Proposal of PFAS restriction – comments Agoria

Introduction

Agoria represents the technological industry in Belgium, more than 2100 member companies provide multiple technological solutions and products for society.

MANUFACTURING

BUILDING TECHNOLOGIES

Office & warehouse equipment
Windows, doors and facades
Lifts
Lighting
Home Automation
Individual Heating (CIV)
Heating, ventilation & cooling
Smart Building

ENERGY TECHNOLOGY

Multi-Energy

MANUFACTURING & PROCESS TECHNOLOGY

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Compressors
Textile Machinery
Machine Construction & Components
Pumps & Valves
Industrial Ovens
Industrial Cooling
Food Equipment
Machines for the food industry, packaging and pharmaceutical industries
Industrial Automatisation
Metal-Alliance.be

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Defence Equipment & Services
Agoria Fire Technologies
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Information Security
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TELECOM INDUSTRIES

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The proposed PFAS restriction covers more than 10.000 substances, which have a broad application within the technological solutions provided by the members of Agoria. Most of our companies have articles/products containing PFAS in their production processes and only limited use PFAS as a substance within their production process. It is in that perspective impossible to give an exhaustive overview of all concerned sector(s) and (sub-) uses in detail. But given the unique combined properties of PFAS, the substitution in multiple uses is challenging without any proper view to date on the potential alternatives.

For our companies there are several major challenges faced with this very broad restriction:

- An important challenge is to **identify** all different PFAS present in their complex products with a dynamic, broad and international supply chain,
- Besides the identification, it is equally challenging to find **suitable alternatives** in a short period of time as proposed within the restriction, if at all suitable alternatives are already existing.
- In the complex production processes of our companies also multiple PFAS containing articles are fulfilling a crucial role (filters, sealings, etc…). As for the products, identification is rather difficult, finding a substitution is challenging and will in all cases involve a complete **redesign of installations** with a significant investment cost,
- Also **maintenance and repair** will become challenging. Both for the products our members are supplying which are containing PFAS as well as in the production processes of our members. After the restriction it will be impossible to exchange in an existing product/installation certain PFAS containing articles/products given that the functionality is not the same within an existing design..

The contribution of Agoria on behalf of our members, is articulated around several major elements and focusing on some applications identified through the membership:

- General attention points on this proposed restriction which are broadly applicable
- The use of PFAS in heating, ventilation, air conditioning, cooling and refrigeration equipment
- High end-sealing applications, filters, gaskets, coatings,
- The use of PFAS in batteries as binder,
- The use of PFAS in semiconductor production,
- The use of PFAS in industrial installations.

Other applications, not yet identified in detail can be equally important and challenging for the technological industry; but given the limited time available as well as the difficulties to identify all uses, this is not taken up in this stage. We also refer to the contribution of several of the European sector federations in which Agoria is also a member and which contributed also to this stakeholder consultation. These are amongst others APPLIA, Digital Europe, EPEE, Orgalime, Semi Europe.

1. General attention points on the proposed restriction

In principle, a clearly **defined procedure for the application, review and eventual extension of exemptions** is necessary, especially in the case of a broad restriction of previously non-declarable substances. The **exemptions currently envisaged are insufficient** and do not take into account the relevance of PFAS for a wide range of uses and possible innovations in the technology industry.

It is important to foresee clear provisions to allow for products with long lead-times, ordered long before the application of the restriction, a clear transition period. It is also very unclear in the restriction proposal whether products which are in stock are to be seen as already put on the market. For the technological industry a proper working solution has to be found avoiding the destruction of unused equipment. This has also to be seen with the combination of spare parts and more specific for certain low rotating stocks.

Spare parts and retreated products must in principle, be exempted from the restriction. The **repair-as-produced principle** must be applied to the placing of spare parts on the market, wear parts and used parts for the purposes of sustainability and economic efficiency.

A general exemption is also needed for **products that have** already been placed on the **market** for **the first time.** Otherwise, they cannot be resold, repaired, maintained, or further processed and placed on the market again as a component of more complex products/articles. The only option would be disposal.

A derogation is needed on the presence of PFAS in recycled materials, in particular for products that do not present a risk of PFAS emissions into the environment during use phase.

Industrial applications in closed systems and equipment components and equipment generally do not cause relevant emissions to the environment when used as intended. Due to the high industrial importance, general and long-term exemptions are necessary, especially if not technically suitable and environmentally safer alternatives are known. Risks in the manufacturing and waste phase are better addressed in the relevant legislation (emissions/occupational health and safety, waste legislation, F-gas regulation).

2. The use of PFAS in heating, ventilation, airconditioning, cooling and refrigeration (HVACR) equipment

2.1. Introduction:

In cooling, heating, air drying and similar applications (broad range of HVCAR equipment) specific refrigerants gases are used for providing the needed heat transfer exchange. A broad range of gases are used ranging from the typical Fluorinated-gases, which contain certain PFAS substances (Fluoropolymers) as well as some non-fluorinated gases. There is a broad range of products designed, ranging from industrial applications towards commercial and residential HVCAR equipment which contribute highly to the decarbonization effort set by the European Green Deal.

These products have to comply with multiple regulations, such as:

- CE marking legislations such as Machinery Directive, Pressure equipment directive, low voltage directive, ….
- The existing eco-design directive with a major focus on energy efficiency targets. This directive will be replaced next year with the Ecodesign for Sustainable Products Regulation (ESPR) broadening the scope of the obligations towards circular economy objectives putting even more stringent obligations to this type of products,
- The F-gas regulation, currently under revision, with as major aim to gradually phase down F-gasses with a high global warming potential,
- The sectoral Extended producer responsibilities (EPR) such as the take back obligation of waste of electrical and electronic equipment,
- …

With the current proposed revision of the F-gas regulation, which is also applicable to F-gases under the PFAS restriction, the European Commission wants to accelerate even more the phasing down of F-gases with high global warming potential. Most producers have therefore initiated R&D projects to shift to F-gases with lower global warming potential, typical PFAS. The proposed restriction, which to our knowledge include PFAS for use of heating and cooling will have an important negative impact on this market. On top of that challenge the market demand is strongly increasing driven by the decarbonization (electrification) of heating and cooling in our society. The proposal will result in technologies which are not affordable anymore for the end-users. Consequently they will have no access anymore to these technologies with (in some regions) health impacts or in some situations no or limited access to the food and cold supply chain. Furthermore the European Commission recently adopted the net zero industry act, identifying this technology as strategic for Europe and hence is focusing on accelerating not only the production in Europe of this type of equipment but also accelerating the deployment of this technology by the EU Repower strategy.

The product design of a cooling/heating equipment needs to take into account all the different regulations which are applicable. In order to achieve the energy efficiency targets from the eco-design directive (the future ESPR), product designs are optimized given the specific used gases for that product. For a given product, there are no drop in alternatives available as the cooling/heating equipment will either not work anymore or work with a far lower energy efficiency and become non-compliant with the eco-design regulation. This will lead to an undesired effect, namely a higher energy consumption. This is contradictory to the targets of becoming the first climate neutral continent as set in the EU Green Deal. In order to comply with a potential PFAS restriction, all products using these PFAS as heat exchanger gases need to be completely redesigned. This process is not only challenging given the broad regulatory environment applicable to these products, but takes typical a long time period of several years.

2.2. Impact on the environment (emissions)

The application of PFAS in different cooling applications is highly regulated through different regulatory frameworks such as:

- F-gas regulation (currently under revision)
- WEEE directive with take back obligation of cooling/heating equipment containing potentially PFAS
- ELV directive for cooling/heating equipment in vehicles
- Service and maintenance of the cooling agent is limited to certified installers

The dossier submitters indicated the degradation product TFA as main reason to include fluorinated refrigerants in the restriction proposal. The recent Environmental Effects Assessment Report from the UNEP (EEAP-2022-Assessment-Report-May2023.pdf (unep.org)) states on page 25 the following on the effects from TFA from refrigerants :

> *The increases in trifluoroacetic acid concentrations due to replacements of the ozone-depleting substances are not expected to pose significant risk to humans or the environment at the present time. Trifluoroacetic acid (TFA) continues to be found in the environment, including in remote regions, although concentrations are so low that they are currently very unlikely to have adverse toxicological consequences for humans and ecosystems [105,106]. The accumulated amount of TFA is expected to increase because of the planned replacement of ODS with short-lived fluorinated chemicals (Fig. 11). However, based on projected future use of these precursors of TFA, no harm is anticipated. There is a large uncertainty associated with the magnitude of other sources of TFA (e.g., potential natural sources, fluorinated pesticides, and pharmaceuticals), which do not fall under the purview of the Montreal Protocol. Trifluoroacetic acid has biological properties that differ significantly from the longer chain polyfluoroalkyl substances (PFAS) and inclusion of TFA in this larger group of chemicals for regulation would be inconsistent with the risk assessment of TFA*.

2.2.1. Manufacturing

There are multiple types of heating and cooling equipment manufactured which can contain PFAS. In order to evaluate the emissions during manufacturing, distinction is made between:

- The *production of re*frigerants – typical outside of the technological industry. These emissions are regulated through the Industrial Emissions directive and the applicable environmental permit of the producers of PFAS. Also the potential emissions of transport and storage are well monitored given the importance to limit the impact on the greenhouse gas effect of these substances,
- The *production of multiple types of cooling and heating equipment*, industrial for multiple uses as well as commercial and residential:
  - During manufacturing an extensive leakage test is performed on every cooling/heating equipment given that emissions of F-gas (PFAS) over the lifetime of the installed product should be avoided due to the greenhouse gas effect,
  - Depending on the type of product, the cooling/heating equipment can be pre-charged with the refrigerant or the product is sold without any refrigerant. In the latter case, the certified installer makes the connection between of the refrigerant network between the in- and outdoor unit and fills the equipment on site. Prefilled products are typical stand-alone products and are filled at the production site of the product. The filling is made without any losses and an adequate monitoring is foreseen in order to detect and mitigate any leakage.
- The *installation of heating and cooling equipment*:
  - Depending on the type of product, the installer will perform after installation another leakage test in order to test the complete circuit and fill it only after no leakage of the circuit is detected on the site,
  - Some products are integrated in a specific application, such as cooling/heating for mobility, food retail, industrial products such as compressors, …. The filling process can take place during manufacturing of the heating equipment or at the moment the circuit is integrated in the application. In both cases leakage tests are always foreseen as well as the avoidance of any spills

2.2.2. Use phase

In order to limit the emissions during use phase, there is an obligatory maintenance of major equipment performed by a certified technician for cooling and heating equipment. Under the current proposal, a 12-year derogation is proposed for service and maintenance of HVACR (heating, ventilation, airconditioning, cooling and refrigeration equipment. However, it is important to consider extending this derogation beyond a specific time frame and basing it on the entire lifecycle of the product rather than limiting it in time.

To ensure circularity and align with the sustainability goals of the EU, it is necessary to take into account the lifetimes of such equipment, which can extend well beyond 12 years on average and up to 30 years for certain applications. By limiting the derogation in time, there is a risk of premature replacement of HVACR units that could otherwise be repaired and maintained. Therefore, we recommend introducing a time unlimited derogation for the service and maintenance of HVACR equipment.

2.2.3. End-of-life phase

The end-of-life for cooling/heating equipment and its refrigerant is typical composed of the following steps:

- Extraction of the refrigerant (PFAS/F-gas) of the equipment by a certified installer
- Different end-of-life management routes, which are in the case of F-gases a legal obligation:
    - Destruction through incineration if the refrigerant is too contaminated and hence cannot be recycled in the same application,
    - Recycling in order to be used again in the same application

Either way, the emissions of the PFAS/F-gas are avoided during this operation.
Some of these equipment fall under take back obligations, such as WEEE and ELV. In these cases, there are clear legal prescriptions foreseen for the proper extraction and end-of-life management of the F-gas/PFAS.

2.2.4. Estimation of emissions

For F-gas emission there is an extensive inventory existing through greenhouse gas reporting. These estimated emissions encompass of course the different industrial applications of F-gas but also the different types of F-gas, some of which are not PFAS substances. This remains of course an estimation but includes all different life-time stages.

Calculating the share of PFAS emissions in the total estimated F-Gas emissions is however not straight forward as this depends on the product mix of heating cooling equipment with the specific type of F-gas contained. As well as the evolutions of the product mix.

2.2.5. Impact on recycling

The recycling route of F-gases has as aim to re-use these F-gases in heating and cooling equipment which will reduce the production of new F-gases. With the restriction proposal as presented, this option will not be feasible anymore given that the PFAS cannot be put on the market anymore once the restriction is in place. The only option left is to destroy these PFAS gases by incineration.

2.3. Proposed derogations

At this moment there are no derogations within the restriction proposal for the use of PFAS as refrigerant in HVACR equipment. This has huge implications towards the increasing market demand for these applications with multiple dimensions and conflicting regulatory frameworks each with their own ambitions. The market increase is due to the transition towards a carbon neutral society for HVACR by electrification (heat pumps).

The revision of the F-gas regulation strives to gradually phase down F-gases with high greenhouse gas potential (150) towards F-gasses with lower greenhouse gas potential. The PFAS substances used in HVACR equipment are on the lower global warming potential gas side of F-gases and multiple products are currently designed in order to use this F-gas due to the objectives of the F-gas regulation.

The restriction has however as a direct effect that these gases cannot be used anymore once the restriction is in place and that a much more dramatic shift in R&D has to be accomplished in an even shorter timeframe than proposed by the already ambitious revised F-gas regulation. This is simply not achievable in the current market perspective and will potentially lead to a slow-down of the availability of products for the decarbonization of the HVACR equipment need for multiple industrial, commercial and residential applications.

The restriction has also a direct impact on the installations with PFAS as refrigerant. In fact, the design of this type of equipment is centered around the type of refrigerant used. This refrigerant cannot be substituted simply by another refrigerant without a complete re-design of the complete product. Enhancing the life-time of the installed equipment will not be possible anymore given that the refrigerant will not be available anymore after the restriction has been put in place, nor can it be recycled.

This means that maintenance of this type of equipment will simply not be feasible. In the case that an existing equipment has to be maintained and refilled with the adequate refrigerant, this will not be possible anymore and the complete equipment has to be exchanged. The scenario's / pathways of the reduction of F-gases incorporates the need for maintenance while the restriction does not foresee at all this option. It simply prohibits future use, including for maintenance. The replacement does not necessary involves only the equipment by itself but can also affect the complete installation such as circuits, industrial products in which they are installed (automotive, cooling for commercial applications, compressors, transport applications…) , the available cooling/heating for a given installation, the energy efficiency, the process efficiency in which the equipment is used... This will lead to multiple and different important unwanted side effects.

There is a need for a proper derogation for the use of PFAS as refrigerant in HVACR equipment in order to be in line with the proposed revised F-gas regulation. A global shift towards non-fluorinated refrigerants is at short term simply not possible given the broad range of applications and challenges within all the different applications. Agoria proposes that the restriction of the use of PFAS in HVACR equipment should be brought in line with the long-term phase out as foreseen in the F-gas regulation. It is already challenging for industry to re-design all the products in the long term to non-fluorinated refrigerants.

There is also a need to ensure that the existing installations can be properly used and maintained over the lifetime of the products. Therefore, a generic derogation for maintenance should be foreseen in the restriction proposal.

Based on the above, Agoria request the following derogations for the use of PFAS in HVACR equipment:

- Extension of the transition period of 18 months to 5 years and a time unlimited derogation for the fluorinated refrigerants used in the HVCAR sector, with a review clause after 10 years. This long derogation is needed given the high uncertainty of the feasibility of a complete re-design of all types of HVACR equipment,
- Exemption for the use of PFAS in maintenance, refurbishment, remanufacturing of existing equipment in order to enhance the lifetime of the equipment.
- Derogation for the export of equipment
- Derogation to ensure proper waste treatment
- Time unlimited derogation for spare parts.

- The contamination threshold in the restriction proposal is too severe. Regarding fluorinated impurities, it's recommended to refer to the threshold of maximum 5.000 ppm for acceptable impurities as indicated in the AHRI standard 700 2019.

3. High-end sealing applications, filters, gasket, coatings, …

3.1. Description use

PFAS substances are commonly used in sealings, filters, gaskets, coatings, … within multiple applications. Amongst this broad range of applications, there are certainly product applications which are easier to substitute with a PFAS free alternative and industry is clearly evolving in this substitution. However, in several cases the PFAS containing application, plays an important role in the product functionality. This is typical under harsh environments of heat, dust, corrosive substances, fluctuating temperatures, high pressure, etc.. In these cases, the substitution of this type of application is much more difficult given that no existing feasible alternative is known to date, which combines the different technical properties needed for a good functioning under the above mentioned conditions and for which PFAS is delivering through its properties this functionality.

3.2. Emissions over the life cycle

3.2.1. Manufacturing

The production of the sealing, filter, gasket, coating is mostly not realized within the technological industry, except some exemptions of very high-end applications (for instance in aerospace applications). Our companies mostly integrate these elements directly or through suppliers which integrate those PFAS-containing elements in more complex products/articles. Sometimes these products are even integrated in a complete subcomponent delivered to our companies, because they are specifically produced to deliver a technical specification. This makes it for the involved companies even more difficult to identify the potential presence of PFAS within this very broad application.

During manufacturing of machinery equipment there is no release of PFAS given that the integrity of these products/articles are not changed at all as it would affect their technical performance. Potential production losses of these products will be handled commonly with the industrial waste treatment foreseen at industrial plants.

3.2.2. Use phase

During the use phase, there are no intentional emissions of the PFAS containing sealings, gaskets and/or filters / coatings. In the case of any malfunctioning of these products, they will be replaced during the use phase. To prevent malfunctioning of the product, maintenance can be performed which could also involve the preventive replacement of these products. These operations are executed by professionals in the maintenance field and the end-of-life products are evacuated and treated as industrial waste. (see below).

Once again it should be mentioned that those high performance sealings, gaskets, filters, mostly contain PFAS for specific technical reasons and performances, mainly provided by the unique properties of the PFAS. To date no alternative substances, products are known which can deliver the same mostly combined functionality for which substitution is challenging. Changing the type of article/product within an existing product would lead in these cases to a loss of functionality of the product or even an early breakdown of the product. This means that maintenance should be performed with the same functional sealing as for those applications there is no drop in substitute. If the specific type of sealing would not be available anymore in case of the restriction of PFAS, the product cannot be repaired anymore and becomes obsolete.

3.2.3. End-of-life phase

The potential waste arising from production, as well as maintenance during the use phase will be dealt with by proper industrial waste management.

The end-of-life management of the element containing the PFAS article/product, really depends on the type of element. Within the members of the technological industry a wide array of different types of elements are manufactured. Some of them are governed by take back obligations, such as waste from electronic and electrical equipment – WEEE, End-of-life vehicles, batteries, …. Others are typical industrial applications and will be found in a B2B environment, for production, multiple types of machines, auxiliaries, …. This equipment has mostly a high value and a long lifetime. The composition is a broad mixture of materials such as a wide range of different metals and plastics. The PFAS containing products are in volume and weight rather limited in quantity, approximate less than 1%,but no effective range can be defined due to on the one side the broad range of different products within a complex supply chain, the complexity of the products as well as the difficulty to identify properly all PFAS in products.

The end-of-life management and potential emissions depend on multiple elements and are difficult to estimate, but a qualitative description is given of the known end-of-life management options and the potential emissions.

Specific for WEEE, ELV, batteries, … the take-back obligations have resulted in recycling value chains which are focused on a proper pre-treatment to separate different materials streams (typical plastics & metals) to achieve the foreseen high recycling yields. It is not clear what the faith of PFAS containing articles/products in this type of products will be, but the separation process strives mostly to achieve a high value stream of metallic waste which contains typical a low range of plastic (including potential PFAS) contamination. The main goal is to optimize recycling efficiency of metals (burning plastic waste is not contributing to metals recycling). Besides that, it helps to avoid certain contaminants in the metals recycling which can pose a significant environmental impact and it maximizes the value of the recycled metals.

Cross contamination of the shredding and separation process of PFAS containing products in the metallic stream could end up in the metallurgical recycling plant. The operation temperature of this metal recycling strongly depends on the metal which is recycled. It can range from 500 to more than 1.400°C. A recent RVIM report indicated that PFAS are degraded above this high temperature (except CF_4 which is needing a temperature around 1350°C to have a complete degradation). The most common use of CF_4 is however in refrigerants.

The plastic waste stream on the other side can potentially contain quantities of PFAS coming from the pretreatment activities. The concentration will obviously depend on the amount of plastic versus PFAS containing sealings and whether there is a mechanical separation process in place of the PFAS containing polymers. We do not have adequate information whether this is technical and economically feasible. The route of plastic recycling is either mechanical or chemical recycling. To date however the mechanical recycling options are most commonly used as there are still challenges in chemical recycling, certainly with regard to high complex mixtures of plastic waste. The potential emissions of mechanical recycling are rather limited and the containing PFAS will be found back again in the recycled plastic which could pose some real challenges to plastic recycling given that the restriction is applicable also to recycled materials with very low concentration limits.

Also for industrial equipment not falling under a take back obligation, the recycling route is in general divided between metals and plastics and the fate of the PFAS contained will be the same.

Other circular strategies are also possible. Ranging from re-use to remanufacturing, but in that case the products/articles containing PFAS are mostly exchanged to assure high quality re-use. The replaced products/articles are following the proper recycling route. Whether this would be possible still with the restriction proposal in place is not clear at all. But as already mentioned this would be impossible for products which are functioning under a harsh environment for which multiple properties of PFAS are used to deliver a solution and where there are no alternatives to date available. Clearly, as already stated there are no drop-in alternatives and mostly the design of the entire product has to be changed. In the case of prolonging the timeline of the product in use, this would simply not be possible anymore and the product becomes obsolete..

3.2.4. Estimations of emissions

This is very difficult to provide given the broad range of uses and applications. As described above, the emissions during the application are minimal within the technological industry; At the end of the lifetime this is as described above depending on the recycling route.

3.2.5. Impact on recycling

The restriction will have mostly an impact on the recycling route of plastics. Those have to be sorted and treated in order to be compliant with the very stringent low values of PFAS as they should be able to be put on the market again. To date, no information is available on the current concentrations. Most of the plastics are at this moment mechanically recycled, without removal of the substances within the plastics. This means that those plastics will probably contain PFAS levels above the levels allowed within the restriction.

3.3. Timeline for substitution

The substitution of PFAS in the type of applications in articles/products is not straight forward since drop in alternatives are not always existing. Typical when a combination of different technical properties is needed, the finding of a substitute becomes difficult since PFAS substances are combining these different properties. These are elements such as low friction, high and/or low temperature (in combinations), dust, water repellant, chemical resistance, cryogenics, high and/or low pressures, fire resistance, etc… In those cases the substitution will involve a complete re-design of the product and typical a drop in alternative is not at hand in one substance/solution. Without having yet a view on existing alternatives for PFAS in those products/articles, the timeline of this re-design is rather important.

Important to take into account in this case are also the challenges as well as the unwanted side effects. Challenges consist mainly in substituting the PFAS product/article whilst keeping the same functionality of the product as well as complying with all regulatory obligations applicable to the product, such as energy efficiency, water tightness, machinery directive, … On the functionality, there are multiple side effects which are very difficult to avoid. Some examples:

- Changing a PFAS sealing in aerospace by a metal sealing would give the same functionality but with an important increase in weight (tons) which will highly increase fuel consumption
- Redesign a sealing in certain compressors will demand more material given that the high temperature around the alternative seal has to be 'evacuated in' order to avoid for instance early failures due to this high temperature,
- Seals are extensively used in industrial installations, with aggressive media, high temperature, … without the needed PFAS seals, entire installations can become obsolete given that they have to be redesigned
- Filters are commonly used as air filters in industrial installations. They combine the resistance to high temperature, corrosive environment, dust repellent, fire protection, … Drop in alternatives have major challenges of ensuring the same effective air filtration and operational certainty that for instance the filters are not getting fire and thus losing their functionality. On top of that they are integrated into an existing installation.

3.4. Proposed derogation

At this moment, we do not have a clear global view yet of all the applications and the challenges of substitution. Especially in these cases where the different technical properties of PFAS are combined in the application.

Given the uncertainty of finding alternatives for these applications, Agoria requests the following derogation in these specific applications:

- Extension of the transition period of 18 months to 5 years. This long derogation is needed given the high uncertainty of the feasibility of a complete re-design of all types of equipment involved,
- Exemption for the use of PFAS in maintenance, refurbishment, remanufacturing of existing equipment in order to enhance the lifetime of the equipment.
- derogation to ensure proper waste treatment time unlimited derogation for spare parts in order to be able to repair as build. A broad range of the involved equipment have a lifetime well beyond 10 years some even a lifetime of 30 to 50 years

4. Batteries

4.1. Description use

An important use of PFAS, more specifically fluoropolymers, within Li-Ion batteries is as binder material for the metal oxides on the cathode. The use of PFAS is linked towards the different specific technical characteristics of these PFAS, needed for the functioning of the battery (such as heat resistance). Multiple battery chemistries are using these types of PFAS as binder material, which are essential to be able to provide for high efficient batteries for future needs such as electromobility, electronics, …

Also some more 'classical' uses of PFAS in elements such as sealings, gaskets, etc… are equally important given the environment in which different type of batteries have to function. These are covered in other comments provide by Agoria and showcase the same challenges.

4.2. Emissions over the life cycle

4.2.1. Manufacturing

The manufacturing of the PFAS is covered by the producers of these substances, with amongst others of course the permitting and the Industrial Emissions Directive. Also the application of this material in the battery manufacturing is outside of the scope of the members of Agoria and is dealt with the manufacturing of the battery. However, we do have some production and research towards active battery material and the future generation of battery chemistry for enhancing amongst others the transition to future carbon neutral electromobility.

Some batteries are used stand-alone, but typical automotive batteries are assemblies starting from cells, modules to battery packs. During this assembling, no emissions are to be expected given that these are sealed modules which are put together into a battery for an electrical vehicle.

4.2.2. Use-phase

During the use phase batteries are designed to keep their integrity with no emissions.

4.2.3. End-of-life phase

At the end-of-life of a battery from an electrical vehicle, several strategies can be envisaged depending on the state of health of the battery pack but also other elements which are ranging from re-use, remanufacturing for other applications (stationary battery pack) towards recycling.

Typically as a first step, the battery will be removed from the car. At this moment no emissions are to be expected given that the removal should keep the integrity of the battery casing. Afterwards, the battery in the casing is dismantled in a specific facility with appropriate protection equipment to prepare the battery for either re-use or recycling. At this moment, specific for batteries of electrical vehicles this activity is not yet developed in full scale given the buildup of the market. Depending on the specific circular strategy, this dismantling should be going in a certain level of detail, either on the level of modules or on the level of cells

Within the re-use/remanufacturing, the different modules within the battery are typically recombined in a new stationary battery without changing the composition, without manipulation at the level of the battery chemistry. This means that the PFAS substances remain contained in the closed battery module and or battery packs. Exposure in this case is not existing.

The recycling route has as an objective to maximize the recycling yields for several metals which are contained in the individual cells of the batteries. In that case the individual modules will be further dismantled on the level of cells to optimize the recycling routes and to obtain the recycling targets as defined in the battery directive.

The individual cells in the battery contain the so called black mass, which is active battery material (metaloxides), in certain cases graphite, certain fluoropolymers (PFAS), a thin copper foil, … This black mass is recycled through a pyrometallurgical process at high temperature (well above 1.400 °C) where all the fluoropolymers are destroyed. This recycling process is the same process as for the recycling of smaller batteries (Li-Ion), whereby of course the smaller Li-Ion batteries are not further dismanteled. The dismantling at the level of the black mass is not done yet through a large scale industrial operation, given the low amounts of batteries coming back from the end-of-life market. Given however that these types of batteries contain different hazardous substances, clearly the necessary protection equipment for human health and environment is already foreseen in the current small scale operations.

4.4.4. Impact on recycling

The PFAS restriction will currently not have an impact on recycling given that the focus of the recycling is with regard to the contained critical and strategic materials within the batteries. The PFAS contained in the battery as binder, will typical be destroyed during the metallic recycling which is happening in pyrometallurgical process at ultra high temperatures (well above 1.400°C)

4.5. Substitution & Derogation

The substitution of PFAS in multiple different types of batteries, each with their specific technological solution is challenging. To date there are no alternatives existing for multiple applications of different types PFAS in batteries such as, binder materials, gaskets, different types of batteries such as solid state/zinc air/Lithium, electrolyte, …. Finding suitable alternatives will take much more time as the proposed generic transition period, also for those limited applications where substitution would be feasible given the lead time needed given the complexity of the product, the production chain, the requalification…

Agoria recommends to foresee at least a transition period of 13,5 years with a revision clause for extending this transition period. For some applications, our estimation are that this period of 13,5 years will be too short given the estimated timeframe of finding an alternative substance (about 10 years) and the timeframe from testing to commercialization (another 5 years).

5. PFAS use in semiconductor production

5.1. Introduction

The recent Chip act of the European Unions focus on increasing the independence of Europe of imported semiconductors by increasing European production. The semiconductor production is typical a very complex industrial manufacturing activity for which certain PFAS substances are used. From the starting point of the announcement of the PFAS restriction, more in-depth research has been done within the European semiconductor industry to update the identified PFAS uses in order to have a better view on the challenges such a restriction would mean for the semiconductor industry within Europe.

The semiconductor industry depends highly of:

- Process chemistries,
- Semiconductor manufacturing equipment
- Semiconductor manufacturing infrastructure
- Semiconductor manufacturing support equipment
- Semiconductor devices

All elements are needed to be able for a production capacity within Europe in order to be able to deliver to the European chipsact and other flagship initiatives such as defined within the Green deal.

5.2. Uses of PFAS within the semiconductor industry

Different types of uses of PFAS were identified in the semi-conductor industry, for more information we refer to the contribution of Semi Europe. This is a widely complex production process with multiple steps performed under controlled atmosphere. To give an insight the seven major production steps in which some PFAS is needed are described below:

- **Photolithograpy**: Photolithography is a patterning process that defines where to add or remove materials in each step of the fabrication of integrated circuits. Specialized fluorinated organic chemicals serve several important roles in performing photolithographic patterning processes
- **Wet chemical processing**: a number of different semiconductor manufacturing operations, including cleaning, etching, plating and planarization, employ aqueous- or solvent based formulation. Some of these applications use fluorinated organic chemicals
- **Fluorocarbon uses in plasma etch and deposition.** Perfluorocarbons (PFCs) and hydrofluorocarbons (HFCs) are essential gases for directional etching and cleaning of silicon compounds**.** Silicon and silicon compounds are the fundamental semiconductor components; they provide the conductive properties of metal as well as operating as an insulator. Additionally, fluorinated organometallic compounds are essential for the deposition of metal-containing films.
- **HTFs.** Many semiconductor manufacturing processes entail physical and chemical processes that require precisely controlled temperatures, and thus are highly reliant on HTFs. In both cooling and heating applications, fluorinated HTFs (F-HTFs) help ensure the ability to provide the precise temperature control required in specific manufacturing operations within the semiconductor fabrication process, and enable the testing of products to ensure the appropriate performance of semiconductor chips within finished electronic products.
- **Assembly, test and packaging materials.** A semiconductor package encloses one or more semiconductor devices or integrated circuits, protecting the device from the environment. The package connects the semiconductor to the printed circuit board (PCB); dissipates heat; and provides protection from the surrounding environment, particularly from moisture, shock/vibration, dust, etc.

- **Semiconductor manufacturing and related equipment (SMRE) and infrastructure articles.** Semiconductor manufacturing facilities and the manufacturing equipment and infrastructure within them contain a multitude of articles. An article is any object made from one or more substances and mixtures which during production is given a special shape, surface or design that determines its function to a greater degree than its chemical composition, whether on its own or in an assembly with other articles, substances and mixtures. PFAS-containing articles include those made of a fluoropolymer, articles coated or painted with a fluoropolymer, or other PFAS-containing materials (such as oligomers) and those made of non-PFAS polymers containing PFAS processing/machining aids or additives. Many semiconductor manufacturing applications require the use of PFAS-containing articles for safety, contamination control, resilience and other factors.
- **Pump fluids and lubricants.** Semiconductor manufacturing relies on the extensive use of robotics, automation and vacuum systems to achieve nanometer-scale precision. The use of lubricants, many of which need to be fluorinated, is essential to the precision and reliability of these systems.

These processes typical take place under highly controlled atmosphere, being cleanroom facilities.

5.3. Timeline for substitution and derogation

For Agoria and the semi-conductor industry it is important to have a proper derogation for the semiconductor production, which of course should cover also the supply and value chain for this complex manufacturing. Any failure would have an important negative impact to the future of semiconductor manufacturing within Europe. The derogation must capture all PFAS uses as identified by Semi Europa and submitted already. The derogation should be time unlimited as the first identification of the R&D needed for substitution indicate a time line well beyond 12 years. Therefore Agoria propose to have a revision taking into account progress of R&D within 12 years.

6. PFAS use in industrial installations

6.1. Description use

Due to the physical properties of PFAS, these substances are used within multiple industrial installations and equipment in a wide range of industries, such as metals productions, chemicals and pharmaceutical industry waste incineration … and this in multiple applications, such as:

- Sealings, gaskets in piping, industrial processes,
- Filters for air emissions
- Filters for waste water treatment plants
- Protective industrial clothing,
- ….

In these applications, most of the PFAS containing articles have a specific function which is linked to different combinations of the properties of PFAS and ensures the well-functioning of the application. Sealing, gaskets s typical ensures that liquid/gasses is not leaking under different circumstances, with typical the use of PFAS containing material for situations which are challenging such as corrosion, temperature, pressure, oil, dust, water etc… Filters in industrial applications can have different functions, such as filtration of all kinds of water (with a broad range of temperature, air filtration, off-gas filtration, with corrosive substances, high temperatures, humidity, pressure,etc…

These products are typical important parts of the well functioning of an industrial installation, with as aim to avoid the impact of the substances in the installation on the environment due to spills, emissions to air, water, soil, … mostly of aggressive or hazardous substances. Reason why these types of products are under a regular maintenance scheme in order to assure the proper functioning of their role. Installation safety is important to avoid incidents which could have a negative impact on the environment.

6.2. Emissions over the life time

6.2.1. Manufacturing

The manufacturing of the PFAS is covered by the producers of these substances, with amongst others of course the permitting and the Industrial Emissions Directive. The manufacturing of seals, gaskets, filters are sometime performed within the technological industry and also in that case, the emissions should (can be) regulated through the environmental permit.

6.2.2. Use phase

According to our knowledge to date there are no emissions during the use phase. The use of sealings and gaskets is the same application as in other products.

6.2.3. End of life phase

Several situations exists during end-of-life. The most common is the end-of-life of the product due to maintenance/repair. At that moment the product is isolated from the installation which is under maintenance and replaced by a new equipment. At that moment the end-of-life product is evacuated and treated accordingly within the value chain of industrial waste.

For sealings, gaskets, this involves either a recycling or incineration route – see section on sealings. For filters for off-gas and water treatment, typical this filter is charged with materials which are hazardous. The end-of-life management is typical hazardous waste treatment. It is not clear whether this involves a destruction of the material but this type of products at the end-of-life are not recycled but landfilled or incinerated. We do not have any knowledge about the potential emissions in this case.

6.2.4. Estimation of emissions of PFAS

No clear information available to date.

6.2.5. Impact on recycling

For sealings see section on sealings. Filters as well as protective industrial clothing is typical not recycled after the lifetime but follows the route of incineration. For filters, due to the fact that they are charged with other materials, the waste is in most of the time hazardous waste which is treated accordingly.

6.3. Timeline for substitution

For the sealings and gaskets, the same problem of the timeline of substitution is existing as the use of sealings – see comments above. For filters in industrial installations there is also no timeline available for substitution. Given that these type of products are regular maintained in order to assure the well functioning of the product, combined with the fact that there are no drop in alternatives, the restriction would have a dramatic impact on existing industrial installations which should be completely reviewed and rebuild once the restriction is in place as there is the need of maintenance and replacement which will not be feasible anymore. In fact a filter is designed for a specific use (filtring effect on hazardous substance with a certain performance under certain conditions – temparture, pressure, corrosivity ..to protect the environment). Simply putting a similar filter from size without PFAS would have impacts on the performance of the installation towards environmental protection and efficiency of filtration. One element is for instance the increased potential of fire in the filter installation with as major incident a malfunctioning of the filter with an impact on the environment and a shut down of the installation. In short; it would consist a major negative impact to a lot of companies which would have to stop operations until an alternative installation with the same environmental performance is build.

This type of installations have typical a high CAPEX and a long life time, if the maintenance is well performed. The CAPEX for environmental protection can go up to 50% of the total CAPEX installed which would have an important impact on this kind of substitution.

6.4. Proposed derogations

At this moment there is no information available on viable alternatives. Specific for filters needed for off-gas and waste water treatment, several elements have to be taken into account, such as efficiency of the solution in order to ensure a proper protection of the environment, operational safety, but also costs such as adaptation of the installation, etc… Given that on the one side the zero pollution agenda of the European Commission strives at further reductions of industrial emissions, the current challenge of finding suitable equipment which can provide lower emissions and the crucial role of PFAS at this stage in this type of equipment, it seems clear to Agoria that solutions at short term are not feasible. On top, for installations falling under the IED, this challenges is tackled through the revisions of the BREF's in which this topic could be looked into.

Therefore Agoria proposes for industrial installation to have a derogation which is linked to the finding of alternatives within the BREF revision process in order to assure that the environmental performance is not compromised and that the timeframe of an eventual restriction is linked to the availability of viable alternatives. Otherwise, there will be a regrettable substitution with higher (other) environmental emissions and without clear view on the actual impact on the environment of the use of PFAS in filters.

Given the high potential impact on industrial installation it is strictly necessary to provide a clear derogation for maintenance and repair for this type of installations (filters, sealings, gaskets, …). This should not be timebound.

Given the uncertainty of finding alternatives for these applications, Agoria request the following derogation in these broad applications in which the PFAS is used for which different technical properties are combined:

- Extension of the transition period of 18 months to 5 years and a time unlimited derogation for the use of PFAS in these applications, with a review clause after 10 years. This long derogation is needed given the high uncertainty of the feasibility of substitution combined with the long life time of existing industrial installations making use of these applications,
- Exemption for the use of PFAS in maintenance, of existing equipment over the lifetime of the industrial installation which can be long 30-50 years given the high CAPEX involve