ANALYSIS OF ALTERNATIVES

and

SOCIO-ECONOMIC ANALYSIS

PROVIDED AS COMMENTS TO THE PUBLIC CONSULTATION ON THE REACH RESTRICTION PROPOSAL ON PER- AND POLYFLUOROALKYL SUBSTANCES (PFAS)

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Date:	22.09.2023

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LIST OF ABBREVIATIONS

AE	Aqua Europa
AoA	Analysis of Alternatives
AOX	Adsorbable Organic Halides
BAT	Best Available Techniques
CSR	Corporate Social Responsibility
Da	Dalton
DBPs	Disinfection By-Products
DG ENV	Directorate-General for Environment
DGMT	German society for membrane technology
DWD	Drinking Water Directive
EBIT	Earnings Before Interest and Tax
ECHA	European Chemicals Agency
ECTFE	Ethylenechlorotrifluoroethylene
EEA	European Economic Area
EN	European Standard
EPDM	Ethylene-propylene-diene(monomer) rubber
EU	European Union
EUSA	European Union of Swimming pool and Spa Associations
FFKM	Perfluoroelastomers
figawa	German association of companies for gas and water technologies
FKM	Fluoro rubbers
FP	Fluoropolymers
FPM	Fluoro rubbers
GWI	High Voltage Direct Current Conversion
HNO_3	Nitric Acid
HVDC	High Voltage Direct Current Conversion
IED	Industrial Emissions Directive
LCI	Labour Cost Index
NaOCl	Sodium Hypochlorite
NBR	Nitrile butadiene rubber
NPV	Net Present Value

OEM	Original Equipment Manufacturer
PES	Polyethersulfone
PFAS	Per-and polyfluoroalkyl substances
PFPE	Perfluoropolyethers
PLC	Polymer of Low Concern
POM	Polyoxymethylene
PP	Polypropylene
prEN	Draft European Standard
PTFE	Polytetrafluoroethylene
PVC	Polyvinylchloride
PVDF	Polyvinylidene fluoride
PVDF-HFP	Poly(vinylidene fluoride-co-hexafluoropropylene)
PVDF-PET	Polyvinylidene fluoride - polyethylene terephthalate
PVDF-PP	Polyvinylidene fluoride – polypropoylene
R&D	Research and Development
RO	Restriction Option
SCFP	Side-chain fluorinated polymers
THM	Trihalomethanes
UBA	Umweltbundesamt
UF	Ultrafiltration
USD	U.S. Dollar
UV	Ultraviolet
UWWTD	Urban Wastewater Treatment Directive
WRR	Water Reuse Regulation

SUMMARY

The present document is part of the submission of figawa e.V., DGMT and AE for the public consultation on the PFAS restriction proposal.

It describes the use of fluoropolymers (FPs) in products used for water treatment processes, which include the treatment of drinking water, wastewater, industrial water, and pool water. Water treatment systems are essential for safeguarding human health and the environment, as they efficiently eliminate pollutants and microorganisms from drinking water and modify water qualities according to the specific requirements of wastewater, industrial water, and pool water. These systems rely on established technologies, including chemical, physical, and mechanical methods, known for their energy efficiency and operational safety. However, their effectiveness and safety hinges heavily on the use of FPs.

FPs are high-performance materials with exceptional properties, such as chemical resistance, thermal stability, fouling resistance, material flexibility and anti-friction / gliding properties. There is no other available material that combines this wide range of functions and therefore no suitable alternatives exist at this time. Hence, figawa primarily supports an exemption of fluoropolymers by way of a time-unlimited derogation for the water treatment applications or at least the longest derogation period to perform the research necessary to find and implement alternatives that meet high standards, which would certainly require more than 20 years.

In summary, the consequences of a PFAS restriction, as outlined by the socioeconomic evaluation, amount to roughly 370.89 million Euros (NPV 2025) or 15.13 million Euros annually over a 45-year period. It must be noted that not all impacts have been monetised in this assessment. The valuation of impacts and extrapolation of most impact categories has remained difficult due to constraints in data availability for the entire sector and all stakeholders. **Data, wherever applicable for OEMs, was obtained by some figawa members for exemplary valuation which must be seen as a bare minimum indication of socio-economic estimates at least at the OEM level in the supply chain**. Impacts associated with other stakeholders in the supply chain are only qualitatively explained.

1. Introduction

This comment is submitted in the name of figawa e.V.[1], the German association of companies for gas and water technologies supported by DGMT e.V.[2] (German society for membrane technology) and Aqua Europa AE[3]. Our members provide products and services for the utilisation and distribution of gas and liquid fuels as well as the distribution and the treatment of drinking water and water for industrial and municipal purposes including wastewater and pool water treatment.

figawa has more than 275 member companies, which generate around 34 billion Euros of revenues annually. As an industry association, we bring together interests and advocate for standardized regulations and legislative processes to ensure long-term legal and planning certainty for all market participants. With our expertise, technology, and open dialogue, we aim to drive progress and innovation in our industries. Cross-cutting issues, as well as needs and requirements of our members are addressed in our industry aligned sector coordination groups.

The figawa members have aligned into three clusters based on the presence of PFAS in their product portfolio and applications to provide comments for the PFAS restriction proposal. These clusters are:

1. Water treatment (drinking water, wastewater, industrial water, water reuse and pool water)
2. Water supply (public infrastructure, water distribution in buildings and water measurement and distribution of thermal energy) and
3. Gas & liquid fuels (application and distribution)

To fulfil their responsibility of providing millions of private households, municipalities and industry with resources such as gas, liquid fuels, and water, our members depend on a variety of fluoropolymer-based technical components, all of which with high requirements towards their mechanical and chemical properties. This does not only guarantee a functioning infrastructure with an enormous economic impact on the European society but also the very safety of the European population.

It is important to note that figawa members are not manufacturers of per- and polyfluoroalkyl substances (PFAS) or polymer PFAS raw material. They mainly assemble end-products from components and are only a part of the supply-chain. They are thus not directly involved in the development process of PFAS-free alternatives, which exhibit the complex set of physicochemical properties required for their products. It is additionally worth noting that due to the members' position in the supply chain, the exact composition of components in relation to PFAS is often unknown to them.

Under this premise, the members identified that polymeric PFAS are of extraordinary importance for the safe and durable operation of their products. Polymeric PFAS may be categorized into three groups: Fluoropolymers (FPs), perfluoropolyethers (PFPEs), and side-chain fluorinated polymers (SCFPs) (ECHA, 2023) (Korzeniowski, et al., 2023). Of these three classes, FPs including fluoroplastics (e.g. polytetrafluoroethylene (PTFE) or polyvinylidene fluoride (PVDF)) and fluoroelastomers (e.g. fluorine rubber (FKM)) are the most important for the figawa members. This is also reflected by the first comment

[1] https://figawa.org/

[2] https://www.dgmt.org/the-dgmt.html

[3] https://aqua-europa.eu/

submitted by figawa[4], in which a time-unlimited derogation for FPs was proposed. The importance of FPs for the members' products becomes apparent when analysing the components used for the manufacture of their end-products (see section 2.2).

FP have very high molecular weight (usually > 10,000 Da) and show excellent thermal, chemical, photochemical, oxidative, hydrolytic and biological stability with low flammability, low friction, good gliding properties, good electrical insulation, neutral electrical charge and resistance to degradation. No reactive groups are present in the structure of FPs. They are characterized by a carbon-only polymer backbone with F atoms directly attached to it, a unique feature in the chemical space. Fluoropolymers do not bioaccumulate, are not mobile and fulfil the Polymer of Low Concern (PLC) criteria (OECD, 2009).

The following report addresses the products and the respective applications for '**Cluster 1: Water treatment**'. It is the consolidated information of figawa's members and aims to represent the European water treatment sector. The report provides an overview on where FPs are present and what functionalities are provided by them. In addition, potential alternatives are discussed in section 2 and a hypothetical substitution timeline is presented in section 3. Socio-economic impacts of a potential restriction of PFAS are described in section 4.

1.1. Water Treatment

Water treatment is any process that improves the quality of water to make it appropriate for a specific end-use. The end use may be drinking water, industrial water, pool water and many other uses, including being safely returned to the environment after wastewater treatment. Water treatment removes contaminants and undesirable components or reduces their concentration so that the water becomes fit for its desired end-use. Technologies include dosing of chemicals, various filtration technologies (adsorbers, filter media and membranes), ion exchange for softening and disinfection or oxidation steps (UV, chlorine, chlorine dioxide, ozone etc.).

Most disinfection methods are highly aggressive and/or oxidizing or they contain membranes that must be regularly cleaned with aggressive and/or oxidizing chemicals, and therefore require materials that are inert towards the respective substance / technology. FPs are high-performance materials which are used in water treatment equipment, as they are not only inert towards aggressive media, but also provide further critical properties. These are discussed in detail in section 2.2.1.

1.2. EU Regulations / directives

Of all global water resources, only 0.5 % are useable and available freshwater sources and water scarcity is one of the main challenges of the century. Currently, more than 3 billion people face water scarcity every year and this number will increase to 5 billion by 2050 (UN Water, n.d.). Protecting water resources and re-use of any (waste-)water is thus of crucial importance for society.

It is therefore no surprise that several policy initiatives are addressing this issue and aim to protect water resources. In the EU, the Commission has launched the 'Blueprint to Safeguard Europe's Water Resources' in 2012, an approach which aims to improve current EU water legislations (Kurrer & Lipcaneanu, 2023). In the following, a selection of relevant

[4] Comment 4433 from 2023-06-02 accessible via https://echa.europa.eu/documents/10162/8d917581-7faf-4e1a-26d4-073d52b3406e (last accessed 2023-09-15)

EU legislations is presented that govern the treatment and management of water and wastewater.

Drinking Water Directive (EU) 2020/2184 (DWD) (EUR-Lex, 2020a)

The DWD aims to ensure the quality of water intended for human consumption. It provides maximum allowed levels for various contaminants, such as heavy metals. This is done by providing definitions for water quality standards and descriptions on control and monitoring. The DWD further ensures access, protects sources and distribution of drinking water. It also provides legal basis for the harmonisation of materials and products in contact with drinking water, such as FPs, which according to the DWD are suitable to be used for drinking water.

Urban Wastewater Treatment Directive 91/271/EEC (UWWTD) (EUR-Lex, 2014)

The UWWTD requires the collection and treatment of urban wastewater to protect human health. It sets discharge limit values to ensure that releases of nutrients and pollutants are safe.

Industrial Emissions Directive 2010/75/EU (IED) (EUR-Lex, 2011)

The IED regulates pollution from industrial activities. Best Available Techniques (BAT) must be followed to ensure that emissions of chemicals to the environment are prevented or minimised.

Regulation (EU) 2020/741 on minimum requirement for water reuse (Water Reuse Regulation / WRR) (EUR-Lex, 2020b)

The WRR provides minimum water quality requirements for the safe reuse of treated urban wastewaters in agricultural irrigation.

The legislations shown above illustrate that the implementation of BATs is not optional but an absolute requirement to ensure that both the society and the environment are provided with clean and safe (drinking) water. In certain applications, such as the use of water for steam sterilisation in hospitals, specific European standards (e.g. EN 285:2015+A1:2021: "Sterilization - Steam sterilizers - Large sterilizers") require water qualities which are achieved with the water treatment technologies described in this document and which rely on the use of FP's.

2. ANALYSIS OF ALTERNATIVES

2.2. Fluoropolymers and Fluoropolymer-containing components

All submitted comments and documents describe the use of FPs for each cluster, respectively. Short-chain PFAS are not in scope of this submission.

Water treatment systems protect people and the environment every day and enable industrial processes. The known technologies (chemical, physical, mechanical) have proven to be energy efficient and operationally safe but rely directly on the use of high-performance plastics containing PFAS. To remove pollutants and microorganisms from water, highly reactive disinfectants and oxidants such as chlorine, chlorine dioxide, active bromine or ozone are used. Therefore, fluoropolymers are required in treatment systems as sealings, hoses, linings and coatings or as a material for other components with high demands on chemical resistance often in combination with good gliding properties. In addition, measuring and control systems in water treatment processes also rely on FPs. Monitoring through sensors is essential for efficient, safe, and reliable water treatment processes.

Table 1 provides an overview on which FPs are commonly used in water treatment applications.

TABLE 1: OVERVIEW ON RELEVANT FPS AND THEIR FIELD OF APPLICATION IN WATER TREATMENT

Fluoropolymer used in water treatment (non-exhaustive)	Fluoropolymer abbreviation	Associated components in which the fluoropolymer is used (non-exhaustive exemplification)
Ethylenechlorotrifluoroethylene	ECTFE	Flexible membranes, fittings, moulded parts, pipes, valves
Perfluoroelastomers	FFKM	Gaskets, membranes, sealing materials
Fluoro rubbers	FPM, FKM	Ring seals, flat gaskets, moulded gaskets, sealing materials, flexible membranes
Polytetrafluoroethylene	PTFE	Tubes, hoses, valve seats, (ion-selective) membranes, lubricants, sealing materials, coatings, gliding bearings, dispensing heads, pump heads, spacers, fittings, high-voltage connectors
Polyvinylidene fluoride	PVDF	Tubular membranes, ultrafiltration membranes, high voltage connectors, valves, valve seats, fittings, pipes, moulded parts, tower packing, float switch, flow meter, meter devices, sensing electrodes, pipes, pump heads, shaft seals
Polyvinylidene fluoride - polyethylene terephthalate	PVDF-PET	Tubular membranes, ultrafiltration membranes
Poly(vinylidene fluoride-co-	PVDF-HFP	Tubular membranes, ultrafiltration

hexafluoropropylene)		membranes, pipes, fittings
Polyvinylidene fluoride - polypropylene	PVDF-PP	Tubular membranes, ultrafiltration membranes

Water treatment products encompass a wide range of product groups, which consist of several individual components. Products mainly include water treatment and -softening systems (end-product group 6) as well as valves/regulators/monitors/injectors (end-product group 3). An illustrative distribution of end-product groups is depicted in Figure 1. A detailed description is provided in the Chemical Safety Report of this submission.

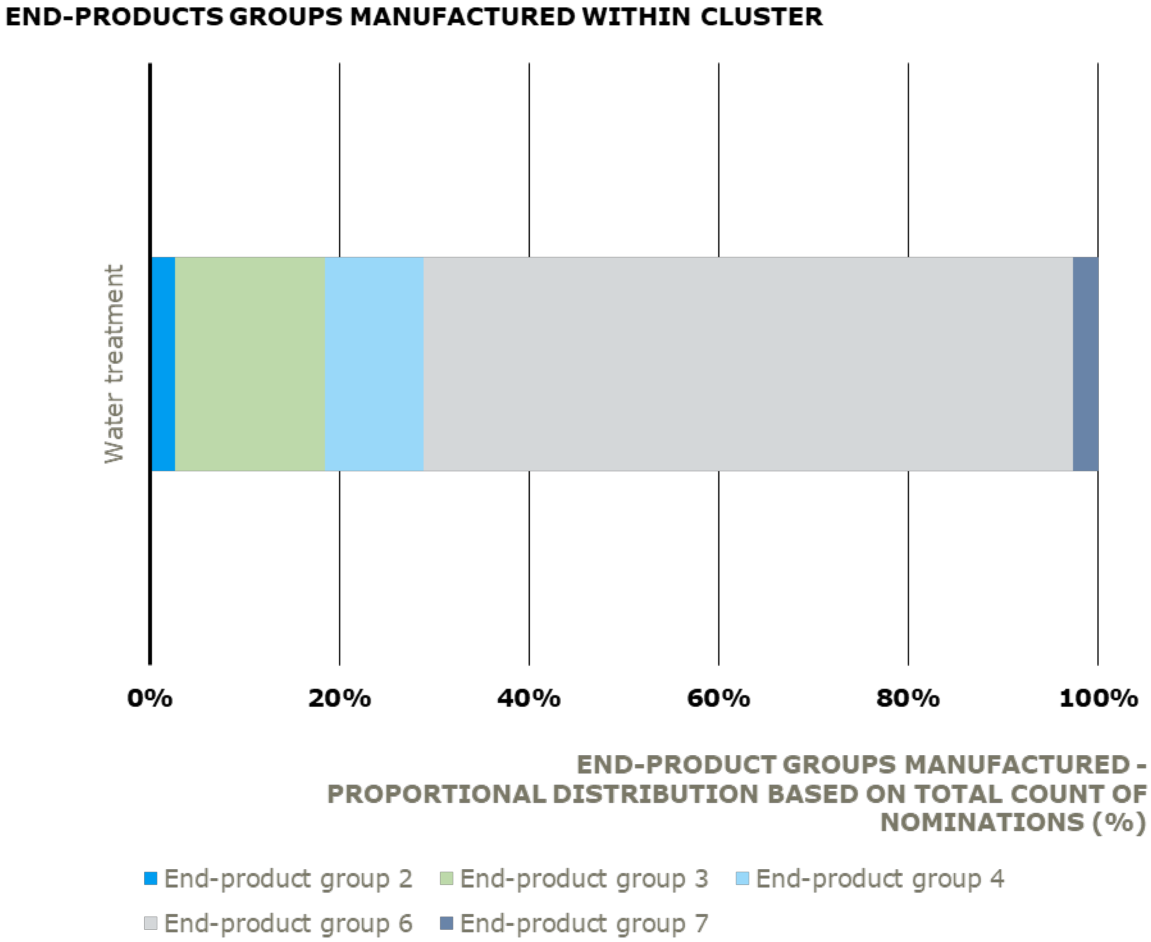

FIGURE 1: END-PRODUCT GROUPS MANUFACTURED WITHIN CLUSTER. GROUPS ARE DEFINED AS END-PRODUCT GROUP 2: SEALS, (O-)RINGS, MEMBRANES, SLEEVES; END-PRODUCT GROUP 3: BALL VALVES, VALVES, BUTTERFLY VALVES, FLOW/PRESSURE REGULATORS AND MONITORS, INJECTORS; END-PRODUCT GROUP 4: PIPES, PIPING SYSTEMS; END-PRODUCT GROUP 6: WATER TREATMENT INCLUDING WATER SOFTENING SYSTEMS (MEMBRANES FOR FILTRATION, ION EXCHANGER, OZONE, ACTIVE BROMINE, ELECTRO-CHLORINATION, CHLORINE DIOXIDE, CHEMICAL DOSING, UV); END-PRODUCT GROUP 7: METERS, SENSORS, ANALYSIS TOOLS AND CONTROLS.

Table 2 provides an overview on the component groups and the related end-product groups for which they are used. In consistency to the structure of the market – end-products are mostly assembled from various components – several FP-containing components are used per end-product group. Also, the same component group may be used in different end-product groups. For example, (O-)rings and other sealings as well as electronic components are used in most end-product groups.

TABLE 2: FLUOROPOLYMER-CONTAINING COMPONENTS AND USE IN END-PRODUCT GROUPS

Component group	Component details	End-product group (see Figure 1)				
		2	3	4	6	7
1	Spacers, anchors, caps, nozzles, fittings, ball valves, pump heads, hose connections/hoses, valves/valve seats	-	+	+	+	-
2	Use as processing aid, contact passivation, etc.	-	-	-	-	-
3	Electronic components (circuit boards, displays, injection units, flow meters, etc.), cables, batteries	-	+	+	+	+
4	Housings, containers, reactors, flame retardant plastic components	-	-	-	+	-
5	Paints, adhesives, potting compounds, binders, multi-component compounds, coatings	-	-	+	+	-
6	Membranes	+	+	-	+	-
7	O-rings, retaining rings, shaft seals, molded seals (gaskets)/(flat) sealings	+	+	+	+	+
8	Lubricants (greases, oils), lubricant coatings, bearings / slide bearings	-	+	+	+	+

Acronyms: +: Components used for the manufacture of this end-product group; -: Components not used for the manufacture of this end-product group; End-product group 2: Seals, (O-)rings, membranes, sleeves; End-product group 3: Ball valves, valves, butterfly valves, flow/pressure regulators and monitors, injectors; End-product group 4: Pipes, piping systems; End-product group 6: Water treatment including water softening systems (membranes for filtration, ion exchanger, ozone, active bromine, electro-chlorination, chlorine dioxide, chemical dosing, UV); End-product group 7: Meters, sensors, analysis tools and controls

It must be highlighted that the main group of products, which are the focus of the submission, are products/components in direct contact with water and/or an aggressive oxidizing agent or disinfectants. These products/components must show high resistance towards chemicals, temperature, pressure and provide further functions, such as material flexibility and gliding properties in order to withstand the harsh conditions of water treatment. In addition, components in contact with drinking water must be suitable for drinking water use, as specified in the DWD.

However, this submission also includes products needed in water treatment, such as control technology components (e.g. meters, sensors), and which include FP-containing parts. While direct contact to water and chemicals is usually not the case, these products are needed for the safe operation of water treatment processes. Hence, they are mentioned here for information purposes.

The following figures illustrate components containing fluoropolymers as used in water treatment technologies as a non-exhaustive exemplification for the scope of the current report (Figure 2 to Figure 6).

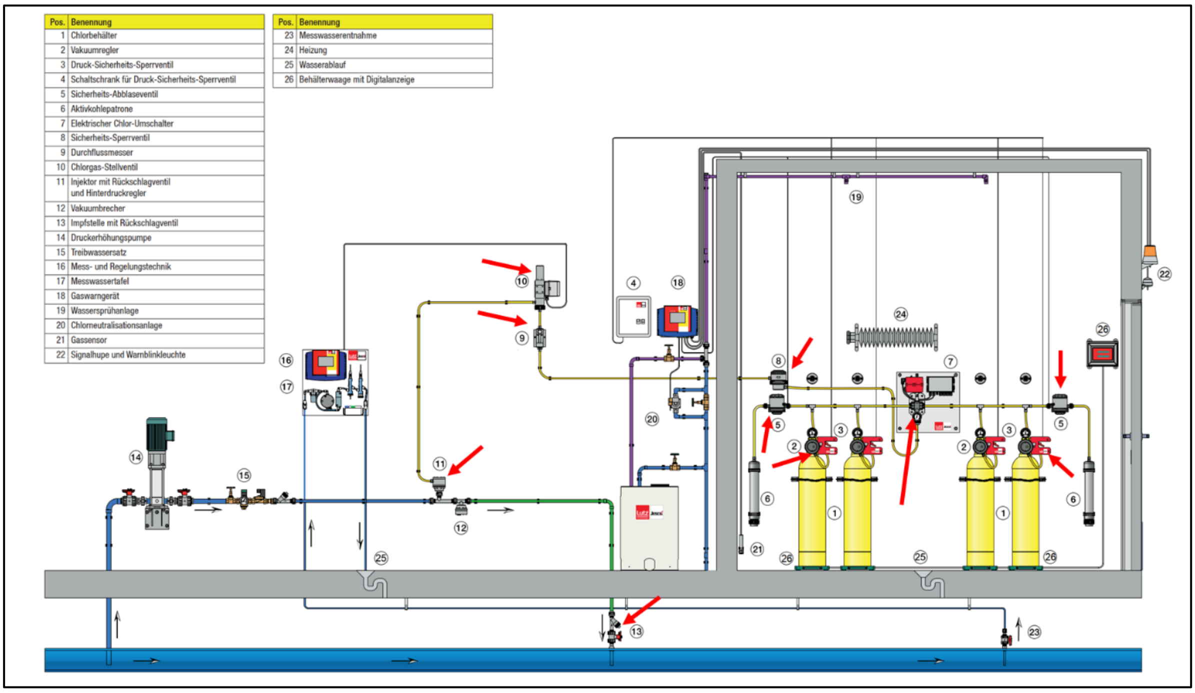

FIGURE 2: FLUOROPOLYMER-CONTAINING PARTS (INDICATED BY RED ARROWS) OF A CHLORINE DOSAGE UNIT WITH A SWITCH OVER UNIT. PVDF, PTFE AND FKM IN USE FOR E.G. VALVES, INJECTORS, VACUUM REGULATOR.

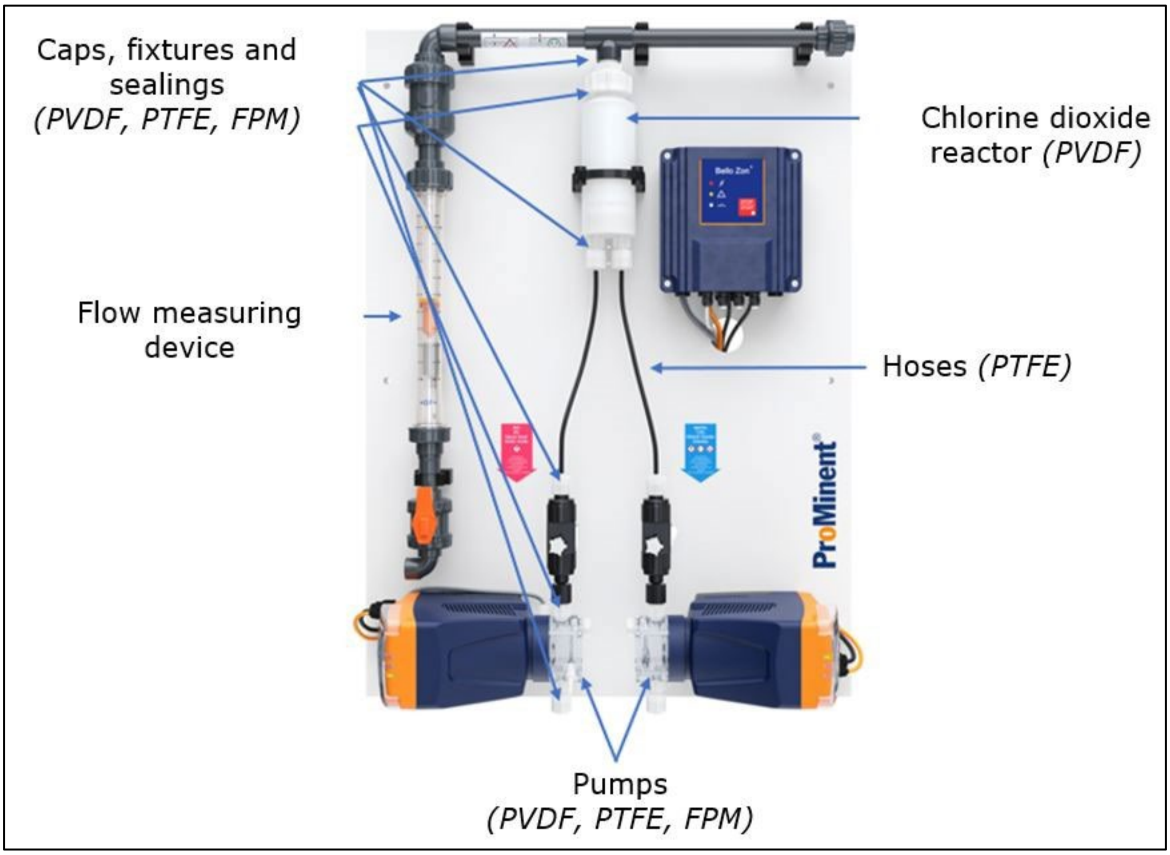

FIGURE 3: FLUOROPOLYMER-CONTAINING COMPONENTS AS PART OF A CHLORINE DIOXIDE PRODUCTION PLANT FOR WATER TREATMENT.

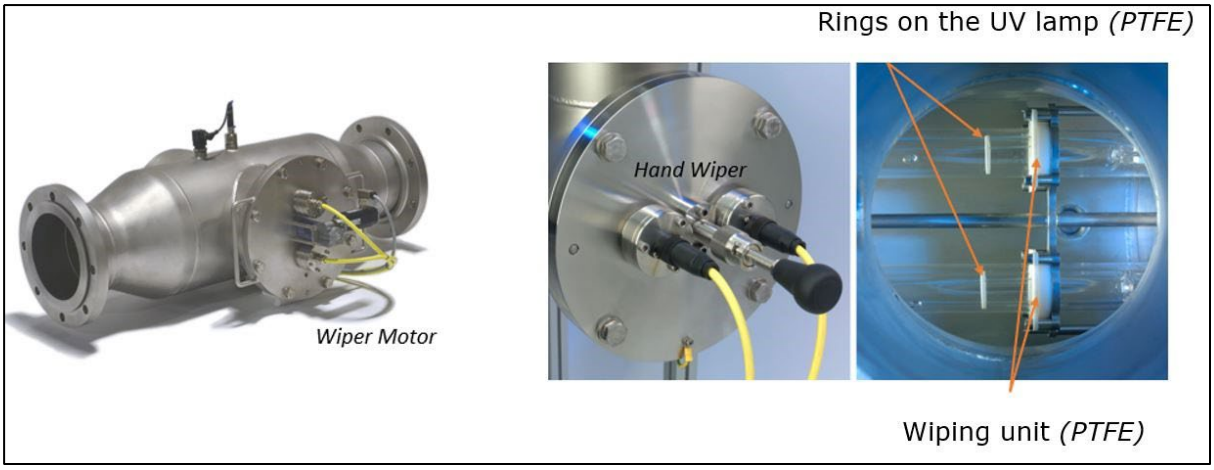

FIGURE 4: FLUOROPOLYMER-CONTAINING COMPONENTS AS PART OF A UV WATER TREATMENT PLANT.

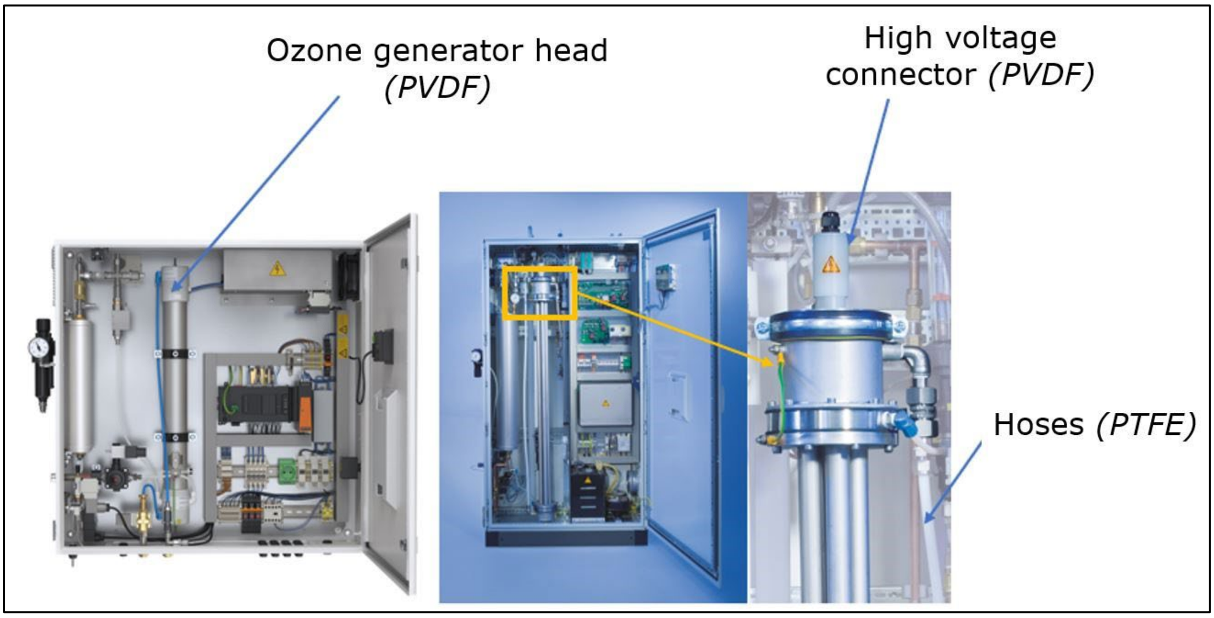

FIGURE 5: FLUOROPOLYMER-CONTAINING COMPONENTS IN AN OZONE WATER TREATMENT PLANT.

FIGURE 6: FLUOROPOLYMER-CONTAINING COMPONENTS IN AN ELECTROLYSIS WATER TREATMENT PLANT.

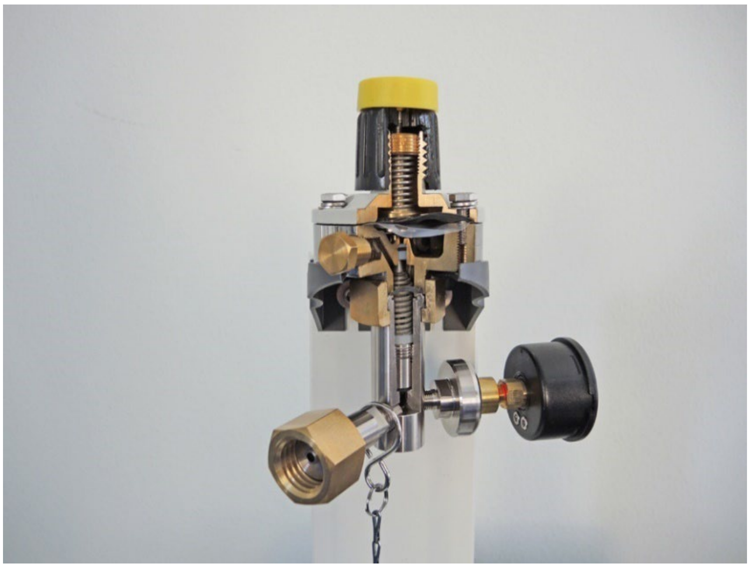

FIGURE 7: VACUUM REGULATOR FOR GAS CHLORINATION SYSTEM CONTAINING A MEMBRANE MADE OF PFAS

2.2.1. The value chain of fluoropolymers in water treatment technologies

Reiterating the critical importance of water treatment systems, these systems effectively remove contaminants and microorganisms from drinking water and adjust water properties to meet the unique needs of wastewater, industrial water, and swimming pool water. However, their efficiency largely depends on the use of PFAS. To achieve effective water purification, highly reactive disinfectants and oxidants like chlorine, chlorine dioxide, active bromine or ozone are employed.

Fluoropolymer-based components are crucial in water treatment technologies, as they enable strong oxidizing and disinfecting properties. Ozone-based treatment effectively disinfects and removes metals, micropollutants, and odours from water, while UV-based treatment efficiently disinfects against bacteria and viruses. Both methods are combined in (bio)pharmaceutical applications to ensure thorough disinfection and preservation. These advanced technologies, alongside other methods, guarantee optimal water treatment for drinking water, industrial use, and water re-use. Electrochlorination, which is based on the electrolysis of a sodium chloride solution or a similar process, is used for disinfection in swimming pools and drinking water devices.

Utilized in various aspects of the treatment process, such as sealings, hoses, linings, coatings, and other critical components that come into contact with the chemicals used during water treatment, fluoropolymers' significance extends to equipment used in physical processes, like UV disinfection, where their exceptional resistance to high doses of UV radiation ensures the process's effectiveness. In addition to the chemical resistance, the mechanical properties of FPs are equally important. The material flexibility and low friction coefficient of FPs make them the most suitable materials for sealing applications under harsh conditions (e.g. pressure, temperature).

Ultrafiltration (UF) membranes are a separation technology based on pressure or concentration gradients. It removes dissolved substances of high molecular weight, such as microorganisms and micropollutants. UF membranes are used in the treatment of industrial and urban wastewater, as well as for the production of municipal drinking water and clean water for industry processes. Moreover, in membrane filtration, especially PVDF-based fluoropolymers play a pivotal role in withstanding the harsh chemical cleaning cycles and aggressive substances present in the water being treated.

Other equipment, such as dosing pumps, drum pumps (for pumping treatment chemicals) and conventional pumps, rely on the above listed properties of FPs, too, as they are in direct contact with aggressive media / technology.

Additionally, fluoropolymers are extensively used in measuring and control systems that are integral to water treatment processes. These systems rely on sensors made with fluoropolymers, which are fundamental for continuously monitoring water quality and treatment efficiency. Their presence is irreplaceable in ensuring the smooth and reliable functioning of water treatment processes.

2.2.1.1. Key stakeholders within the value chain

A general overview of the value chain of water treatment technologies using fluoropolymer-based components is depicted in Figure 5. The value chain comprises of **manufacturers producing fluoropolymers and downstream companies processing the respective substances** (e.g., into pellets and powders) for a variety of use applications. The processed fluoropolymers are further provided to **component manufacturers** which produce parts/components dependent on the substances as part of their portfolio. The respective fluoropolymer-based components are then sold to **original equipment manufacturers (OEMs) of water treatment technologies** for numerous applications.

The main customers and stakeholders of water treatment technologies using fluoropolymer-based components can be broadly categorized into **municipal and industrial water treatment facilities, public and private recreational facilities, industry-specific users, building services and infrastructure, public facilities and institutions, and sales and distribution channels**.

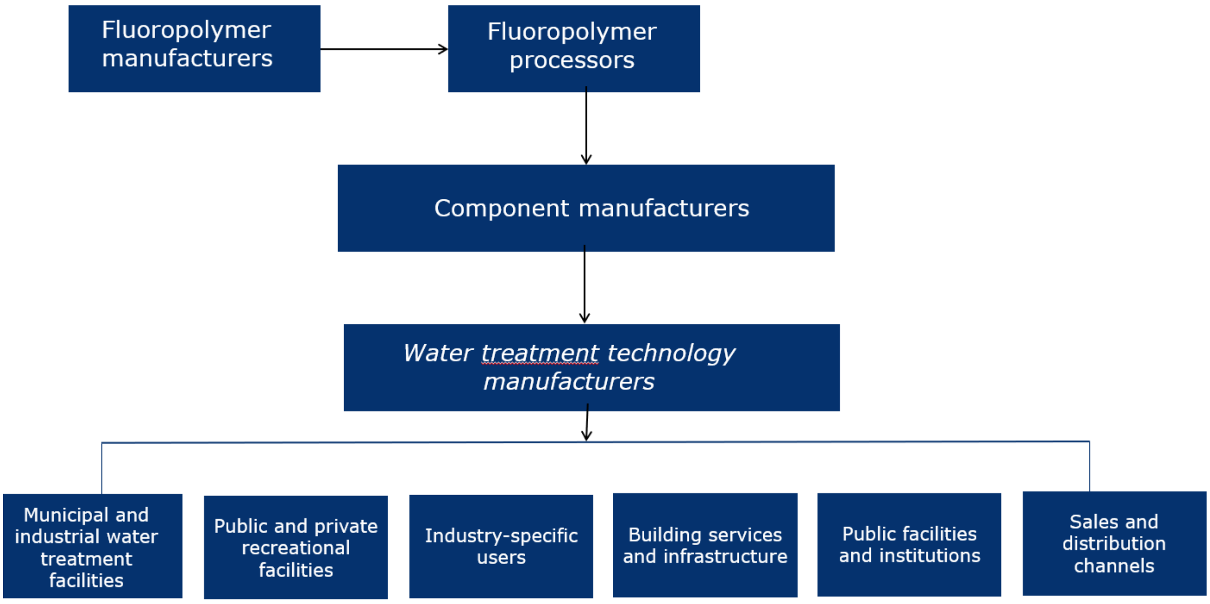

FIGURE 8: SCHEMATIC PROVIDING A SUMMARY OVERVIEW OF THE MAIN STAKEHOLDERS IN THE VALUE CHAIN OF WATER TREATMENT TECHNOLOGIES USING FLUOROPOLYMER-BASED COMPONENTS.

A non-exhaustive overview of the main customers of water treatment technologies using fluoropolymer-based components is listed below:

1. Municipal and industrial water treatment facilities:
   - Municipal drinking water and wastewater treatment plants
   - Plant and apparatus construction and engineering companies
   - Industrial process water of different compositions (incl. highly purified and drinking water): health care and hygiene, (Bio)Pharmaceutical and cosmetics, Pulp & paper, Food & beverages, Agriculture, and others
2. Public and private recreational facilities:
   - Public and private customers for swimming pools
   - Small and large aquariums, aquaculture, and zoos
3. Industry-specific users:
   - Plant manufacturers (OEMs), e.g., Equipment manufacturers building filtration installations
   - Energy supply (utilities, process water, hydrogen production)
4. Building services and infrastructure:
   - Decentral drinking water treatment device (e.g. private softener) / drinking water dispenser users in building services (private and commercial)
   - Sanitary, heating and building systems wholesale; distributors
   - Plumbers/installers in the field of plumbing and heating, and other commercial and industrial users of processing technology
5. Public facilities and institutions:
   - Public facilities (e.g., schools and sports halls)
   - Research
   - Hospitals, retirement and nursing homes
6. Sales and distribution channels:
   - Sales companies/distributors/wholesale
   - Sales representatives/sales agents; national subsidiaries or external partner companies in other EU and EEA countries, with similar distribution channels as in Germany
   - Direct sales / Own sales team, e.g., to large-scale chemical companies and other industries, car manufacturers, swimming pools
   - For building services, private and industrial customers: Three-stage distribution of the sanitary industry via specialist wholesalers and installers.

Number of stakeholders involved in the sector across the EEA

A study performed on behalf of Directorate-General for Environment (DG ENV) as support to the implementation and further development of the Drinking Water Directive (98/83/EC), in particular on materials in contact with drinking water focused on 12 of about 150 product categories identified as likely to include products focused on drinking water (Umweltbundesamt GmbH, 2017). However, the proportion of each category comprising drinking water products could not be exactly assessed, so data was only indicative of the relevant activities, such as water treatment technologies and water distribution systems. It has been estimated in this study that more than 5,000 companies within the EU are involved in producing finished products used in contact with drinking water. A smaller share of these companies is expected to belong to the sector of water treatment technologies, another and probably larger share to the sector of water distribution systems.

Number of water treatment technology units across EEA

Table 3 below provides a breakdown of disinfection units in the EU.

TABLE 3: THE NUMBER OF DISINFECTION SYSTEMS USING FLUOROPOLYMER-BASED COMPONENTS IN THE EEA

Water treatment technology	Number of installation units
Ozone-and bromine-based technology	76,934 (actual and projected between 2008 - 2023) (GWI, 2023)
UV-based technology	1,248,277 (actual and projected between 2008 - 2023) (GWI, 2023)
Chlorine based disinfection[5]	6,413,297 (actual and projected between 2008 - 2023) (GWI, 2023)
Total	***7,738,508***

It is estimated that a minimum of **7,738,508 water treatment technology units** using fluoropolymer-based components are currently or projected to be installed in the EEA by end of 2023 at different customers. Due to a medium life-cycle of such plants of around 15 years, it is estimated that all introduced in 2008 are still in operation, probably even older plants are in operation and the number significantly higher.

The largest group is chlorine-based technologies. Chlorine-based technology include the use of various substances like chlorine, sodium hypochlorite, chlorine dioxide and others. The chlorine-based disinfectants are marketed in various form like gas, solutions, granulates or are getting produced in-situ. Chlorine-based disinfectants are getting used in various application fields.

Chlorine based technologies account for most disinfection processes for drinking water in the EU (Connell, 1998). Furthermore, in 2016, approximately 100,000 public and 5 million private pools in the EU rely directly on various chlorine-based technologies. Besides, about 3 million softening plants primarily for private use are estimated to be in the market from which around 1 million have an internally self-disinfection mechanism based on an electrochlorination process (Graß et al.; 2014). This results in a total sum of 6,413,297 chlorine disinfection systems using fluoropolymer-based components. The rest of the total number accounts for critical uses in industrial water treatment, wastewater disinfection, cooling towers (e.g. legionella prevention) and other uses. Applications like drinking water for the agricultural livestock or watering could not be estimated.

2.2.1.2. Market and financial considerations

As an indication of the market value of the water treatment systems in the EEA, data on the global and European spending on some technologies between 2008 through 2023 (projected) was extracted from the GWI database. For instance, global spending on UV disinfection is estimated at 31,037 million Euros, with the European market accounting for 25 % of it or 7,759 million Euros. In the ozone and bromine-based disinfection sector, global spending is estimated at 16,621.40 million Euros with the European market

[5] This includes all chlorine derivatives and chlorine compounds (bleach, hypochlorides, chlorine dioxide, chlorine gas, "chlorine" produced in situ, etc.). Furthermore, it also includes all private (and public) baths.

accounting for 23.9 % of this total, or roughly 3,972.51 million Euros. Additionally, in the chlorine-based disinfection market, global spending is estimated at 44,353 million Euros, with Europe accounting for 25 % of that total or 11,088 million Euros. These projected estimates include the capital expenditure (CAPEX) for such installations as well as ancillary installations of sensors, ozone remnant destruction, piping and dosing components.

Proportional to the split in applications for this cluster as explained above, a distribution of the market value between stakeholders (see Section 2.2.1.1) has remained difficult. Given the diversity of stakeholders and components (see Table 2) captured by this sector, only financial estimates of industry stakeholders were estimated with emphasis on figawa members. Overall, it is already evident that there are additional manufacturers of water treatment technologies depending on fluoropolymer-based components in the EEA which could not be represented in the current report due to a lack of appropriate data. The data presented was collected in a survey with figawa members and aggregated to give an overview for the companies in the cluster that provided data.

As such, figawa members constituting more than 275 member companies generated around 34 billion Euros of revenues in 2022. The members covered under the scope of this assessment have reported that, of their individual total revenues, on an average, in 2022 a share of annual revenues of 54 % (ranging between 31 – 100 %) was dedicated to supply of water treatment installations dependent on the components associated with FPs. Similarly, the share of total annual EBITs that are attributed to PFAS were estimated at 90 % on average (ranging between 90 – 100 %) in 2022.

Figure 9 depicts the annual sales revenues registered in the EEA by the figawa members for all products and products dependent on PFAS respectively. The data shown relates to the financial years 2020, 2021 and 2022.

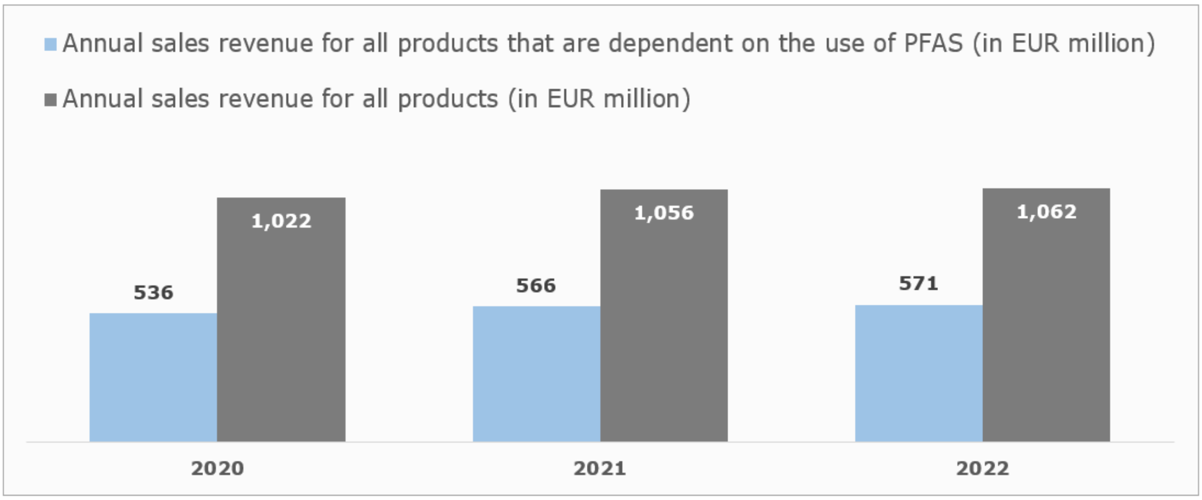

FIGURE 9: TOTAL REVENUES AND PFAS-DEPENDENT REVENUES OF WATER TREATMENT TECHNOLOGIES GENERATED BY FIGAWA MEMBERS.

Figure 10 depicts the annual earnings before interest and tax (EBIT) registered in the EEA by the figawa members for all products and products dependent on PFAS respectively. The data shown relates to the financial years 2020, 2021 and 2022.

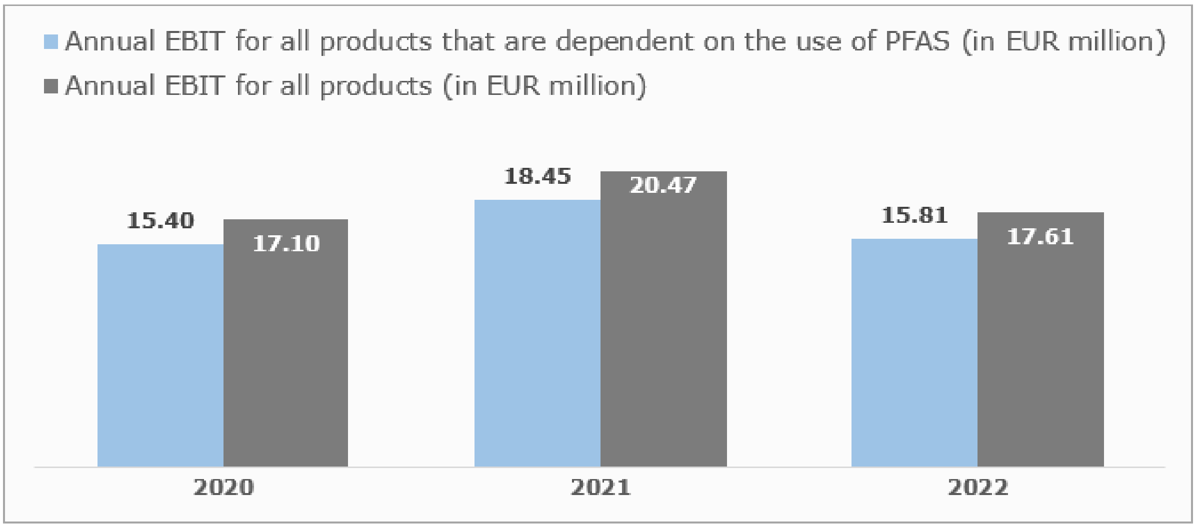

FIGURE 10: TOTAL EBIT AND PFAS-DEPENDENT EBIT GENERATED IN THE EEA BY WATER TREATMENT TECHNOLOGIES OF FIGAWA MEMBERS.

For water treatment technologies, in 2022, 2,607 jobs were registered, attributed to figawa member companies employed in the EEA that are dependent on PFAS, i.e., their jobs rely on the production/sales of different water treatment technologies using fluoropolymer-based components.

2.2.2. Description of the function(s) of Fluoropolymers and performance requirements of associated products

FPs are high-performance materials with unique properties that are needed for applications under harsh conditions. There is no single key function of FPs for the use in water treatment, but a combination of several properties that are necessary to ensure the safe functioning of the system. Any alternative must be able to provide these functions simultaneously; otherwise, the safety of water treatment products will be compromised. In the following, the functions of FPs are described. For example, chemical resistance is of vital importance for sealing materials used in chlorination plants for disinfecting water. However, the material properties of FPs are equally important. Sealing materials do not only have to withstand aggressive media, but also provide a certain material flexibility, which allows them to maintain their physical properties under a wide range of temperatures and pressures.

<u>Chemical- /UV resistance</u>

FPs show excellent chemical resistance towards several chemical groups, such as strong acids, strong bases, strong oxidants, salts, halogens, and solvents (chlorinated solvents, aliphatic- & aromatic). The high chemical stability of FPs is an absolute requirement, as the disinfection step of water treatment includes the use of aggressive media / technologies.

Most components and devices used in water treatment are exposed to highly corrosive, oxidative and reactive process steps. Components must therefore be inert towards halogens (chlorination, bromination), oxidants (ozonation) and resist radiation (UV disinfections).

UF membranes, for example, are used in water treatment of industrial wastewater, which can be strongly acidic / basic, such as the treatment of heavy metal sludge with a pH of 0. UF membranes must be inert in the pH range of 0 – 13.

In addition, UF membranes are cleaned regularly using highly oxidative solutions, such as HNO_3- or NaOCl-solutions, to remove any organic residues and to disinfect the membrane.

There is not a single standard that defines the chemical resistance requirements for water treatment products, but a palette of various standards for individual products. Standard prEN 17971 (In-situ generating and dosing devices of biocides for drinking and swimming pool water treatment – Ozone), for example, specifies the chemical resistance requirements for components used in ozone treatment.

Fouling resistance

Residues of organic and biological matter, surfactants, oil and grease and other materials remain on the surface of products and components, which are in direct contact with (waste-)water. This can result in fouling of the materials, which leads to decreased product duration and reduced properties, such as low friction, material flexibility and leak-tightness. For UF membranes, fouling results in reduced filtration properties and thus to a significantly reduced lifetime of the membrane.

Temperature resistance

In certain applications, the process temperature can reach up to 80 °C. Hence a certain temperature resistance is important to withstand temperature changes and swings for an increased amount of time. For example, in industrial membrane electrolytic processes, temperatures can reach more than 80 °C.

Pressure resistance

Sudden and strong pressure swings can occur during water treatment. Products, such as sealing materials and membranes are therefore be exposed to pressures changing from -400 up to 2000 mbar. FPs can resist high pressures and their properties will not be detrimentally impacted by pressure swings, thus ensuring safe and efficient functioning (e.g. filtration), as well as long durability.

Material properties

FPs combine properties, such as flexibility, durability, high tensile strength and impact resistance. This allows them to maintain their physical properties under a wide range of harsh conditions. Membranes, for example, need to withstand stretching, vibrations and pressure swings during application without suffering efficiency and durability declines. In addition, exposure to air scouring and abrasive particles demand wear resistance.

Leak tightness

FPs are used in sealing rings, gaskets, valves, pump heads and other components, which require a high level of leak tightness. FPs prevent the leakage of aggressive gases or liquids, harmful and bio-hazardous substances and organisms, either present in the contaminated water or used during water disinfection, into the treatment plant and into the clean water reservoir. Thus, FPs are a critical safety measure to protect workers, society and the environment from exposure to these hazardous substances and organisms. As mentioned previously, FPs must withstand a wide pressure range and pressure swings without compromising leak tightness.

The leak tightness requirements are defined by various standards depending on the type of product. Examples are:

- EN 14743 for water softeners
- EN 13443-1 for mechanical filters

- EN 14812 for chemical dosing systems

Anti-friction / gliding properties

FPs have one of the lowest coefficients of friction providing them with excellent low-friction and gliding properties. This is used in various applications, such as gliding elements, valves and gaskets. Their gliding protects surfaces and components from friction and thus the risk of wear, which leads to decreased efficiency and product durability.

2.3. Efforts made to identify alternatives

2.3.1. Research and development

As depicted in Figure 8, companies providing equipment and technologies for water treatment are located at the bottom half of the value chain. The figawa members and the contributing members of DGMT of the water treatment sector ('water treatment technology manufacturers') do not produce PFAS or polymer PFAS raw materials. They mostly assemble individual components of water treatment systems (e.g., sealing rings, gaskets, pipes, membranes), which they purchase from a broad range of suppliers ('component manufacturers'), into the various water treatment systems (for further information, please refer to the CSR document of this submission). Consequently, any research and development (R&D) on alternative substances and technologies must be coordinated and conducted with the component manufacturers and producers of (alternative) high-performance materials ('chemical suppliers').

The members of figawa, DGMT and AE are in communication with their suppliers regarding:

- Availability of alternative materials / components
- Testing of alternative materials / components lab-scale
- Testing of alternative materials / components during application
- Certification requirements

However, it must be highlighted that the majority of suppliers do not provide any alternative materials and technologies and it must be assumed that most producers of materials and component manufacturers are still at the early stages of R&D, if this has been started at all.

In summary, no suitable alternatives are available at this stage, as the high requirements for water treatment, as requested by several regulations and standards, aggravates the search for suitable alternative materials / technologies.

2.3.2. Identification of alternatives

As stated in the previous section, R&D efforts for the identification of alternatives are still at a very early stage. The table below provides an overview on potential alternatives that have been either mentioned by suppliers or have been taken from literature. The figawa members of this cluster aim to further identify alternatives and conduct tests for those that will be shortlisted based on availability, economic feasibility, safety considerations and an initial screening of technical feasibility.

As can be seen from the table below, it is not possible to identify one alternative that might be suitable for every product and component therein. An alternative such as ceramics might be further investigated as an alternative for FPs used in certain (UF) membrane applications but is definitely not suitable for the use in fittings or hoses, where a certain material flexibility is needed. Hence, R&D efforts will take significant time to identify suitable alternatives for all components, which are needed for an efficient and safe water treatment. This is also reflected in section 3, where a hypothetical substitution timeline is discussed.

Academic research on FP alternatives in water treatment processes is also still at an early stage. A screening of available literature has provided some insights into potential alternatives, albeit only for a few applications.

Regarding membrane technology for water filtration, two major alternative groups are found in literature: ceramics and polymers. While ceramics show some promising technical properties, such as good chemical-, temperature- and fouling resistance, they have not yet been researched in sufficient detail for their application in UF membranes (Ağtaş, et al., 2021). Their very high cost of 500 – 1000 USD/m² (Tomczak & Gryta, 2021), has excluded them from further testing. Hence, on the one hand further testing is necessary to conclude on their technical feasibility, on the other hand, the high price deems their use in commercial, industrial and public installations as economically unfeasible und unrealistic.

Polyethersulfone (PES) is one of the polymers, which is highly discussed as a potential alternative for FPs in UF membranes. PES provides a certain degree of chemical resistance, especially towards oxidising substances (Ran, 2015) but it cannot reach the same inertness to a wide range of chemical groups compared to FPs. The thermal stability of PES is sometimes described as good (McKeen, 2006) (Ran, 2015), and in other references as low (Yfantis, et al., 2022). Hence, no definite conclusion on the temperature resistance can be made based on the literature.

However, the main drawback of PES is its insufficient fouling resistance due to its hydrophobicity (Abid, et al., 2022).

Another polymer discussed as an alternative in literature is Polyvinylchloride (PVC). PVC demonstrates some favourable properties, such as chemical and thermal stability (Masoumi Khosroshahi, et al., 2018) (Behboudi, et al., 2017). Nonetheless, the chemical resistance is insufficient and does not cover the wide range needed in water treatment. And like PES, the main drawback of PVC is its insufficient fouling resistance, too (Behboudi, et al., 2017) (Yong, et al., 2019). In addition, PVC and its additives are currently under investigation by ECHA following a request by the EU Commission.

Polypropylene (PP) has also been studied with similar results as PES and PVC: PP is resistant towards certain chemicals, but not as many as FPs (Wang, et al., 2020), and the main drawback is its insufficient fouling resistance (Arkema Inc., 2007).

A study by Arkema investigated the chemical resistance of polymeric materials compared to PVDF for the use in various applications including water filtration membranes (Arkema Inc., 2007), see Figure 11. PVDF shows excellent chemical resistance towards strong acids, halogens, strong oxidants, aromatic solvents, chlorinated solvents, aliphatic solvents and towards weak bases & salts. Resistance is decreased only towards strong bases and ester & ketones. None of the other tested polymers can compete with PVDF. PP and PVC are severely attacked by most media and their chemical resistance is thus unacceptable. Glass-fibre reinforced Polyester is on average mildly attacked and thus provides on average, fair chemical resistance.

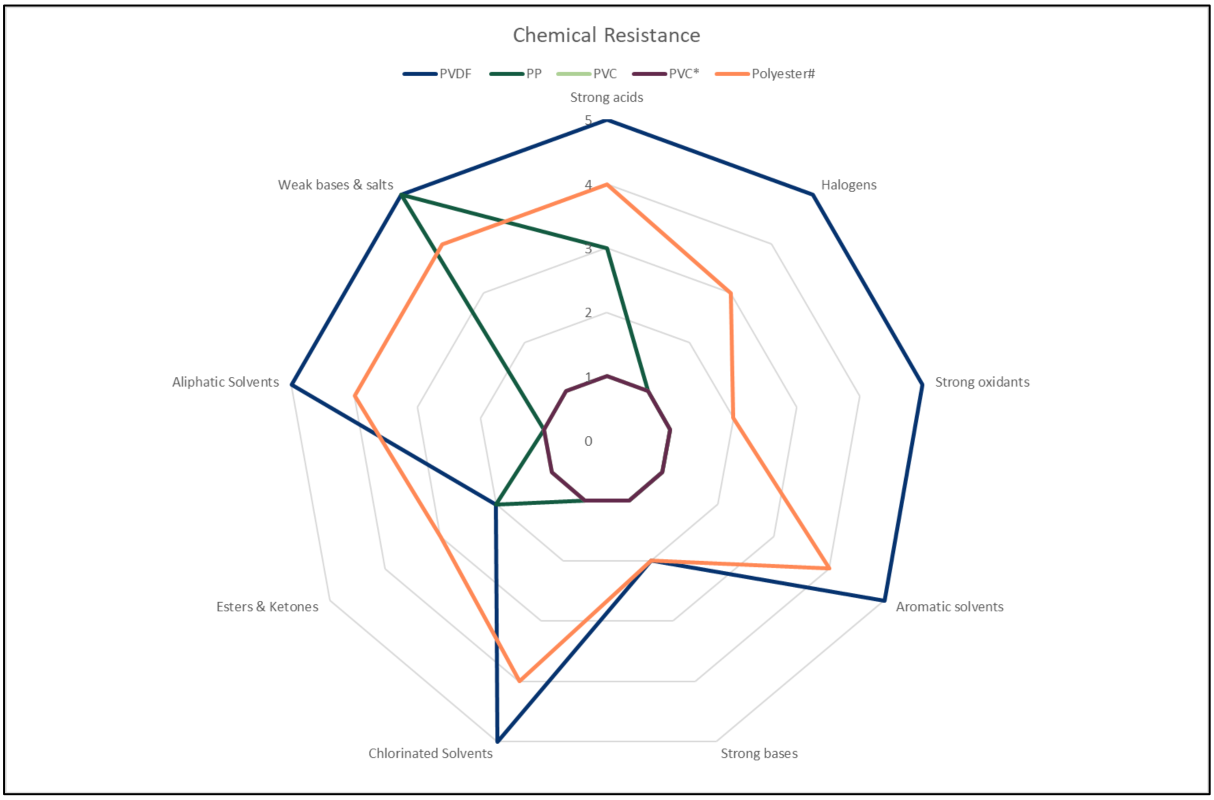

FIGURE 11: CHEMICAL RESISTANCE OF VARIOUS POYLMERIC MATERIALS. * PVC TESTED AT TEMPERATURES ABOVE RECOMMENDED LIMIT. # GLASS-FIBRE REINFORCED POLYESTER. 1: UNACCEPTABLE RESISTANCE / SEVERE ATTACK / DETERIORATED MATERIAL; 2: POOR RESISTANCE / ATTACKED / MATERIAL SOFTENED AND/OR SWOLLEN; 3: FAIR RESISTANCE / MILD ATTACK; 4: GOOD RESISTANCE / SLIGHT ATTACK; 5: EXCELLENT RESISTANCE / INERT.

There are some publications that discuss the suitability of certain polymers, rubbers and silicones for sealing materials. Ethylene propylene diene monomer rubber (EPDM) and Nitrile butadiene rubber (NBR) have been studied for their leak-tightness in sealants (Kömmling, et al., 2019). However, no comparison to FPs is provided and it is thus not possible to determine if a sufficient functionality can be provided for the application in water treatment technologies. This applies to the reference found for silicones and silicone rubber, too (Wallau, et al., 2021).

TABLE 4: OVERVIEW OF POTENTIAL ALTERNATIVES

Potential alternative	Potential application	Availability	Technical feasibility	Further considerations
Adhesive bonding	Fittings	Available	Decreased chemical-, UV- and temperature resistance	Reduced leak-tightness due to decreased chemical- and temperature resistance is a safety concern
Ethylene propylene diene monomer rubber (EPDM)	Pipes, piping systems	Available	No information yet available	
Ethylene propylene diene monomer rubber (EPDM)	Sealing materials	Available	Limited temperature resistance Limited chemical resistance Decreased UV resistance Reduced gliding properties Potentially feasible for treatment of seawater More R&D necessary to conclude technical feasibility	Shorter durability will result in additional costs (ring sealants made from EPDM are only durable for 1 year)
Ceramics	(UF) membranes	Limited availability	Good chemical-, fouling- and temperature resistance. Low material flexibility More R&D necessary to conclude technical feasibility	Ceramics are significantly more expensive than FPs (estimated 500 – 1000 USD/m², see Tomczak & Gryta, 2021[Error! Bookmark not defined.]) and thus not applicable for large scale (industrial) applications

Nitrile butadiene rubber (NBR)	Pipes, hoses	Available	Decreased chemical resistance	
Polyethersulfone (PES)	(UF) membranes	Available	Decreased fouling and chemical resistance	Increased use of NaOCl will become necessary for disinfecting (cleaning of) membranes
Polyethylene (PE)	Pipes, piping systems	Available	Decreased chemical resistance	Shorter durability will result in additional costs (PE pipes are only durable for 1 year) and higher risk of exposure to other persons when not exchanged in the required frequency,
Polyoxymethylene (POM)	Gliding elements (e.g. in valves)	Available	Decreased chemical resistance Decreased material flexibility and gliding properties	
Polyvinylchloride (PVC)	Pipes, hoses	Available	Decreased chemical resistance	Potentially hazardous additives
Polyvinylchloride (PVC)	Valves	Available	Decreased chemical- and temperature resistance	Reduced leak-tightness due to decreased chemical- and temperature resistance is a safety concern

Polyvinylchloride (PVC)	Fittings	Available	Decreased chemical- and temperature resistance Decreased UV resistance Increased material brittleness	Reduced leak-tightness due to decreased chemical- and temperature resistance is a safety concern
Polyvinylchloride (PVC)	Moulded parts	Available	Decreased chemical- and temperature resistance Increased material brittleness	
Stainless steel	Pipes, piping systems	Available	Decreased chemical resistance (prone to corrosion) Only feasible for certain applications, where material flexibility is not of high priority More R&D necessary to conclude technical feasibility Requires additional measures for cathodic corrosion protection by sacrificial anodes resp. protective current.	Corrosion may result in leakage → safety concern
Silicones	Pipes, hoses	Available	No information yet available	

Silicones / silicone rubbers	Sealing materials	Available	Reduced technical feasibility. More R&D necessary to conclude technical feasibility	

3. SUBSTITUTION TIMELINE

figawa primarily supports an exemption of fluoropolymers by way of a time-unlimited derogation for the applications relevant for its members (see section 2.2) or at least the longest derogation period to perform the research necessary to find and implement alternatives that meet their high standards, which would certainly require more than 20 years.

In this section a hypothetical substitution is described, as there are currently no suitable alternatives available, and it is unclear if substitution will ever be possible for all water treatment components. Nonetheless, the timeline needed for a potential substitution has been estimated. However, it must be highlighted that this is based on assumptions and estimations and serves as a justification why a derogation period is requested, which goes beyond the longest provided period of 12 years in the PFAS restriction proposal[6].

In addition, the estimated substitution timeline generalises all applications in water treatment. In reality, all individual components must be assessed separately or at least in product category groups, as requirements and testing schemes might differ. In some cases, a substitution may be successful, but in other cases, especially for components with direct contact to aggressive and reactive media, substitution is expected to fail.

Figure 12 and Table 5 describe the substitution timeline and the steps included therein. A total substitution timeline of 23 years is estimated if provision of spare parts is not included. If we include spare parts, the substitution timeline extends to 29-34 years.

As described in section 2.2.1.1, the water treatment technology manufacturers are dependent on R&D and substitution efforts from component manufacturers and chemical suppliers. According to our information based on communication with our immediate suppliers, R&D for alternatives is still at a very early stage and some have not yet started the search for alternatives. Hence, in the substitution timeline the time needed for suppliers to identify and develop alternative materials and technologies is included as Phase I. We have estimated a best case where the supply chain will require seven years to provide multiple alternatives for different components in water treatment processes. This timeline can be shorter for some applications / components and in other cases require more than 7 years.

Once a palette of alternative components becomes available, figawa members can then start their own R&D process and test the provided parts in-house for water treatment applications (Phase II). In the case that alternatives prove to be successful, the next Phase (Phase III) entails product re-designs to adjust for the new components. The adjusted products are then subject to further testing at customer sites to ensure that the components are suitable for actual use conditions and for longer periods. If the alternative products fulfil the customers' requirements, regulatory and technical requirements must then be addressed in Phase IV. This could mean that certain technical standards and/or customer requirements might need to be changed and adjusted or in other cases, certain products are subject to re-certification. This process can be costly and time-consuming. Upon successful re-certification, products containing alternative components can then be gradually included into the product portfolio and introduced to the market (Phase V). To

[6] For the socio-economic impact assessment, a time-unlimited derogation period has been used for the calculations.

allow customers to gradually change to the new products, a transition phase (Phase VI) is necessary to complete substitution.

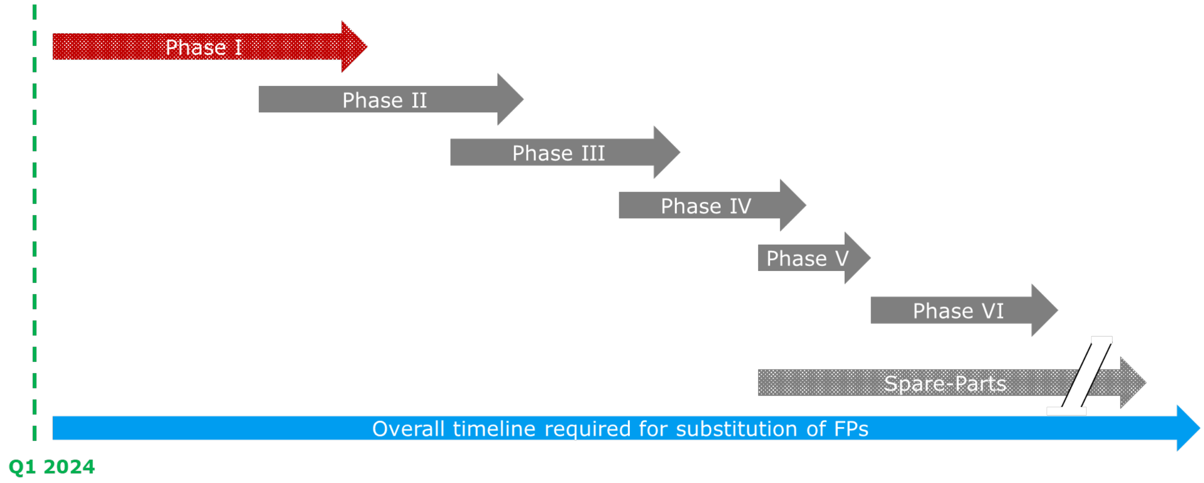

FIGURE 12: OVERVIEW OF SUBSTITUTION PHASES

TABLE 5: DESCRIPTION OF SUBSTITUTION PHASES

Phase	Description	Period (in years)
I	R&D of suppliers: Identification, testing and commercialisation of alternative materials and technologies by chemical suppliers and component manufacturers	7
II	R&D of potential alternatives (in-house / with suppliers) Testing of potential alternatives (in-house / with testing facilities)	6 (2 year overlap with Phase I)
III	Product re-design and readjustments External R&D and testing of potential alternatives (at customers) Large-scale tests	5 (1 year overlap with Phase II)
IV	Adjusting standards and requirements (with customers and/or authorities) Product certification	4 (1 year overlap with Phase III)
V	Inclusion of alternative products into market / addition to product portfolio	2 (1 year overlap with Phase IV)

VI	Transition phase to 100 % substitution	4
Spare-parts	Availability of FP-containing spare parts	10 – 15 (starting from Phase V)
Total substitution timeline without spare-parts (in years)		**23**
Total substitution timeline with spare-parts (in years)		**29 – 34**

4. SOCIO-ECONOMIC ANALYSIS

This chapter aims to compare the environmental risks associated with continued use (where emissions are used as a proxy) of fluoropolymers with the corresponding socio-economic benefits to the EEA society. The consequent chapters draw upon the analysis of the chemical safety report and input provided by figawa members.

It must be emphasised that the data available for monetizing impacts (such as foregone profits, one-off costs, and unemployment costs) was limited to German figawa member companies that utilize fluoropolymers in the production of water treatment technologies. Comprehensive data coverage for other EU member states or stakeholders within the scope of this report was unattainable, and available estimates do not precisely correspond to the same sector. Consequently, these results should be considered as illustrative examples for the EEA, rather than comprehensive representations.

4.1. Emissions as a proxy for risk

figawa members utilize FPs for the safe and durable operation of their products, including water treatment and heating as well as cooling systems. These members primarily engage in assembling end-products, and emissions from the manufacturing phase are considered controlled and negligible. During the intended use of end-products, emissions are also considered controlled due to the chemical stability and durability of FPs. Potential emissions may arise from wear-and-tear or the use of lubricants, although these are estimated to be small.

Data regarding emissions from waste treatment, such as incineration, are limited, but it is expected that more information will become available in the future. This may lead to improvements in abatement technologies. Both figawa and its members support the need for more data to establish appropriate regulatory approaches. Manufacturers of FPs are already taking steps to reduce emissions, such as phasing out the use of fluorosurfactants in production (Solvay, 2023) and the development of non-fluorinated polymerization aids (Gujarat Fluorochemicals, 2022).

In conclusion, figawa members produce essential products for water treatment, and heating and cooling systems, with a low concentration of FPs. The exposure potential during manufacturing, use, and disposal is minimal, although some emissions may occur.

4.2. Restriction scenario

According to current expectations, a potential PFAS restriction assumes entry into force (EiF) mid-2025, with the ban being enforced in 2027. In this sense, two restriction options (ROs) have been proposed (ECHA, 2023):

- RO1: A full ban with no derogations and a transition period of 18 months
- RO2: A full ban with use-specific time-limited derogations (18 month-transition period plus either a 5- or a 12-year derogation period)

Notably, as stated in the previously published restriction proposal, RO2 is considered to be the preferred option by the submitting Member States (ECHA, 2023).

As previously mentioned in section 2.2, no substances of concern (*i.e.*, short-chain and volatile PFAS substances) are used for the manufacturing of fluoropolymer-based components of the water treatment technologies within the scope of the current report.

Given the classification of fluoropolymers as polymers of low concern (PLC) (Korzeniowski, et al., 2023) and the absence of PFAS-free alternatives to water treatment technologies using fluoropolymer-containing components, figawa members commissioning the current report request a time-unlimited derogation for the use of fluoropolymers in water treatment technologies.

To assess the socio-economic impacts on the EEA society that would result in a restriction scenario in which no such time-unlimited derogation would be granted, the following sections introduce the business reactions of the different actors in the value chain (see section 2.2.1.1) and the associated consequences that would become applicable in such a scenario.

4.2.1. Business reactions of upstream stakeholders in the value chain

In a hypothetical scenario where fluoropolymers are not exempted from PFAS restrictions, significant consequences would be observed for fluoropolymer producers, processors, and component manufacturers. The supply chain would be disrupted, as fluoropolymer producers and processors could no longer provide their products to component manufacturers in scope of this assessment. Consequently, this disruption may lead to a complete closure of associated business activities for the upstream stakeholders. The severity of the disruption could potentially result in some companies facing a complete shutdown of their operations within the EEA, especially if their non-fluoropolymer-dependent production activities are unable to sustain long-term business viability.

Resultingly, foregone profits and job losses are anticipated for these upstream stakeholders. In cases where a complete shutdown becomes necessary, additional one-off investment costs for dismantling facilities, clean-up and remediation will become necessary.

4.2.2. Business reactions of manufacturers of water treatment technologies (OEMs)

In a scenario where fluoropolymer-based water treatment technologies face restrictions, all OEMs within the EEA, who are the dossier submitters, would find themselves compelled to discontinue their associated business lines. For many companies, this could result in a complete cessation of operations, especially if their product portfolio heavily relies on fluoropolymer-based technologies. Depending on their specific circumstances, such as their presence in non-EEA markets or their involvement in other prominent business areas outside the EEA, some manufacturers might consider relocating entirely to non-EEA countries or transitioning to different business sectors. Depending on the geographical markets served and prior experience, certain OEMs point out that they would relocate the remaining business outside the EEA. Other companies however find it impractical to relocate as the increased distance to their target markets outside the EU would impede lead times and delivery efficiency.

In certain cases, OEMs may choose to adapt their assembly lines, which would entail substantial capital costs, including the closure of existing lines and potential job losses. The impact of this situation could vary based on whether subsidiaries of a particular OEM are also affected, adding further uncertainty regarding research and technology development. On the other hand, some OEMs lack the expertise to switch to a different business domain, and as international demand declines, they anticipate that the European sites would not be repurposed for other applications, eventually leading to their dismantlement.

If an alternative becomes available, the members advise that a transition to PFAS-free products would be pursued to the extent possible and realistic whilst the components in contact with oxidizing and disinfecting agents like chlorine, chlorine dioxide, and ozone possess the resilience of PFAS-containing materials. The use of PFAS-free alternatives significantly increases vulnerability to faults and leads to more frequent leaks. As a consequence, operating personnel, and in the case of public and private swimming pools, even bathers, may be exposed to chlorine-containing gases and vapours more frequently.

Regarding the impacts, such a scenario would result in lost profits and job losses for the manufacturers of fluoropolymer-based water treatment technologies within the EEA. Additionally, potential one-off investment costs for dismantling facilities would have significant repercussions on EEA society as a whole.

4.2.3. Business reactions of downstream stakeholders[7] in the value chain

If fluoropolymers are not exempted from PFAS restrictions in water treatment technologies, various industries would face profound consequences. Downstream customers relying on these technologies, including those using spare fluoropolymer-containing components, would be adversely affected.

As maintenance and repair of spare parts in existing systems as well as manufacture of new systems with PFAS components is hindered under this restriction, both **municipal and private drinking water treatment plants** would be constrained to adopt less effective techniques. The dearth of fluoropolymer-dependent technologies for drinking water treatment would result in severe consequences, as no viable alternatives are presently accessible. This restriction scenario would jeopardize the provision of adequately treated drinking water, heightening the perils of waterborne diseases. Drinking water treatment plants might struggle to achieve quality standards, incurring one-time investment expenditures for the replacement of current technologies and requiring increased chemical dosages.

Swimming pools would also be required to supplant fluoropolymer-based methodologies with less effective alternatives. This would diminish the availability of safe pool water and potentially culminate in the breach of EU regulations, thereby resulting in financial penalties and limited access to functional swimming pools. The process would also entail one-time additional expenses and possibly heightened operational costs.

Industrial users employing fluoropolymer-based equipment for utilising **process waters** would also be obliged to retrofit less efficient methodologies, thereby giving rise to supplementary capital costs, augmented operational expenses, and potential environmental releases of by-products. Contingent upon water quality, industrial users might incur fines for non-compliance with water regulations. In the most adverse case, this could eventuate in business disruptions, profit losses, and workforce reductions.

Municipal wastewater treatment plants in the EEA would have to switch to less efficient methods, like the Activated carbon method, requiring considerable retrofitting expenditures and elevated operational costs. Municipal plants engaged in the treatment of wastewater with low levels of contaminants would confront capital expenses for retrofitting and increased ongoing operating outlays. On the other hand, those grappling with copious

[7] As it is difficult to capture the business reactions in case of such a restriction scenario of the different downstream stakeholders listed in section 2.2.1.1, this section focuses on three main customer segments, namely municipal drinking water plants, wastewater plants and industrial users.

levels of contaminants would incur additional expenses, diminished micropollutant removal rates, and an escalated risk of non-compliance penalties. Indirect consequences would inevitably impact industrial entities reliant on municipal wastewater plants for external treatment.

Similarly, downstream users encompassing building services and infrastructure, as well as other public facilities, institutions, and sales and distribution channels, would experience impaired business continuity. This disruption would transpire due to the unavailability of treated water at acceptable levels.

4.3. Impact assessment

Fluoropolymers play a crucial and irreplaceable role in water treatment systems as they effectively enable removing harmful substances, safeguarding human health and the environment. Despite continuous research efforts, no viable alternatives to fluoropolymers have been found so far. Introducing substitute materials would require rigorous and prolonged testing, especially for critical applications like water treatment. Moreover, incorporating alternative materials would necessitate redesigning existing certified products, potentially impacting overall system functionality and significantly reducing their service life. The unavailability of maintenance parts could result in complete system replacements long before their intended end-of-life, leading to substantial costs for both industries and the public sector.

The implications of forgoing the use of fluoropolymers are far-reaching, endangering public water supply, the efficient operation of wastewater treatment plants, water treatment processes in industries, and the functionality of swimming pools. This highlights the indispensable role that fluoropolymers currently play in ensuring the proper functioning and safety of water treatment systems.

As presented in chapter 4.2, the lack of a time-unlimited derogation for the use of fluoropolymers for water treatment technologies in the context of the PFAS restriction would generate consequences for several stakeholders along the specific value chain, thus further impacting the entire EEA society. In this regard, the following impacts will be covered in this chapter, either in a monetized form – whenever quantitative data was available – or in a qualitative manner:

- **Broader societal impacts**
- **Socio-economic impacts**
  - **Foregone profits** due to business shutdown at the level of:
    - component manufacturers
    - manufacturers of water treatment technologies *(monetization available)*
    - downstream stakeholders (e.g., pharmaceuticals, cosmetics sectors)
  - **Job losses** at the level of:
    - component manufacturers *(monetization available)*
    - water treatment technology producers *(monetization available)*
    - downstream stakeholders (e.g., pharmaceuticals, cosmetics sectors)
  - **Additional one-off costs** for decommissioning and clean-up of facilities due to business shutdown at:
    - component manufacturers
    - water treatment technology producers

  - downstream stakeholders (e.g., pharmaceuticals, cosmetics sectors)
- **Additional one-off costs** for replacing existing installations for treating drinking water, swimming pool water, process water and wastewater *(monetization available)*
- **Increased annual operating costs** for treating drinking water, swimming pool water, process water and wastewater

For the current impact assessment, the PFAS restriction is assumed, for simplicity, to enter into force mid-2025. While accounting for an 18-month transition period, the impact realization period is considered to begin in 2027. The base year of the analysis is 2025 and the impact assessment period was set to a timeframe between 30 and 45 years, in agreement with the impact assessment period considered in the PFAS restriction proposal (ECHA, 2023).

To monetize the respective impacts, a social discount rate of 3 % was consistently used throughout the assessment when deriving the net present value (NPV) or the annualized value for any given amount, in accordance with the latest guideline from ECHA on socio-economic analysis (ECHA, 2011).

For the applicable impact categories mentioned above, not all impacts have been monetised in the following chapters. The valuation of impacts and extrapolation thereof has remained difficult due to constraints in data availability for the entire sector and all stakeholders. **Data, wherever applicable for OEMs, was obtained by some figawa members for exemplary valuation which must be seen as a bare minimum indication of socio-economic estimates at least at the OEM level in the supply chain** (see Figure 8). Impacts associated with other stakeholders in the supply chain are only qualitatively explained.

4.3.1. Social impacts

With respect to the societal consequences incurred in the EEA in case of the considered impact assessment scenario, this section provides an overview over the effects related to unemployment as well as population health.

4.3.1.1. Broader societal impacts

As previously elaborated in section 4.2.3, imposing a PFAS restriction on water treatment technologies employing fluoropolymer-based components could severely impact the supply of drinking water. Assuming these technologies cannot be substituted by other PFAS-based methods, municipal water treatment plants in the EEA may struggle to eliminate contaminants from treated water, compromising their ability to deliver high-quality drinking water to consumers. Consequently, disinfection of drinking and bathing water may become increasingly challenging, leading to a potential decline in hygiene and heightened risk of water-borne diseases spreading throughout the EEA population, which would negatively affect public health.

Moreover, wastewater management issues could arise, necessitating the adoption of more costly and/or energy-intensive technologies. Additionally, the risk of accidents in public and private water supply systems could increase as new and unfamiliar materials are employed.

In general, the EEA may face a loss of investments and diminished growth opportunities in various sectors, particularly water-intensive industries that require ultrafiltration (UF) membranes as a pre-treatment for reverse osmosis, due to the aforementioned difficulties.

As mentioned in section 2.2.1.1, more than 5,000 EU companies produce products used for drinking water, including water treatment technologies and distribution systems. A minimum of 7,738,508 fluoropolymer-based water treatment units are installed in the EEA. In 2016, the European Union of Swimming Pool and Spa Associations reported approximately 100,000 public pools and 5 million private pools in the EU, where various chlorination methods were employed. As these systems would not be viable without PFAS, the socio-economic impacts are anticipated to be considerably more substantial. The potential consequences have been categorized as follows:

- Increased risk of water-borne diseases from the compromised drinking water supply and reduced pollutant removal rates from treated wastewater.
- Regarding swimming pools and safety, there is a potential reduction in swimming pool availability and decreased safety for swimmers owing to decreased swimming pool water quality.
- In terms of product availability and risks, there could be lower availability of products such as medicines, essential products like food and beverages, and cosmetics. This could lead to potentially increased food poisoning risks through contaminated food and beverage consumption.
- There is a possibility that there will be a rise in product prices, such as medicines and basic products like food and beverages, as well as cosmetics. This increase could be due to heightened operation costs that may be passed on to consumers.
- As for the environmental footprint, there could be an increased environmental footprint associated with less efficient water treatment technologies.
- Lastly, when considering water re-use capacity, there might be reduced water re-use capacity, especially for purposes like irrigation.

Despite the importance and potential impact of the aforementioned consequences on the EEA society, the assessment of these issues in the given context is primarily descriptive and not supported by precise data estimates. This is mainly due to the lack of sufficient data or information available to make accurate quantitative evaluations.

4.3.1.2. Social cost of unemployment

As already emphasized in sections 4.2.1. and 4.2.2, no time-unlimited derogation for the use of fluoropolymers in water treatment technologies from the PFAS restriction would result in job losses at manufacturers of such technologies as well as the level of upstream stakeholders in the value chain. The social cost associated with these job losses at that would be incurred by the EEA society in such an impact assessment scenario is monetized in this section.

Methodology

According to a valuation paper commissioned by ECHA (Dubourg, 2016), the social cost of unemployment associated with job losses can be evaluated based on the following components:

- The value of lost output/wages during the period of unemployment
- The cost of acquiring a new job
- Recruitment costs
- Scarring costs (i.e., the impact of being made unemployed on future earnings and employment possibilities)

- The value of leisure time during the period of unemployment

The latter component is defined as a negative cost (i.e., a benefit) of unemployment. As such, it is subtracted from the total cost resulting from the first four components.

For the current assessment, the figures from the aforementioned paper have been updated with recent data representative for 27 EU countries, by using 2021 estimates for wages (Rogers & Marques, 2021) and Eurostat 2021 data on the duration of unemployment (Eurostat, 2022 a.). The figures for average wages were projected to the year 2027 when they are assumed to accrue by using an average Labour Cost Index (LCI) of 2.425 % based on the LCI values registered between 2016 and 2021 and provided by Eurostat (Eurostat, 2022 b.). Notably, although estimations for wages are already available for 2022, for consistency with the data on unemployment duration, 2021 data has been used.

This approach leads to a value of the costs associated with losing one job of 98,151 Euros in 2027, which is comparable to the population-weighted average for EU-27 reported in the aforementioned valuation paper (Dubourg, 2016). By multiplying the number of job losses expected in the EEA in such an impact assessment scenario with the costs associated with losing one job, the total social costs incurred by the EEA society could be computed. Notably, for the evaluation of the number of job losses in such a scenario, the following additional assumptions were applied:

- It is estimated that a minimum of 1,424 jobs at the respective figawa member companies dependent on the production/sales of water treatment technologies relying on fluoropolymers would be lost at manufacturers of such technologies, which is about 55 % of all the PFAS-related jobs of the respective member companies in total (2,607) (see baseline employment information in section 2.2.1.2.).
- The research conducted on materials in contact with drinking water (Umweltbundesamt GmbH, 2017) also suggests that the EU employs over 100,000 people for producing products used with drinking water, generating annual sales of up to 40 billion Euros. Assuming that an additional 2 % of these jobs could be lost in the water treatment technology sector, such as those related to component manufacturers, it would result in a further loss of 2,000 jobs, or an additional factor of 1.4 times.

Results

At the level of manufacturers of water treatment technologies relying on fluoropolymers, it is estimated that a minimum of 1,424 jobs at the respective figawa member companies would be lost in the EEA in 2027 in an impact assessment scenario. Additionally, as explained in the assumptions above, another 2,000 jobs are expected to be lost in the upstream supply chain in 2027. The total social cost of 3,424 job losses is thus estimated at **316.78 million Euros** (NPV 2025). The value is equivalent to an annualized amount of **16.16 million Euros** per year of additional social costs considering a 30-year impact assessment period. This translates to an annualized amount of **12.92 million Euros** over a 45-year period.

TABLE 6: THE SOCIAL COST OF UNEMPLOYMENT INCURRED BY THE EEA SOCIETY IN CASE OF THE IMPACT ASSESSMENT SCENARIO DUE TO JOB LOSSES AT MANUFACTURERS OF WATER TREATMENT TECHNOLOGIES.

Socio-economic impact factor	Value [million Euros]
The social cost associated with all job losses at manufacturers of water treatment technologies in 2027	139.77
The social cost associated with all job losses in the upstream supply chain in 2027	196.30
Net present value in the base year (NPV 2025)	316.78
Annualized amount over a period of 30 years	16.16
Annualized amount over a period of 45 years	12.92

It is important to acknowledge that the information provided above solely represents a subset of figawa members and incorporates a minimal assumption for stakeholders in the upstream supply chain. Consequently, it should be emphasized that **these figures do not offer a comprehensive portrayal of the entire sector's impacts**. In reality, considering all stakeholders, the overall impacts would likely be considerably larger.

4.3.2. Economic impacts

As outlined in the beginning of section 4.3, the absence of a time-unlimited derogation for the use of fluoropolymers in water treatment technologies in the context of the PFAS restriction would generate several economic impacts for the different stakeholders in the value chain described in section 3.2.4.1. This section will cover the following impact categories incurred in the EEA:

- Producer surplus losses
- Additional one-off investment costs
- Additional operating costs

4.3.2.1. Producer surplus losses

As already explained in section 4.2, in a restriction, all stakeholders whose businesses depend on these substances would be affected.

Although fluoropolymer producers and processors as well as manufacturers of components for water treatment technologies would experience substantial foregone profits in such a restriction scenario (see section 4.2.1), for the current impact assessment these effects remain unquantified due to a lack of appropriate data. Given the current data availability, to maintain a conservative approach, the focus of this chapter is limited to the monetization of the foregone profits incurred by manufacturers of water treatment technologies.

Methodology

According to a guideline published by ECHA on evaluating losses in producer surplus, these foregone profits are the result of premature retirement of productive capital assets and represent losses to the EEA society (ECHA, 2021a). Based on this methodology, the foregone profits can be accounted for as producer surplus losses for the remaining service lifetime of capital assets at the point of decision making. The remaining service lifetime is based on the period of time needed by competitors to take over the respective market share dependent on the substance use (ECHA, 2021a).

Consequently, the following assumptions were made to monetize these producer surplus losses within the EEA due to foregone profits:

- To maintain a conservative approach and in line with the above-mentioned guideline (ECHA, 2021a), foregone profits were considered to accrue over a period of 2 years only.
- The valuation of producer surplus losses uses EBIT as a proxy. EBIT losses have been considered to start occurring in 2027.
- It was assumed that the entirety of EBITs contingent upon sales of fluoropolymer-based water treatment technologies would be forgone by the corresponding manufacturers (as demonstrated by the baseline financial data in section 2.2.1.2), To remain conservative, it was also assumed that the annual loss of EBIT should not surpass the EBIT attributed to the total PFAS use in this sector, which was the case for several member companies.
- The EBIT values of the year 2022 were considered a conservative proxy for the EBIT values expected to be registered in 2027, i.e., potential growth rates between 2022 and 2027 have not been taken into account.

Results

No time-unlimited derogation for the use of fluoropolymers in water treatment technologies would lead to foregone profits of **29.37 million Euros** (NPV 2025) for the EEA society. Notably, this amount only accounts for the producer surplus losses incurred in such an impact assessment at the level of OEMs of water treatment technologies. Annualized over a 30-year impact assessment period, this amount is equivalent to **1.50 million Euros** in terms of losses for the EEA society per year. Considering a 45-year period, the annualized costs become equal to **1.20 million Euros** per year (Table 7).

TABLE 7: FOREGONE PROFITS AT MANUFACTURERS OF WATER TREATMENT TECHNOLOGIES RELYING ON THE USE OF FLUOROPOLYMERS IN CASE OF THE IMPACT ASSESSMENT SCENARIO.

Socio-economic impact factor	**Value [million Euros]**
Foregone profits per year at manufacturers of water treatment technologies in the years 2027 and 2028	15.81
Net present value in the base year (NPV 2025)	29.37
Annualized amount over a period of 30 years	1.50
Annualized amount over a period of 45 years	1.20

As there are other OEMs of water treatment systems in the EEA besides figawa members that provided relevant data for demonstration of producer surplus losses in the EEA, it has to be noted that this is an underestimation of the lost profits on the real sector within the EEA. As described in section 2.2.1.1, the study performed by UBA estimated that more than 5,000 companies within the EU are involved in producing finished products used in contact with drinking water. A smaller share of these companies is expected to belong to the sector of water treatment technologies, another and probably larger share to the sector of water distributions systems.

4.3.2.2. Additional one-off investment costs

In section 4.2.2 it has been already outlined that, in the absence of a time-unlimited derogation from the PFAS restriction for the use of fluoropolymers for water treatment technologies, such existing installations at municipal plants for wastewater/drinking water treatment as well as industrial sites would have to be replaced. The additional capital costs arising as a result of such technology replacements are estimated in the current section.

Methodology

In the following, the total one-off investment costs are based on estimations of the figawa member companies for their own companies only. They estimated e.g., costs for the planning and construction of a new production plant for a substitute of the PFAS-based products, the testing facilities, e.g. for filters, softeners, and all necessary systems, as well as the conversion and shutdown of the previous production lines, of 26.25 million Euros in 2027.

Results

Overall, a lack of a time-unlimited derogation from the PFAS restriction for the use of fluoropolymers in water treatment technologies would result in additional capital costs for the figawa member companies of **24.74 million Euros** (NPV 2025). This is equivalent to an annualized amount of **1.26 million Euros** in terms of additional costs for the EEA society per year over a 30-year impact assessment period. Over a 45-year period, the amount is equivalent to **1.01 million Euros** per year (Table 8).

TABLE 8: ADDITIONAL CAPITAL COSTS FOR DECOMMISSIONING/REPLACING EXISTING WATER TREATMENT TECHNOLOGIES IN THE EEA IN CASE OF THE IMPACT ASSESSMENT SCENARIO.

Socio-economic impact factor	Value [million Euros]
Additional one-off capital costs for in the EEA in 2027	26.25
Net present value in the base year (NPV 2025)	24.74
Annualized amount over a period of 30 years	1.26
Annualized amount over a period of 45 years	1.01

It should be noted that the additional capital costs presented here underestimate the actual implications for the EEA water treatment sector. This is because, besides figawa members who provided data on additional capital costs for decommissioning existing water treatment technology installations, there are other OEMs and corresponding additional public and private installations in the EEA that have not been considered. According to Table 3, a total of 6,738,508 water treatment technology units are anticipated to be installed in the EEA by the end of 2023. **Since the impact demonstrated here is based on a limited amount of figawa members, the actual impact of decommissioning and replacing existing installations would likely be far more significant.**

4.3.2.3. Additional operational costs

As already described in section 4.2.2, in case no time-unlimited derogation from the PFAS restriction would be granted for the use of fluoropolymers in water treatment technologies, many wastewater treatment plants as well as industrial users would have to switch to less efficient technologies that will not be able to deliver acceptable treatment results in many cases, questioning the viability of continued operations in the EEA. This would in turn result in increased annual operating costs, for instance for energy (e.g., due to increased frequency of recycling) or for a higher dosage of (harmful) chemicals as well as bottlenecks in the supply of suited water quality resulting in cost intensive replacement strategies. Due to lack of appropriate data for a quantitative assessment, these impacts are however only qualitatively described at this stage.

4.3.3. Environmental impacts

A lack of a time-unlimited derogation from the PFAS restriction for water treatment technologies using fluoropolymer-based components would require the use of less-efficient methods to replace, wherever possible, such technologies. This would in turn result in a higher carbon footprint - e.g., for more frequent recycling of the contaminated active carbon material during using the Active carbon technology – as well as a higher load of contaminants in wastewater because of the missing effective oxidation and/or disinfection treatment stage.

PFAS-free alternatives do not enable the removal of certain antibiotics (e.g., Sulfamethoxazol) and several micropollutants from urban wastewater. Additionally, the potential use of bleach (Hypochlorite) for oxidation purposes by industrial users would increase the levels of Trihalomethanes (THM) and other chlorinated substances such as chlorophenols, Disinfection By-Products (DBPs), Adsorbable Organic Halides (AOX) in the treated wastewater for direct discharge. Additionally, the potential use of the bleaching method by industrial users would increase the levels of THM and other chlorinated substances such as chlorophenols in the treated wastewater for direct discharge.

Even the technology of UV disinfection contains PFAS material mostly used in sealings, wipers and as lubricants. UV disinfection is considered to be much less harmful to human health as it does not generate chlorinated DBP´s. A ban of PFAS in UV technology would require an intensive search for possible substitutes finally with an open result for the durability of the alternative materials.

4.3.4. Distributional impacts

In section 4.3.1.2 it was already mentioned that a PFAS restriction covering water treatment technologies using fluoropolymer-based components would result in several jobs to be lost in the EEA throughout the value chain of such technologies. As a result of such job losses, significant severance payments would be incurred by EEA companies where dismissals would become necessary. Nevertheless, such payments are considered distributional impacts and are not counted towards the overall monetized costs projected in this impact assessment.

Similarly, fines incurred by wastewater treatment plants and potentially by industrial users (see section 4.2.3) in case of non-compliance with regulatory standards for treated water following the potential replacement of fluoropolymer-dependent technologies with less efficient water treatment methods are also distributional impacts and not reflected in the monetized impacts computed here.

As a further remark regarding distributional impacts, it should be noted that the socio-economic impacts discussed in the current report would tend to be distributed throughout the EEA, with several countries being impacted to different extents. In particular, the countries in which manufacturers of water treatment technologies are based (e.g., Germany, France, Italy, Sweden, Austria, Italy), but also customers situated in Southern Europe, would be most affected from the perspective of producer surplus and job losses. In general, also many high-tech companies will be affected anywhere in the EEA, of which many are essential for digitization and the Green Deal, e.g., cooling High Voltage Direct Current Conversion (HVDC) for wind power. Meanwhile, increasing water prices may affect especially Member States in Southern and South-Eastern parts of Europe more than the others.

4.3.5. Compilation of socio-economic impacts

Table 9 provides a summary overview of the socio-economic impacts that would be incurred in the EEA in case there would be no time-unlimited derogation from the PFAS restriction for the use of fluoropolymers in water treatment technologies. Overall, the corresponding monetized costs sum up to a total of **370.89** million Euros (NPV 2025). The value is equivalent to an annualized amount of **18.92 million Euros** per year of additional social costs considering a 30-year impact assessment period. This translates to an annualized amount of **15.13 million Euros** over a 45-year period. These values do not account for qualitatively described impacts, such as further environmental, health and market effects.

TABLE 9: SUMMARY OF SOCIO-ECONOMIC IMPACTS INCURRED IN THE EEA IN CASE OF THE IMPACT ASSESSMENT SCENARIO.

Description of major impacts	**Monetised/quantitatively assessed/qualitatively assessed impacts**
1. Monetised impacts	**Value in million Euros [per year over 30 years] [per year over 45 years] [overall as NPV 2025]**
Foregone profits at manufacturers of water treatment technologies	**[1.50] [1.20] [29.37]**
Additional one-off capital costs for decommissioning/replacing existing water treatment technologies (NPV 2025)	**[1.26] [1.01] [24.74]**
The social cost associated with all job losses at manufacturers of water treatment technologies	**[16.16] [12.92] [316.78]**
Sum of monetised impacts	**[18.92] [15.13] [370.89]**
2. Additional qualitatively assessed impacts	
Higher environmental footprint associated with less efficient technologies	Not monetised
Higher risks of water borne diseases among the EEA consumer population	
Reduced availability of consumer goods and increased prices for EEA consumers	Not monetised
Increased annual operating costs for the operation of less-efficient technologies for water treatment	Not monetised

5. Limitations and uncertainties

While a conservative approach was taken throughout the current assessment, there are several data limitations in the analysis which led to an underestimation of the monetized socio-economic impacts summarized in section 4.3.5.

As previously emphasized in sections 4.3.2.1, 4.3.2.2 and 4.3.1.2, appropriate data for the monetization of impacts (foregone profits, one-off costs and costs of unemployment) was only available in the context of the German figawa member companies relying on the use of fluoropolymers when producing water treatment technologies. No reliable data coverage for other EU member states or even stakeholders falling under the scope of the current report could be made available; other estimates available do not exactly refer to the same sector. Therefore, the results can be regarded as exemplary for the EEA rather than area wide.

Furthermore, to maintain a conservative approach and due to lack of appropriate estimates, no foregone profits occurring upstream in the value chain (e.g., at fluoropolymer producers and processors, component manufacturers) were accounted towards the monetized impacts in this report. These effects are nonetheless expected to be large, thus leading to an underestimation of the results presented in section 4.3.5.

Finally, there was no data available for the monetization of further impacts on the EEA society associated with a lack of a time-unlimited derogation for the use of fluoropolymers in water treatment technologies. In this sense, effects related to the increased environmental footprint, reduced security of water supply and associated increased risk for all potentially affected public and private infrastructure could only be evaluated qualitatively.

6. CONCLUSION

In summary, the ramifications of a PFAS restriction, as determined by the socioeconomic evaluation, amount to approximately 370.89 million Euros (NPV 2025) or 15.13 million Euros per annum over a 45-year timespan. Although the assessment solely incorporates contributions from figawa members included in the scope of this request, it is crucial to underscore the far-reaching implications of such a restriction, in the absence of the desired exemption, upon the entirety of the EEA society.

Central to the argument is not the decline in revenue or employment levels, but the indispensable factor that some PFAS materials are fundamental to the effective operation of water treatment processes, particularly for drinking water. Secure access to uncontaminated, hygienically safe potable water is vitally essential to the provision of general interest services, categorizing it as a critical component of infrastructure, systemically significant, and indispensably linked to public health. A similar rationale can be applied to other uses of water treatment; wherein a non-exhaustive list of primary clients utilizing water treatment technologies that rely on fluoropolymer-based components includes municipal drinking water treatment plants, decentralized drinking water treatment devices for private or professional use, wastewater treatment facilities, public and private swimming pools, the (bio)pharmaceutical and cosmetics industries, as well as the pulp and paper, food and beverage, agriculture, and other industrial sectors. Insufficient time to identify, evaluate, and integrate suitable alternatives is likely to result in disruptions arising from hindered maintenance and repair actions and new installations, ultimately leading to supply chain complications.

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