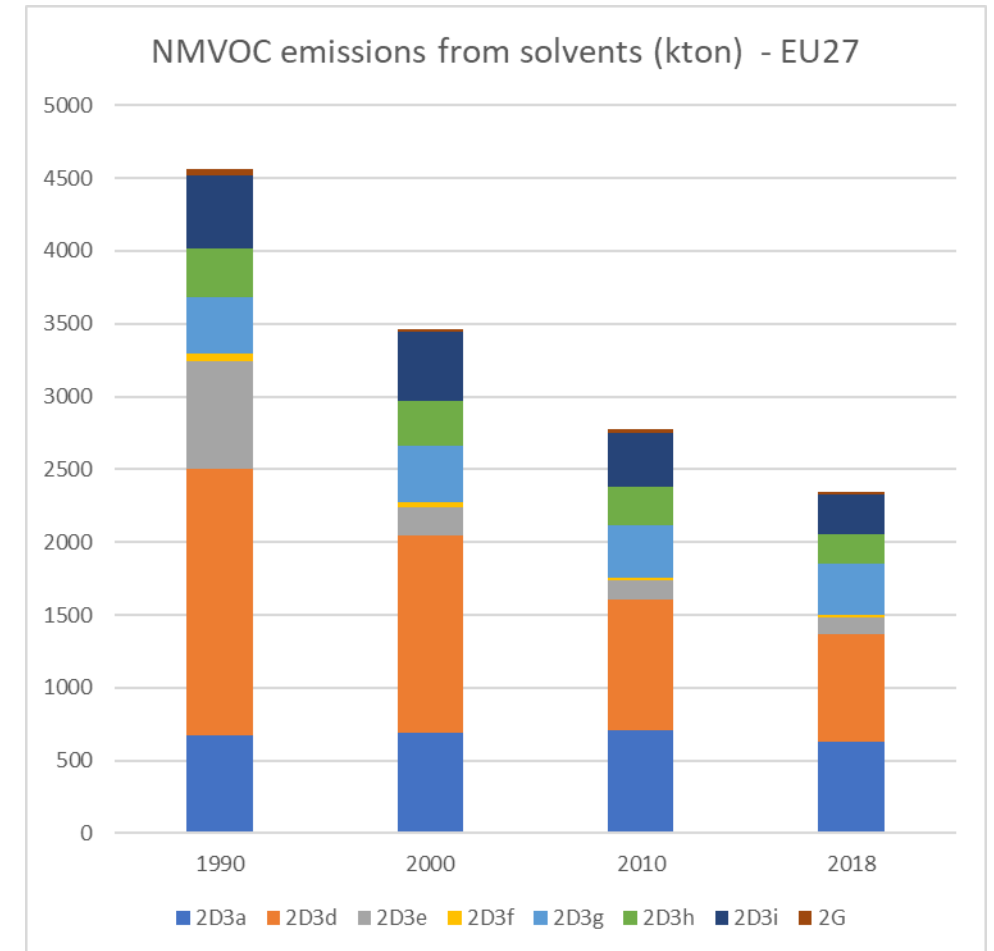


› GNFR E: PRODUCT USE

- › GNFR category E (and underlying NFR categories) comprises NMVOC emissions from the use of products
 - › Typically these are hydrocarbons used in a variety of products
 - › Most of these are classified as solvents, but some do not meet the definition for solvents
- › Definitions (*Solvent Directive, 1999/13/EC*):
 - › Non-methane volatile organic compound shall mean 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 condition of use”
 - › Solvent definition: Organic solvent shall mean any VOC which is used alone or in combination with other agents, and without undergoing a chemical change, to dissolve raw materials, products or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dissolver, or as a dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or a plasticiser, or as a preservative”
- › (*NEC Directive 2284/2016/EU*) NMVOC: “all organic compounds other than methane, that are capable of producing photochemical oxidants by reaction with nitrogen oxides in the presence of sunlight”

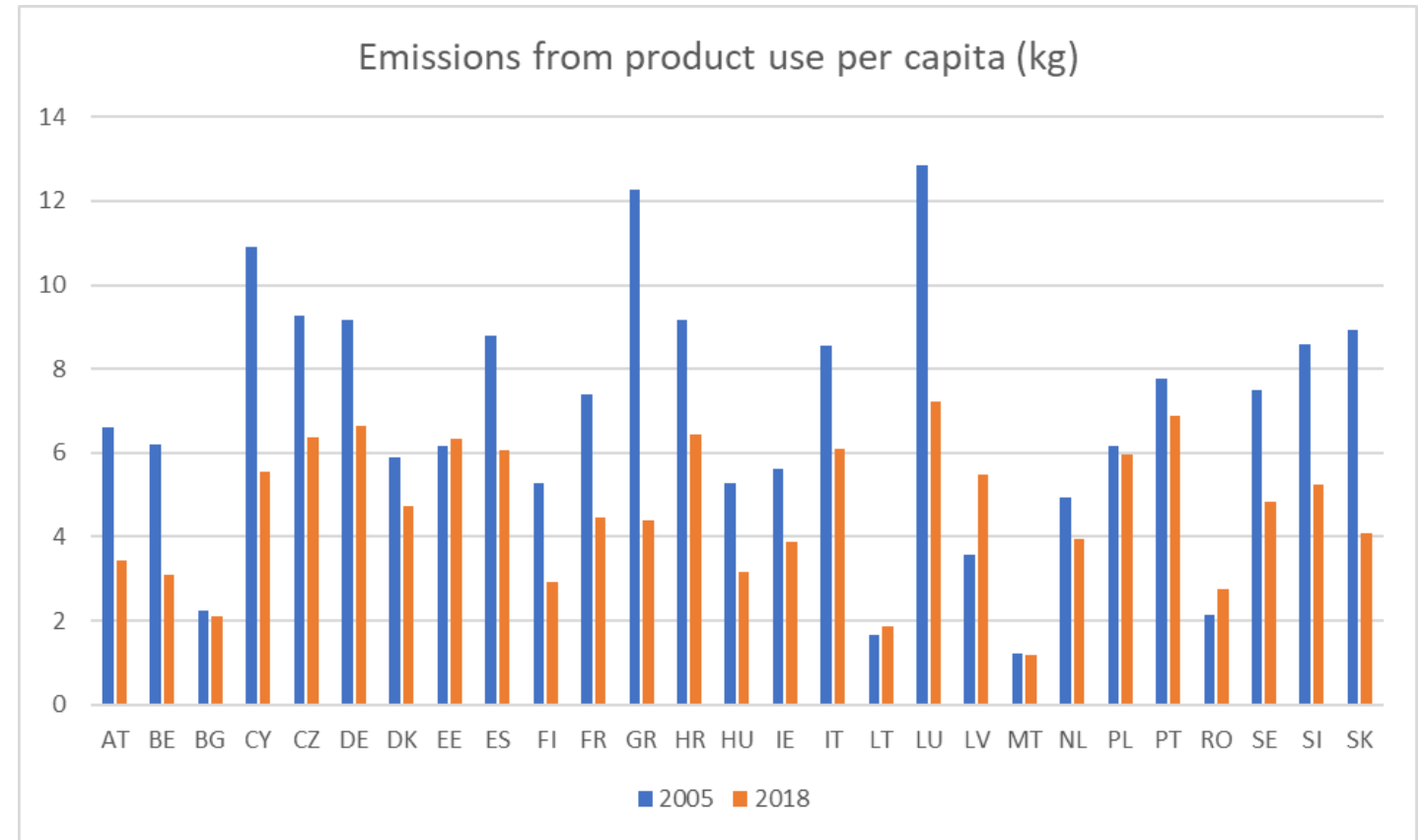
› EMISSIONS FROM PRODUCT USE

- › Many (solvent-containing) products are present in our daily life:
 - › Cosmetics (e.g. gels, aerosols, creams)
 - › Cleaning products
 - › Paints, coatings
- › In the solvent sector, NMVOC emissions are not a unwanted by-product (e.g. in combustion) but the solvent is a necessity for the product to do what is intended
- › Main sources of solvent NMVOCs nowadays in EU:
 - › 2.D.3.a Domestic use of solvents
 - › 2.D.3.d Paint application
 - › 2.D.3.g Chemical products



› EMISSIONS FROM PRODUCT USE

- › Reported data in 2005 and 2018, expressed per capita
- › Emission reduction differs between countries
 - › More than 30% reduction in half the Member States
 - › On the contrary, 4 MS report an increase in emissions over this period
- › Some countries still using Tier 1 (or Tier 1-like) approach for the respective NFR categories, which does not take into account sector or technology changes over time



› TASK FORCE ON EMISSION INVENTORIES & PROJECTIONS



- › Main aim is to support the process of inventory compilation and reporting under LRTAP and NECD
- › Expert Panels providing technical support in focus areas
 - › Combustion & Industry Panel includes all stationary combustion, industrial production and product use, and waste
 - › Update and maintain the EMEP/EEA Guidebook
 - › Lots of sectors with each their challenges, and no direct funding
 - › Facilitate exchange of information between the countries (and other stakeholders involved)

› CHALLENGES FOR INVENTORY COMPILATION

EMISSION FACTORS

- › For many of the solvents, the default assumption would be 100% of the solvents going to the air (EF = 1 ton/ton)
- › However, especially in industrial applications solvent may be applied in (semi-)closed systems limiting the release to the atmosphere, especially when the solvents are applied in specific conditions, e.g. higher temperature regimes
- › Important: **product ≠ solvent**
 - › While for solvents it could be assumed that most goes into the air, this is not the case for the solvent-containing products
 - › Some products may only contain small portions of solvents, where others may be almost pure solvent
 - › For instance: paints containing solvents, where the solvent content depends strongly on the type of paint (solvent-borne, water-borne paints and for different applications)

› CHALLENGES FOR INVENTORY COMPILATION

ACTIVITY DATA

- › More challenging than the emission factors
- › Most countries do not have detailed information on the use of products generally available
- › Some of the Nordic countries have set up a product register where all products being put on the market are registered (production, import and export). This way, use can be estimated when the stock is assumed not to change
- › Generally however at European level, these data are available only to a very limited extent
 - › Prodcom (Eurostat) holds very detailed product-specific data on production and trade, but is only partially filled
 - › National datasets may exist in some countries like in the Nordic countries
 - › Other countries need to collect this information in another way (branche organisations, dedicated studies)

› CHALLENGES FOR INVENTORY COMPILATION

METHODOLOGIES AVAILABLE

- › EMEP/EEA Guidebook provides the basic guidance, including methodologies and associated emission factors
 - › Tier 1 approach: a single EF representing a complete NFR source category
 - › Tier 2 approach: stratification between different products or technologies (**mandatory for key categories**)
- › However, most critical is the collection of suitable **activity data** on the use of solvents and/or solvent-containing products
 - › Needs to be explored at the country level since at EU level this information per MS is scarce

Box 1. Examples of solvent-containing products

Cosmetics and toiletries

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

Car care products

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

Household products

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

DIY/buildings

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

› APPROACHES FOR INVENTORY COMPILATION

GUIDEBOOK APPROACH (TIER 1)

- › Example: Domestic use of solvents (2.D.3.a)
- › Tier 1: Emission factor per capita, representing an “average” use of these small-scale products
- › Not to be used when this is a key category!

Box 1. Examples of solvent-containing products

Cosmetics and toiletries

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

Household products

Aerosols, all types
General purpose cleaners
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Air freshener, slow release
Toilet blocks
Disinfectants
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Car care products

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Antifreeze
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Car waxes and polishes
De-icer pumps
Engine degreasers
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DIY/buildings

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

Table 3.1 Tier 1 emission factors for source category 2.D.3.a Domestic solvent use including fungicides

Tier 1 default emission factors					
	Code	Name			
NFR Source Category	2.D.3.a	Domestic solvent use including fungicides			
Fuel	NA				
Not applicable	NO _x , CO, SO _x , NH ₃ , BC, Pb, Cd, 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				
Not estimated	PM _{2.5}				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
NMVOC — western Europe (*)	1.8	kg/capita	0.6	3.0	Assessment of available sources (described below)
NMVOC — other countries	1.2	kg/capita	0.5	1.7	Assessment of available sources (described below)

(*) In this table, western Europe refers to the EU Member States as of 1 January 1995 plus Iceland, Norway and Switzerland.

› APPROACHES FOR INVENTORY COMPILATION

GUIDEBOOK APPROACH (TIER 2)

- › Example: Domestic use of solvents (2.D.3.a)
- › Tier 2a (solvent-based approach) and Tier 2b (product-based approach)
- › Method to be applied selected based on activity data availability

Table 3.2 NMVOC emission factors for source category 2.D.3.a Domestic solvent use including fungicides for different solvent types/applications

Tier 2 emission factors					
	Code	Name			
NFR source category	2.D.3.a	Domestic solvent use including fungicides			
Fuel	N/A				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/practices	Various, see below				
Region or regional conditions					
Abatement technologies	N/A				
Not applicable	NO _x , CO, SO _x , NH ₃ , BC, 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				
Not estimated	PM _{2.5}				
Subsector	Value (NMVOC)	Unit	95 % confidence interval		Reference
			Lower	Upper	
Agrochemical uses	1 000	g/kg solvent	950	1 000	ESIG (2015)
Blowing agents	1 000	g/kg solvent	950	1 000	ESIG (2015)
De-icing	1 000	g/kg solvent	950	1 000	ESIG (2015)
Binder and release agents	1 000	g/kg solvent	950	1000	ESIG (2015)
Professional consumer cleaning	500	g/kg solvent	300	700	ESIG (2015)
Industrial, professional and consumer coatings	750	g/kg solvent	500	1 000	ESIG (2015)
Road and construction	950	g/kg solvent	950	1 000	ESIG (2015)
Other consumer uses (households, aerosols, cosmetics)	950	g/kg solvent	700	1 000	ESIG (2015)

Table 3.4 Tier 2 NMVOC emission factors for source category 2.D.3.a Domestic solvent use including fungicides for different products and product types

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.a	Domestic solvent use including fungicides			
Fuel	N/A				
SNAP (if applicable)	060408	Domestic solvent use (other than paint application)			
Technologies/practices	Various, see below				
Region or regional conditions					
Abatement technologies					
Not applicable	NO _x , CO, SO _x , NH ₃ , BC, 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				
Not estimated	PM _{2.5}				
Sector	Value (NMVOC)	Unit	95 % confidence interval		Reference
			Lower	Upper	
Cosmetics and toiletries (all)	127	g/kg product	60	250	ISPRA (2012), USEPA (1995)
Cosmetics and toiletries (non-aerosol)	85	g/kg product	50	120	ISPRA (2012), Passant et al. (2012)
Cosmetics and toiletries (aerosol)	270	g/kg product	140	540	ISPRA (2012)
Household products (all)	16	g/kg product	8	33	USEPA (1995), ISPRA (2012)
Household products (non-aerosol)	10	g/kg product	7	15	Passant et al. (2012), ISPRA (2012)
Car care products (all)	180	g/kg product	100	340	ISPRA (2012), USEPA (1995)
Car care products (non-aerosol)	250	g/kg product	125	500	Passant et al. (2012)
Do it yourself (DIY)/buildings (adhesives)	66	g/kg product	5	130	Passant et al. (2012), USEPA (1995)

› APPROACHES FOR INVENTORY COMPILATION

GUIDEBOOK APPROACH (TIER 2)

- › Example: Paint application (2.D.3.d)
- › Tier 2 approach distinguishing between different paint types (solvent content, abatement measures)
- › Need to have this detailed information available at national level

Table 3-4 Tier 2 emission factors for source category 2.D.3.d Decorative coating application, Decorative paint, Construction of buildings, Conventional solvent-based products

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.d	Coating applications			
Fuel	NA				
SNAP (if applicable)	060103	Paint application : construction and buildings			
Technologies/Practices	Use of conventional solvent-based products containing 50 wt-% solvent				
Region or regional conditions					
Abatement technologies					
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, PM2.5, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Not estimated					
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	230	g/kg paint	100	300	Assessment of data from EGTEI (2003)

Table 3-7 Tier 2 emission factors for source category 2.D.3.d Industrial coating application, Vehicle refinishing

Tier 2 emission factors					
	Code	Name			
NFR Source Category	2.D.3.d	Coating applications			
Fuel	NA				
SNAP (if applicable)	060102	Paint application : car repairing			
Technologies/Practices	Vehicle refinishing				
Region or regional conditions					
Abatement technologies	Solvent-based primer and basecoat; no secondary measures				
Not applicable	NOx, CO, SOx, NH3, TSP, PM10, PM2.5, BC, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, PCB, PCDD/F, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB				
Not estimated					
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NM VOC	720	g/kg paint	400	1000	EGTEI (2003)

› APPROACHES FOR INVENTORY COMPILATION INFORMATION FROM INDUSTRY



- › TFEIP is cooperating with the European solvents industry since 2010
- › ESIG has collected solvent production data in the EU-27/28 from companies
- › Based on this starting point, an alternative NMVOC inventory was calculated for comparison/cross-check with inventories
- › Years: 2008, 2009, 2013, 2015, annual from there (2019 coming soon)

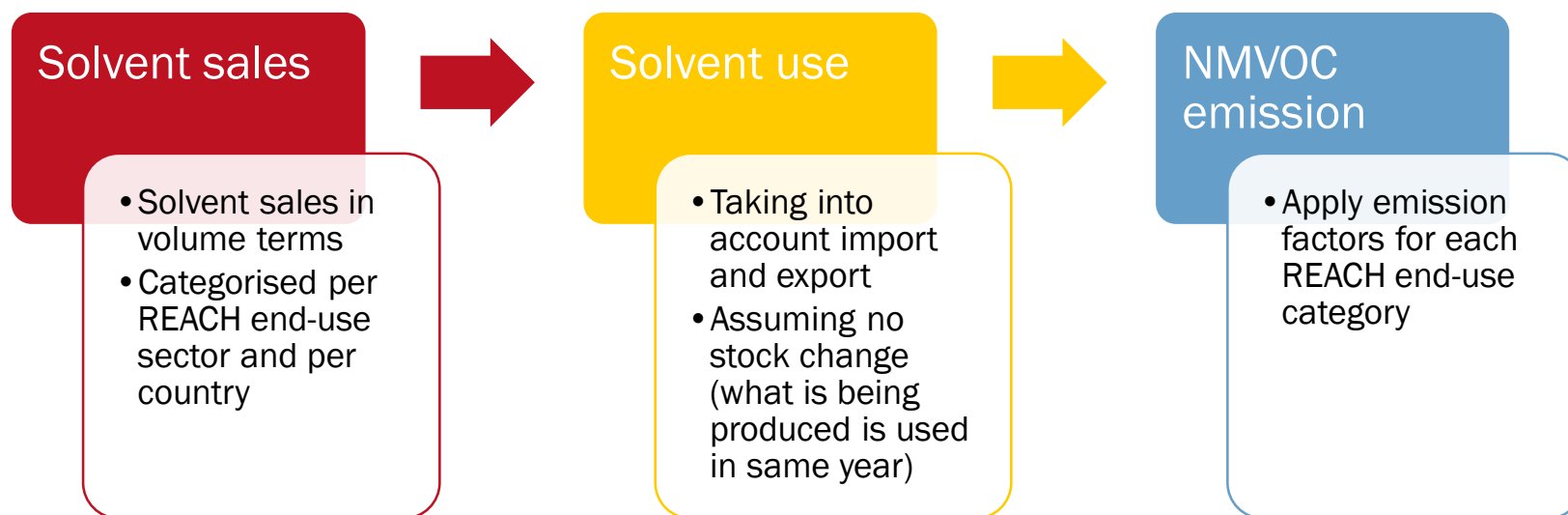


Atmospheric Environment
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European solvent VOC emission inventories
based on industry-wide information

John K. Pearson



› **APPROACHES FOR INVENTORY COMPILATION**

INFORMATION FROM INDUSTRY

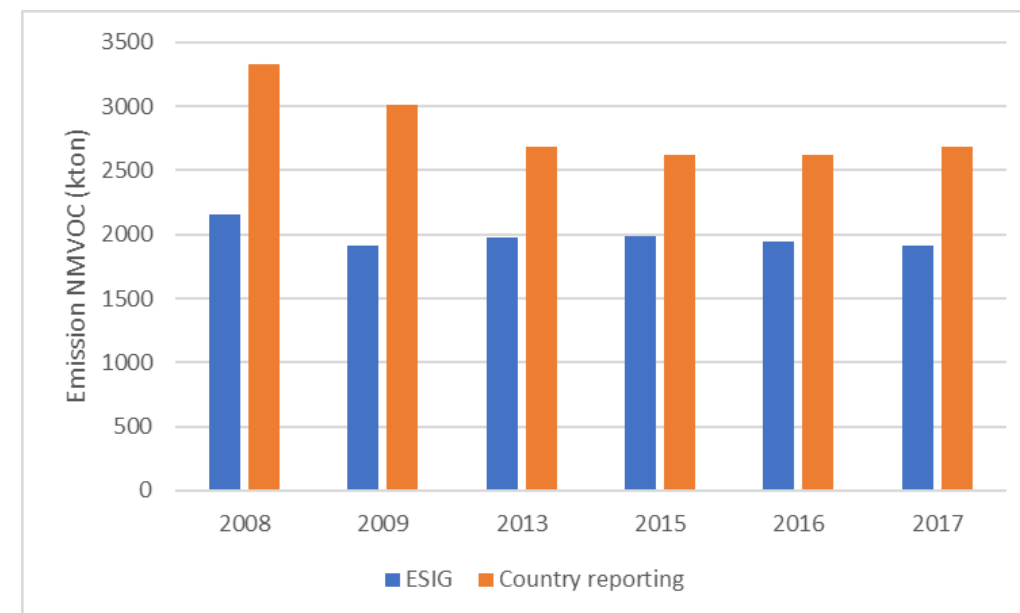


- › The information regarding this inventory has been included in the EMEP/EEA Guidebook and could be used as a starting point for the inventory
- › However, there are some important limitations hampering direct uptake in inventories:
 - › Only solvents included, not products containing non-solvent VOCs
 - › Sector classification uses REACH end-use categories rather than NFR structure
 - › Not all historical years available, although there is an annual process in place now
 - › Data not available for all Member States individually (confidentiality rules)
 - › Starting point is solvent sales in each country, for import/export assumptions are made
- › However, this information could provide valuable information to support the inventory compilation

› APPROACHES FOR INVENTORY COMPILATION INFORMATION FROM INDUSTRY



- › Comparison shows ESIG is ~ 30-40% lower in multiple years
- › Multiple reasons for this discrepancy:
 - › Inclusion of non-solvent VOC emissions in country inventories
 - › Use of outdated emission factors / activity data in country inventories
 - › Import/export of solvents at EU level



- › Information is available, please contact ESIG or TFEIP co-chair(s) for more information!

› CHALLENGES FOR INVENTORY COMPILATION

THE WAY FORWARD

- › All Member States face the same issue here
- › While some Member States are still facing how to move from Tier1 to Tier2, some others may already have developed a method
- › Working together and looking across the country boundaries is therefore a key step to make progress
- › TFEIP aims to facilitates such cooperation and dialogue, yet with limited funds cannot organise the actual work itself but rather facilitate
 - › In 2010 and 2016, dedicated workshops were organised for MS to exchange on the inventory methodologies specifically for solvents
 - › Make use of this opportunity and come forward with your issues so we can discuss possible solutions



› CONCLUSIONS

- › NMVOC emissions have been reduced by ~60% since 1990
- › Product use (including solvent use) is the most important contributor to anthropogenic NMVOC emissions nowadays, representing 37% of total EU27 emissions (2018)
- › Estimating emissions of NMVOC from product use is a challenge
 - › Mainly related to the difficulty to collect activity data, resulting in the use of Tier 1 for key categories in some cases
- › TFEIP aims to help where possible
 - › Update the Guidebook to describe in clear terms what is needed and provide all information that could potentially be helpful, introduce new methods where possible
 - › Apart from that, we aim to connect Member States to each other (and other stakeholders) outside their country
- › Work with industry (ESIG) to make actual data on solvent use in Europe available and ultimately suitable for inventory compilation
 - › This poses some challenges, but the availability of data is certainly helpful for cross-checking and understanding where gaps may exist



› **THANK YOU FOR
YOUR TIME**

TNO innovation
for life