

**AGC's CONTRIBUTION TO THE CONSULTATION ON THE RESTRICTION
PROPOSAL ON PFAS
AS REGARDS GENERAL COMMENTS AND GENERAL INFORMATION ON
FLUOROPOLYMERS
NON-CONFIDENTIAL**

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Introduction

AGC is a world leading producer of fluoroproducts, with production sites in Japan as well as in the United Kingdom via its European subsidiary, AGC Chemicals Europe, Ltd. (AGCCE).

AGC values the opportunity to submit comments on the restriction proposal on per- and polyfluoroalkyl substances (hereafter “U-PFAS restriction proposal”) under REACH. AGC supports the European Union’s overall Green Deal objectives by committing to responsible manufacturing principles, continuously improving the best available techniques in their manufacturing process, limiting environmental emissions where feasible, and conducting R&D to advance its technologies.

AGC is conscious of the wide range of its derogation requests. However, AGC would like to stress that they relate to critical uses for the EU green and digital transition (e.g. fluoropolymer-based ion exchange membranes in the production of green hydrogen), for the human health or for safety and reliability of equipment in operation (e.g. use of nonwoven filters in medical equipment, electronics, transport).

AGC is a member of the PlasticsEurope-Fluoropolymers Product Group (FPG), the European Chemical Industry Council’s FluoroProducts and PFAS for Europe (FPP4EU), the Alliance for Telomer Chemistry Stewardship (ATCS), and the Conference of Fluoro-Chemical Product Japan (FCJ). As such, AGC supports the comments each organisation has submitted.

In addition to this public contribution, AGC has submitted confidential contributions in separate documents for each of the following to the consultation on the REACH restriction proposal on PFAS: fluoropolymers; C6 fluorotelomers; substances used in

pharmaceuticals and agrochemicals; and hydrofluorocarbons (including fluorinated gases)

Part 1. General Comments

AGC would like to share the following general comments on the U-PFAS restriction proposal.

1. Scope of restriction option analysis

The restriction proposal encompasses “*any substance that contains at least one fully fluorinated methyl (CF₃-) or methylene (-CF₂-) carbon atom (without any H/Cl/Br/I attached to it)*”, following the 2021 OECD definition of PFAS. Nevertheless, it was stressed in the OECD’s recommendations and practical guidance, that the definition should only be employed for structural identification and classification, not for regulatory action.¹ Besides, the OECD definition does not take into account hazardous properties or risks of PFAS, only the chemical structure, which has been recognized by the Dossier Submitters.²

The broad chemical scope, including substances varying widely in terms of properties³ or which have already been restricted, should be revised. We suggest only including the chemistry that will actually be assessed and restricted, in particular for the risk assessment as this creates a distorted image of the chemistry to be restricted.

2. Fluoropolymers

At least 18 types of fluoropolymers, e.g., PTFE and ETFE, representing 96% of the globally and commercially available fluoropolymers meet the OECD criteria for Polymers

¹Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance, OECD, the Environment Directorate, Chemicals and Biotechnology Committee, July 9, 2021, ENV/CBC/MONO, 25, No.61. [pdf \(oecd.org\)](https://www.oecd.org/dataoecd/25/61/5c9b1b1d.pdf)

² Annex XV Restriction Report Proposal for a Restriction of Per- and polyfluoroalkyl substances (PFASs), European Chemicals Agency (ECHA), p. 19. [Submitted restrictions under consideration - ECHA \(europa.eu\)](https://echa.europa.eu/en/chemicals-restriction-reports/annex-xv-restriction-report-proposal-for-a-restriction-of-per-and-polyfluoroalkyl-substances-pfas)

³ Properties of certain PFAS cannot be extrapolated to other PFAS.

of Low Concern (PLC), i.e., polymers deemed to have insignificant environmental and human health impacts. This is due to their high stability and resistance to environmental degradation, and the fact that they are non-toxic, non-bioavailable and non-bio accumulative^{4 5 6}. The main human health and environmental concerns related to these fluoropolymers do not stem from the polymer as such. It is rather presumed to be due to other chemicals used in or derived from the manufacturing process, that may have varying hazard profiles, as well as the presence of other chemicals bound to the fluoropolymer products placed on the market, or to decomposition into other chemicals during the end-of-life treatment of these fluoropolymer products⁷. Moreover, in a 2023 study of appropriate regulatory management options for PFAS, it was concluded by the Environment Agency and Health and Safety Executive of the United Kingdom that fluoroplastics and fluoroelastomers are low hazard groups of PFAS and restrictions should not apply to this group⁸.

The Responsible Manufacturing Project is an initiative of Fluoropolymer Product Group (FPG), which is engaged in concrete actions related to responsible fluoropolymer manufacturing practices. As a member of FPG, AGC is committed to the Responsible Manufacturing Project, its principles, and objectives to implement abatement techniques in order to minimise emissions from production to air, water and soil.

The programme of the Project is comprised of three pillars:

- A commitment to reduce non-polymeric PFAS emissions from fluoropolymer manufacturing;

⁴ *Fluoropolymers Chemical Economics Handbook*, S&P, November 2022, [Fluoropolymers - Chemical Economics Handbook \(CEH\) | S&P Global \(spglobal.com\)](#)

⁵ "A Critical Review of the Application of Polymer of Low Concern and Regulatory Criteria to Fluoropolymers," *Integrated Environmental Assessment and Management*, Henry, Barbara.J., et al., 14, 3 (2018): 316-334. DOI: 10.1002/ieam.4035.

⁶ "A critical review of the application of polymer of low concern regulatory criteria to fluoropolymers II: Fluoroplastics and fluoroelastomers," Korzeniowski, Stephen H., et al., *Integrated Environmental Assessment and Management* 19, 2 (2023): 326–354. DOI: 10.1002/ieam.

⁷ REGULATORY MANAGEMENT OPTION ANALYSIS FOR FLUOROPOLYMERS: Final report prepared for Fluoropolymers Group (FPG) of Plastics Europe, Chemservice, November 4, 2021. [Fluoropolymers Product Group - RMOA September 2021.pdf \(plasticseurope.org\)](#) (accessed May 5, 2023).

⁸ Analysis of the most appropriate regulatory management options (RMOA). Substance Name: Poly- and perfluoroalkyl substances (PFAS). Health and Safety Executive, UK. March 2023. [UK REACH: Regulatory management option analysis \(RMOA\) \(hse.gov.uk\)](#)

- A platform to promote the adoption of commercially available state of the art technologies to minimise non-polymeric PFAS emissions in manufacturing; and
- A commitment to inform downstream users of fluoropolymers on their safe handling and use.

To achieve these pillars, the following Average Emission Factors of non-polymeric PFAS residues from polymerisation aid technology used in the fluoropolymer manufacturing process have been set:

- By end 2024: 0.009% to air; 0.001% to water
- By end 2030: 0.003% to air; 0.0006% to water

Where technically feasible, AGC is also researching and developing technologies that no longer require fluorinated polymerisation aids for the production of fluoropolymers.

AGC strongly believes that fluoropolymers should be fully derogated under the U-PFAS restriction, based on their low human and environmental hazard profile, high economic value to the society, and emissions minimisation from manufacturing and end-of-life.

3. F-Gases

AGC supplies HFCs, HFC-mixtures, HFOs and HFC-HFO mixtures of F-Gases. It is important to note that fluorinated gases:

- Do not fall within the REACH criteria regarding persistence;
- Do not present significant toxicity or bio-accumulation concerns;
- Are subject to a robust EU and Global regulatory framework, namely the Montreal Protocol, Kigali Amendment, and the F-Gas Regulations, managing their environmental impact.

F-gases are used in closed systems and recovered at end-of-life. The EU F-gas Regulation specifies a robust recovery mechanism for all substances within scope, including the prevention of emissions, the precautions to limit emissions during production, transport, and storage, as well as at the recovery, recycling, reclaim, destruction and disposal phases.

HCFO gases have very short lifetimes and are generally removed through chemical reactions in the lower troposphere. This results in them having negligible influence on both global warming and ozone depletion. Trifluoroacetic acid (TFA) has been identified as a possible breakdown product of HCFCs, HFCs, HFEs, HFOs and HCFOs. However, a recent report by the United Nations Environment Programme's Environmental Effects Assessment Panel (UNEP EEAP) discusses trifluoroacetic acid (TFA) in the global environment.

It states that:

- (a) uncertainties remain in understanding of the sources, routes of formation, and environmental fate of TFA specifically proportion of anthropogenic and natural sources;
- (b) concentrations of TFA are so low that are currently unlikely to cause adverse toxicological effects and based on projected future use precursors of TFA, no harm is anticipated;
- (c) inclusion of TFA in PFAS group of chemicals for regulation would be inconsistent with the risk assessment of TFA⁹

4. Legality

From a legal perspective, no substance can be restricted under REACH without fulfilling the criteria for hazard or exposure (Article 57(f) REACH), together with a proven *“unacceptable risk to human health or the environment arising from the manufacture, use or placing on the market of substances”* (Art 68 REACH). The proof demonstrating the unacceptable risk must be gathered by conducting a risk assessment following the conditions of Annex XV to REACH. In the U-PFAS restriction proposal, all PFASs were grouped into one category to restrict them as one single class. Therefore, this would result in the restriction of substances that have not been properly risk assessed and for which an unacceptable risk has not been demonstrated.

While persistence is considered an intrinsic property, persistence in and of itself is not an intrinsic hazard. At the same time, no conclusion has been reached on

⁹ Environmental Effects of Stratospheric Ozone Depletion, UV Radiation, and Interaction with Climate Change, 2022 Assessment Report, UNEP 2022 Assessment Report of the Environmental Effects Assessment Panel. [EEAP-2022-Assessment-Report-May2023.pdf \(unep.org\)](#)

bioaccumulation and toxicity criteria for each substance and/or subgroup. Therefore, this argument cannot be used as a justification for chemical regulation. The Dossier Submitters consider that persistence in combination with other potential additional hazard properties is equivalent to Persistency, Bio accumulative, Toxicity (PBT) / very Persistent, very Bioaccumulative (vPvB) properties, with any release being a proxy for unacceptable risk.

The dossier sets a dangerous precedent, where any substance could be restricted based on a combination of properties without having to prove an unacceptable risk to human health or the environment.

5. Environmental emissions

The restriction dossier is exclusively based on assumptions and concerns related to increasing emissions and long-term exposure.

*“Yearly emission estimates for PFASs during PFAS production were **derived from tonnage estimates** provided by industry, multiplied with ERC factors (see Annex B for further details)”* (p. 143).

While the dossier provides a quantitative assessment of expected releases by sector, it fails to give an indication on whether such releases reach a level of concern that could represent a risk.

Besides, the dossier does not analyse the technologies in use or commercially available to minimise emissions to the environment, nor the amounts of releases that could be reduced by using such technologies. As stated in Annex B of the restriction proposal (i.e., Section B.9.1, p. 226): *“minimising emissions is key to reduce risks in the long term”*. It can be, therefore, concluded that the dossier submitters agree that sound management of emissions will reduce risks and render the restriction unnecessary.

Based on the fact that all fluoropolymers are completely mineralised at a temperature of 800°C¹⁰, and that the large majority of PFAS are incinerated with even municipal

¹⁰ Per- and polyfluorinated substances in waste incinerator flue gases, RIVM report 2021–0143, J. Bakker, B. Bokkers, M. Broekman, National Institute for Public Health and the Environment. DOI 10.21945/RIVM-2021-0143. <https://www.rivm.nl/bibliotheek/rapporten/2021-0143.pdf>

incinerators requiring a minimum combustion temperature of 850°C¹¹, it can be concluded that effective waste management measures are in place to mitigate the environmental impact of PFAS.

6. Baseline

By setting default thresholds at 25 ppb for one PFAS, 250 ppb for the sum of PFASs, and 50 ppm for polymeric PFAS no substance, mixture or article can comply with, the restriction will drive a full PFAS ban except for specific derogated uses. Default thresholds should be based on scientific data and commensurate with the related risk. However, some PFASs, such as fluoropolymers, are used in a wide array of products across multiple downstream sectors, sometimes the same product being used in several applications, which makes them difficult to identify across the value chain. For such products, the approach taken may prevent the realisation of the intended functions of the end-use.

7. Description of analytical methods

At the current time, there is no accurate nor standardised single analytical method available capable of measuring the total PFAS concentration in products, which raises serious implementation and enforceability challenges to both industry and regulators with regards to product compliance. It has been acknowledged by the Enforcement Forum of ECHA that although restriction proposal refers to the existing restriction provisions on PFOS and PFOA, to claim successful implementation of PFAS restriction, standard methods for the analytical testing of the content of the substances covered by a proposed restriction should be developed. This is relevant in terms of enforceability and the availability of analytical methods.¹² The chemical scope of the restriction proposal on all

¹¹ Fluoropolymer waste in Europe 2020- End-of-life (EOL) analysis of fluoropolymer applications, products and associated waste streams, Conversio report, July 2022. [EUU Almdel supplerende svar på spørgsmål 49 Report ProK Fluoropolymers 20220719 \(ft.dk\)](#)

¹² Opinion on an Annex XV dossier proposing restrictions on undecafluorohexanoic acid (PFHxA), its salts and related substances, European Chemicals Agency (ECHA), Committee for Risk Assessment (RAC) & Committee for Socio-economic Analysis (SEAC), p. 146–147. [Submitted restrictions under consideration - ECHA \(europa.eu\)](#)

PFAS would translate into a wide range of substance specific tests for both solid and liquid materials.

For an overview of the existing testing methods, please consult the contributions to this public consultation from FPG and ATCS.

8. Transitional period

We consider that for each of the applications submitted in our public consultation, alternatives to non-fluorinated products would be very difficult from a technical and socio-economic point of view. If the derogation period is delimited before the alternatives have been developed and their technical feasibility has been fully verified, we are concerned that it will cause significant disruption to a wide range of industries in the EU. In order to avoid such disruptions, the derogation and transition period should be set based on the results after the development of alternatives and their technical feasibility in terms of its production and use has been fully verified.

In addition, the proposed general transition period of 18 months is not sufficient to ensure a smooth transition to fluorine-free alternatives for applications for which substitution can be envisaged. Businesses need time to adapt their industrial production, equipment, processes, test materials against application standards, etc., otherwise high socio-economic impacts can be expected.

Due to the unparallel complexity of this restriction affecting thousands of substances, AGC considers that a transition period of at least 54 months should be granted for the U-PFAS restriction proposal. In comparison, for the restriction proposal on PFHxA, its salts and related substances, the Committee for Socio-Economic Analysis (SEAC) proposed a 36-month transition period for one single class of substance, justifying its decision on complexity.

In addition, the restriction should allow for the extension of specific transition periods when research and development identify no suitable alternatives from the technical and economical standpoints at the end of the original transition periods.

9. Reporting obligations & confidentiality concerns

Paragraphs 7 and 8 of the proposed restriction require manufacturers to provide information about the identification of the substances manufactured and placed on the market. To satisfy this requirement, the reporting entity needs to obtain relevant substances information from the upstream chemical substance manufacturers. To do so, it is anticipated that highly sensitive proprietary information on the type, function, and quantity of PFAS contained in the product may need to be disclosed by the chemical manufacturer through the supply chain. However, the proposed restriction does not provide specific protection measures for such information to be shared.

PFAS are critical for the EU strategic autonomy and safety and reliability of equipment in operation, e.g. semiconductors, energy, military, medical, transportation, and construction. As such, national security and critical infrastructures may be exposed to various risks if confidential information is not protected through the supply chain. Without appropriate measures, chemical manufacturers will be forced to disclose confidential business information, creating a competitive disadvantage on the international market and thus increasing the EU reliance of key infrastructures and technologies for the strategic autonomy towards third countries.

AGC, as a manufacturer, would like to ask for:

- Elements of definition for the information required for the identification of substances;
- Specific procedures for the protection of confidentiality in case the information qualifies as business confidential;
- Clarity on the legal framework and mechanisms used to address unintentional information leaks to external parties.

It is worth noting that in the United States, during the application process for the registration of a chemical substance under the Toxic Substances Control Act Premanufacture Notice (TSCA-PMN), chemical structures can be designated as confidential and reported to regulatory authorities using a specific code (referred to as an Accession Number) representing the chemical structure. This procedure effectively ensures the preservation of information confidentiality and could be implemented at the EU level.

10. Innovation

PFAS present an unparalleled combination of properties for uses in industrial and commercial applications, in which they enable major innovations supporting the EU green and digital transition (twin transition), the EU strategic and energy autonomy and the safety of society. This is especially true for technologies such as fuel cells, electrolyzers, hydrogen production, semiconductors and solar photovoltaics.

However, the Annex XV Restriction Report in its current form creates uncertainty for investment decisions and innovation. This may result in a relocation of the key value chains for the EU innovation outside the EU, with a risk of compromising critical European sectors relying heavily on these materials. A restricted access to high-performance PFAS-materials will further impact the European industrial competitiveness. Indeed, where PFAS support the scaling up of the EU's manufacturing capacity for net-zero technologies and the digital industry through innovation, which in turn enables lowering production costs and increase competitiveness, their restriction would significantly impede progress.

Therefore, the restriction should allow new exemptions for technologies and applications currently unknown and for which PFAS is critical for the twin transition, the EU energy and strategic autonomy and the safety and reliability of equipment in operation.

11. Spare Parts

AGC believes that spare parts should be excluded from the scope of the restriction proposal to ensure that, in line with the objectives of the [Ecodesign for Sustainable Products Regulation](#) and the [Right to Repair](#), consumers can benefit from the durable use of products throughout their entire lifecycle.

Under the existing Directive and future legislative framework on the ecodesign of products, manufacturers and sellers of certain product categories will be required to ensure the availability of spare parts for a predefined period of time after the last item is placed on the EU market. Therefore, in order to avoid unwarranted replacements of durable products and an increase of premature waste, the restriction on the

manufacturing and placing on the market should not apply to parts required for repairs and servicing of existing products that have already been installed or are in use.

As an example, one of our downstream users highlighted a need for a repair and maintenance of existing ETFE Film projects (e.g., Allianz Arena in Germany). From time to time, ETFE Film cushion needs to be repaired using ETFE tape. Customers need to have access to ETFE films for a period of 30-40 years, which is a typical building lifetime. Other types of films cannot be deployed as the dimension and design of the cushion and substructure is based on the mechanical properties of the ETFE Film.

Note that in case spare parts would not be exempted, this would raise liability questions for producers on legal or commercial guarantees for products where compatibility between fluorinated and non-fluorinated parts in the end-product cannot be guaranteed.

12. Use of PFAS in manufacturing equipment

The use of PFAS (such as PTFE and ETFE) in manufacturing equipment and fixtures in manufacturing plants is essential from the perspective of ensuring manufacturing safety in various process industries including chemical, pharma and semi-conductor. PFAS should not be prohibited in manufacturing plants where the equipment and its operations are controlled.

Part 2. General Information on Fluoropolymers

AGC is the world's leading producer of ETFE and PTFE, which are produced in the UK and in Japan. AGC manufactures other fluoropolymers (PFA, fluorinated ionomers, CYTOP™, AFLAS® FEPM and FFKM, Perfluoropolyethers and LUMIFLON FEVE) in Japan.

As such, this document relates to a variety of end-uses of fluoropolymers in a wide array of industrial sectors. Fluoropolymers provide a unique set of properties for technologies which require a high level of safety and reliance and are critical to the green and digital transition and to the EU strategic and energy autonomy. The information provided is to the limit of AGC's knowledge which, as a manufacturer, is not aware of all specialist applications.

AGC is asking for a derogation covering all fluoropolymers under the U-PFAS restriction, for the following reasons:

- **Low hazard profile:** fluoropolymers have a low hazard profile and do not pose any risk to the human health and the environment (please refer to the document on General Comments).
- **Responsible Manufacturing Project:** as a member of the Fluoropolymer Product Group (FPG), AGC is committed to responsible manufacturing principles and commitments outlined in the Responsible Manufacturing Commitment. AGCCE is committed to implementing its targets, which include the following:
 - A voluntary commitment to reducing non-polymeric PFAS emissions;
 - Participating in a platform promoting the adoption of commercially available state of the art technologies to minimise non-polymeric PFAS emissions in its manufacturing;
 - A commitment to inform downstream users of fluoropolymers on their safe handling and use.
- **No suitable alternatives:** fluoropolymers are used in a variety of applications for which high technical, high safety and high-performance requirements are necessary and cannot be achieved with non-fluorinated alternatives.
- **High societal value:** fluoropolymer-based technologies are the cornerstone of the green and digital transition and of the EU strategic autonomy in a wide array of industrial sectors, e.g. hydrogen, semiconductors, batteries. A ban of fluoropolymers would have a serious socio-economic impact and would undermine the EU competitiveness towards third countries.

The section on fluoropolymers addresses ECHA's questions, **from a manufacturer standpoint**, while complementing AGC's submission to the calls for evidence on the U-PFAS restriction proposal. AGC will provide information on AGC's different fluoropolymer products used in a wide range of applications in the sectors researched by the Dossier Submitters.¹³

¹³ Annex XV restriction report, proposal for a restriction on Per- and polyfluoroalkyl substances (PFASs), Annex A, Table A.1. Overview of PFAS applications and the level at which they were researched. <https://echa.europa.eu/documents/10162/f71f3bed-e48d-5004-d195-e293c38d0602>

Key functionalities provided by fluoropolymers

Fluoropolymers are fundamental to a wide range of technologies, e.g., semiconductor, fuel cells, wind turbines, batteries, solar photovoltaics, etc. highly valuable to deliver on the EU green and digital transition.

Fluoropolymers present a specific set of properties making them irreplaceable:

- **Heat resistance:** fluoropolymers are able to maintain their physical properties at very high temperatures. This makes them particularly suitable for use in aerospace or electronic components.
- **Chemical resistance:** fluoropolymers are highly resistant to chemicals, acids, fuels, solvents. This makes them a material of choice for use in chemical processing equipment and pharmaceuticals.
- **Mechanical properties:** mechanical properties include high tensile strength, flexibility, and impact resistance.
- **Electrical properties:** fluoropolymers present unprecedented adhesive and cohesive properties under high voltage, making them particularly suitable for use in batteries.
- **Inertness:** fluoropolymers are inert, non-reactive and stable (they do not degrade or decompose over time). These properties make them suitable for a wide range of industrial applications where exposure to chemicals is likely.
- **Cryogenic properties:** fluoropolymers present excellent cryogenic properties, which makes them particularly suitable for use in high-tech applications such as aeronautics, electronics or chemical industries.
- **Separation / barrier properties:** fluoropolymers have excellent moisture barrier and superior gas separation properties.
- **Dielectric properties:** dielectric properties cover low dielectric constant (Dk) and dissipation factor (Df) and are unaffected by fluctuations in temperature and humidity. This makes them a material of choice for use in electronics and telecommunication applications.
- **Weather resistance:** fluoropolymers are able to maintain their physical properties even when exposed to harsh weather conditions, e.g., environmental

degradation, including exposure to ozone, ultraviolet radiation. This makes them a material of choice for architectural coating or films.

- **Durability:** fluoropolymers can withstand harsh conditions while maintaining their physical properties. This makes them particularly suitable for use in seals, gaskets, and wires and cables insulation.
- **Non-stick properties:** fluoropolymers prevent sticking, making them a material of choice for applications for which sticking is a concern.

Availability, technical and economic feasibility, hazards and risks of alternatives

Fluoropolymers give the combinations or ranges of properties required for the applications that set them apart from alternative products. Alternative materials usually only present similar performance to fluoropolymers for a specific parameter or property, however overall, have lower performance and increased weight of articles. Another consequence is a reduced durability of most articles that use fluoropolymers as one of their critical components, which would be followed by more frequent maintenance and replacements due to failures. Some future challenges could further include component redesign and operating condition requirements, which emerge with less compatibility and versatility. There is a potential for higher risk of exposure of workers to hazardous substances if fluoropolymers are phased out in certain applications, such as chemical industry processing equipment or laboratory equipment. There are also higher risks if non-fluorinated materials were used in terms of safety, for instance due to failure of vehicle or aircraft parts. In addition, there is a risk for increased emissions if fluoropolymers were no longer available due to alternatives increasing the weight of articles (e.g., transport). More broadly, alternative materials would hamper the development of advanced technologies and innovation efforts (please refer to the General Comments document).

Fluoropolymers' unique properties are used to provide specific technical requirements necessary to ensure a high level of safety, performance and durability of many components and articles of multiple critical industries. This makes it extremely challenging to find a viable alternative. Our products must pass rigorous application standards, therefore lower product performance of potential alternatives will not meet the

technical requirements of our downstream users for most applications. Besides, requalification of products is lengthy and costly, and alternatives must be assessed along the whole value chain. While alternatives might be considered to offer benefits in one or two areas, they often fail to offer the combination of properties that fluoropolymers deliver. These specific combinations of properties are not matched by any of the alternatives and thus makes fluoropolymers so valuable. Lower performance could mean higher cost to operate by our customers, premature failures of parts, more waste generated and lower energy efficiency.

	unit	standard	PTFE	PFA	ETFE	LDPE	Silicone
melting point	°C	ASTM D4591	327	310	270	110-120	nd
density	g/cm3	ASTM D792	2.13-2.20	2.12-2.17	1.73-1.74	0.91-0.93	0.95-0.98
tensile strength	MPa	ASTM D638	20-35	25-35	38-42	70-160	4-10
tensile elongation	%	ASTM D638	200-400	300-350	300-400	90-800	50-500
continuous use temperature	°C	JIS K7226	260	260	150	82-100	150
dielectric constant	1kHz	ASTM D150	2.1	2.1	2.6	2.25-2.35	3.5-5
arc resistance	sec	ASTM D495	>300	>300	75	135-160	nd
water absorption	%	ASTM D570	0.01	0.01	0.03	<0.015	1
flame retardance		UL-94	V-0	V-0	V-0	HB	HB
acid resistance		ASTM D543	good	good	good	poor	poor
alkali resistance		ASTM D543	good	good	good	poor	good
solvent resistance		ASTM D543	good	good	good	poor	poor

Table 2. Compared properties of PTFE, PFA, ETFE and non-fluorinated materials

In addition, we would like to stress that the market has already switched to fluorine-free alternatives where suitable. However, the low performance of fluorine-free alternatives hampers critical industries for the EU strategic autonomy, e.g., renewable energy, semiconductors, chemical industry, e-mobility, currently relying on fluoropolymer-based products to fully transition. As a result, fluorine-free substances have a limited market, and their production cannot be easily increased.

Indispensability of fluoropolymers – sector by sector

Fluoropolymers in the **automotive and aerospace sectors** provide durable and effective protection against heat, aggressive fluids such as hydraulic fluids and fuels, humidity, vibrations, and compression. Parts made with fluoropolymers meet European limits for exhaust gas emissions such as Euro 6 reducing public health effects. When used in fuel hoses, they improve fuel efficiency and prevent evaporative emissions. Based on EU Regulation [540/2014](#) on sound level of motor vehicles, all types of vehicles are required to be equipped with sound absorption parts. ETFE for wires and cables in

automotive applications meets the following standards: LV112 automotive standard specification, IATF 16949 and other car manufacturer standards (VW, Mercedes, BMW). Without ETFE, compliance with the EU Regulation [540/2014](#) would be extremely challenging.

For **aviation and aerospace**, the EN9100 standards must be fulfilled as well as specific aerospace standards for military use.

When used in **architectural applications**, fluoropolymers have to meet fire safety standards. They provide durability, are easy to clean, and reduce energy use thereby reducing cost. All non-fluorinated alternatives tested would provide for lower performance, resulting in earlier replacement and therefore in an increase in costs and waste generated. Multiple layers of coating would need to be applied to meet the same level of weather and stain resistances as ETFE, which would result in more frequent and longer refurbishing. ETFE film is needed to provide mechanical strength and transparency over a long period of time (>30 years).

In addition, ETFE films are extremely expensive and are therefore chosen for its unique technical capability to justify the extra cost. When used as coatings, only fluoropolymers such as FEVE can meet weatherability industry standards such as Qualicoat Class 3 and AAMA 2605.

In **chemical industries**, fluoropolymers enable a high level of energy efficiency and environmental safety. Moreover, alternative materials utilised in the manufacture of chloroalkali, for example, (asbestos and mercury) have already been phased out due to toxicity. Because fluoropolymers are chemically resistant, they prevent corrosion of equipment, thus, increasing longevity. This reduces maintenance downtime and cost of replacing corroded parts.

In **manufacturing equipment and fixtures in manufacturing plants** of any industry sectors, the use of PFAS (such as PTFE) is essential to ensuring manufacturing safety.

In the **electronics industry**, fluoropolymers meet chemical resistance as aggressive chemicals are used in production of semiconductors. They have high dielectric properties, high heat resistance and fire resistance, which are necessary to produce electronic parts.

When used in **medical applications**, fluoropolymers reduce a risk of cross infections and by increasing durability reduces risks of failure and subsequent need for replacement.

AGC has carried out extensive collaborative research together with customers and research organisations (e.g. Fraunhofer Institute, EDAG, Smithers Rapra) in the market. The conclusion is that it is currently not technically feasible to replace fluoropolymers with non-fluorinated materials and get the same performance as with fluoropolymers.

In order to switch to non-fluorinated alternatives (if at all possible), re-qualifications in all downstream sectors would be needed, taking several years. At the moment, non-fluorinated alternatives do not perform well enough to meet the required specifications and would have an impact in terms of safety. In addition, huge costs would be involved in re-qualifying new materials (> €100K per qualification/per grade/per customer).

Socio-economic impacts for companies, consumers, and other affected actors

Fluoropolymers are an expensive class of polymers and usually selected as a “last” option when all other non-fluorinated alternatives have been assessed and cannot be used or when the applications need much longer service life. If less expensive non-fluorinated alternatives were available, our downstream users would have switched to those a long time ago for costs reasons.

We strongly believe that the continuous availability of fluoropolymers in the EU is an absolute requirement for the efficient realisation of the EU Green Deal. Any restriction banning the use or innovation strongly limiting the accessibility to these products would have a very strong negative impact on several key sectors of the EU economy.

AGC is a producer and supplier of fluorochemistry, this is our core business and principal technology. Therefore, substantial negative impact on AGC, its value chain and the wider society are to be expected in the case of a switch to non-fluorinated alternatives.

Particularly, the absence of derogation for fluoropolymers would have a major impact on our industry. It would result in limited PFAS-based materials availability on the EU market, or in high reliance on imports manufactured outside the EU. In turn, lower fluorochemicals volumes placed on the EU market would result in price increases and



supply shortages. This would strongly impact the highly technical sectors (e.g., automotive, aerospace, electronics, medical, etc.) relying on these substances for their high performance and safety characteristics.

Implications for AGC

In a no-derogation scenario, AGC would withdraw from the EEA market for all fluoropolymers with ensuing job losses.

Market share and employment

The combined effect of the Annex XV restriction proposal on fluoropolymers would result in the likely closure of AGC's UK manufacturing plant and significant job losses in the EEA, including our employees in the EU sales office and in research & development.

Safety concerns during manufacturing

A major concern consists in the regrettable substitution to non-fluorinated alternatives causing solubility issues and inhibiting the reaction with raw materials. When used as process media, the end-products cannot display all the required characteristics in terms of quality, performance and production volumes. This will ultimately result in the non-viability of the chemical process from the commercial standpoint, and raise safety issues during the manufacturing process.

Implications for downstream users

An absence of derogation for fluoropolymers would leave many key sectors of the EU economy without alternative materials, which could lead to major restructuring / plant closures, job losses and supply shortage. This also includes regression of advanced technologies and the reduced ability of Europe to compete and attract high and medium technology manufacturing investment (if it is not possible to prototype and produce competitive products), efficiency losses, higher initial (investment) costs and higher maintenance costs. The diversity of specific applications would pose major product qualification issues alongside design implications and alternatives must be assessed along the whole value chain. In the absence of derogation, we expect lower product performance resulting in higher safety risks, higher cost to operate by our customers,

increased emissions to the environment due to premature failures of parts, more waste generated, lower energy efficiency and shorter product lifetime.

Impacted Downstream Sectors

Our customers make tens of thousands of unique products from ETFE each year, supplied to e.g. **marine** (cables and harnesses for ships, Remotely Operated underwater Vehicles, sonar systems, offshore and subsea), **communication** (coaxial, data, fibre optic and hybrid cables and harnesses for mobile telecom and other applications), **defence and aerospace** (cables and harnesses for air, marine and land applications), **industrial applications** (cables and harnesses for sensors, gas turbines, power tools, medical, etc) or **power generation** (safety class nuclear cables, cables for wave, tidal and wind power).

A restriction of ETFE will significantly impact the manufacturing of semiconductors, which are extremely complex. The manufacturing requires more than 2,000 process steps, hundreds of production materials, and approximately 26 weeks to manufacture and test. Besides, stringent qualifications must be carried out with customers to ensure the products' specific technical requirements are met and deliver on the product function and performance.

Our customers make a variety of products from PTFE (seals, bearings, valves, gaskets), supplied amongst others to the chemical industry, pharmaceutical and transport industry and are used in a wide range of other industrial applications (e.g. electronics, filtration). Moreover, PTFE, ETFE, FFKM, PFA are also used extensively in biopharmaceutical and pharmaceutical manufacture (products like gaskets, O-rings, valves, filtration membranes, SU bioreactors, vessels, pipe lining, pumps, containers, tubes, fittings, HEPA filters, lubricant sprays (PTFE) etc.) due to their unique functional properties and low reactivity.

Within the **semiconductors sector**, a no-derogation scenario for CYTOP™ will lead to severe disruptions of downstream production (electronics, semiconductors medical, filtration, and analytical science). It will preclude any innovation potential based on CYTOP technologies in these sectors within the EU and production capacities would be transferred outside the EEA, with technologies supporting the digital and green transition moving to other parts of the world (e.g., semiconductor manufacturing).

AGC estimates that without TARC material, semiconductor manufacturers in EU countries will not be able to conduct commercial production at a viable cost. This is particularly true for EU-based semiconductor manufacturers who use i-line, KrF and ArF dry in the photolithography process since TARC material is essentially used as the standard process material in the industry. Without TARC material, there will be many economic difficulties such as significant production yield loss, patterning with desired node width is not possible, and a larger semiconductor size, requiring more chip/process materials.

Several thousand companies in the automotive, semiconductor, electrical, medical, and analytical equipment-related sectors in the EU would be affected by the unavailability of FORBLUE sunsep™ **for dehumidification (or humidification) of compressed gas used in their factories.**

In the **electronics sector**, SURECO AF supports the reduction of weight/volume, which has a positive effect on the environment and is currently pushing the technological advancement. A restriction of PFPEs would result in reduced safety, lower performance, and hinder innovation of the EU electronics and automotive sectors. In the **transport sector**, fluorinated ionomers are a key technology to deliver on the European Green Deal and reduce CO₂ emissions. Hydrogen produced from PEM water electrolysis can be used by consumers and industry for fuel cell vehicles covering light, medium and heavy-duty vehicles (water is the only emission from fuel cell vehicles). Hydrogen produced from PEM water electrolysis can be used in gas turbines for electricity either as a blend with methane or as a 100% hydrogen feed which can reduce or eliminate CO₂ emissions from electricity production.

In **metal manufacturing**, a restriction of FORBLUE sunsep™ will render the supply of specialty steel to users impossible, severely restricting economic and technological development.

Within the **medical devices sector**, unavailability of FORBLUE sunsep™ will impair patient monitoring in capnography and asthma applications by reducing detection accuracy and response performance, with an impact on human life. It is estimated that 35% of breath analysis applications would be affected. Future technological development opportunities for humidification module application in oxygen generators for home

healthcare would also be severely limited. Besides, CYTOP™ would substantially contribute to the expansion of medical diagnosis technology with the biochip as well as the expansion and progress of sterilization technology with the UVC-LED will become blocked. The latter technologies are, for instance, important in the context of the emergence of COVID-19.

Within pre-treatment of instrumentation, electronics and energy, petroleum and mining, and fuel cell vehicle sectors, the unavailability of FORBLUE™ Sunsep™ will cause all analyzer manufacturers to change the measurement method of atmospheric gas analyzers, which is expected to take 5 to 10 years to develop.

For the chemical industry, a non-derogation scenario for FLEMION™ would have wide-ranging consequences for the supply chain of many downstream sectors¹⁴¹⁵¹⁶: sodium hydroxide is used to manufacture, soaps, detergents, paper, rayon, dyes, and petroleum products. Sodium hydroxide can also be used in metal cleaning and processing, processing cotton fabric, electroplating, oxide coating, and electrolytic extraction. Downstream sectors include aluminum textiles, food, beverage paper and pulp industries as well as water treatments.

The following downstream users would be affected:

- HCl-ODC (Cl₂ recovery by electrolysis of HCl): a restriction of **FORBLUE™ S-Series** will stop the production of hydrochloric acid electrolysis equipment, mainly affecting MDI/TDI manufacturers who recover chlorine from by-product hydrochloric acid.
- TMAH (Tetramethylammonium hydroxide) & its analogues by electrolysis: in case of restriction, there will be a lack of supply of electrolysis, which will affect the production of TMAH and have a significant impact on semiconductor manufacturing.
- Functional water by electrolysis: if fluorinated ion-exchange membranes are no longer available, the functional water generators will no longer be viable, thus affecting functional water equipment manufacturers.

¹⁴ The use of fluoropolymers in European chlor-alkali production, public information, EuroChlor, July, 2020. <https://www.eurochlor.org/wp-content/uploads/2020/07/11-Use-of-fluoropolymers-in-chlor-alkali.pdf>

¹⁵ [Products of Chlorine - Products of Chlorine \(eurochlor.org\)](https://www.eurochlor.org/products-of-chlorine/)

¹⁶ [Products of Sodium hydroxide - Products of Chlorine \(eurochlor.org\)](https://www.eurochlor.org/products-of-sodium-hydroxide/)

- Synthesis by electrolysis and reduction/oxidation by electrolysis: a restriction of fluorinated ion exchange membranes will affect the realization of a carbon-neutral society.

In the **pump sector**, a restriction of PFA will entail earlier failures in pumps and necessary process changes, which in addition to often stand-still times for maintenance and reduced production capacity could lead to higher consumer prices. Furthermore, in case of leakage, for instance in plants where aggressive, toxic and volatile substances are pumped, a higher risk for workers, users and the environment would ensue.

Regarding gas and water technologies, substitute products would require major design changes in the long run. In case of restriction, there is a risk that spare and maintenance parts for existing networks cannot be supplied, which would result in expensive replacements before the end of service life. Significant investments would be required for networks with such technology. As such, public and industrial water supply could be endangered and the benefits for the environment would be marginal because materials in contact with drinking water are currently subject to high standards.

Stopping using LUMIFLON™ FEVE resins in architectural coating will lead to increased maintenance costs and environmental impacts, as weathering resistance and long lifecycle could no longer be provided to the structures. Consequently, the number of times the structures would have to be repainted would significantly increase, and so would the related emissions to the environment. Airplanes coated without fluoropolymers would require more frequent maintenance, resulting in a longer downtime and increased costs.

In case of a restriction on coating systems, AGC will have to stop the importation of the Lumiflon FEVE resin into the EEA. The production of these coatings will move outside the EEA to continue serving global customers and adjust specifications downwards. For example, Airbus would not be allowed to sell/import an aircraft with a PFAS containing coating produced outside the EEA into the EEA.

Safety concerns

AFLAS® FFKM could not be used to manufacture critical parts of applications necessary to the green and digital transition, e.g. batteries, semiconductors, solar panels, etc.

Besides, this will result in concerns around media safe handling, increased emissions to the environment, increased exposure and risk to human health and increased risk of accidents during production and in use areas.

Implications for Society

Contribution to the green transition

Banning fluoropolymers would represent a significant loss for the green transition – both in terms of accelerated deployment of renewable energy and decarbonisation of the EU economy – and would endanger the EU energy security and independence (fluoropolymers notably contribute in phasing out fossil fuels).<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021R1119> This is supported by the 2023 JRC supply chain and material demand analysis, which foresees a growth in the renewable energy sector in the coming years, with solar and wind power becoming major contributors, as well as major energy sources in the EU (i.e. energy production). Wind energy deployment, solar photovoltaics and electrolyzers are identified as relevant technologies.¹⁷ The EU will need to ensure the availability of fluoropolymers for these technologies in order to deliver on the objectives¹⁸ in terms of renewable electricity and hydrogen set out in the **Renewable Energy Directive**¹⁹.

Within solar energy, fluoropolymers such as ETFE films, fluorinated ionomers, and LUMIFLON FEVE are used extensively in building or coating integrated photovoltaic modules, and solar panels / cells. The demand, innovation and manufacturing capacities will increase²⁰ in the near future to support the objective of the **EU Solar Energy**

¹⁷ JRC Publications Repository – Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU- A foresight Study, European Commission. [JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study \(europa.eu\)](https://publications.jrc.ec.europa.eu/repository/handle/JRC132889)
<https://publications.jrc.ec.europa.eu/repository/handle/JRC132889>

¹⁹ [European Green Deal: EU agrees stronger legislation to accelerate the rollout of renewable energy, European Commission, press release, March 2023. REPRESENTATIONS - European Green Deal: EU agrees stronger legislation to accelerate the rollout of renewable energy \(europa.eu\)](#)

²⁰ JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU - A foresight study, European Commission. [JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study \(europa.eu\)](https://publications.jrc.ec.europa.eu/repository/handle/JRC132889)
<https://publications.jrc.ec.europa.eu/repository/handle/JRC132889>

Strategy²¹ to bring online almost 600 GW of photovoltaics by 2030. ETFE films, PTFE and fluorinated ionomers are key components of green hydrogen production and a material of choice for chlor-alkali electrolysis. FLEMION™ membranes are for instance essential for chloralkali production in the EU which must comply with high safety standards, large costs and are heavily regulated²². The JRC report on supply chains²³ identifies three important electrolyser types for water electrolysis (i.e. PEM, anion exchange membrane and alkaline water electrolysis) for which (expanded) PTFE and PFSA for PEM electrolysis are considered important process materials. Future growth of electrolyser capacity deployment is expected to progress rapidly²⁴. The current EU leadership on electrolyser technology needs to be secured by **preserving innovation and know-how**. Green hydrogen” from PEMEL can be used for fuel cell vehicles or for blending into natural gas networks hence reducing the carbon footprint. Restricting fluoropolymers will result in difficulties in achieving energy-related environmental regulations and the impracticality of achieving a hydrogen society, especially in the transport sector²⁵.

The impact of a restriction of AFLAS ® FFKM and AFLAS ® FEPM in the energy sector will result in a reduced level of effectiveness of refineries – thereby increasing the costs for the end-user -, higher prices for energy, oil, gas and machinery, reduced reliability, greater inconvenience, significantly greater dangerous process in oil exploration, potential safety risk and environmental pollution. This will endanger the EU energy strategic autonomy.

²¹ COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS EU Solar Energy Strategy, EUR-LEX, 2022. [EUR-Lex - 52022DC0221 - EN - EUR-Lex \(europa.eu\)](#)

²² “The use of fluoropolymers in European chlor-alkali production”, EuroChlor, Public information, July 2020, <https://www.eurochlor.org/wp-content/uploads/2020/07/11-Use-of-fluoropolymers-in-chlor-alkali.pdf>

²³ JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU - A foresight study, European Commission. JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study (europa.eu) <https://publications.jrc.ec.europa.eu/repository/handle/JRC132889><https://publications.jrc.ec.europa.eu/repository/handle/JRC132889>

²⁴ JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU - A foresight study, European Commission. <https://publications.jrc.ec.europa.eu/repository/handle/JRC132889><https://publications.jrc.ec.europa.eu/repository/handle/JRC132889>JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study (europa.eu)

²⁵ Facts about the automobile industry, ACEA, 2023. [Facts about the automobile industry - ACEA - European Automobile Manufacturers' Association](#)

For these reasons, it is critical that the U-PFAS restriction proposal foresees **derogations for the use of fluoropolymers in the production of renewable energies.**

Following the ban of the placing on the market of combustion engines as of 2035, the **Sustainable and Smart Mobility Strategy**²⁶ aims to zero-emission vehicles by 2050. key relevant technologies identified by the JRC study on supply chains include batteries, electric motors and fuel cells. In the same vein, BloombergNEF identified in November 2022 the EU targets for CO₂ emissions reduction in road transport as one of the major market drivers for electric vehicles and fuel cell vehicles.²⁷ The use of Li-ion batteries is expected to dominate the battery markets in the EU for the next 20 years and their future demand will increase in particular in the automotive sector. In addition, fluoropolymers (e.g. PVDF and PTFE) and hydrofluoric acid are identified as key intermediate materials for the production of battery precursors. Among fuel cells, PEMs are found to partially dominate the market (in number and capacity) and are expected to grow significantly within the passenger car market. Crucial processed materials for PEMFCs identified include *“carbon nanotubes and graphene nanosheets treated with PTFE for GDL and platinum or platinum alloys for the catalyst”* and electrolytes are described as membranes made of PFSA polymers (e.g. Nafion).²⁸ Fluoropolymers can contribute to different aspects to this effect. For instance, AFLAS® is increasingly used in electric vehicle (high temperature) cables for its flexibility, low flammability and chemical resistance. ETFE is notably used for electric vehicle battery cooling/thermal management hoses, and in fuel hose liners to ensure no charge build up and avoid potential fuel fires. In particular, SELEMION is required to bring ORFBs (Organic Redox Flow Battery) to the market, for the purpose of providing superior performance to rechargeable batteries and reducing GHG (Greenhouse Gas) emissions. The use of SELEMION anion exchange membranes based on ETFE will also offer high durability and stability in the ORFB application²⁹ in the context of the transition to electric vehicles while PTFE is used as a binder for electric-

²⁶ COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, European Commission, 2020. resource.html.europa.eu

²⁷ Zero-emissions Vehicle Factbook, BloombergNEF special report, 2022. [ZEV Transition - COP26 \(bbhub.io\)](https://bbhub.io)

²⁸ JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU - A foresight study, European Commission. <https://publications.jrc.ec.europa.eu/repository/handle/JRC132889>
<https://publications.jrc.ec.europa.eu/repository/handle/JRC132889> JRC Publications Repository - Supply chain analysis and material demand forecast in strategic technologies and sectors in the EU – A foresight study (europa.eu)

²⁹ Fraunhofer ISE 05/2022

vehicle next generation batteries and fluorinated ionomers for large-scale renewable energy storage. These applications - highly dependent on the use of ETFE - will be the cornerstone of the decarbonisation of the EU transport sector in the next decades.³⁰. Especially, PEM Fuel Cells are regarded as the only feasible way to decarbonise the heavy transport sector (trucking, shipping, rail), which means that without an exemption for this use, the EU would not be able to meet its climate objectives. REDOX Flow batteries are considered as a viable solution for energy storage for grid balancing and for greater integration of renewable energy into grids.

For these reasons, fluoropolymer-based technologies contributing to the green transition should be derogated from the U-PFAS restriction to avoid slowing down the renewable energy roll-out. An absence of derogation would result in global competitors taking the lead on clean technologies and there would further be an opportunity cost to the European economy from losing out on future capacity expansions. Furthermore, production capacities, technology and know-how would be transferred outside the EU, while technologies supporting the European Green Deal would move to other parts of the world (e.g., PEM electrolysis, fuel cells, solar PV).

Contribution to innovation

Fluoropolymers have a substantial potential to support innovation. This holds true for instance for fuel cell and electrolyser technology to ensure a full hydrogen supply chain and production technologies but also for the production of solar photovoltaic. Innovation would further lead to lower costs of production and increased competitiveness. It could be noted that in this regard, fluoropolymers are of critical importance in supporting the scaling up of the EU's manufacturing capacity for the net-zero technologies, the wider EU net-zero industry, and the security of energy supplies. In particular, within the **Net Zero Industry Act**³¹, fluoropolymer applications are key enablers for several of the identified “**net-zero technologies**” (e.g. renewable energy technologies; electricity and heat storage technologies; renewable fuels of non-biological origin technologies; sustainable alternative fuels technologies; electrolyzers and fuel cells) and “**strategic net-zero technologies**” and projects (solar photovoltaic technologies; battery/storage

³⁰ Fuel cells - A realistic alternative for zero-emissions?, Bernhardt W., & Riederle S., 2014. [Fuel cells – A realistic alternative for zero emission? | Roland Berger](#)

³¹ Net-Zero Industry Act, making the EU home to new technologies manufacturing and green jobs, European Commission. [Net-Zero Industry Act \(europa.eu\)](#)

In addition, CYTOP™ is used exclusively in the photolithography process, offering extremely high transparency and can be used in very thin film coatings, which is essential for semiconductor innovation.

In case of restriction, the EU Chips Act would be fundamentally undermined as a major portion of semiconductor and high-tech production in EU countries will disappear, expansion and progress of medical diagnosis technology with the biochip will be blocked, so the expansion and progress of sterilization technology with the UVC-LED will be. For example, sterilization and medical diagnosis are important technologies required to cope with the COVID-19 issues.

The **Regulation establishing the Union Secure Connectivity Programme for the period 2023-2027**³⁴ aims for the improvement of “*the resilience, security and autonomy of the Union’s and Member States’ communication services*” while the **Digital Decade Policy Programme 2030**³⁵ ambitions that “*all populated areas are covered by next-generation wireless high-speed networks with performance at least equivalent to that of 5G*”. The information, communication and digital technologies sector is also identified as strategic by the abovementioned JRC study. Relevant technologies include data transmission networks, with submarine cable systems being of particular importance, including its main components such as optical fiber cables, branching units and repeaters which are protected against submarine environments. Copper was further identified as a water barrier in submarine cables and PTFE as an important processed material. Given that the demand for data transmission capacity will increase steadily in the future, additional cable system capacity deployment will be necessary. Major innovation, including increasingly powerful, thinner and more resource efficient chips, with progress

³⁴ Regulation (EU) 2023/588 of the European Parliament and of the Council of 15 March 2023 establishing the Union Secure Connectivity Programme for the period 2023-2027, EUR-LEX, 2023. [EUR-Lex - 32023R0588 - EN - EUR-Lex \(europa.eu\)](#)

³⁵ DECISION (EU) 2022/2481 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 14 December 2022 establishing the Digital Decade Policy Programme 2030, Official Journal of the European Union, 2022. [Publications Office \(europa.eu\)](#)

More generally, a loss of innovation and talents through the company would occur. This will lead to higher unemployment rate and to difficulties in achieving a <2C global warming scenario (Paris Agreement).

Emissions in the end-of-life phase:

As a member of the Fluoropolymer Product Group (FPG), AGC is committed to responsible manufacturing principles and commitments outlined in Responsible Manufacturing Commitment. The Responsible Manufacturing Commitment aims to continuously improve and/or develop *“the best available techniques in the manufacturing process, management of environmental emissions, development of R&D programs for the advancement of technologies allowing for the replacement of PFAS-based polymerization aids, and/or the increase of recyclability and reuse of its products in line with the objectives of circular economy.”*

AGCCE is committed to implement its targets, which include the following:

- A voluntary commitment to reducing non-polymeric PFAS emissions by achieving Average Emission Factors⁴⁰ of non-polymeric PFAS residues from polymerisation aid technology used in the fluoropolymer manufacturing process

⁴⁰ Average Emission Factors are calculated as follows (in percentage): Annual emission of non-polymeric PFAS residue from non-polymeric polymerization aid technology [added or generated]/total annual amount of fluoropolymers produced on site. Method of calculation of emission factor based on the Equation 1. Calculation of emission factors from Annex B of PFAS restriction proposal p. 227 [Submitted restrictions under consideration - ECHA \(europa.eu\)](https://echa.europa.eu/restrictions-under-consideration/-/substance-rev/72301/term?viewsubstances_WAR_echarevsubstanceportlet_SEARCH_CRITERIA_NAME=Per-+and+polyfluoroalkyl+substances+(PFAS)&viewsubstances_WAR_echarevsubstanceportlet_SEARCH_CRITERIA_EC_NUMBER=-)

The achievement of these Average Emission Factors is independent of whether fluorinated, non-fluorinated or no polymerization aids are being used in the production of fluoropolymers, at each of our sites.

[https://echa.europa.eu/restrictions-under-consideration/-/substance-rev/72301/term?viewsubstances_WAR_echarevsubstanceportlet_SEARCH_CRITERIA_NAME=Per-+and+polyfluoroalkyl+substances+\(PFAS\)&viewsubstances_WAR_echarevsubstanceportlet_SEARCH_CRITERIA_EC_NUMBER=-](https://echa.europa.eu/restrictions-under-consideration/-/substance-rev/72301/term?viewsubstances_WAR_echarevsubstanceportlet_SEARCH_CRITERIA_NAME=Per-+and+polyfluoroalkyl+substances+(PFAS)&viewsubstances_WAR_echarevsubstanceportlet_SEARCH_CRITERIA_EC_NUMBER=-)

“Polymerisation aid is the term used to describe a surfactant or emulsifier, fluorinated or non-fluorinated”

of 0.009% to air and 0.001% to water by 2024 and of 0.003% to air and 0.0006% by the end of 2030.

This commitment further entails continued efforts to investigating and developing R&D programs to achieve technological innovation enabling the substitution of PFAS-based polymerisation aids during fluoropolymer production, cooperation with National Competent Authorities on non-polymeric PFAS emissions to air and water from European fluoropolymer manufacturing sites by the end of 2024 and furthering the use of targeted and non-targeted analytical techniques to progress in the understanding of non-polymeric PFAS emissions to air and water which are not captured or destroyed;

- Participating in a platform promoting the adoption of commercially available state of the art technologies to minimise non-polymeric PFAS emissions in its manufacturing;
- A commitment to inform downstream users of fluoropolymers on their safe handling and use through the provision of a Guide for the Safe Handling of Fluoropolymer Resins.

AGC have been actively involved in development of this commitment and implementation. We are committed to address PFAS in the manufacturing stages, whilst reinforcing our existing responsible manufacturing approach. As part of our Responsible Manufacturing approach, AGC Chemicals Europe Ltd. (UK Site) have established PFAS emissions reduction targets to air and water which will be achieved through a combination of investments planned for 2024 and smaller scale continuous improvements to the fluoropolymer manufacturing process. Furthermore, we have and are continually investing to further increase our analytical capabilities to aid method development and to increase the quantity and quality of the analysis further. AGCCE continues to work closely with regulators to ensure regular assessment of the substances we use.

In accordance with its Sustainability Policy, AGC is constantly improving its emission control measures and mapping the emission levels of priority substances. We are in full compliance with local, national and international regulations and are continually developing and investing in our manufacturing processes to reduce our emissions further and replace PFAS where technically feasible. We are already implementing Best



Available Technologies and over the last two decades have incorporated a number of emission abatement equipments into our manufacturing process.

AGC is taking the health, safety, and protection of its employees seriously. Exposure on site is well controlled. From local exposure monitoring data, we can demonstrate that we are not exposing employees above the exposure limits as set by local and national authorities. AGC is a signatory to the US EPA PFOA Stewardship Programme, and together with other signatories, has successfully honoured to strict commitments of the programme in terms of emission and product content reductions. The EPA PS programme as such is over and did not cover other PFAS, any new emissions reduction programme would not be related to it. Over the past decades, a number of new techniques have been developed to capture in particular short-chain PFAS from production effluents. In general, such techniques are largely implemented in the industries in EU, Japan and the US.

During end of life

Fluoropolymer waste is safely handled. Conversio's "Fluoropolymer Waste in Europe in 2020" report⁴¹ assessed the fluoropolymer applications and products' waste generation and streams at end-of-life. It finds that most of the end-of-life fluoropolymer applications are collected through commercial and industrial waste streams, with a small proportion being collected in residential or private waste streams. At end-of-life, *"almost 84% of the total fluoropolymer waste collected in Europe in 2020 is either (co-)incinerated or thermally destructed"*, around 13% was sent to landfill sites and around 3% was collected separately for recycling. In addition, the report established that around 20% of fluoropolymer materials processing result in fluoropolymer processing losses, which are considered of high value for certain companies and are often subject to recycling, whereas there is potential to recycle much more of the post-consumer fluoropolymer materials (e.g. mechanical recycling of certain fluoropolymers such as PVDF and PFA and chemical recycling of fluoropolymer waste to obtain fluoropolymer raw materials for

⁴¹ Fluoropolymer waste in Europe 2020, Conversio, final report, 2023. [EUU Almdel supplerende svar på spørgsmål 49 Report ProK Fluoropolymers 20220719 \(ft.dk\)](#)

re-use in the manufacture of products with no impact on quality) further meeting growing market demand and ensuring security of supply.

Automotive

Automotive are subject to the End-of-Life Vehicle Directive (ELV). Member States have to set up separate collection systems and comply with targets for the collection, treatment and recovery of end-of life vehicles in order to ensure that they are discarded without endangering the environment.

It is assumed that the amount of fluoropolymer per end-of-life vehicle is in the range of 0.20-0.25 kg. The engine is usually shredded together with the car body. Most of the auto-shredder residue undergoes energy recovery (~60%) or is landfilled (~35%), while 5% of auto-shredded residues are sorted for mechanical recycling. This is explained by the fact that recycling is a complex and costly process since very low amounts of fluoropolymers would need to be extracted from an automotive of several tons.

A more sophisticated automotive shredder residue (ASR) processing beyond the typical metal separation is limited throughout Europe, with approximately 10-15% of the industrial shredders having specialized processes for the extraction of plastics, recycling around one-fourth of the total plastics in the ASR stream.

Eurostat estimates that the total recycling rate by weight for ELVs in EU28+2 was ~87%. On average 120 kg of shredder residue, including fluff, plastics, rubber, small metal and glass particles, per vehicle in Europe is being recycled through energy recovery and landfill.

Many European countries qualify polymeric residues, E+E waste and ELV shredder waste as hazardous with associated handling and treatment requirements such as high temperature treatment or energy recovery.

Aerospace

Some airplanes parts are dismantled for reuse. Recycling of airplanes is established as a second step, primarily for the recycling of metals (aluminium, titanium, stainless steel and magnesium). More than 90% of non-recyclable aircraft materials are treated as energy recovery.

Energy

Photovoltaic cells (PV) are subject to the Waste Electrical and Electronic Equipment (WEEE) Directive. The Directive requires Member States to set up separate collection systems and reach recycling and re-use targets. Photovoltaic cells are dismantled for the recovery of aluminium and other metals (10–15%). At the end of life, the share of fluoropolymers in the total amount of PV modules is less than 1%. Due to its limited presence, it is neither collected separately, nor recycled.

Medical

Currently, figures relate only to medical fluoropolymers products with a short lifetime, for which the waste volume is limited to approximately 1,000 tonnes and for which more than 90% undergoes energy recovery due to classifications of biohazard material, requiring waste incineration.

Electronics

Electronics waste is subject to the Waste Electrical and Electronic Equipment Directive.

The waste electrical and electronic equipment waste stream is mainly sent to energy recovery, some is sent to disposal, while the percentage of disposal is often lower in Western and Northern European countries.

In the semiconductor industry, fluoropolymer products have a lifetime of up to 20 years. In most companies, fluoropolymer waste is separately collected for incineration or mixed with other plastics. The semiconductor industry is in principle one of the most interesting industries for fluoropolymer recycling due to the usage of thermoplastic and often less contaminated high purity fluoropolymer materials.

On batteries end of life, separate collection is established in many European countries, including the recovery of metals in recycling processes. According to the European Portable Battery Association (EPBA), a collection rate of slightly over 40% for portable batteries is established in Europe. Polymeric residues are mostly treated as hazardous waste and undergo energy recovery processes. Almost two thirds of all end-of-life lithium-ion batteries are then exported primarily to Asia for further recycling processes. The Batteries Regulation further aims to prevent and reduce adverse effects from the generation and management of waste batteries on the environment and human health

by establishing several obligations for producers of portable batteries to ensure greater amounts of waste batteries are collected and properly managed. Obligations related to separate and proportionately frequent collection of waste, a take-back and collection system and free collection offers to relevant entities will support the Regulation's main objective. With targets for producers including a 73% collection of waste portable batteries by 2030 and a 61% collection of waste LMT batteries by December 2031, waste batteries amounts are expected to be considerably reduced.

Process Industries

Typically, external waste management companies are responsible for the waste treatment of fluoropolymer waste from production and plant equipment. Many companies (especially in the chemical, food and pharmaceutical industry) have very strict requirements for the fluoropolymer waste treatment with their external waste management companies.

In the chemical industry, typical lifetime of fluoropolymer applications such as liners or coating for the handling of abrasive fluids or substances is on average 15 to 20 years. Chemical companies apply strict requirements for the fluoropolymer waste treatment to ensure 100% disposal, in line with the EU waste legislations.

In the food industry, most of the time, fluoropolymers waste undergoes energy recovery.

In the pharmaceutical industry, recycling opportunities are usually limited due to specific regulations set by the industry to protect the products.

Architecture

ETFE films coated fabrics in buildings and constructions have a high lifetime of at least 20 to 30 years.

ETFE films and waste products used in the construction sector are 100% recyclable, ETFE films helping achieve waste minimization:

- ETFE film can be recycled for reuse as a resin for cabling & wiring.
- ETFE can be disposed of safely by incineration, provided the incinerator has the correct scrubber systems to handle hydrogen fluoride and related emissions.

Emissions in the end-of-life phase - effectiveness of incineration under normal operational conditions with respect to the destruction of PFAS and the prevention of PFAS emissions.

AGC would like to refer to the incineration study⁴² submitted by FPG as part of the ECHA consultation. The most common fluoropolymers (PTFE, PVDF, PFA and FKM) were assessed and incinerated in the form of post-use samples as a mixture under standard operating conditions for municipal and industrial waste incineration. Among the main findings, it was found that fluoropolymers converted to inorganic fluorides (i.e. hydrogen fluoride) and carbon dioxide. Furthermore, there were no significant emissions of long-chain PFAS, nor of TFA or light fluorocarbons such as CF₄ or C₂F₆, and no short-chain PFAS could be detected after incineration. Overall, the research project concluded that *“the results confirm that fluoropolymers at their end of life when incinerated under representative European municipal incinerators conditions do not generate any measurable levels of PFAS emissions and therefore pose no risk to human health and the environment.”*

Proposed derogations – Tonnages and emissions

We would like to stress that fluoropolymers volumes cannot be used as emissions numbers. Fluoropolymers are embedded into the articles and there is no emission during use. Note that AGC is a PFAS manufacturer and does not have information to provide an overview per end-use. Further information should be searched in the contributions of our downstream users or relevant industry associations.

⁴² Pilot-Scale Fluoropolymer Incineration Study: Thermal Treatment of a Mixture of Fluoropolymers under Representative European Municipal Waste Combustor Conditions, Dr. Gehrmann and al, 2023.