National Institute for Public Health and the Environment
Ministry of Health, Welfare and Sport

baua: Bundesanstalt für Arbeitsschutz und Arbeitsmedizin

KEMI Swedish Chemicals Agency

NORWEGIAN ENVIRONMENT AGENCY

Ministry of Environment and Food of Denmark
Environmental Protection Agency

Summary page:
2nd Stakeholder Consultation on a Restriction for PFAS

I. Reasons and aims of this analysis

Update: The submission period was extended from the 19th of September to the 17th of October 2021!

The competent authorities for REACH of the Netherlands, Germany, Denmark, Sweden and Norway are currently preparing a REACH Annex XV Restriction Dossier for the group of PFAS (per- and polyfluoroalkyl substances) described below (as defined under Section II. Substances) since all these substances are considered to be persistent.

The consequences of this persistence include that the presence of these substances in the environment is practically irreversible, and pose an unacceptable risk to the environment and humans. All uses of PFAS (professional and industrial uses, consumer uses of mixtures and articles) result in emissions into the environment and contribute to the overall concentrations of PFAS in the environment. Many members of this group already occur ubiquitously in the environment and contaminate the ground- and untreated water due to their high mobility. In addition, some of these substances accumulate in biota and/or are suspected to be toxic.

In view of these properties, the above mentioned competent authorities for REACH are considering proposing EU-wide measures covering all PFAS (as defined under Section II. Substances) to reduce those risks.

This questionnaire is intended to provide you/the respondents with the current overview the five authorities have on the different uses of PFAS. By checking the presented data and providing feedback you/the respondents can ensure that the correct information is used for the assessment and preparation of a REACH Annex XV Restriction Dossier. Furthermore, you/the respondents can provide the authorities with currently still lacking information. EEA tonnages & emissions presented depict the European perspective, which the authorities created from the gathered information. If tonnages or emissions are challenged, please do so at European level, not at individual company level. For alternatives (and transition costs) this is slightly different and individual companies likely have valuable information.

I. Reasons and aims of this analysis

General:

The purpose of the 'investigation report summaries' (download is possible on the next page) is to present our current knowledge and understanding regarding uses of PFAS with a focus on use tonnages, emissions, alternatives and substitution costs, etc. The data are important for both risk assessment and the socio economic analysis (SEA).
The investigation report summaries have been prepared based on more detailed PFAS use investigations. It should be noted that these investigation report summaries should not be considered to be equivalent to the Annex XV restriction report, which is in a preparation phase.
Presented data reflect the current knowledge and during the project new data might become available. It is not guaranteed that the information presented here will be used in the Annex XV restriction report or in the presented way. For instance: Presented quantities or costs could be higher or lower.
The information provided is largely of a general nature and is not intended to address the specific circumstances of any particular individual or entity. Further, the information is not professional or legal advice.
In case respondents fill out the survey several times, only the latest entry will be considered.

Scope:
This survey is intended to provide an opportunity for stakeholders to confirm the understanding of the five countries prepararing the restriction proposal, or provide updated information, on PFAS uses, including tonnages, emissions, alternatives and transition costs. Information can also be valuable, if it confirms estimates that are currently marked as uncertain by the five countries.
This survey is not intended as an opportunity to provide feedback on the essential use concept.
This survey is not intended as an opportunity to provide feedback on the (chemical) scope of the proposed restriction.
The use of PFAS in fire fighting foams is not part of this call for evidence. ECHA is preparing a separate Annex XV restriction dossier on this use.
Stakeholders are invited to add information on uses not mentioned in the report summaries under section A (general questions).

Public sources / literature references:
Presented numbers (i.a. tonnages & emissions) represent the situation in the European Economic Area (EEA). If you have a different view, please provide this information on EEA level with reference to public sources.
In case transition times are applicable due to substitution, please refer to the respective legal text where possible. In instances where the information presented in the investigation report summaries is challenged, but no reference to literature or public sources are made to justify such challenges, we are unlikely to be able to take the comments into account.

Others:
PFAS tonnages for the described uses cannot be added up for a full tonnage overview as this might lead to double counting. In case no information is available, the authorities will follow a reasonable worst-case approach when estimating emissions to the environment. Concerning the presented summaries, the authorities from the five countries do not accept any liability with regard to the use that may be made of the information contained. Use of the information in these summaries remains the sole responsibility of the reader. Although, the information provided in the summaries has been prepared with the utmost care, possible errors or omissions cannot be excluded. The authorities from the five countries do not accept any liability with regards to any such errors or omissions.

II. PFAS in scope

As indicated by the name, per- and polyfluoroalkyl substances (PFASs) comprise a group of organic substances containing alkyl groups on which all or many of the hydrogen atoms have been replaced with

fluorine as structural fragments.

PFAS in the scope of this call for evidence have the following structural formula:

X-(-CF_2-)n-X' with n ≥ 1 and X, X' not being H (thus including X-CF_3) meaning fluorinated substances that contain at least one aliphatic carbon atom that is both, saturated and fully fluorinated, i.e. any chemical with at least one perfluorinated methyl group (-CF_3) or at least one perfluorinated methylene group (-CF_2-), including branched fluoroalkyl groups and substances containing ether linkages, fluoropolymers and side chain fluorinated polymers.

Although all PFAS will be considered for regulation, a non-exhaustive list of the most frequently used substances and substance groups may be found in the supplementary document accompanying this questionnaire and consultation which can be downloaded under the following link: Supplementary document.pdf

III. Target group of this questionnaire

Questions are addressed to the whole supply chain including **industry associations, manufacturers, importers, distributors and downstream users**.

Of interest is information on **PFAS** and **alternatives to PFAS.** Both, PFAS as such and PFAS contained in mixtures and articles are of relevance. Alternatives include chemical (non-fluorinated) as well as technical replacements for PFAS.

Please note that this questionnaire consists of 66 pages in total. It will, however, allow you to navigate through blocks of questions depending on your type of information or data. Hence, you will be able to specifically respond to the questions relevant to you. There will be max. 4 pages of questions per use ticked in Section A (general questions).

In the table below, the hyperlinks on the right side will allow you to download summary reports for the different uses for which further information is requested. In some cases a second hyperlink is available. In these cases the lead authority assessing the use already published a summary report on their website.

Use	Hyperlinks to report summaries
Cleaning agents, polishes and waxes (non-industrial uses)	Report summary cleaning agents polishes waxes july 2021.pdf
Cosmetics	Report summary cosmetics july 2021.pdf
Food contact materials & packaging	Report summary food contact materials and packaging july 2021.pdf
Lubricants	Report summary lubricants july 2021.pdf
Construction products	Report summary construction july 2021.pdf
Medical devices	Report summary medical devices july 2021.pdf
Medicinal products	Report summary medicinal products july 2021.pdf
Metal plating & manufacturing of metal products	Report summary metal plating and manufacturing of metal products july 2021.pdf
PFAS production (manufacturing)	Report summary PFAS and PFAS polymer production july 2021.pdf

Ski treatment	Report summary ski treatment july 2021.pdf PFAS in the treatment of skis - use, emissions and alternatives
TULAC (textiles, upholstery, leather, apparel and carpets)	Report summary TULAC july 2021.pdf
Petroleum & mining	Report summary petroleum and mining july 2021.pdf PFAS in mining and petroleum industry – use, emissions and alternatives
F-gas uses	Report summary F gas uses july 2021.pdf Application of Fluorinated Gases (F-Gases) in the European Economic Area
Electronics & energy	Report summary electronics and energy july 2021.pdf
Transportation	Report summary transportation july 2021.pdf
Waste	Report summary waste july 2021.pdf

IV. Information on institute/organisation/person & data protection rights

Information on institute/organisation/person & data protection rights can be downloaded via the following link: GDPR.pdf

Fields marked with * on this page are mandatory fields.

PERMISSION FOR INFORMATION PURPOSES: I agree to the personal data I provide in the present survey, including my name and my e-mail address, to be collected, processed and stored for potential follow-up questions regarding this survey by the service provider of the Federal Institute for Occupational Safety and Health (BAuA), namely Webropol Deutschland GmbH, and to these being subsequently stored in the database of the Federal Office for Chemicals.
*

Yes

Information on institute/organisation/person

Name	Elisa
Surname	Consoli
Name of institute/organisation	EFCTC (a sector group of Cefic)
E-Mail	eco@cefic.be

Can we contact you with follow-up questions? *

Yes

Note on Confidentiality of information and data

I understand that it is my responsibility not to include confidential information in responses to general comments and in any responses to requests for specific information (e.g. company name, properties, assets, costs etc.). The competent authorities for REACH will not be held liable for any damages caused.
*

Yes

I understand that it is my responsibility to mark confidential data and attachments as confidential. *

Yes

V. Questions - Section A - General questions

For which use would you like to submit information? Please select all uses on which you would like to provide information.

Construction products
Medical devices
PFAS production (manufacturing)
F-gases
Transportation
Waste

If relevant, please further specify your use (e.g. textiles used in personal protective equipment).

EFCTC is providing answers on the assumption that all F-gases are currently in the scope, being aware that this might not be the case for the final proposal dossier.

V. Questions - Section B - Cleaning agents, polishes & waxes (non-industrial uses)

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary cleaning agents polishes waxes july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Cleaners (for glass, metal, ceramic, carpet and upholstery)	?	?	?
Aftermarket carpet care	?	?	?
Dishwashing products (rinse aids)	?	?	?
Dry cleaning products	?	?	?
Waxes and polishes (for i.e. furniture, floors and cars)	?	?	?
Windshield wiper fluids	?	?	?
Windshield treatments (for automobiles)	?	?	?
Rain-repellent fluids	?	?	?

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the
waste stage of the articles. These emissions are covered in a separate section.

V. Questions - Section C - Cleaning agents, polishes & waxes (non-industrial uses)

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Cleaners (for glass, metal, ceramic, carpet and upholstery)	- hydrocarbon or silicone based surfactants - siloxane gemini surfactants
Aftermarket carpet care	- silicone dioxide
Dishwashing products (rinse aids)	?
Dry cleaning products	?
Waxes and polishes (for i.e. furniture, floors and cars)	- carnauba wax - nonfluorinated non-ionic or anionic surfactants
Windshield wiper fluids	- non fluorinated surfactants (e.g. sodium dioctyl sulfosuccinate)
Windshield treatments (for automobiles)	- polydimethylsiloxane
Rain-repellent fluids	?

V. Questions - Section D - Cleaning agents, polishes & waxes (non-industrial uses)

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section B - Cosmetics

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary cosmetics july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes F) per year in the EEA[1]	Expected trend (--/-/0/+/++)[2]	TF Emission[3]/year EEA (tonnes F)	EOF Emissions[4]/year in EEA[5] (tonnes F)
Skin Care	8.2	0	6.2	0.009
Toiletries	0.6	0	0.5	0.3
Hair Care	1	0	0.9	0.5
Perfumes and Fragrances	0	0	0	0
Decorative Cosmetics	1.2	0	0.7	0.2

[1] Based on the total fluorine (TF) measurements. Quantities PFAS/year are obtained by using a conversion factor of
1.4-2.0.

[2] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[3] Emissions to wastewater based on the total fluorine (TF) measurements.

[4] Emissions to wastewater based on total extractable organic fluorine (EOF) measurements.

[5] Emissions relate to mixture/article use. They do not include PFAS production and the waste stage of the articles. These emissions are covered in a separate section. Also note that emissions do not include mixture/article production..

V. Questions - Section C - Cosmetics

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives[1]
Skin care	?
Toiletries	?
Hair Care	?
Perfumes and fragrances	?
Decorative cosmetics	?

[1] Based on the information gathered so far, the authorities conclude that PFAS can be replaced by other ingredients and do not have unique functions. One reason is that there are far more non-PFAS cosmetic products within the same product categories as the PFAS containing products.

V. Questions - Section D - Cosmetics

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section E - Cosmetics

Specific questions for the use

V. Questions - Section B - Food contact materials & packaging

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary food contact materials and packaging july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	**Tonnage (tonnes/PFAS) per year in the EEA** **PFAS solely polymers in table**	**Expected trend (--/-/0/+/++)[1]**	**Emissions/year in EEA[2] (tonnes/PFAS)**
Packaging	Product: 41,351,000 (paper and board) Product: 20,500,000 (plastic packaging) PFAS: 827 - 4,962 (in paper and board) PFAS: ? (for plastic packaging)	+ (3%)	124 - 871
Cookware	Product: ? PFAS: 3,500 (Plastic Europe, AFW, 2017)	+ (5%)	1,633 - 4,716 (mainly recoating emissions)
Industrial applications	Product: ? PFAS: 3,000[3] (Plastic Europe, AFW, 2017)	++ (10 - 20%)	

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production

and the waste
stage of the articles. These emissions are covered in a separate section.

[3] Including pharmaceuticals (could not be disaggregated).

V. Questions - Section C - Food contact material & packaging

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Packaging	- natural greaseproof paper - vegetable parchment - clay coatings - silicone - biopolymers (e.g. chitosan, starch, cellulose, polyvinyl alcohol, bioplastics such as polylactic acid (PLA), biowaxes) - synthesis plastics (e.g. low-density polyethylene (LDPE), linear low-density polyethylene (LLDPE), high density polyethylene (HDPE), polypropylene (PE), ethylene vinyl alcohol (EVOH), polyvinyl alcohol (PVOH), polyvinylidene chloride (PVDC), polyethylene terephthalate (PET)) - microfibrillar cellulose (MFC), cellulose nanofibrils (CNFs), cellulose nanocrystals (CNCs) - aqueous dispersions of co-polymers (e.g. styrene acrylic emulsion (SAE)) - aqueous dispersions of waxes (e.g. TopScreen) - water soluble hydroxyethylcellulose (HEC) - alkyl succinic anhydride (ASA), alkyl ketene dimer (AKD) - aluminium foil - lamination using impermeable barriers - other plant fibres (miscanthus, etc.) - bitumen coating - re-usable materials
Consumer cookware	- ‘ceramic’ coatings (sol-gel) as replacement of coating material - silicone coatings as replacement of coating material - silicone cookware (not coated metal) as alternative base material, uncoated - superhydrophobic coatings and hydrophobic coatings as replacement of coating material (Nanoscopic layer which is able to resist water. They are made from different materials like zinc oxide polystyrene, precipitated calcium carbonate, carbon nano-tube substances, manganese oxide polystyrene.) - enamelled cast iron / seasoned cast iron as alternative base material and non-stick coating - full ceramic cookware (not just coated) as alternative base material - carbon steel as alternative base material, uncoated - anodized aluminium coating as alternative base material, may be coated - stainless steel as alternative base material, uncoated - copper as alternative base material, uncoated

Industrial applications	- stainless steel - ceramic coatings - silicone and silicone coatings - synthetic rubbers and similar compounds (nitrile rubber, ethylene propylene rubber, neoprene, PES (polyethersulfone))

V. Questions - Section D - Food contact material & packaging

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section B - Lubricants

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary lubricants july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Formulation of lubricants	< 3,000	+ (5% up to 2030)	in soil, surface water and air: 50 in waste stage: 40
In-use stage (sealed articles)	< 3,000	+	80
In-use stage (open applications)	100	+	90

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and only for the formulation of lubricants also the waste stage of the articles. The emissions for PFAS production and the waste stage are also covered in a separate section.

V. Questions - Section C - Lubricants

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
PTFE (micropowder)	- graphite - amorphous silica - molybdenum disulphide - boron nitride, other inorganics (e.g. layer building zinc phosphates) - water-based phenolic-melamine gold lacquer' alternative (still in R&D phase)
PTFE-thickened silicone oil for specific applications	- polyurea

High-bearing aromatic thermosetting polyester (ATSP) coating	- graphene

V. Questions - Section D - Lubricants

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section B - Construction products

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary construction products july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use		Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Polymeric PFAS	Formulation of articles and commercial construction mixtures	7,390	++ (5 - 8% for PTFE, PVDF, EFTE until 2030)	in soil, surface water and air: 330 in waste stage: 170
	In-use stage (outdoor articles)	3,270		in soil, surface water and air: 212
	In-use stage (indoor applications)	3,270		in soil, surface water and air: 2
	In-use stage (outdoor mixtures)	164		in soil, surface water and air: 9
	In-use stage (indoor mixtures)	150		in soil, surface water and air: 0.1
Non-polymeric PFAS	Formulation of articles and commercial construction mixtures	10,900	+ (1% for 2020 -2050)	in soil, surface water and air: 273 in waste stage: 163
	Use of processing aids	3,700		in soil, surface water and air: 5 in waste stage: 3,695
	In-use stage (outdoor articles)	1,712		in soil, surface water and air: 110
	In-use stage (indoor applications)	1,712		in soil, surface water and air: 1
	In-use stage (outdoor mixtures)	1,420		in soil, surface water and air: 91
	In-use stage (indoor mixtures)	1,502		in soil, surface water and air: 0.75

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and only in some cases the waste stage of the articles. The emissions for PFAS production and the waste stage are also covered in a separate section.

V. Questions - Section C - Construction products

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Thermal insultation applications	- polyisocyanurate - phenolic thermal product
Processing aids in the production of construction products	? (only confidential information)
Architectural fabrics	- cotton and other natural fibres - polyamid (nylon) - polyester - fiberglass - aramid (Kevlar, Twaron) - carbon fibres
Fluoropolymer tube lining	- polypropylene - silicone - PVC
Paints and coatings	- polyurethane - polyester powder - wax emulsions - silicones/silanes/polysiloxanes - hydrocarbon polymer technologies
Coating additives	- hydrocarbon and silicone-based surfactants - short chain, polyether-modified siloxanes - low molecular weight polyether-modified siloxanes - siloxane multi-functional surfactants - alkoxylates (silicone and solvent-free)
Superhydrophobic coatings	- polymeric matrix (the binder) added to hydrophobic nanoparticles (the filler)
Wood primer and inks	- sulfosuccinates (e.g. sodium salt of di-(2-ethylhexyl) sulfosuccinate
Rust protection systems, marine paints,resins, printing inks and coatings in electrical applications	- propylated napthalenes - propylated biphenyls

Do you have information on additional alternatives for any of the described applications that have not been disclosed in the attached information?

The range of substances, mixtures and conditions present in our chemicals processes require linings with exceptional chemical resistance for a range of substances. Fluoropolymers such as PTFE have this required range of chemical resistance for the substances, we handle including strong acids (e.g. HF) and mixtures containing numerous substances that require a broad range of chemical resistance that is simply not provided by polypropylene, silicone and PVC. The safe handling of these substances is a pre-requisite for operating these plants so if a suitable alternative lining cannot be found the continued operation will be put in doubt. These processes currently contribute hundreds of millions of euros to the EEA economy and employ many hundreds or thousands of employees.

V. Questions - Section D - Construction products
Questions in relation to impact of legislative measures (for companies and industry associations)
V. Questions - Section B - Medical devices
Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary medical devices july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use[1]	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[2]	Emissions/year in EEA[3] (tonnes/PFAS)
Anesthetics	2 - 1,000	+	~ 2 - 1,000
Contrast media	2 - 100	?	~ 2 - 100
Propellants	160 - 400	?	~ 160 - 400
MDI incl. F-gases	24,000 - 43,000	?	~ 4,200
Medical devices incl. packaging (mainly polymers)	3,700 - 14,000	?	90

[1] Contrast media, propellants and F-gases are mentioned here as medical devices.

[2] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[3] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the waste
stage of the articles. These emissions are covered in a separate section.

Do you have information that indicates that the information provided on the tonnage should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

The “tonnage per year in the EEA” for MDIs appears to be the total tonnage of HFC 134a & HFC 227ea consumed in the EEA and not the quantity used in MDIs production in the EEA. A more representative HFC tonnage used in MDIs can be estimated using the annual tonnes of CO2e reported under the MDI exemption (from the EEA Fluorinated gas report 2020 (Table A5.25)) and dividing it by an assumed GWP of 1600 (92% HFC 134a & 8% HFC 227ea (MCTOC Assessment Report 2018)) giving an annual usage between 6 – 7 ktes, add to that a fraction of the "Other [pre-filled] products and equipment" given in Table A5.11 to allow for imports of pre-filled MDIs.
The UK is significant both as a supplier of HFCs for MDI use and the production of MDIs.

Do you have information that indicates that the information provided on the emissions should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

The source of the emissions number is unspecified, but it looks to be in the right ballpark with around a third to a half of all MDIs produced in EEA exported to patients outside the EEA.
The UK is a significant user of MDIs.

The environmental release category (ERC) is a key REACH use descriptor to define the release factors of a chemical substance in a specific use exposure scenario. It is used in various modelling tools to derive environmental exposure estimates. ERC default factors are used to estimate emissions of PFAS in three major life-cycle stages, namely the production stage including manufacture of substances, formulation of mixtures and production of articles, the 'in-use' stage, and the waste stage.

Please indicate if you have information on specific emission values (SPERCs) for (groups of) PFAS, based on measurements and / or model calculations.

The Environmental Release factor of 100 % assumed in this process is a conservative estimate based on the reasonable premise that both the function of MDIs requires the propellant to be released and the propellant is unaltered in the process of delivering the treatment. Presumably for the sake of ease, it also assumes that although many MDIs are either not used or not completely used before they are disposed of all the propellant in all MDIs is ultimately released to the environment.
It is noted that there are MDI return systems in place so their current effectiveness at reducing propellant emissions must be considered to be negligible.

Do you have information that indicates that the information provided on the expected trend should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

Opposing factors need to be considered in this case, including:
i) The EEA is a major global producer of MDIs and global MDI use is growing (MCTOC Assessment Report 2018 & EEA Fluorinated gas report 2020) indicating a current increasing trend
ii) However, a reducing trend can also be predicted based on the following factors
a. Using new alternative propellant with lower liquid density/mass of propellant per device
b. The move to alternative NIK delivery systems for some treatments
c. The impact of the F-gas regulation
d. The impact of national health polices

Overall, a flat or slight downward trend in tonnes of HFCs used in MDIs in the EEA is expected over the next 10 years.
That said
i) A significant new MDI treatment
ii) A significant move away from an existing major MDI treatment (e. g. Salbutamol)
iii) The movement out of the EEA of MDI production for rest of world use

all have the potential to have a large effect on the trend.

Do you have information on risk management measures to minimize the use, human exposure and emissions to the environment for your application of PFAS?

Yes

Please specify and/or refer to literature/public sources.

The use of propellants in MDI applications is subject to strict GMP regulatory control for both manufacturing and end-user scenarios where the risks associated with exposure to the drug products contained in MDIs is generally the determining factor. See answer to the question on legal approval schemes in section C.

V. Questions - Section C - Medical devices

Questions in relation to alternatives (mainly for individual companies)

What is the specific application/functionality of PFAS in your product(s)/processes?

Not applicable to EFCTC.

Are in your view non-PFAS alternatives technically feasible in your product(s)/processes?

No

Please specify why.

Whilst it is true that alternative Not In Kind (NIK) treatment solutions are available for some existing MDI treatments it is not true to say that there is currently a technically feasible NIK alternative for all MDI treatments for all patient groups. The MCTOC Assessment Report 2018 executive summary states "It is not yet technically or economically feasible to avoid HFC MDIs completely in this sector because, currently; for salbutamol, there are economic impediments in switching forms from some HFC MDIs to multi-use DPIs; and some patients (Young children and frail elderly) cannot use DPI alternatives to HFCs MDIs"
The same inability to use a DPI is expected to be true for most veterinary applications of MDIs.
Therefore, the feasibility of finding a technically viable non-PFAS alternative propellant for all MDIs, allowing continued MDI use for the necessary treatments and patient groups, may well rest on the final PFAS definition used in any restriction.

Are in your view non-PFAS alternatives economically feasible in your product(s)/processes?

No

Please specify why.

Whilst it appears likely that for some treatments non-PFAS NIK alternatives are economically feasible this is not the case for all MDI treatments. The MCTOC Assessment Report 2018 Executive Summary states "It is not yet technically or economically feasible to avoid HFC MDIs completely in this sector because, currently; for salbutamol, there are economic impediments in switching forms from some HFC MDIs to multi-use DPIs; and some patients (Young children and frail elderly) cannot use DPI alternatives to HFCs MDIs".
As above, the feasibility of finding an economically viable non-PFAS alternative propellant for all MDIs, allowing continued MDI use for the necessary treatments and patient groups, may well rest on the final PFAS definition used in any restriction.

Do you have information on the alternatives' risk profile?

No

Are there legal approval schemes for your product(s)/processes, which have to be taken into account in case PFAS alternatives will be used?

Yes

Please specify and/or refer to literature/public sources.

All medicines must go through a strict regulatory approval process which can take several years to complete, and which often needs to be repeated across a number of national and regional approval agencies including EMA, MHRA, FDA, etc.

What is the average approval time?

Typical development and approval time for a new propellant is greater than 10 years.
Average approval time for a new filling plant is up to 5 years depending on whether a new facility or retrofitted facility is being considered.

Do you actively work on finding alternatives?

Yes

Please specify.

EFCTC members have been active in developing alternatives to existing HFC MDI propellants, these alternatives (e.g. HFC 152a and HFO 1234ze) whilst still fluorocarbons have lower GWP, typically fewer fluorine atoms, shorter atmosphere lifetimes, lower or zero molar ratio to breakdown to TFA.
It is unclear if some or all of these alternatives will be included within the final PFAS restriction.
Note: In most cases the treatment approval process for these alternative propellants is still to be completed and therefore there is always the possibility that no suitable new MDI propellant formulation is approved for some treatments and hence the existing propellant would remain as the only approved formulation.

If alternatives have been identified as potentially suitable, which timescale do you foresee for a complete transition to those? Please explain.

A complete transition of a new MDI propellant would take more than 10 years to develop, test, approve, install new production facilities and gain acceptance from prescribers and patients. Across a range of product formulations This assumes that a suitable non-PFAS alternative propellant can be identified.
It is noted that between ~1989 -2003 a similar regulatory enforced transition took place from CFCs to HFCs due to the Montreal protocol. Commission communication COM (1998) 603 final, written when that transition was already well underway, includes many of the considerations that will still be relevant for an MDI propellant transition under any restriction. Albeit that some of the data on usage referring as it does to CFCs and the regulatory approvals process in this communication is out of date.
Some fluorocarbon alternatives are already going through this transition with some MDI producers having announced plans to begin use of these alternatives starting in 2025.

Do you have information on alternatives for any of the described applications in the attached information?

Two of the current alternatives being investigated as new MDI propellants are listed as 1,1-difluoroethane (HFC- 152a) and 1,3,3,3-Tetrafluoropropene (HFO 1234ze).
Although isobutane has also been proposed as an MDI propellant no EMA approved treatments are known to exist using isobutane (see MCTOC 2018 report).

V. Questions - Section D - Medical devices

Questions in relation to impact of legislative measures (for companies and industry associations)

What is the economic impact (in euro) and social impact (e.g. jobs) on your business/company if the use of PFAS is prohibited?

a) In 3 years.

Within 3 years of HFC MDI production being prohibited in the EEA (i.e. worse case of neither essential use nor continued production for non-EEA patients being allowed) it could be expected that non-EEA MDI producers would increase their production to the extent they are able to compensate for the loss of EEA production. Considering the lengthy approval process for a new propellant, they are likely to use the existing HFC 134a and HFC 227ea propellants hence negating any climate and TFA reduction benefits of the EEA leading the way on lower climate impact alternative propellants. Even with this increase in non-EEA MDI production there could/would be a significant impact on patients due to a global shortage of MDIs with those least likely to be able to pay suffering most.

Other details on economic and social impacts on HFC propellant suppliers and MDI producers will be provided by the respective companies.

b) In 10 years.

Within 10 years of HFC MDI production being prohibited in the EEA (i.e. worse case of neither essential use nor continued production for non-EEA patients being allowed) Global MDI production would have moved outside of EEA, losses in production, sales or jobs in the EEA due to loss of propellant supply are likely to have been replaced, at least partially, outside of the EEA.

Other details on economic and social impacts on HFC propellant suppliers and MDI producers will be provided by the respective companies.

c) Please explain by providing your calculations.

Assuming only the MDI consumption in the EEA was effected by the restriction (most likely case) and that the global increase in MDI consumption would partially offset this reduction the reduction in global HFC propellant consumption in HFC MDI production may fall by up to 50 % immediately after any EEA prohibition (due to loss of EEA MDI production) but regain most of the HFC propellant consumption and HFC MDI production in the following decade, mostly likely by initially continuing to use the higher GWP propellants due to the easier approval process hence slowing any transition to lower GWP & lower TFA producing alternatives.

What is the economic impact (euro) on your business/company, if the following measures will become mandatory? Please make your (indicative) calculations transparent.

a) A maximum concentration of e.g. 0.1% (or less) PFAS is set in mixtures and/or articles.

This is not specific as the quantity of product used depends upon the application. The final definition of PFAS will be critical. No currently approved HFC propellant formulation used in MDIs would be permissible without an essential use exemption from any restriction. For the companies responsible for current propellant production/distribution and use in MDI production in the EEA the result would be complete closure of that part of their operations with a loss to the EEA economy of millions of Euros and could lead to a disruption in global MDI supply.

The cost to the industry to develop an alternative would also be considerable, according to the MCTOC Assessment Report 2018 “Development costs for the transition of MDIs from CFCs to HFCs have been estimated to be well in excess of US$2 billion, and the phase-out of CFC MDIs took over 20 years to complete”.

b) Obligation to label your products visibly with "Contains PFAS".

Minor impact on redesigning and reprinting packaging. The impact of this obligation on the labelling of medical products would need to be investigated.

c) Obligation to report amount of PFAS in use and respective emissions.

At the propellant producer/importer level only a minor impact would be expected as extensive reporting and data collection already occurs, although it impossible to be definitive without knowing the precise reporting requirements. However, in the downstream user group significant changes may be required as some use sectors may not currently report.

d) Specific waste management requirements with the obligation to collect, treat or recycle PFAS containing waste separately.

At the propellant producer level, the handling and disposal of the gases is already well managed with little impact anticipated under any new specific waste management requirements, although it impossible to be definitive without knowing the precise waste management requirements.

At the end user (general public) level it is anticipated, based on the current level of return of MDIs at the end of their useful life, that it would require a significant effort by the members states, regulators and supply chain actors to ensure the 100s of millions of MDIs prescribed annually in the EEA are disposed of by any specific waste management system.

e) In case you are using PFAS polymers: no PFAS processing aids are allowed during polymer production.

Not considered applicable for the supply of the propellant used in MDIs although Fluoropolymers are used in treatment delivery mechanisms and in the production of the propellants and APIs. The presence of leachable processing aids is already a factor in the consideration of approval of medical devices including MDIs.

V. Questions - Section E - Medical devices
Specific questions for the use

If available, please provide information on PFAS emissions during medical device production.

EFCTC members are F-gas suppliers who are not involved in Medical Device Production.

If available, please provide information on market trends for contrast media, propellants, F-gases and/or medical devices.

Propellant supply in the EEA is showing a small but steady increase in HFCs sold under the MDI exemption - see Table A5.25 of the EEA Fluorinated gas report 2020.
However as stated above; new alternative propellants and the move to NIK alternative delivery systems (e. g. DPIs) is expected to move the trend downwards.
In combination a flat or slight downward trend of tonnes of HFC propellant used in MDIs is expected over the next 10 years in the EEA.

If available, please provide information on fluorine-free alternatives for medical devices.

A number of not in-kind (NIK) delivery systems are available that do not use F-gas propellants (e. g. DPIs), although in some cases PFAS containing materials maybe used e. g. as surface coatings.
For a number of patients groups and veterinary applications suitable approved fluorine free/non HFC MDI alternatives are NOT known to exist at this time.

V. Questions - Section B - Medicinal Products
Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary medicinal products july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)

Medicines (human pharmaceuticals)	> 500[3]	+	> 500[3]
Medicines (veterinary pharmaceuticals)	?	?	?
Pharmaceutical intermediates[3]	8,200 (ECHA)	?	?

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the waste
stage of the articles. These emissions are covered in a separate section.

[3] The whole molecule/API is counted in this calculation.

V. Questions - Section C - Medicinal Products
Questions in relation to alternatives (mainly for individual companies)
V. Questions - Section D - Medicinal Products
Questions in relation to impact of legislative measures (for companies and industry associations)
V. Questions - Section E - Medicinal Products
Specific questions for the use
V. Questions - Section B - Metal plating & manufacturing of metal products
Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary metal plating and manufacturing of metal products july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Metal plating	2 - 57 (6:2 FTS in chrome plating)	-	11.4 (6:2 FTS in chrome plating)
Manufacture of metal products	960 (fluoropolymers)	0	?

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the waste
stage of the articles. These emissions are covered in a separate section.

V. Questions - Section C - Metal plating & manufacturing of metal products

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Metal plating (here specifically chrome plating)	- alkane sulfonates - amines, C12-C14 alkyl, ethoxylated - oleo amine ethoxylates (e.g. mixtures with (Z)-octadec-9-enylamine, ethoxylated) - 3-[dodecyl(dimethyl) ammonio]propan-1-sulfonate (mixture with 3-hydroxypropane-1- sulfonic acid and amines, coco alkyldimethyl, N-oxides) - paraffin oils, sulfochlorinated, saponified - isodecanol, ethoxylated - chromium (III) plating - add-on air pollution control devices (e.g. packed bed scrubbers) - thermal spraying (e.g. high velocity oxygen fuel process) - physical vapour deposition - case hardening process (e.g. plasma nitriding) - laser metal deposition - anhydrous ionic liquids based on chromium (III)salts - closed coating reactors - nickel-based coatings - sulfonation of plastics with sulfur trioxide in the gas phase - acidic permanganate solutions, nitric acid and trichloroacetic acid mixtures
Manufacture of metal products	?

V. Questions - Section D - Metal plating & manufacturing of metal products

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section E - Metal plating & manufacturing of metal products

Specific questions for the use

V. Questions - Section B - PFAS production (manufacturing)

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary production july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Fluoropolymers	Produced: 49,458 - 101,763 Imported: 36,148 (Eurostat) Exported: 28,718 (Eurostat)	+ (stakeholder)	in air: 10 - 20 in water: 3 - 6
F-gas	Produced: 13,600 - 52,800 Imported: 84,284 (Literature) Exported: 10,371 (Eurostat)	0 (stakeholder)	in air: 280 - 1,086 in water: 0.6 - 2.3
Remaining PFAS	Produced: 53,902 - 118,051 Imported: 103,586 (Eurostat) Exported: 131,866 (Eurostat)	+ (stakeholder)	in air: 11 - 24 in water: 3 - 7

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions only relate to PFAS production. They do not include mixture/article production, mixture/article use and the
waste stage of the articles. These emissions are covered in the other sections of this survey.

Do you have information that indicates that the information provided on the tonnage should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

-> Why should the import & export figures be considered here?
In our opinion, this table should only contain the production figures. The import and export figures are not related to the production data.
-> Rather than indicating a wide range for the production figures, the EEA data should be taken here. They are quite reliable. (21,160 mt in 2019 as also mentioned in the Summary Report).
-> The trend for the production (without import / export) would then not be zero, but minus.
(See EEA Report, p.17 and Annex 5, Table A5.1)
-> Concerning data on emissions, the consultation of the European Industrial Emissions Portal by the EEA could help:
https://industry.eea.europa.eu/explore/explore-data-by-pollutant
(A search by “advanced filter” allows the selection of specific “pollutants” like “greenhouse gases”).

Do you have information that indicates that the information provided on the emissions should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

Based on experience of the EFCTC members, the value proposed (2%) does not reflect the reality of the emissions of F-gases in the context of production. Further information can be found based on the national reports according to EU requirements.

The environmental release category (ERC) is a key REACH use descriptor to define the release factors of a chemical substance in a specific use exposure scenario. It is used in various modelling tools to derive environmental exposure estimates. ERC default factors are used to estimate emissions of PFAS in three major life-cycle stages, namely the production stage including manufacture of substances, formulation of mixtures and production of articles, the 'in-use' stage, and the waste stage.

Please indicate if you have information on specific emission values (SPERCs) for (groups of) PFAS, based on measurements and / or model calculations.

F-gases do not fall under the requirements to report emission values according to the SPERCs system. For further information, see above.

Do you have information that indicates that the information provided on the expected trend should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

As evidenced in the EEA report (table A5.1), the production of HFCs is reducing due to the F-gas Quota Phase-Down. Future trends on production cannot be discussed within EFCTC in compliance with EU competition law.

Do you have information on risk management measures to minimize the use, human exposure and emissions to the environment?

Yes

Please specify and/or refer to literature/public sources.

Examples of German regulations:

* Gefahrstoffverordnung (Ordinance on hazardous substances)
* Betriebssicherheitsverordnung (Regulation for Industrial Safety)
* Technische Regeln für Gefahrstoffe 900, 745, 746, 510, 509, etc. (Technical rules for hazardous substances 900, 745, 746, 510, 509, etc.)
* several rules and regulations by the Deutsche Gesetzliche Unfallversicherung, e.g. DGUV Information 213-053 (Safe use of flexible hose lines)

V. Questions - Section C - PFAS production (manufacturing) Questions in relation to alternatives (mainly for individual companies)

Do you have the possibility to produce fluorinated polymers without fluorinated processing aids?

No

Please explain:

Not applicable to EFCTC

V. Questions - Section D - PFAS production (manufacturing) Questions in relation to impact of legislative measures (for companies and industry associations)

What is the economic impact (in euro) and social impact (e.g. jobs) on your business/company if the use of PFAS is prohibited?

a) In 3 years.

The current regulatory measure in the EU F-gas Regulation specify a timetable to 2030. Investment and planning has been made by producers and down-stream users to take into account this timetable. A prohibition in less than this time period would cause a complete disruption of the transition from higher-GWP products and could result in issues for the EU climate change ambitions. Overall, this would mean a loss of competitiveness of the EU market, forcing production to be moved outside the EU.

b) In 10 years.

A prohibition of F-gases would result in a complete shut-down of the production and distribution of the affected products. This would result in the closure of the manufacturing sites in the EU (costs several € 100s millions). Several hundreds of jobs would be lost within the production section and a similar number of jobs lost within the distribution sector as, in many cases, distribution for non-fluorinated alternatives is a different model. Recovery for recycling/reclaim of products would cease. Research and development in companies which produce fluorinated alternatives would also cease.
Overall, this would mean a loss of competitiveness of the EU market, forcing production to be moved outside the EU

What is the economic impact (euro) on your business/company, if the following measures will become mandatory? Please make your (indicative) calculations transparent.

a) A maximum concentration of e.g. 0.1% (or less) PFAS is set in mixtures and/or articles.

No fluorinated fluids or blends would be possible. As companies responsible for production/distribution the result would be complete closure with a loss to the EU economy of millions of Euros.

b) Obligation to label your products visibly with "Contains PFAS".

Bulk products are already labelled as HFC, and the GWP is also specified. Labelling of products and products-containing items are already required under article 12 of the F-gas, which is comprehensive.

c) Obligation to report amount of PFAS in use and respective emissions.

Requirements are already in place under the F-gas Regulation for bulk products and leakage.
See F-gas regulation (Regulation (EU) 517/2014) chapter II on containment (articles 3 to 10).

d) Specific waste management requirements with the obligation to collect, treat or recycle PFAS containing waste separately.

This is already regulated by national and international legislation:

EU:
*Waste Framework Directive (Directive 2008/98 EC)
https://ec.europa.eu/environment/topics/waste-and-recycling/implementation-waste-framework-directive_en
EU countries must report to the European Commission on the implementation of the EU waste laws, including on the achievement of targets for waste collection, re-use, recycling and recovery every year or every two years. This data can be found on Eurostat.

Germany:
*Chemikalien-Klimaschutzverordnung, §8 Rückgewinnung u. Rücknahme verwendeter Stoffe
(Regulation for chemicals and for the protection of the climate, §6 recovery and take-back of used substances)
*Kreislaufwirtschaftsgesetz
(Circular Economy Law)

France:
*Code de l'Environnement (Livre V, Titre IV, Chapitre III, Section 6), articles R.543-75 to R.543-123
https://bit.ly/2WQmE5n

e) In case you are using PFAS polymers: no PFAS processing aids are allowed during polymer production.

Not relevant for the EFCTC.

V. Questions - Section E - PFAS production (manufacturing)
Specific questions for the use

If available, please provide data on the amount of fluorinated additives used in fluoropolymer production (kg/ton).

Not relevant for the EFCTC

If available, please provide data on the tonnages used (yearly EEA) and applications of PTFE and PVDF micropowders.

Not relevant for the EFCTC

V. Questions - Section B - Ski treatment

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary ski treatment july 2021.pdf

Additionally, the Norwegian Environment Agency also published a short version of the report. This version can be accessed via the following link: PFAS in the treatment of skis - Use, Emissions and Alternatives

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Ski wax	1.64	-	in soil: 0.452 in surface water: 0.452 in air: 0.041 in waste stage: 0.695

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production. The
emissions for PFAS production and the waste stage are also covered in a separate section.

V. Questions - Section C - Ski treatment

Questions in relation to alternatives (mainly for individual companies)

Sub-Use		Non-PFAS alternatives
Ski wax	Fluorine-free waxes	- hydrocarbon and paraffin waxes - siloxanes (but they are subject to environmental concerns) - nanoparticle-based waxes are being developed.
	Alterations to the ski itself	- a modified microstructure of the ski base - improved performance of the polyethylene of the ski - heating the base to obtain a better glide - controlling the vibrations of the ski

V. Questions - Section D - Ski treatment

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section E - Ski treatment

Specific questions for the use

V. Questions - Section B - TULAC (textiles, upholstery, leather, apparel and carpets)

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary TULAC july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	**Tonnage (tonnes/PFAS) per year in the EEA** Low/High	**Expected trend (--/-/0/+/++)[1]**	**Emissions/year in EEA[2] (tonnes/PFAS)** Low/High
Home textiles	6,230/27,368	++	?
Consumer apparel	8,161/47,148	++	?
Professional apparel	5,220/20,044	++	?
Technical textiles	6,201/26,541	++	?
Medical applications	331/1,095	++	?
Leather	?	++	?
Other	15,041/20,496	++	?
Total	**41,184/142,692**	**++**	**4,933/18,103**

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the waste
stage of the articles. These emissions are covered in a separate section.

V. Questions - Section C - TULAC (textiles, upholstery, leather, apparel and carpets)

Questions in relation to alternatives (mainly for individual companies)

Sub-Use		Non-PFAS alternatives
Home textiles	Carpets and rugs	- non-ionic polymer - ester compounds - hydrocarbon compounds, - organic solvent and water
	Curtains	- no specific substances found, see general textile (FF)
	Upholstery (e.g. fabrics for soft-furnishings, including large furniture items)	- hydrotreated heavy naphtha (petroleum) - non-ionic polymer, ester compound, hydrocarbon compound, organic solvent and water
Consumer apparel	Outdoor wear	- non-ionic polymer - ester compounds - hydrocarbon compounds - organic solvent and water - mixture of linear and branched hydrocarbons
	Indoor wear	?
	Sports wear	?
	Footwear	?

Professional apparel	Professional sports wear and footwear	?
	PPE for industrial applications e.g. for chemical workers, fire-fighters, O&G workers, law enforcement and military forces	
Technical textiles	Outdoor technical textiles e.g. canvas, awnings, tarps, tents, bags, sails, rope, umbrellas	?
	Medical applications "non-woven", e.g. surgical drapes, gowns, curtains	
	High performance membranes e.g. automotive and medical	

Textile in general (multiple sub-category uses)		- paraffin - non-ionic polymer - ester compounds - alcohols, C12-16, ethoxylated (>5-15 EO) - hydrocarbon polymer dispersion - aqueous preparation of polymer waxes - paraffin oils and a fat modified melamine resin - dispersion of paraffin wax and acrylic copolymer - paraffin oils and a fat modified melamine resin and blocked polyisocyanates - dispersion of paraffin oils and a fat modified melamine resin - naphtha (petroleum), hydrotreated heavy, - modified wax dispersion - (bee-) wax - carnauba wax - acrylate copolymer - dispersion of fat-modified chemicals and paraffin - plant seed oil, bio based product - acrylic polymer and paraffin dispersion - acrylic polymer and silicone reactive dispersion - acrylic polymer, reactive silicone and paraffin dispersion - functionalised polymers/waxes, cationic - emulsifier-free paraffin wax - emulsion containing aluminum - acrylic polymer and dispersion of fatty derivatives - polyethylene oxide mono-C12-16-alkyl ether - aminofunctional PDMS - sodium methylsiliconate water - potassium methylsiliconate - isobutyltrimethoxy silane - octylsilane - hexyltriethoxysilane - blend of n-octyltriethoxysilane and reactive silicone, octyltrimethoxysilane-based - methoxy terminated silsesquixanes - emulsion of polydimethylsiloxane - cationic polysiloxane and polyester - polysiloxane - mixtures of silicones and stearamidomethyl pyridine chloride, sometimes together with carbamide (urea) and melamine resins - aminofunctional polysiloxanes - water-based silicone emulsion - solvent-dilutable silicone solution - siloxane dispersion with modified polyamide, - acrylic polymer and silicone reactive dispersion - dodecamethyl pentasiloxane (PDMS)

		- aqueous, solvent free dendrimers - anionic dispersion of an aliphatic polyether urethane - polyurethane emulsion, water-based - anionic dispersion of a matt polyether polyurethane, water-based, solvent free - anionic dispersion of an aliphatic polycarbonate urethane - plasma based nano-coating, molecularly attached hydrophobic 'whiskers' attached to individual fibres, uses a hydrocarbon polymer
Leather	Leather in general	- hybrid (silicone/hydrocarbon) - solvent-dilutable silicone solution - water-based silicone emulsion
Other	Home fabric treatments (sprays)	- alkyl polysiloxane solution

V. Questions - Section D - TULAC (textiles, upholstery, leather, apparel and carpets)

Questions in relation to impact of legislative measures (for companies and industry associations)

V. Questions - Section E - TULAC (textiles, upholstery, leather, apparel and carpets)

Specific questions for the use

V. Questions - Section B - Petroleum & mining

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary petroleum and mining july 2021.pdf

Additionally, the Norwegian Environment Agency also published a short version of the report. This version can be accessed via the following link:PFAS in mining and petroleum industry – use, emissions and alternatives

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Quantity of product used (t)	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)

Water and gas traces	1	1	0[3]	in soil: 0 - 0.005 in water: 0.020 - 0.025 in marine water: 0 - 0.110 in air: 0.025 - 0.070 in waste stage: 0.020 - 0.145
Drilling/Production chemicals	170	3 - 8	0[3]	in soil: 0 - 0.045 in water: 0.070 - 0.210 in marine water: 0.020 - 0.760 in air: 0.085 - 0.635 in waste stage: 0.015 - 0.230
Fluoropolymers (all) Low scenario[4]	3,500 - 7,500.5	0.004 - 0.008 monomeric PFAS	0[3]	in soil: < 0.001 in water: < 0.001 in marine water: < 0.001 in air: 0.001 - 0.002 in waste stage: 0.001 - 0.003
Fluoropolymers (all) High scenario[5]	3,500 - 7,500.5	0,9 - 1,9 monomeric PFAS	0[3]	in soil: 0 .020 - 0.045 in water: 0.003 - 0.006 in marine water: 0.020 - 0.040 in air: 0.270 - 0.580 in waste stage: 0.310 - 0.670

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production.

[3] Conservative annual growth of 1%.

[4] 1 ppm monomeric PFAS in fluoropolymers (Lohmann et al., 2020).

[5] 0-2000 ppm monomeric PFAS in fluoropolymers (Ökopol 2014 and used in PFOA restriction).

V. Questions - Section C - Petroleum & mining

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Water and gas tracers	- radioactive tracers - noble gas isotopic tracer - xenon - radiolabelled compounds

Drilling and production (antifoaming)	- polydimethylsiloxane (PMDS) oils - ethyl siloxanes - polypropylene glycol - naphthalene/1,2,4-trimethylbenzene based products - dipropylene glycol monomethyl ether - 2,6-dimethylheptan-4-one.
Fluoropolymers	- steel - other metal alloys - non-metal materials (ceramic or epoxy based) - cross-linked polyethylene (XL PE) - polyamides such as ethylene propylene diene (EPDM) - hydrogenated nitrile Rubber (HNBR) - polyether ether ketone (PEEK)

V. Questions - Section D - Petroleum & mining
Questions in relation to impact of legislative measures (for companies and industry associations)
V. Questions - Section E - Petroleum & mining
Specific questions for the use
V. Questions - Section B - F-gas uses
Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary F gas uses july 2021.pdf

Additionally, the Norwegian Environment Agency also published a short version of the report. This version can be accessed via the following link: Application of Fluorinated Gases (F-Gases) in the European Economic Area

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)[3] all emissions to air for F-gases
Domestic refrigeration	122	0	17
Commercial refrigeration	7,915	+	9,547
Industrial refrigeration	2,360	-	3,680
Transport refrigeration	1,010	0	1,341
Mobile air conditioning	5,221	++	11,726
Stationary air conditioning and heat pumps	7,465	++	7,458
Foam blowing agent (closed cell)	4,940	+	4,186
Foam blowing agent (open cell)	271	0	1,074
Fire protection	863	0	703
Propellants (non-MDI)	504	-	701

Solvents	?	0	> 11
Cover gas for magnesium casting	?	+	> 23
Other	?	?	35

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the waste
stage of the articles. These emissions are covered in a separate section.

[3] Due to large tonnages in stock, emissions can be higher than annual tonnage.

Do you have information that indicates that the information provided on the tonnage should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

Your market data on F-gases filled into new products and in stocks each year appears to be primarily sourced through data collated by the EU/EEA Govts in UNFCCC report (EU, 2020a). However, the cited data clearly stems from different sources. It's unclear why domestic refrigeration demands 122t of F-Gases for new products in 2018, when Reg(EU) 517/ 2014 has banned the placing on the market of HFCs with GWP of 150 from Jan 2015 and most of the viable refrigerants do not meet the 150 GWP threshold. Most of the 863mt for fire applications are exported outside the EEA, not contributing to the inventory of HFCs in the EEA. In the EEA report, the supply of F-gases for fire protection was 130 tons in 2019.Figures referenced in open and closed cell foam blowing agents are inconsistent with figures referenced elsewhere (e.g. construction). We believe that consistency in the numbers used in the different sections of the questionnaire and amongst the expert summary reports is crucial.

Do you have information that indicates that the information provided on the emissions should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

We have difficulties to fully understand the figures as presented; in particular, as they contradict some of the figures presented in other experts' reports (e.g. transportation). As a sector, we are not able to recognize these figures. In principle, over time, the cumulative emissions should not exceed the cumulative tonnage. Therefore, the existing disparity between the emissions and tonnage would not be expected to persist.

Do you have information that indicates that the information provided on the expected trend should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

The trend data presented in the table above is unclear, as it shows an expected strong increase in the use of F-gases in mobile air-conditioning. Assuming that this would depend on a strong increase of vehicles in Europe, it would contradict the fact that the EU market is already saturated with vehicles. Moreover, the trend towards electric vehicles, which use hermetically sealed cooling systems, should be taken into account. According to the European Automobile Manufacturers' Association (ACEA) report, 9.9 million new passenger cars were sold across the European Union in 2020, which is 23.7% less than the previous year (when more than 13 million cars were sold) - New passenger car registrations in the EU – ACEA – European Automobile Manufacturers' Association

Do you have information on risk management measures to minimize the use, human exposure and emissions to the environment for your application of PFAS?

Yes

Please specify and/or refer to literature/public sources.

Emissions of HFCs are managed/controlled under the F-gas Reg(EU)517/2014. It details leakage checks on certain equipment, a phase-down schedule, and restrictions on applications.
-Art. 6: detailed records that must be kept and retained by operators of equipment, they must be available to the MS competent authorities. Consultation with individual MS will enable a complete analysis of the actual leakage/emissions from equipment and demonstrate the effectiveness of risk management measures on human exposure and emissions to environment
-Art. 3: (1) intentional release of F-gases in the atmosphere shall be prohibited where it is not technically necessary for the intended use. (2) Operators of equipment that contains F-gases shall take precautions to prevent the unintentional release. They shall take all measures technically and economically feasible to minimise leakage of F-gases
-Art. 4: measures required to prevent leaks
-Art. 10: training and certification requirements for handling f-gases

V. Questions - Section C - F-gas uses

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives

Domestic refrigeration	- iso-butane - propane (not in-kind refrigeration cycles)
Commercial refrigeration	- CO_2 - isobutane - propane
Industrial refrigeration	- CO_2 - ammonia - n-butane
Transport refrigeration	- CO_2 - ammonia - CO_2 with N_2 as direct coolant - propane (not in-kind: advanced cool box storage)
Mobile air conditioning	- CO_2 - propane
Stationary air conditioning and heat pumps	- CO_2 - ammonia - propane
Foam blowing agent (closed cell)	Depending on the specific application: - cyclopentane - iso-pentane - n-pentane - isobutane - n-butane - 2-chloropropane - dimethyl ether (DME) - methyl formate - methylal - CO_2 / methyl formate - CO_2 (water) - CO_2 (liquid) - CO_2 / ethanol - water blown foams
Foam blowing agent (open cell)	
Fire protection	- inert gases (nitrogen and argon) - CO_2 - water mist technologies - inert gas generators - fine solid particle technology - dry chemical agents - water and aqueous salt solutions
Propellants (non-MDI)	Compressed gases: - air - nitrogen - nitrous oxide - CO_2
	Liquefied gases: - butane - propane - isobutane - dimethyl ether

	Not-in-kind alternatives: - trigger sprays - finger pumps - squeeze bottles - non-sprayed products including roll-ons - bag-on-valve products
Solvents	Depending on the specific application: - isopropyl alcohol (IPA) - n-Propyl bromide - dichloromethane - trans-1,2-dichloroethylene - trichloroethylene (TCE) - perchloroethylene (PER) - volatile methyl siloxanes - hydrocarbons (hexane, heptane, benzene) - acetone - semi-aqueous / aqueous cleaning - manual cleaning methods (aerosols, brush, trigger spray, liquid immersion, spot cleaning, wipes) - ultrasonic - plasma cleaning - supercritical fluids – CO_2 - no clean fluxes
Cover gas for magnesium casting	- SO_2 - argon - salt fluxes - powdered sulfur

What is the specific application/functionality of PFAS in your product(s)/processes?

The main applications of F-gases include:
- data centre cooling
- District heating and cooling
- Air-conditioning
- Firefighting
- Heat pumps
- Insulation foam blowing agent
- Metered dose inhalers (MDIs)
- Mobile air-conditioning
- Organic Rankine cycles (ORC)
- Electronics manufacturing
- Magnesium casting
- Cold chain (refrigerated transport, industrial refrigeration, commercial refrigeration, pharmaceutical cold chain)

More detailed information on applications can be found on the EFCTC website: https://www.fluorocarbons.org/applications/

Are in your view the listed non-PFAS alternatives technically feasible in your product(s)/processes?

No

Please specify why.

The table of sub-uses does not provide a comprehensive use guidance to alternatives. Refrigeration and Air-conditioning use has to be broken down into a larger number of sub-sectors (report and annex in 2011 Preparatory study for a review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases Final Report Prepared for the European Commission in the context of Service Contract No 070307/2009/548866/SER/C4). Many of these sub-sectors are unique and the alternatives must be selected on a case-by-case basis.
The list of alternatives for the sub-sectors does not include fluorocarbon alternatives and is, therefore, incomplete. A number of lower-GWP F-gas alternatives are available and, for example, are not included within the definition used in this study as they do not include the appropriate chemical entities.

Are in your view the listed non-PFAS alternatives economically feasible in your product(s)/processes?

No

Please specify why.

The list of alternatives is not complete as it omits certain fluorocarbon alternatives. Any analysis of the economic feasibility must include the energy efficiency of the alternatives and the measures required to operate equipment safely. The basis of the REACH restriction is on the emissions of products to the environment. It must be noted that there will equally be similar emissions from equipment for non-fluorocarbon alternatives some of which are flammable or hazardous to health (please see information below).

Do you have information on the alternatives' risk profile?

Yes

Please describe.

According to the substance information cards available on the ECHA website:
- Ammonia (NH3) causes severe skin burns and eye damage, is toxic if inhaled, is very toxic to aquatic life and is a flammable gas; moreover, this substance is toxic to aquatic life with long lasting effects and contains gas under pressure and may explode if heated.
- HCs are in general extremely flammable and explosive if heated. Additionally, some may affect fertility or the unborn child (CH4; C6H14) or cause damage to organs through extended or repeated exposure (C6H14). Others (C6H14; C5H12; C7H16; C8H18) may be fatal if swallowed, cause skin irritation, are toxic to aquatic life with long lasting effects and cause drowsiness or dizziness
- Carbon dioxide (CO2) contains gas under pressure and may explode if heated and contains refrigerated gas and may cause cryogenic burns or injury.

Are there legal approval schemes for your product(s)/processes, which have to be taken into account in case PFAS alternatives will be used?

Yes

Please specify and/or refer to literature/public sources.

F-gases used in the HVACR industry are already highly regulated via REACH, F-gas regulation, and MAC directive. F-gas Regulation already provides reporting requirements, quota limitations, and a framework for leak and end of equipment life mgmt, training & certification, and enforcement. Existing elements can be strengthened to include all low GWP alternatives achieve & stronger enforcement mechanism to limit emissions & enable circularity. F-Gases are used in many applications, mostly in closed systems. For the usage in HVACR the following Directives are valid:
- low voltage (2014/35/EU)
- Machinery (2006/42/EC)
- Pressure Equipment (2014/68/EU)

For the MAC application for Germany the KBA (Kraftfahrt-Bundesamt) approves new vehicles and vehicle parts, including the refrigerant in a MAC-system. The HVACR industry and downstream users need to follow several Safety and Equipment Standards, (EN-378/ 1-4, ISO 5149, IEC 60335-2-40, IEC 60335-2-89), valid for alternative refrigerants too.

Do you actively work on finding alternatives?

Yes

Please specify.

EFCTC Member companies have invested € 100s millions in the research, development and manufacture of alternatives to higher-GWP HFCs. Alternatives include R-32, HFOs, HCFOs and lower-GWP blends. This investment has been undertaken in response to the constraints under the F-gas Regulation and the Kigali Amendment to the Montreal Protocol.
Downstream users of F-gases have also invested in technology development to be able to use the developed alternatives in their products.

If alternatives have been identified as potentially suitable, which timescale do you foresee for a complete transition to those? Please explain.

Lower-GWP HFCs, HFOs and HCFOs have already been identified and the downstream industries are already investing billions of Euros in the transition from higher-GWP products. This investment has been occurring since before the adoption of the EU F-gas Regulation and takes into account the defined phase-down schedule and the phase-out of certain applications. Certain industries such as automotive air-conditioning have completed the transition from HFC-134a to HFO-1234yf for all new vehicles.

V. Questions - Section D - F-gas uses
Questions in relation to impact of legislative measures (for companies and industry associations)

What is the economic impact (in euro) and social impact (e.g. jobs) on your business/company if the use of PFAS is prohibited?

a) In 3 years.

The current regulatory measure in the EU F-gas Regulation specify a timetable to 2030. Investment and planning has been made by producers and down-stream users to take into account this timetable. A prohibition in less than this time period would cause a complete disruption of the transition from higher-GWP products and could result in issues for the EU climate change ambitions. Overall, this would mean a loss of competitiveness of the EU market, forcing production to be moved outside the EU.

b) In 10 years.

A prohibition of F-gases would result in a complete shut-down of the production and distribution of the affected products. This would result in the closure of the manufacturing sites in the EU (costs several € 100s millions). Several hundreds of jobs would be lost within the production section and a similar number of jobs lost within the distribution sector as, in many cases, distribution for non-fluorinated alternatives is a different model. Recovery for recycling/reclaim of products would cease. Research and development in companies which produce fluorinated alternatives would also cease.
Overall, this would mean a loss of competitiveness of the EU market, forcing production to be moved outside the EU

What is the economic impact (euro) on your business/company, if the following measures will become mandatory? Please make your (indicative) calculations transparent.

a) A maximum concentration of e.g. 0.1% (or less) PFAS is set in mixtures and/or articles.

No fluorinated gas refrigerants or blends would be possible. As companies responsible for production/distribution the result would be complete closure with a loss to the EU economy of millions of Euros.

b) Obligation to label your products visibly with "Contains PFAS".

Bulk products are already labelled as HFC, and the GWP is also specified. Labelling of products and products-containing items are already required under article 12 of the F-gas, which is comprehensive.

c) Obligation to report amount of PFAS in use and respective emissions.

Requirements are already in place under the F-gas Regulation for bulk products and leakage. See F-gas regulation (Regulation (EU) 517/2014) chapter II on containment (articles 3 to 10)

d) Specific waste management requirements with the obligation to collect, treat or recycle PFAS containing waste separately.

Article 9 of the F-gas Regulation concerns producer responsibility schemes. A number of Member States have already put these in place; examples are:

Germany:

*Chemikalien-Klimaschutzverordnung, §8 Rückgewinnung u. Rücknahme verwendeter Stoffe
(Regulation for chemicals and for the protection of the climate, §6 recovery and take-back of used substances)

*Kreislaufwirtschaftsgesetz
(Circular Economy Law)

France:

*Code de l'Environnement (Livre V, Titre IV, Chapitre III, Section 6), articles R.543-75 to R.543-123
https://www.legifrance.gouv.fr/codes/section_lc/LEGITEXT000006074220/LEGISCTA000006176997?dateVersion=30%2F09%2F2021&nomCode=&page=1&query=r%C3%A9cup%C3%A9ration+et+de+d%C3%A9struction&searchField=ALL&tab_selection=code&typeRecherche=date&anchor=LEGISCTA000006176997#LEGISCTA000006176997

V. Questions - Section E - F-gas uses

Specific questions for the use

Within the following applications/uses, what are the barriers to the substitution from F-gases to fluorine-free alternatives, and how much time would it require to address those?

Barriers to substitution.

Commercial refrigeration, and specially alternatives to F-gases in mid to large scale facilities	intrinsic properties of alternatives/safety issues/availability of alternatives
Transport refrigeration	intrinsic properties of alternatives/safety issues/availability of alternatives
Mobile air conditioning in cars, vans and trucks	intrinsic properties of alternatives/safety issues/availability of alternatives
Foam Blowing Agent, both closed and open cell	intrinsic properties of alternatives/safety issues/availability of alternatives

Time required to address barriers to substitution.

Commercial refrigeration, and specially alternatives to F-gases in mid to large scale facilities	In case alternatives do exist, considerable time will be needed for the formal approval of the use as well as for the capacity building and adaptation of equipment (additionally, the life-cycle of the current equipment is about 10 years). It is impossible to predict the exact timeline and costs. For some applications, alternatives are not available; therefore, time and funds for R&D should be added to the considerations above.
Transport refrigeration	In case alternatives do exist, considerable time will be needed for the formal approval of the use as well as for the capacity building and adaptation of equipment (additionally, the life-cycle of the current equipment is about 10 years). It is impossible to predict the exact timeline and costs. For some applications, alternatives are not available; therefore, time and funds for R&D should be added to the considerations above.
Mobile air conditioning in cars, vans and trucks	In case alternatives do exist, considerable time will be needed for the formal approval of the use as well as for the capacity building and adaptation of equipment (additionally, the life-cycle of the current equipment is about 10 years). It is impossible to predict the exact timeline and costs. For some applications, alternatives are not available; therefore, time and funds for R&D should be added to the considerations above.
Foam Blowing Agent, both closed and open cell	In case alternatives do exist, considerable time will be needed for the formal approval of the use as well as for the capacity building and adaptation of equipment (additionally, the life-cycle of the current equipment is about 10 years). It is impossible to predict the exact timeline and costs. For some applications, alternatives are not available; therefore, time and funds for R&D should be added to the considerations above.

Is there any potential niches, systems or processes that would still rely on F-gas use in a 10-years perspective within the applications/uses mentioned above, but also in other ones, such as for example:

Reliance on F-gases in a 10-year perspective?

Industrial refrigeration	YES
Domestic air conditioning and heat pumps for space heating	YES
Commercial air conditioning and heat pumps	YES
Solvents	YES
Propellants (non-MDI)	YES
Electronic cooling	YES
Other (please specify in the field to the right)	No answers

Do you have information on the use of F-gases apart from the ones considered so far (heating/ventilation/air conditioning/refrigeration, foam blowing agents, propellants, solvents, fire suppression, and as cover gas), like e.g. in electronics cooling/data centers or use as solvents in 3D printing?

No

V. Questions - Section B - Electronics & energy

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary electronics and energy july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA (tonnes/PFAS)
Electronics industry and semiconductor	Non-Polymers: 1,200 Polymers: 3,100 Total: 4,300	++	Production: 700 Use: 20 Recycling / waste: 900

Semiconductor	Non-Polymers: 85 Polymers: 1,400 Total: 1,485	++	
Energy industry	Non-Polymers: 250 Polymers: 1,200 Total: 1,450	++	Production: 40 Use: 1 Recycling / waste: > 24
Batteries	Polymers: 15,000	++	Production: ? Use: ? Recycling: ?

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

V. Questions - Section C - Electronics & energy

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Electronics industry and semiconductor	For fluoroelastomers in sealing: ethylene propylene diene monomer (EPDM) and silicone rubbers For wire insulation: ilicone materials Polyetheretherketone (PEEK) For photolithography (hard and not for all applications): hydrocarbon-based greases, Molybdenum disulfide, graphite
Energy industry	For fluoropolymer-based backsheets for photovoltaic cells polyolefin could be an alternative. Other fluorine free backsheets made of polyethylene terephthalate (PET) and/or ethylene vinyl acetate (EVA) can/are also used For cables: Mica and EPDM For seals: Hydrocarbon elastomers For batteries :Solid-state batteries For fuel cells: For PEM membranes: Hydrocarbon membrane and sulphonated polyetheretherketone (PEEK) Reinforcement material as alternative to PTFE: Electrospun polybenzimidazole-type materials For sealings: Some elastomers without fluorine exist and could potentially be used in the future for the Membrane Electrodes Assembly (MEA) function For immersion cooling: Synthetic oil

V. Questions - Section D - Electronics & energy

Questions in relation to impact of legislative measures

(for companies and industry associations)

V. Questions - Section E - Electronics & energy

Specific questions for the use

V. Questions - Section B - Transportation

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary transportation july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use		Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0 /+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Body-, hull and fuselage construction		?	0	?
Sealing applications		111,104 (fluoroelastomers in road transportation vehicles)	0	?
Lubrication		?	0	?
Hydraulic fluids		?	0	?
Electrical engineering and information technology		?	++	?
Coating and finishings (incl. textiles, interiors and related applications, e.g. coating of trim materials)		?	+	?
HVACR systems (heating, ventilation, air conditioning and refrigeration)	F-gases in road transportation vehicles	184,130	+	9,000
	F-gases in systems in trains/ships/aircrafts	?	+	?
	F-gases in systems for transport refrigeration	10,926	+	495.8
Health protection and lifesaving equipment (incl. firefighting, life vests, life rafts, airbags, …)		?	+	?

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions relate to mixture/article production and mixture/article use. They do not include PFAS production and the waste
stage of the articles. These emissions are covered in a separate section.

Do you have information that indicates that the information provided on the tonnage should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

The number presented in the table (184,130) represents the stock in the transport sector in the EEA and not the annual consumption. The consumption can be calculated based on data provided by the summary expert report on transport.

Do you have information that indicates that the information provided on the emissions should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

The Mobile Air Conditioning emission per year should be 3,006 MT/year due to a lower refrigerant leakage rate.
Calculation: based on amounts of PFAS in HVACR-systems (ca. 0.6 kg/personal vehicle, ca. 1 kg / unit per truck and ca. 6 kg / unit per bus) and taking into account the total number of registered passenger cars (242,727,242), trucks (sum of light and heavy commercial vehicles: 34,340,233) and busses (692,207) in the EU (ACEA 2019) it can be assumed that a total amount of approx. 180,000 t of F-gases are used in HVAC-systems for passenger comfort in road traffic in EEA. Based on an average leakage of 10g/vehicle per year (see David Sousa – Pastel 2009) with a charge size of 0.6kg, this equates to a leakage rate of 1.67%. 180,000 MT x 1.67% = 3,006 MT emissions in EEA per year.
Source: https://pastel.archives-ouvertes.fr/file/index/docid/501173/filename/Sousa_Thesis.pdf (page 21, paragraph 1.3. System and components emissions level)

The environmental release category (ERC) is a key REACH use descriptor to define the release factors of a chemical substance in a specific use exposure scenario. It is used in various modelling tools to derive environmental exposure estimates. ERC default factors are used to estimate emissions of PFAS in three major life-cycle stages, namely the production stage including manufacture of substances, formulation of mixtures and production of articles, the 'in-use' stage, and the waste stage.

Please indicate if you have information on specific emission values (SPERCs) for (groups of) PFAS, based on measurements and / or model calculations.

The automotive industry is actively developing technologies to detect leakage working closely together with R-1234yf recovery machine suppliers to lower the risk of human exposure and emissions to the environment. When a car is taken into the garage with an air-conditioning system problem or for an air-conditioning check, a fully automated standard leakage test is performed before re-charging the system to check for leaks. These machines follow the SAE 2016 standard and are also widely used in Europe.
References: MAHLE Service Solutions | SAE Certified ACX1280 R1234yf Recovery Machine Continues to Gain Great Customer Feedback and Industry Award
New Robinair air conditioning service unit for R1234yf refrigerant - Bosch Media Service (bosch-presse.de)
https://www.sae.org/news/2016/02/sae-standards-point-way-to-service-of-r-1234yf-systems

Do you have information that indicates that the information provided on the expected trend should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

Total light vehicle sales for new vehicles in EEA are not projected to increase after 2023 (IHS 2018, p 8). In addition, new technologies that will promote car sharing (e.g. autonomous driving will reduce car ownership) have not been factored into these demand projections. This means that after 2023, the EEA will have a stable fleet size for light vehicles (light vehicles use ~80% of total refrigerant in mobile air-conditioning, see previous question for calculation). For trucks and trailers (much smaller in total market size compared to light vehicles), the estimated new production CAGR is around 1% after 2023 (Roland Berger, 2018, p30 & 31). Therefore, only very limited further growth in the annual production of PFAS (in total tonnes per year) is expected after 2023. Furthermore, hybrid and electric vehicles require a hermetic electric compressor which facilitates considerably the refrigerant containment (Pastel 2009, p31). The outlook should therefore be 0.

Do you have information on risk management measures to minimize the use, human exposure and emissions to the environment for your application of PFAS?

Yes

Please specify and/or refer to literature/public sources.

Several regulations are in place, which regulate the responsible usage and supports minimizing emissions of F Gases, most adequate is the EU 517/ 2014 (F Gas Regulation), which is currently under revision and is going to address containment of F Gases (including HFOs). This revision will impact the MAC Directive (Directive 2006/40/EC) as well.

V. Questions - Section C - Transportation

Questions in relation to alternatives (mainly for individual companies)

Sub-Use	Non-PFAS alternatives
Body-, hull and fuselage construction	?
Sealing applications	?
Lubrication	?
Hydraulic fluids	?
Electrical engineering and information technology	?
Coating and finishings (incl. textiles, interiors and related appliactions, e.g. coating of trim materials)	- silicone based chemicals - sulfosuccinates - propylated aromatics - fatty alcohol polyglycol ether sulphates - alkyl acrylates - polyurethanes and -acrylics
HVACR systems (heating, ventilation, air conditioning and refrigeration)	- air - water - ethylene glycol - mineral oils - silicone oils - alcohols - natural gases: HC-600 (n-butane), R-717 (Ammonia), R-744 (CO_2)
Health protection and lifesaving equipment (incl. firefighting, life vests, life rafts, airbags, …)	?

What is the specific application/functionality of PFAS in your product(s)/processes?

Refrigerants in mobile air-conditioning for passenger cars, truck, buses, ships, planes and trains and in various refrigerated transport equipment.

Are in your view the listed non-PFAS alternatives technically feasible in your product(s)/processes?

No

Please specify why.

The alternatives lack to offer an effective and efficient air-conditioning functionality at a wide enough temperature range. In particular CO2, does not operate effectively (from a technical perspective) particularly in hot climates where air-conditioning is operated for longer periods. The air-conditioning efficiency of the vehicle will be severely compromised (requiring significant modifications to the hardware of existing air-conditioning systems) and the air-conditioning system will require significantly more energy to cool the cabin to ambient temperature. The 2018 report commissioned by AFCE also states that studies such as Papasavva (2014) have shown that, in a global context, R1234yf is a better alternative than CO2, when considering all direct and indirect emissions during the life cycle (LCCP) of the vehicle and the refrigerant.
Source: https://docs.lib.purdue.edu/cgi/viewcontent.cgi?article=2474&context=iracc

Are in your view the listed non-PFAS alternatives economically feasible in your product(s)/processes?

No

Please specify why.

Both R-134a and R-1234yf refrigerants are highly efficient at transporting heat at high and lower temperatures. Alternative refrigerants (like CO2) will require significantly more expensive compressors, hoses, etc. and more energy to operate due to the increased system pressure to establish a working system. This increases the weight and cost of the total air-conditioning system significantly with lower technical performance (especially at high temp., >30°C). The additional cost per vehicle of the components and the total life cycle costs will be significantly high (higher energy consumption due to lower AC efficiency and additional car weight, installation and maintenance of the additional equipment, etc.) The 2018 report commissioned by AFCE states that studies such as Papasavva (2014) have shown that, in a global context, R1234yf is a better alternative than CO2, when considering all direct and indirect emissions during the life cycle (LCCP) of the vehicle and the refrigerant.

Do you have information on the alternatives' risk profile?

Yes

Please describe.

CO2 presents a particular challenge in automotive because its pressure is significantly higher (10x) than HFO-1234yf and HFC-134a. It has been difficult to contain CO2 in the flexible hoses needed in vehicles to manage vibration during vehicle use. In addition, a leak in the CO2 system can lead to high levels of CO2 in the cabin without being easily detected when inhaling. In the case of HFO, the pressure in the system is much lower (10x), hence the amount of refrigerant that can potentially leak into the cabin is much lower. Butane and propane are highly flammable substance. Butane has a higher boiling point (app. 0°C) vs HFO-1234yf, which makes it difficult to use in all geographies under norm conditions. The pressure will be too low to offer sufficient thermodynamic performance.

Are there legal approval schemes for your product(s)/processes, which have to be taken into account in case PFAS alternatives will be used?

Yes

Please specify and/or refer to literature/public sources.

Vehicle road-worthy and safety legislation (type approval) ensures a safe usage of our products in automotive applications. Our customers (the OEMs) go through a rigorous development and test program to demonstrate compliance. Obtaining legal approval for a technical feasible alternative to R-134a and R-1234yf outside the F-gas regulation starts with ASHRAE registration and is followed by vehicle road-worthy and safety legal approval (type approval). For flammable refrigerants, compliance with ATEX requirements is mandatory. Certain regions/jurisdictions require a Risk Assessment to be completed before installation.
https://www.ashrae.org/technical-resources/standards-and-guidelines/read-only-versions-of-ashrae-standards
https://ec.europa.eu/growth/sectors/automotive/technical-harmonisation/faq-auto_en

What is the average approval time?

Based on the experience of the EFCTC members, the average approval time is as follows:
- ASHRAE and ISO817 registration: typically, ~12-18 months
- Vehicle type approval: typically, ~24-48 months after ASHRAE registration

Consideration should also be given to the timeframe required to allow continued F-Gas supply for maintenance. An example could be taken from article 6 of the MAC directive (Directive 2006/40/EC), where the provision allowed for an overall period of about 11 years (since the directive adoption in May 2006 until January 1st, 2017) the retrofitting and refilling of vehicles.

Do you actively work on finding alternatives?

No

V. Questions - Section D - Transportation
Questions in relation to impact of legislative measures (for companies and industry associations)

What is the economic impact (in euro) and social impact (e.g. jobs) on your business/company if the use of PFAS is prohibited?

a) In 3 years.

There are currently around 250 million cars in the EU and banning F-gases under REACH will require a managed transition over a period of the lifetime of the vehicles (10-15 years) with ongoing maintenance and servicing using F-gases. This could particularly influence the transition to electric vehicles.

The current regulatory measure in the EU F-gas Regulation specify a timetable to 2030. Investment and planning has been made by producers and down-stream users to take into account this timetable. A prohibition in less than this time period would cause a complete disruption of the transition from higher-GWP products and could result in issues for the EU climate change ambitions.

In general, a prohibition of F-gases would result in a complete shut-down of the production and distribution of the affected products.

b) In 10 years.

The impact mentioned above on vehicles would equally apply to this case.
A prohibition of F-gases would result in a complete shut-down of the production and distribution of the affected products. This would result in the closure of the manufacturing sites in the EU (costs several € 100s millions). Several hundreds of jobs would be lost within the production section and a similar number of jobs lost within the distribution sector as, in many cases, distribution for non-fluorinated alternatives is a different model. Recovery for recycling/reclaim of products would cease. Research and development in companies which produce fluorinated alternatives with lower GWP would also cease with significant job losses.

c) Please explain by providing your calculations.

As a sector group of an industry association, the EFCTC is not able to discuss details information regarding economic impact. The information provided is a rough estimation based on the approximative knowledge of the EFCTC members.

What is the economic impact (euro) on your business/company, if the following measures will become mandatory? Please make your (indicative) calculations transparent.

a) A maximum concentration of e.g. 0.1% (or less) PFAS is set in mixtures and/or articles.

No fluorinated fluids or blends would be possible. As companies responsible for production/distribution the result would be complete closure with a loss to the EU economy of millions of Euros.

b) Obligation to label your products visibly with "Contains PFAS".

Bulk products are already labelled as HFC, and the GWP is also specified. Labelling of products and products-containing items are already required under article 12 of the F-gas, which is comprehensive.

c) Obligation to report amount of PFAS in use and respective emissions.

Requirements are already in place under the F-gas Regulation for bulk products and leakage.
See F-gas regulation (Regulation (EU) 517/2014) chapter II on containment (articles 3 to 10).

d) Specific waste management requirements with the obligation to collect, treat or recycle PFAS containing waste separately.

F-Gas Suppliers and their distribution partners are already applying rigorous waste management requirements and working with the Automotive OEMs and the Aftermarket (e.g. equipment manufacturers for garages to recover and re-use refrigerants) to reduce refrigerants to the absolute minimum. The current EU No 517/2014 “F-Gas Regulation” includes the para on containment, which focuses on leakage reduction which EFCTC is fully supportive off. EFCTC sees further opportunities to upgrade the end of life disposal approach to date.
Annex I of the EU Directive 2000/53/EC on vehicles end of life covers the waste management of gases used in the vehicles air-conditioning systems.

V. Questions - Section E - Transportation

Specific questions for the use

For this restricton proposal the assessment of the transportation sector encompassess: road traffic, ships, trains and aircrafts. We identified the following applications of PFAS in the transportation sector:

1.) Body-, hull and fuselage construction
2.) Sealing applications
3.) Lubrication
4.) Hydraulic fluids
5.) Electrical engineering and information technology
6.) Coating and finishings (incl. textiles, interiors, and related applications e.g. coating of road signs)
7.) HVACR systems (heating, ventilation, air conditioning and refrigeration)
8.) Health protection and life saving equipment (incl. fire prevention and fire fighting)

V. Questions - Section B - Waste

Questions in relation to the use (mainly for industry associations)

The following linked information presents the current picture: Report summary waste july 2021.pdf

In the tables presented on this page and the following, '?' in the cells show that the authorities do not have any information available. Input to fill these gaps is highly appreciated.

Sub-Use	Tonnage (tonnes/PFAS) per year in the EEA	Expected trend (--/-/0/+/++)[1]	Emissions/year in EEA[2] (tonnes/PFAS)
Textiles/TULAC	43,605	++	WWTP: 3.5 (median)
Food contact material (paper & board)	2,894	+	Landfill: 1.8 (median)
End-of-life-vehicles (ELV)	2,219	+	Incineration:

Waste electrical and electronic equipment (WEEE)	?	++	Flue gas: ? Bottom ash: 0.03 Fly ash: 0.05
Sewage sludge	0.404	?	0.3

[1] -- = strong decrease, - = decrease, + = increase, ++ = strong increase, 0 = neutral

[2] Emissions only relate to the waste stage. They do not include mixture/article production, mixture/article use and PFAS production. These emissions are covered in the other sections of this survey.

Do you have information that indicates that the information provided on the tonnage should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

Examples of relevant information can be found in a number of sources including the following:
- France : 541 mt (including CFC, HCFC, HFC, HC) were collected from WEEE in 2019
- ADEME (Agence de la Transition Écologique), Rapport annuel de l'observatoire des gaz fluorés, France, Données 2019
- https://librairie.ademe.fr/dechets-economie-circulaire/4055-gaz-fluores-donnees-2019.html (page 25)

Do you have information that indicates that the information provided on the emissions should be adjusted?

Yes

Please specify and/or refer to literature/public sources.

Further information on the emissions relating to waste could be found in the following documents:
- Montreal protocol, see 2018 TEAP Report, Vol 2: Decision XXIX/4 TEAP Task force Report on Destruction Technologies for controlled substances
- Montreal protocol, see 2018 TEAP Report, Supplement to the April 2018 Decision XXIX/4 TEAP Task Force Report on Destruction Technologies for controlled Substances --> the European Commission provided information on destruction technologies for controlled substances used in the EU for the supplementary TEAP report.

The environmental release category (ERC) is a key REACH use descriptor to define the release factors of a chemical substance in a specific use exposure scenario. It is used in various modelling tools to derive environmental exposure estimates. ERC default factors are used to estimate emissions of PFAS in three major life-cycle stages, namely the production stage including manufacture of substances, formulation of mixtures and production of articles, the 'in-use' stage, and the waste stage.

Please indicate if you have information on specific emission values (SPERCs) for (groups of) PFAS, based on measurements and / or model calculations.

Examples of relevant information can be found in a number of sources including the following:
- France : 541 mt (including CFC, HCFC, HFC, HC) were collected from WEEE in 2019
- ADEME (Agence de la Transition Écologique), Rapport annuel de l'observatoire des gaz fluorés, France, Données 2019
- https://librairie.ademe.fr/dechets-economie-circulaire/4055-gaz-fluores-donnees-2019.html (page 25)

Further information on the emissions relating to waste could be found in the documents listed under the question on emissions.

Do you have information that indicates that the information provided on the expected trend should be adjusted?

No

Do you have information on risk management measures to minimize the use, human exposure and emissions to the environment?

Yes

Please specify and/or refer to literature/public sources.

Due to the reduced availability of high-GWP HFCs because of the F-gas quota phase down and the entailed price increases, recycling has become much more attractive for installers and their customers (end-users like supermarkets, etc.) Several companies have built/ are planning the construction of new reclamation facilities in the EU within the recent/ coming years. The collection/ collection methods of used refrigerant have improved a lot within the recent years because of its increased value (see more info under the question on recycling).

V. Questions - Section E - Waste

Specific questions for the use

If available, please provide information on PFAS recycling.

F-gases are being recycled (easy cleaning process) or reclaimed (more complex cleaning process, including quality analysis) by many companies in the EU with a strongly increasing trend.
The 1523mt figure in EEA report is below the real reclamation number because the EU F-gas Reporting tool (HFC Registry) currently only allows companies, who are also producers, importers or exporters of F-gases, to report on their reclamation volumes in the software. F-gas destroyers can register in the software, but they can only report on their destroyed volumes, not on the reclaimed. Companies only doing recycling/ reclamation cannot register in the software. Additionally, there is an assumed high rate of recycling by installers, who do not report to the EEA, confirmed by interviews with installers

Thank you for your participation!

This is the last page of the survey. Please make sure your information is correct. After clicking on 'Submit', you will not be able to change your entries anymore. The following page however will give you the opportunity to save your answers as PDF document or print them.