# Critical Use of Fluoropolymers in the Functioning of Modern Society

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*In the context of the upcoming restriction of PFAS, there appears to be significant confusion concerning the most relevant sectors where fluoropolymers are used. This paper intends to clarify that fluoropolymers are used mainly in industrial sectors of high value to society. The outstanding combination of properties that fluoropolymers exhibit makes them extremely valuable materials in a wide variety of applications. While there have been some historic uses in consumer applications, these uses are currently anecdotic, particularly for those linked to very dispersive uses (which excludes use in cookware), and represent a minute proportion of the overall uses when compared to industrial applications, where fluoropolymers' outstanding properties are capitalized on. Fluoropolymers contribute decisively to the progress and well-being of society in five key areas: safety & well-being, environment and circularity, decarbonization, performance and comfort, being the latter the only one that can be attributed to dispersive consumer applications.*

## I. Introduction

For many years, Per- and polyfluoroalkyl substances (PFAS) have been at the centre of the regulatory debate in many jurisdictions. In Europe, this became even more intense in 2020, after 5 Member States of the European Economic Area expressed an intention to file a restriction proposal under the REACH Regulation on all PFAS.[1] Since then, different debates have taken place involving various stakeholders, trying to clarify which specific chemicals would be impacted by the restriction, and to which extent. The definition[2] used by regulators to define the scope of the proposal leads to approximately 10,000 chemicals potentially under the umbrella of this initiative. The fact that PFAS can be categorised in a significant variety of different sub-groups or sub-families requires certain technical knowledge to fully understand such differences and what is more, the different areas of applications of the components of those sub-groups, which can involve completely opposite fields of application.

Fluoropolymers are a differentiated sub-group in the PFAS universe, pertaining to the group of polymeric PFAS. Even in this group, they can be clearly separated from other polymers due to their composition and structures.[3] These differences apply also to the sectors in which the different materials covered by the PFAS definition can be used. For example, while fluoropolymers are used mainly in industrial applications, other fluorinated polymers (e.g., the so-called Side Chain Fluorinated Polymers) see extensive use in dispersive consumer applications, such as textiles, upholstery, leather, apparel and carpets (TULAC).

Due to their highly valuable properties (e.g., non-stick, temperature resistant, and durability) fluoropolymers have also seen some use in applications with potential consumer contact. The most classical

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1 ECHA, 'Five European states call for evidence on broad PFAS restriction' (2020) ECHA/NR/20/13 <https://echa.europa.eu/-/five-european-states-call-for-evidence-on-broad-pfas-restriction> accesed 1 May 2023.

2 OECD, Toward a new comprehensive global database of per- and polyfluoroalkyl substances (PFASs)' (2020) Series on Risk Management No. 39. Organisation for Economic Co-operation and Development.

3 Jaime Sales, Francisco Hernández, Deepak Kapoor, Marcel van den Noort, 'Fluoropolymers: The Safe Science That Society Needs' (2022) 5 International Chemical Regulatory and Law Review 1, 13-23.

one is the use for coating frying pans to grant anti-adherence properties, or in professional or technical clothing.[4] Direct consumer uses of fluoropolymers are possible, such as in cosmetics,[5] ski waxes [6] or as lubricant for chains in bicycles.[7] However, taking into consideration all the possible applications in which fluoropolymers are used, the contribution of dispersive consumer uses is minimal. Nonetheless, it appears that the relevance of those consumer uses in the regulatory discussion has been disproportionately magnified in comparison with the more critical industrial uses, which are frequently ignored or hidden by certain stakeholders.

Under REACH the correct reporting of the uses of a substance is essential to properly assess the risks associated with its use. Besides manufacture and formulation, the so-called 'end uses' need to be reported. According to ECHA Guidance,[8] 'end-use' means the use of a substance as such or in a mixture, as a last step before the end-of-life of the substance, namely before the substance is consumed in a process by reaction during use (including intermediate use), is emitted to waste streams or the environment or is included into an article. The corresponding definitions of the different end-uses following ECHA Guidance are as follows:

- **Use at industrial site**: All end-uses of the substance (as such or in a mixture) carried out at industrial sites should be reported under this life cycle stage.
- **Widespread use by professional workers**: Widespread uses by professional workers correspond to uses carried out in the context of commercial activities and assumed to take place in most towns of a certain size, by multiple actors each at low scale e.g., local garage, small cleaning businesses.
- **Consumer use:** All end-uses of the substance as such or in a mixture carried out by consumers can be reported under the consumer use life cycle stage.

However, if the substance becomes part of an article, the subsequent life cycle stage (the service life) is to be considered additionally, as follows:

- **Service life**: For a given substance incorporated into an article, the service life is considered to be the period of time an article remains in service (or in use). Articles containing the substance can be used or processed by consumers, by workers at industrial sites and/or by professional workers.

Based on these definitions, the use of frying pans coated with fluoropolymers is not a consumer use; instead, the use of those pans has to be evaluated as a service life. In contrary to the use of a frying pan coated with fluoropolymers uses like cosmetics, ski waxes or bicycle chain lubricants are direct consumer end-uses.

## II. Reasons Why Fluoropolymers are Used and Benefits They Provide

The properties that fluoropolymers provide are well known and have been discussed previously by different authors[9] and can be summarised as follows:

- Inertness and non-reactivity; high resistance to corrosion and chemical attack.
- Low and high temperature resistance: with a range as large as -263°C to +260°C for Polytetrafluoroethylene (PTFE).
- Very low coefficient of friction to any solid.
- Low and ultra-low permeation rates.
- Ultraviolet radiation (UV) resistance.
- Excellent electrical insulation, low dielectric constant, low variations of conductivity.
- High level of fire safety; no flame propagation and low smoke generation.

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4 Performance Fluoropolymer Partnership, 'Consumer Products' (2023) <https://fluoropolymerpartnership.com/fluoropolymer-applications-and-uses/consumer-products/> accessed 1 May 2023.

5 US FDA, 'Per and Polyfluoroalkyl Substances (PFAS) in Cosmetics' (2022) <https://www.fda.gov/cosmetics/cosmetic-ingredients/and-polyfluoroalkyl-substances-pfas-cosmetics> accessed 1 May 2023.

6 Wood Group, 'Update of market data for the socio-economic analysis (SEA) of the European fluoropolymer industry' (2022) <https://fluoropolymers.plasticseurope.org/application/files/1216/5485/3500/Fluoropolymers_Market_Data_Update_-_Final_report_-_May_2022.pdf> accessed 1 May 2023.

7 Juliane Glüge, Rachel London, Ian T. Cousins, Jamie DeWitt, Gretta Goldenman, Dorte Herzke, Rainer Lohmann, Mark Miller, Carla A. Ng, Sharyle Patton, Xenia Trier, Zhanyun Wang, and Martin Scheringer, 'Information Requirements under the Essential-Use Concept: PFAS Case Studies' (2022) 56 Environ Sci Technol 10, 6232–6242.

8 ECHA, 'Guidance on Information Requirements and Chemical Safety Assessment' (2015) 12.

9 Barbara J Henry, Joseph P Carlin, Jon A Hammerschmidt, Robert C Buck, L William Buxton, Heidelore Fiedler, Jennifer Seed and Oscar Hernandez, 'A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers' (2022) 14 Integrated Environmental Assessment and Management 13, 316–334; Chemservice, 'Analysis of alternatives to fluoropolymers and potential impacts related to substitution in different sectors of use' (2022).

– High and ultra-high purity with extremely low leach out properties.
– Stress-crack and cut-through resistance.
– Flex fatigue properties enabling thermal expansion/contraction in temperature cycles.
– Biocompatibility.
– High Flex life.
– Durability.
– Hydrophobicity; neither water nor water-containing substances wet fluoropolymers, providing excellent repellent properties to many chemicals.
– Non-stick, and consequently non-fouling properties, along with sufficient bonding in certain multilayer applications.

The benefits that the use of fluoropolymers bring to the different applications in which they are used, based on the combination of the properties described above, can be categorised in mainly 5 groups.

## 1. Safety

Fluoropolymers are materials known for their outstanding chemical resistance. They can resist attack from virtually any chemical, particularly strong acids, bases and other corrosive substances. In parallel, they are also resistant to high and low temperatures, allowing high reliability in a broad temperature range. This grants fluoropolymers their extreme durability. Due to this combination of properties, fluoropolymers are essential materials in, for example:

– **Chemical processing industry**: whenever harsh chemicals or stringent conditions of use are required (e.g., high temperature operations), fluoropolymers are the material of choice. They ensure reliability of systems which, in case of failure, could result in high-risk situations for workers or the environment, due to potential leakage, spills or releases of highly corrosive substances at very high temperature.
– **Aerospace industry**: fluoropolymers are used for insulation of electrical and data transmission cables. These cables can be subject to extreme conditions where ensuring reliability is critical. As an example, it is estimated that around 300 km cables are needed in regular commercial airplanes, reaching close to 500 km in some of the most modern planes. These cables need to perform in variable conditions, such as high temperatures near the engine and low temperatures in areas close to the external part of the fuselage at high altitudes. On top of this, exposure to aggressive oils is to be expected for these cables. Any malfunction of the electrical system will lead to high-risk situations for passengers and crew. Fluoropolymers provide the best performance, particularly due to their excellent dielectric properties that prevent electric arc fires in cables. As an example, the case of the Swissair 111 flight that crashed near Peggy's Cove, Nova Scotia, on the night of 2 September 1998, resulting in the death of 215 passengers and 14 crew members can be highlighted. The conclusion from the accident investigation report[10] concluded that the accident was caused by a fire generated by electric arc effect, most likely via electrical cable associated with the in-flight entertainment network. It was determined that aircraft certification standards for material flammability were inadequate. It is also worth mentioning that fuel systems in aircrafts are based on fluoropolymer lined equipment, as they are stable in a kerosene environment.

The high chemical resistance of fluoropolymers, combined with smooth surfaces and extremely low amount of leachables, brings about enhanced durability and prevents degradation potential during use. This allows these materials to guarantee high purity of process streams that are handled with the aid of fluoropolymer-based products (e.g., pipes, tubes, pumps, valves, joints, gaskets, seals, o-rings). As previously discussed, this is relevant for the chemical processing industry. But high purity is also critical to ensure safety conditions in other areas, for example:

– **Pharmaceuticals**: the production of medicines and vaccines require highly pure streams avoiding contamination that may come from process equipment, due to degradation from wear or to the effect of aggressive chemicals. Failure to grant this property could result in undesired health effects for the general public via contamination. Furthermore, the fact that articles based on fluoropolymers can be cleaned at high temperatures provides an advantage in front of other materials

10 TSBC, 'Transportation Safety Board of Canada. Swissair 111 Investigation Report - Executive Summary' (2003) <https://www.tsb.gc.ca/eng/medias-media/fiches-facts/a98h0003/sum_a98h0003.html> accessed 1 May 2023.

that may be used in the pharma sector such as glass, which has a tendency to break.
- **Food processing**: a wide variety of food processes must be handled via complex equipment. From conveyor belts to tubes transferring liquids (e.g., coffee machines), fluoropolymer-based equipment guarantees high purity of food avoiding contamination with impurities that could otherwise reach humans. Here, fluoropolymers' outstanding non-stick properties due to their very low coefficient of friction play a key role.
- **Water filtration**: fluoropolymers are necessary elements in membranes used in water filtration systems. The use of lower performing products could reduce the ability of those membranes to ensure clean water that may later be consumed by the general population. Water systems are frequently cleaned with chlorine under pressure. While most materials tend to hold on to bacteria and algae, this is not the case of fluoropolymers.
- **Medical implants**: perhaps the most evident proof that fluoropolymers are intrinsically safe is that they are the material of choice for a variety of medical implants, including cardiovascular stents, patches and other products that are introduced in the human body and intended to remain there for a long time. It therefore becomes evident that fluoropolymers play a vital role in safety of humans.

## 2. Decarbonization

Fluoropolymers are critical materials that enable the EU Green Deal. Without these materials, key technologies that are expected to help Europe to achieve its ambitious energy transition will not be available, or their efficiency will be seriously compromised. Some examples are the following:
- **Lithium-ion batteries**: fluoropolymers are used as electrode binders and separator coatings in these batteries, providing interconnectivity within each electrode. This facilitates electronic and ionic conductivity, increasing the cell manufacturing productivity and the cell safety. Fluoropolymers offer unparalleled cohesive and adhesive properties under high voltage, allowing for closely packed cathode active materials for high density electrodes. With the use of fluoropolymers, different battery components can be packed more closely together, improving the energy efficiency of a single unit, and helping reduce overall size.
- **Proton exchange membranes in green hydrogen**: electrolysers and fuel cell membranes are used in the production of green hydrogen by an electro-chemical reaction. To enable the movement of protons from the anode to the cathode side of the fuel cell, a proton exchange membrane made of fluoropolymers is used due to the efficiency and unique durability, chemical and temperature resistance properties that fluoropolymers offer for this application.
- **Renewable energies**: fluoropolymers improve the efficiency and durability of photovoltaic panels used in solar energy, as well as for wind turbines.
- **Lambda sensors in automotive**: fluoropolymers are used in lambda sensor cables due to their resistance to high temperatures and chemicals, dielectric strength, flexibility, and electrical insulator properties. In vehicles, lambda sensors adjust the fuel amount that is sent to the engine cylinders by optimizing the air and fuel mixture, which in turn will make the engine work properly and reduce carbon monoxide emissions. Lambda sensors allow for this control system via measurement of oxygen in exhaust fumes. This is a critical element in cars and vehicles to control the rate of gas emissions by ensuring that the catalytic converter works in an efficient way. Lambda sensors ensure that the car complies with the European regulations on pollution and carbon emissions, allowing a better control of environmental emissions.
- **Heat pumps, air conditioning and refrigeration systems**: the contribution of the Heating, Ventilation, Air Conditioning and Refrigeration and hot water heating (HVACR) to the Green Deal and to the REPowerEU plan is acknowledged by the European Commission.[11] Fluoropolymers are fundamental parts in equipment and machinery used in this sector, since they ensure reliable performance. HVACR equipment is subject to continued

11 European Commission, 'Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. A Green Deal Industrial Plan for the Net-Zero Age' (2023); European Commission, 'REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition' (2022) <https://ec.europa.eu/commission/presscorner/detail/en/ip_22_3131> accessed 1 May 2023.

changes in temperature and pressure as well as potentially harsh chemicals (refrigerants). Efficient HVACR systems need to rely on materials that will not fail on demand and will last a long time without degradation, including sealings to avoid leakages. Efficient refrigeration also plays a role in safety since it is necessary for preservation of food and medicines.

## 3. Environment and Circularity

The extreme stability of fluoropolymers makes them long lasting in the applications where they are used. Most of those applications involve the use of equipment based on processed fluoropolymers, in the form of pipes, tubes, or other pieces. Fluoropolymers extend the life of the equipment and devices where they are used. This significantly contributes to the objectives of a circular economy by reducing the amount of waste that society needs to handle. Replacing fluoropolymers by other materials that would be less efficient in providing the required properties would result in reduced life span, increased need for maintenance and increased amount of waste. Since most of the inferior alternatives are also plastic or rubber materials, a ban on the use of fluoropolymers would force society to cope with significantly increased amounts of wastes of those materials. Here it is useful to underline that based on recent studies, fluoropolymer waste is estimated to represent only 0.14% of all plastic waste in Europe, and <0.01% total waste (Conversio, 2022)[12]; removing such an insignificant percentage of waste coming from fluoropolymers would dramatically increase the overall quantity of waste that would have to be managed. According to the World Business Council for Sustainable Development (WBCSD, 2023), the definition of a circular economy model must take into account 'long service life' of resources, products, parts and materials, and also keeping them in use. Under this perspective, it is unquestionable that fluoropolymers are key contributors to expanding the life span of products and to avoiding the increase of waste streams to society would eventually need to handle and manage.

12 Conversio, 'Fluoropolymer waste in Europe 2020 – End-of-life (EOL) analysis of fluoropolymer applications, products and associated waste streams' (2022).

The *construction* sector is of particular relevance when evaluating the contribution of fluoropolymers to circularity. Not only do they improve fire safety and energy efficiency of modern buildings, but they also reduce the need for maintenance, replacement and cleaning of structures built with fluoropolymer-based materials. There are a wide variety of modern buildings such as bridges, stadia and domes that have benefited from the use of modern fluoropolymer architectural and construction solutions.

## 4. Performance

Fluoropolymers are frequently the high-cost solution when top performance is required. Downstream users through their value chains see fluoropolymers as the only material of choice when highly demanding process conditions are required. This is intimately linked to the fact that such value chains usually lead to top of the range end-products in terms of technology or societal progress.

The *semiconductor industry* is a clear example of this. In the production of modern, high-tech microchips, particularly with extremely reduced size (indispensable in the production of modern gadgets such as small mobile phones, laptops or watches), it is absolutely necessary to ensure ultra-pure process stream – going as far as having to ensure absence of impurities to the levels of part per trillion (ppt). Lithographic processes (which are technically extremely complex) involve the use of extremely pure harsh chemicals (acids) which may easily attack process equipment made of other materials, hence liberating residuals of ancillary equipment, which may be passed to the process and ruining the whole production. Fluoropolymers are the only product class that ensure reliable and economic performance in the production of modern semiconductors.

A similar rationale can be established for *electric cables*. As in the case of aircrafts, fluoropolymers are used for insulation of high-volume data transmission cables. Modern technology (e.g., 5G) relies on top performance of the materials involved in the process. Furthermore, data centres involved in the storage and processing of information operate under extremely stringent specifications in terms of fire safety. With their excellent dielectric properties and fire resistance, fluoropolymers are practically the only reliable option to cover the high demands of this industry.

### 5. Comfort

Certain products that use fluoropolymers and are in direct contact with consumers are marketed for enhanced performance while this seems a disguise for better comfort. Waterproof apparel, cosmetics, ski waxes, bicycle chain lubricants would fall under that category

Frequently there is a thin line separating 'comfort' and 'safety'; for example, heating systems for seats in vehicles are based on fluoropolymer insulated electric cables. It could be argued if this feature is truly necessary for the functioning of society (a question that would likely need to be answered from the perspective that the feature is already available in most cars – hence population would need to face a downgraded in this option); but if the feature is to be maintained, efficient insulation for such cables is necessary in order to avoid fire and to prevent passengers from electrocuting. Similarly, again referring to the automotive industry, fluoropolymers are used for the manufacture of different parts of car equipment, such as door hinges and seat height adjustment bearings. These parts can be regarded as pivot points which are subject to sporadic demand while cars are running, requiring high reliability and very low friction conditions. Not providing an efficient material for this application would take car technology probably different years back and consumers would need to face squeaking and noisy driving experiences, in addition to increased maintenance, reparations and break-downs. While this property may not be necessarily linked to safety, it could be questioned whether European society is ready to accept reduced functionality in these applications which would lead to significantly reduced comfort when driving or traveling by car – or other means of transport.

Where comfort is truly the only reason for use of fluoropolymers (i.e., a 'nice to have' feature), there could be room for debate if society wishes to maintain those uses or not. The most renowned example is the use of fluoropolymers as anti-stick material in frying pans. Again, for this use it could be argued if 'comfort' alone is truly the only reason for use. Frying pans with highly anti-stick coatings allow for reduced use of oil during cooking (linked to a healthier and safer life-style), reduced use of cleaning agents (less chemicals in the environment) and improved durability of the article (helping circularity objectives). Furthermore, uses of frying pans coated with fluoropolymer are safe, because the temperatures required for decomposition of PTFE will not be reached during normal use, and food will burn before such temperatures are reached. In addition to this, in the event that small particles of PTFE may be released due to excessive use, there is no risk for health because such particles will be eliminated by the human body without any possibility of biological interaction, due to its inertness and the fact that they cannot cross biological membranes.[13] Also, those frying pans will eventually end-up in waste plants where they will be treated as metallic waste, therefore under conditions that should not result in environmental concerns. In summary, this use cannot be considered as very dispersive.

In contrast to designed functional or constructive fluoropolymer parts, dispersive uses of fluoropolymers by consumers (e.g., cosmetics, ski waxes, lubricants for bicycle chains), may eventually result in some releases of fluoropolymers to the environment. Again, the key factor is that those polymers are safe due to their nature and not pose a risk to humans or the environment. Still, if the aspiration of society is to not have these materials in the environment, it should be possible to remove such applications from the market without necessarily placing limits to the relevant industrial applications where fluoropolymers are extremely valuable for society, and where they play a significant role in enhancing safety, decarbonization, circularity, innovation and progress. For example, the already existing microplastics restriction under REACH could be a good instrument to force reduction and eventually elimination of such uses.

## III. Key Sectors of Application of Fluoropolymers

The true value of fluoropolymers becomes apparent when they are used in industrial applications. Concerns expressed in the PFAS restriction proposal in relation to fluoropolymers are mainly related to low

13 Barbara J Henry, Joseph P Carlin, Jon A Hammerschmidt, Robert C Buck, L William Buxton, Heidelore Fiedler, Jennifer Seed and Oscar Hernandez, 'A critical review of the application of polymer of low concern and regulatory criteria to fluoropolymers' (2022) 14 Integrated Environmental Assessment and Management 13, 316–334

| **Wood, 2021 - Sector of use** | Volume 2020 (MT) | Volume % |
|---|---|---|
| Transport | 15,500 | 39.2% |
| Chemical and Power | 11,000 | 27.8% |
| Electronics | 3,500 | 8.9% |
| Food and pharmaceutical industry (F&P) | 2,000 | 5.1% |
| Cookware | 2,000 | 5.1% |
| Textiles and architecture | 1,500 | 3.8% |
| Renewable energy | 500 | 1.3% |
| Medical applications | 500 | 1.3% |
| Other sectors, not included above | 3,000 | 7.6% |
| TOTAL | 39,500 | |

volume consumer applications of which the use is dispersive. Such applications are ultimately of very limited interest to the fluoropolymer industry, and claims are already being made that in most of those applications fluoropolymers could be a 'nice to have', but not truly necessary.[14]

Different initiatives on market research related to fluoropolymers have been performed, with the aim to provide volumes used in the different sectors in which these high value products are used.[15] However, it is difficult to get precise data on some of those consumer uses. In some occasions, such information is flagged as confidential.[16] Nevertheless, it is possible to extract valuable information from such market research activities. The following table shows the data that is available from both initiatives.

Differences in the definition of market segments used in various market research reports result in slightly different numbers. Nevertheless, for the purpose of our analysis, the information displayed on volumes clearly reflects that the major share of fluoropolymer uses is in high value, high technological sectors related exclusively to industrial applications. Putting these figures in context, it appears evident that minor consumer applications, such as uses in cosmetics, ski waxes or bicycle chain lubricants are extremely small and therefore of no interest to the fluoropolymer industry, and no significant impact is to be expected if those uses are discontinued.

## IV. Conclusions

Fluoropolymers bring high value to society. This is achieved via the combination of extraordinary properties that they offer. Such value is maximised when fluoropolymers are used in industrial applications in high technology sectors. The use of fluoropolymers

14 C&EN, 'How fluoropolymer makers are trying to hold on to their business' (2023) <https://cen.acs.org/materials/polymers/fluoropolymer-makers-trying-hold-business/101/i8?linkId=100000191672537> accessed 1 May 2023.

15 Astute Analytics (2021). Global Fluoropolymers Market. Industry Dynamics, Market Size, and Opportunity Forecast for 2027. April 2021; Wood (2021). PFAS in the treatment of skis — Use, Emissions and Alternatives. Report for Miljødirektoratet/ Norwegian Environment Agency.

16 Wood Group, 'Update of market data for the socio-economic analysis (SEA) of the European fluoropolymer industry' (2022) <https://fluoropolymers.plasticseurope.org/application/files/1216/5485/3500/Fluoropolymers_Market_Data_Update_-_Final_report_-_May_2022.pdf> accessed 1 May 2023.

| **Astute Analytical, 2021 - Sector of use** | Volume 2020 (MT) | Volume % |
|---|---|---|
| Industrial equipment: chemical industry | 27,700 | 37.8% |
| Electronics W&C | 9,450 | 12.9% |
| Industrial equipment: other | 6,500 | 8.9% |
| Transport: automotive | 5,280 | 7.2% |
| Industrial equipment: Semiconductors | 4,515 | 6.2% |
| Household | 3,840 | 5.2% |
| Batteries | 3,000 | 4.1% |
| Construction | 3,000 | 4.1% |
| Medical & Pharma | 2,800 | 3.8% |
| Other | 2,500 | 3.4% |
| Transport: aerospace | 2,035 | 2.8% |
| Other electronics | 1,425 | 1.9% |
| Transport: other | 1,265 | 1.7% |
| TOTAL | 73,310 | |

allows for very high standards related to protection of workers and the general population, efficient development of green energy systems, improved longevity of equipment and articles thus helping the circular economy, and outstanding performance in vital sectors that are critical to ensure Europe's autonomy and technological superiority in comparison to other global economies. In contrast, the value of fluoropolymer in some consumer applications that have been related to potential concerns is very limited and is only related to relative improvement of comfort features.

In addition to this, it should be noted that fluoropolymers have been traditionally the innovative solution of choice by many industries to improve process conditions, either related to safety, development of options to decarbonize the economy or to improve durability of materials. A ban on critical uses of fluoropolymers, or any regulatory initiative that may place barriers to the use of these low risk, high value materials will limit or slow down the speed of innovation in the EU.

Consumer uses, or uses of fluoropolymer-based products by consumers that may be regarded as dispersive (handling of which is understood to be more difficult to control in comparison with activities in an industrial set-up) are of no paramount interest to society, and while fluoropolymers are acknowledged to pose no risk themselves to human health or the environment, limitations to those uses would not result in major negative impact to the European society. Still, the fact that legislation to control such uses is already in place (e.g., via the EU REACH microplastics restriction) suggests that no further action is required, and that eventually those uses will progressively disappear from the European market. If there are societal preferences to limit such uses, a broad restriction of all uses of fluoropolymers via a REACH restriction does not appear to be neither efficient nor justified.