

Some observations for consideration on parts of selected report summaries

Introduction

The consultant report summaries of the input received by the authorities to date was useful to understand the methodology and definitions used in these analyses. After carefully reviewing these reports, we would like to share some of our observations for your consideration. We hope for the opportunity to discuss these observations at an appropriate time, to ensure a shared complete and accurate understanding of the market, uses, and benefits of fluoropolymers, including fluoroelastomers, and perfluoropolyethers (PFPEs) in Europe. Key observations and comments have been separated by report summary below. However, where the same comment was noted across multiple reports, the comments have been outlined in this introduction.

General: Some common observations

Clear, Specific, and Descriptive Terminology is Critical to Understand and Regulate these Chemistries

Within and across consultant report summaries, substances have not been consistently classified to the correct substance group and subgroups in concordance with established PFAS terminology¹. Noting that the original authors and most recently OECD², are in concurrence and clearly state that the term PFAS only be used when speaking about all PFAS. The consistent use of clear, specific, and descriptive terminology will facilitate coherent communication, understanding, interpretation, and comparison of published studies as well as serve to highlight similarities and acknowledge key differences between PFAS substance groups, including when applying a science and evidence-based approach to evaluating the technical functionality and economic viability of alternatives (e.g. polymer and non-polymer as well as the named five substance groups: Non-Polymers: (1) Perfluoroalkyl and (2) Polyfluoroalkyl, and Polymers: (3) Fluoropolymer, (4) Polymer-Perfluoropolyethers; (5) Side-Chain Fluorinated Polymers).

¹ Buck et al. (2011), IEAM 2011, <http://dx.doi.org/10.1002/ieam.258>

² OECD (2021), Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance, OECD Series on Risk Management, No. 61, OECD Publishing, Paris. [https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/CBC/MONO\(2021\)25&docLanguage=en](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/CBC/MONO(2021)25&docLanguage=en)

PFAS Substance Group Terminology and Definitions

In the PFAS category “Polymers” it is important to clearly describe the substances being addressed. In the original paper these terms are set forth clearly¹. The broad generic term “fluorinated polymers” encompasses all polymers for which one or more of the monomer units contains the element F, in the backbone and/or in side chains.

- **Fluoropolymers:** Fluoropolymers¹ are a distinct subset of fluorinated polymers. They are polymers with fluorine atoms directly attached to their carbon-only backbone. With their unique physico-chemical properties, these specialty plastics are virtually chemically inert, non-wetting, non-stick, and highly resistant to temperature, fire and weather. Irreplaceable in many applications, their unique *material properties* cannot be guaranteed by other polymers.
 - **Fluoroelastomers:** Fluoroelastomers are a distinct subset of fluoropolymers, since they are based on monomers selected among those used for synthesizing fluoropolymers. Fluoroelastomers are rubbery materials based on several of the same monomers used for producing fluoropolymers. Fluoroelastomers are produced as highly viscous liquids and then cross-linked (or ‘cured’, or ‘vulcanized’) to harden them and impart their elasticity.
- **Side-Chain Fluorinated Polymers:** Side-Chain Fluorinated Polymers are a hydrocarbon polymer backbone with a polyfluoroalkyl side-chain bound to the backbone as well as side-chains that have no fluorinated carbons. The polymer has a comb structure where some of the tines are a side-chain with the perfluoroalkyl moiety and some are hydrocarbon. Side-chain fluorinated polymers have *surface properties*. See: Fluoropolymers Product Group, Plastics Europe. https://fluoropolymers.plasticseurope.org/application/files/7016/1167/4026/Fluoropolymers_vs_Side-Chain_Fluorinated_Polymers.pdf

In a number of the Consultation Report Summaries, the terms “fluoropolymers” and “fluoroelastomers” were incorrectly used interchangeably. It is important to understand that fluoroelastomers are a distinct subset of the larger group of fluoropolymers, and that not all fluoropolymers are fluoroelastomers. Specifically, Chemours found that fluoropolymers such as polytetrafluoroethylene, PTFE, were referred to as fluoroelastomers. This is incorrect. PTFE is not a fluoroelastomer.

Polymerization Aid (PA) vs. Polymer Processing Aid (PPA)

There is a need for alignment in the industry around the usage of two important terms: polymerization aid (PA) and polymer processing aid (PPA). This misalignment was also evident in the consultant report summaries. It is not critical to align on an acronym, but rather for the authorities to understand that these are two, very different uses.

- **Polymerization aid (PA)** is the term used to describe a surfactant, fluorinated or non-fluorinated, used in fluoropolymer polymerization. Certain, not all, fluoropolymer types can be manufactured without a fluorinated PA.
 - Throughout the Consultation reports, Gen-X is listed as an emulsifier and polymerization aid (PA) used to manufacture fluoropolymers. HFPO-DA is the chemical compound commonly referred to as Gen-X. Gen-X is a trade name of Chemours, similarly FRD (also listed in some reports) is an acronym internal to Chemours, and it is inaccurate to list Gen-X or FRD as broad abbreviations when the list of polymerization aids used in the manufacture of fluoropolymers (e.g. PTFE, FEP, PFA, etc.) is far more extensive.
 - For accuracy and to clarify that the term PA does not solely refer to Gen-X, we strongly recommend using alternative abbreviations or generic terms such as “fluorinated emulsifier” or “fluorinated polymerization aid” instead of Chemours trade names.
 - Other polymerization aids include, but are not limited to:

¹ Fluoropolymers are made by (co)polymerization of olefinic monomers, at least one of which contains F bound to one or both of the olefinic C atoms, to form a carbon-only polymer backbone with F atoms directly attached to it, e.g., polytetrafluoroethylene.

- Adona® (2,2,3-trifluoro-3-[1,1,2,2,3,3-hexafluoro-3-(trifluoromethoxy)propoxy] propanoic acid (IUPAC), CAS #: 919005-14-4, EC #: 700-835-7
 - perfluoro[(2-ethyloxy-ethoxy)acetic acid], ammonium salt (EFSA) CAS #:908020-52-0, EC #: 700-323-3
 - Acetic Acid, 2,2-difluoro-2-[[2,2,4,5-tetrafluoro-5-(trifluoromethoxy)-1,3-dioxolan-4yl]oxy]-, ammonium salt (1:1) (EFSA), CAS # 1190931-27-1, EC #: 682-238-0, also known under C604-cyclic or F-DIOX.
- Polymer processing aid (PPA) is a term used to describe a fluoropolymer additive used in a broad range of polyolefin applications, particularly in the manufacturing of polyethylene films, to overcome processing limitations of low viscosity resins. In polyolefin extrusion, the flow rate is limited by the onset of surface defects called melt fracture or shark skin and the lip build-up of dead low molecular weight material. To prevent and overcome extrusion instabilities, the addition of a small amount of PPA promotes material flow and improves yield and throughput contributing to energy savings. The use of a small amount of PPA (typically less than 1000 ppm) is effective in eliminating melt fracture, reducing die pressure, reducing die buildup, promoting downgauging initiatives, reducing energy consumption and carbon footprint, reducing downtime, reducing waste, improving quality, and increasing productivity.

Chemical Processing Industry (CPI) – Missing Use Sector

Chemours notes that the Chemical Processing Industry (CPI) use-sector is not listed in the questionnaire. Specific segments of the Chemical Processing Industry include but are not limited to oxygen production and handling, chlor-alkali production, hydrogen fluoride production, production of polyethylene blown films, and the controlled flue gas cooling, heat exchangers, and heat recovery systems utilized in these and other processes in the chemical industry.

Reliable, high performance, high quality fluoropolymers, including fluoroelastomers, and PFPE lubricants are used in the Chemical Processing Industry to protect equipment from corrosion and prevent product contamination in highly corrosive environments where other polymers do not have the thermal stability or chemical resistance to perform at required levels. In addition to chemical resistance, thermal stability, and cryogenic properties, fluoropolymers have good mechanical properties. For example, fluoropolymers significantly reduce the friction generated by the sliding motion of machine parts, preventing a major cause of wear and tear commonly sustained by industrial machines.

Fluoropolymers are most often used in the following industrial applications:

- Hoses, sealants, gaskets, and tubing for corrosive fluid handling
- Lining for heat exchangers or incinerators to prevent fouling or corrosion and improve energy efficiency
- Lined pipes, columns, and tanks
- Conveyor belts
- Wire and cable coatings for sensors, high-frequency data cable, and high mechanical strength cables
- Filters systems (filter housing, cartridge, woven filters, etc.) to purify chemicals or filter harsh substances from emissions

Additional details and citations were provided in Chemours' response to the first Call for Evidence. Ebnesajjad and Khaladkar, 2017. Fluoropolymers Applications in Chemical Processing Industries: The Definitive User's Guide and Databook. PDL Handbook Series. <https://www.sciencedirect.com/book/9780815515029/fluoropolymers-applications-in-the-chemical-processing-industries#book-description>

Comments and observations on selected Report Summaries

PFAS Production – Comments on Consultation Report Summary

Fluoropolymers are typically synthesized via free radical polymerization methods, which consist of a multistep process that includes the reaction of (primarily) fluorinated monomers in aqueous medium, halogenated solvents or mixtures of both. The polymerization process itself must be optimized in order to achieve the necessary quality of fluoropolymers, including fluoroelastomers, for high performance applications. This includes the selection of appropriate PA such that the structure, properties, yield and performance of the fluoropolymer/ fluoroelastomer is maintained. It is necessary that the PA is stable under the conditions used for polymerization of fluoropolymers and that the PA itself does not inhibit the polymerization. It is known that solvents and PAs containing hydrogen, chlorine, or bromine atoms will lead to chain termination³. For this reason, a number of fluoropolymers, including many fluoroelastomers, currently on the market do require the use of fluorinated PA for the production process.

It has been demonstrated that fluoropolymers satisfy OECD Polymer of Low Concern criteria for low MW leachables, with very low levels of residual monomers, oligomers or other leachables⁴. This can be attributed to both the sensitivity of the polymerization reaction to contamination and the post-polymerization processing steps implemented to remove residuals and drive off volatile monomers. Further, an independent regulatory management option analysis (RMOA)⁵ commissioned for fluoropolymers concluded that a derogation of fluoropolymers and relevant monomers from the PFAS REACH restriction coupled with updates of EU legislation dealing with industrial emissions would be the most appropriate approach to ensure control of risk from manufacturing of fluoropolymers.

³ Ebnesajjad, S (2016), Fluoroplastics Volume 2: Melt Processible Fluoropolymers. Chapter 8 - Polymerization and Finishing Melt-Processible Fluoropolymers. Elsevier Inc, 2016, pages 102-215.

⁴ Henry et al. (2018), IEAM 2011, <https://doi.org/10.1002/ieam.4035>

⁵ Fluoropolymers Group (2021), <https://fluoropolymers.plasticseurope.org/>

We would also like to highlight that following observations from the consultant report summary:

[Page 4, 2. Market Analysis]

- Page 4, first paragraph and Figure 2, we believe that the term polyvinylfluoride (PVF) is incorrect. The term should be replaced with polyvinylidene fluoride (PVDF), given that PVDF is produced for commercial and industrial use in greater volume.

[Page 6, 2.1 Annual EAU (EU27+NO/IS/LI/UK) production/processing tonnage volumes (last 15-20 years)]

- Page 6, Section 2.1, Table 1: PFAS manufactured/processed in the EEA (in tonnes): Additional clarification regarding how the “Remaining PFAS” volume is calculated and what is included (using clear, specific and descriptive terms) would be highly valuable.

[Page 8, 2.2 Annual EEA import volumes (last 15-20 years)]

- Page 8, Section 2.2 Subsection Fluoropolymers: It is not clear what “PFAEs production volumes” is meant to represent under the subsection titled Fluoropolymers. It is possible the third paragraph should begin with PFA rather than PFAEs, which would make greater sense given the second sentence is focused on reported production of PFA in 2015. Recall that PFA is one type of fluoropolymer.

[Page 9, 2.2.1 Eurostat data]

- Page 9, Section 2.2.1 Table 2: A summary of annual imports of PFAS chemicals from third countries into EU27 (tonnes): We believe it is necessary to clarify what is represented by the “Remaining PFAS Volumes” and if they are based on 100% PFAS or if these volumes include formulated products where PFAS is a percentage of the formulation.

[Page 11, Section 2.3 PFAS production in the market]

Page 11, Section 2.3, Table 5: Main global manufacturers of Fluoropolymers, F-gas and other PFAS: Chemours does not have a facility in Germany and therefore this should be corrected. There are other errors in manufacturing locations for other companies presented in this table that should be corrected.

[Page 14, Section 2.10 Identification of alternatives]

- Page 14, Section 2.10, Subsection Fluoropolymers: An expanded list of where there are no viable alternatives for fluoropolymers would greatly enhance the report. One additional example to note is LAN cable wire insulation and electronic component insulation for high frequency communication also does not have a viable alternatives.
- Page 14, Section 2.10, Subsection Other PFAS: It would be valuable if the authors could list the fluoropolymers specified by the survey respondent where the respondent has substituted 100% of the PFAS polymerization aid. In our experience, and as noted above, non-PFAS polymerization aid may work for some fluoropolymers but not all.

Electronics and Energy – Comments on Consultation Report Summary

[Page 3, 1. Uses/Applications]

- Page 3, Section 1, first sentence: PFA (perfluoroalkoxy fluoropolymer) should be included within the list of fluoropolymers that have a unique combination of properties that make them valuable in electronics and energy applications.
- Page 3, Section 1, Table 1: Use categories (where PFAS are applied) in electronics and semi-conductor (incl. immersion cooling): Another use category for electronics not yet in the table is fire resistant data cables.
- Page 3, Section 1, Table 1: Use categories (where PFAS are applied) in electronics and semi-conductor (incl. immersion cooling): It is unclear what the relationship is between lubricating oil on the left column of the table and the enabling of fluoropolymer articles (polymer parts embedded within manufacturing equipment, spare parts and infrastructure, piping, tubing, gaskets, etc.) for semiconductor manufacturing equipment and infrastructure on the right column of the table. Please clarify if the two comments are related or if this is just the structure of the table that makes it appear they are related.
- Page 3, Section 1, Table 1: Use categories (where PFAS are applied) in electronics and semi-conductor (incl. immersion cooling): Within the use category semi-conductor manufacturing column, many of the polymers listed are not PFAS.
- Page 3, Section 1, Table 2: Identified uses of PFAS in the energy industry, coal based power plant: fluoropolymers are also used as filters to control particulate emissions.
- Page 3, Section 1, Table 2: Identified uses of PFAS in the energy industry: Lithium-Ion batteries: The table fails to include several sub-uses of fluoropolymers in Lithium-Ion batteries for electrification of vehicles, examples are electrode binders, separator films/coatings, electrolyte additives, and thermal management pack/module (cooling fluids/refrigerants).
- Page 3, Section 1, Table 2: Identified uses of PFAS in the energy industry: Batteries: The table, and subsequent text on energy storage, fails to include any mention of flow batteries. Efficient and effective energy storage is critical for global energy infrastructure. Flow batteries provide a cost effective option for large-scale energy storage applications (>100 kWh) and fluorinated ionomer membranes (fluoropolymers) are uniquely suited to provide the ionic resistance, mechanical properties, durability, and chemical stability necessary for high-performance flow batteries.
- Page 3, Section 1, Table 2: Identified uses of PFAS in the energy industry, PEM electrolyser/PEM fuel cells: Chemours would add the membrane of PEM electrolyzers is also made out of Fluoropolymers.
- Page 3, Section 1, Table 2, PEM electrolyser/PEM fuel cells: We suggest grouping together MEA, Sealant, Gaskets, and Gas Diffusion Layer/Microporous Layer, since they have the same fluoropolymer sub-use under the use category of PEM fuel cells.

[Page 4, 2 Main PFAS]

- Chemours questions whether there are 100 fluorinated polymers used in the energy and electronics industry. A recent paper identified approximately 40 fluoropolymers as commercially relevant: Identification and classification of commercially relevant per- and poly-fluoroalkyl substances (PFAS). *Integrated Environmental Assessment and Management* **2021**, 17, (5), 1045-1055. <https://doi.org/10.1002/ieam.4450>

[Page 6, 4. Import and Export]

- Page 6, Section 4, This section fails to consider major energy equipment producers in Germany - especially wind **5.1.1c**. It is important to highlight that **5.1.1c** are two very large wind turbine suppliers. It also does not mention Intel and Global Foundries as key stakeholder for the semiconductor industry in the United States.

[Page 7, 5. Manufacturing and Market]

- Page 7, Section 5, sub-section batteries: The numbers provided for this section are outdated according to same source used **5.1.1c**
 - 2020 = 755 GWh
 - 2025 = 2492 GWh - EU 13.4% share
 - 2030 = 3440 GWh - EU 17.8% share

[Page 8, 5. Manufacturing and Market]

- Page 8, Section 5, Sub-section fuel cells: The CAGR provided for the global fuel cell market forecast is significantly lower than what Chemours would expect. Considering the expected evolution of fuel cell applications in transportation alone, Chemours would expect the CAGR to be greater than **5.1.1c**

5.1.1c**[Page 13, 8. Alternatives]**

- Page 13, Section 8, Table 4: List of available non-PFAS substances and technics in electronics, semiconductor and energy industry: The alternatives presented in this table do not offer the same combination of functional properties as fluoropolymers for the specified applications or are not yet market-ready. For example, hydrocarbon-based fuel cells are not viable alternative to fluoropolymers as their performance (lifetime and productivity) are not yet technically ready. Basic research shows promise, but more development is needed prior to replacement to avoid compromising performance, which would also impact cost. This is also true of the replacement of ePTFE with a hydrocarbon-based reinforcement; performance testing to date has been limited to lab scale, with significant differences in performance than that suggested in its early technical stage. Green syn fuels or hydrogen internal combustion engines could be considered, instead of fuel cells, for transportation applications. For PEM WE membrane, the alternative is a different type of electrolysis unit (alkaline), however that method requires a much more consistent energy supply and is therefore of lower benefit when used in conjunction with solar/wind (intermittent energy source). Similarly, silicone materials may not be an adequate alternative for fluoroelastomer seals or wire insulation from a performance standpoint and face scrutiny because they are not biodegradable and silicone (aka polysiloxane) polymers are known to be manufactured using methylated cyclic siloxane monomers. Several of them (e.g., D4, D5) have been identified as SVHC by ECHA. Additionally, ethylene propylene diene monomer does not have the same chemical resistance as a fluoroelastomers and therefore is not a viable alternative. Materials used in electronics and energy applications need to be able to withstand a wide range of temperatures as well as a wide range of aggressive chemicals (i.e. concentrated acids, bases, acids mixed with hydrogen peroxide, etc.). These service conditions have driven the use of fluoropolymers, and more specifically, PFA, PTFE, PVDF, FKM and FFKM.
- Page 13, Section 8, Table 4: List of available non-PFAS substances and technics in electronics semiconductor and energy industry, energy industry: The use of solid-state batteries as an alternative will

likely still require high performance materials for electrode binders – moving to solid state does not mean moving away from use of fluorinated materials.

[Page 15, 11. Environmental and social impact]

- Page 15, Section 11, Sub-section wider economic impact: Given that the report mentions that PFAS products are widely used across all industries, including healthcare, this report should mention electronic/medical components, e.g., imaging cables, imaging devices, etc. It is also important to emphasize that semiconductor chips made using PFAS enable much of the technology in our everyday lives and a restriction of PFAS would be detrimental to technical advancement globally.

[Page 18, Appendix 1: Examples of PFAS used]

- Page 18, Appendix 1, within the list of fluoropolymers included in the table and used in electronic, semiconductor and energy industry, it is important to include PFA as well as fluorinated ionomers.

Medical Devices – Comments on Consultation Report Summary

Overall, this document appears to be a reasonable assessment of a variety of uses of fluoropolymers and fluorinated compounds in Medical applications. However, there appears to be some comingling of Medical Devices and Compounds used in Medical procedures.

[Page 5, 2. Main PFAS substances]

- Page 5 references Fluoropolymer (PFAS) tubes, stating that tubes used for minimally invasive procedures are “...mostly made of ePTFE.” These tubes are not expanded PTFE (ePTFE), but rather fully consolidated, sintered PTFE tubes.

[Page 6, 3. Volume estimations]

- Table 4: It is unclear what is being represented in the table as it indicates both usage and production volumes for fluorinated polymers, which could result in double counting. There is also mention that PTFE tubes are not included in the list. A clarification of whether the volumes represent usage in medical applications and what applications are represented would be valuable for comparison between data sets.

[Page 12, 9. Economic impacts in case of a full PFAS ban]

- States that economic impact is unknown, but FPG report based on data gathered in 2015 states a value of 20M Euro for the fluoropolymer volumes alone. That does not account for the true value of fluoropolymers in medical applications. For instance, PTFE lined guide wires help to shorten medical procedure duration and reduce patient risk. It was estimated in the FPG report that saving just one minute on select surgical procedures would result in an annual savings of 300M Euro across EU. The report also estimates that as of 2015, the total medical sector sales in Europe were estimated at 100 Billion Euro.

[Annex]

- Minimally invasive surgeries should be highlighted, as there is only passing mention of catheters.
- Missing fluoropolymer coatings: catheter guidewire coatings, surgical trays, surgical tools, filters, sterilization coating, catheter liner coating.
- Missing applications: IV tubing, guide catheter, balloon catheter, sheath, catheter protective sleeve, infusion canulae, dilator, tracheostomy tube, pharmaceutical stoppers.

Transportation – Comments on Consultation Report Summary

The report summary states that “fluorine containing materials usually is more expensive compared to most other materials” and assumes in a later section that, for this reason, fluorinated materials are used only where performance requirements leave no other option. This statement is correct for fluoropolymers, which is why the use of fluoropolymers, including fluoroelastomers, is typically reduced to a minimum where possible. On average less than 0.1% of the total weight of a car will be contributed by fluoropolymers and fluoroelastomers.

[Page 3, 1 Uses / Applications]

- Page 3, Section 1, Table 1: The report’s table on “Uses and applications of PFAS in transportation products and articles” states that PFAS are used in industrial feedstock for body-, hull-, and fuselage construction. However, it is doubtful that fluoropolymers are used as a base material feedstock for these applications
- Page 3, Section 1, Table 1: In Sealing Applications, the report mentions fluoroelastomers such as PTFE. PTFE is not a fluoroelastomer. In fact, fluoropolymers (e.g., PTFE) and fluoroelastomers (e.g., FKM) are used. Furthermore, fluoropolymers and fluoroelastomers are not only used in seals in valves and gaskets, but also in quick connects, pumps, fuel systems (safety part). Furthermore, there is a subgroup which doesn’t appear in this report which is tubes and hoses made using fluoropolymers in general (fluoroelastomers and the fluoropolymers PFA, FEP and PTFE)
- Page 3, Section 1, Table 1: In the section electrical engineering and information technology, an important point on the performance standards of semiconductors in the automotive world is missing: Without fluoropolymers, semiconductors used in the automotive industry would not meet the required performance standards (e.g., dielectric constant, thermal, chemical and mechanical stability under use conditions). Furthermore, data transmission is not taken into account: Fluoropolymer insulated copper data cables for high speed and high quality data transmission from numerous sensors to the on-board computer to optimize fuel consumption, minimize emissions (CO₂ and NO_x) and increase safety.
- Page 4, Section 1, Table 1: There seems to be confusion on the use of fluoroproducts, materials such as fluoropolymers and fluoroelastomers, in coatings as seen in the coatings and finishes section. Coating of cables in the Selective Catalytic Reduction system for diesel engines (ad blue) using fluoropolymers should actually refer to cable or wire insulation and instead of “coating of diesel and gasoline particle filter hoses, turbo charger hoses and coolant lines, engine coolant lines and oil cooler lines” it should refer to layers of hoses.
- Page 4, Section 1, Table 1: In the subgroup titled “HVACR-systems in transportation vehicles” the table lists “use as processing aids in the fluoropolymer production” as an example. This example would be relevant to PFAS manufacturing, but it is not clear why it listed or relevant for stated subgroup in transportation.
- Page 4, Section 1, Table 1: In regards to health protection and lifesaving equipment, fluoropolymer insulation on the cables of brake wear sensors, fluoropolymer tubing in ABS, and fluoropolymer insulated cables in collision prevention and adaptive cruise control are missing.

[Page 6-7, 5 Exposure (workers, consumers)]

- Page 6, Section 5: The report fails to address the fact that solid PFAS (fluoropolymers and elastomers) are stable up to temperatures exceeding 300 °C when addressing worker and consumer exposure.

[Page 8, 6 Alternatives]

- Page 8, Section 6.1: Along with good sealing properties (avoidance of permeation, impermeability to gasses) as already mentioned in the summary, FKM and PTFE also show good compression stress resistance along all temperatures and chemicals.

- Page 8, Section 6.2: In the combustion engine system, the report fails to mention fuel hoses, turbo charger hoses, and other fluid hoses as key applications. Furthermore, for alternatives to cable insulations: alternative constructions which use various other polymers fail, as they lack the combination of a number of necessary properties (e.g., thermal, chemical and mechanical stability under use conditions).
- Page 8, Section 6.3: The subsection on lubricants fails to state that they are also used for noise and vibration reduction.
- Page 9, Section 6.4: In the section on coatings and finishes, the alternatives mentioned lack either thermal or chemical resistance properties of fluoropolymers.
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Lubricants – Comments on Consultation Report Summary

[Page 3, 1 Uses & Applications]

- Page 3 contains an opening statement that notes that stakeholder consultation and literature for the lubricants have been presented per sector/industry but includes the caveat that "the list is not necessarily exhaustive." We agree with the assertion that the list is far from exhaustive but would add additional context, given that the overriding consideration is value-in-use. PFPE based lubricants are extremely expensive compared with alternative technologies. Their use is typically reserved for applications where alternatives present a major safety risk (i.e., fire or explosion) or are not economically viable (i.e., service life at operating conditions). PFPE based lubricants enable many applications, and equipment is often specifically designed to exploit their properties.
- Generally, we also think it is important to note that the report does not include a conclusion. Based on the information provided, it is clear no evidence of a viable alternative for PFPE/PTFE-based oils and greases exists. Hence, a ban of PFPE/PTFE-based oils and greases is not only unwarranted but unadvised, given the market gap such action would create.

[Page 5, 2.1 Main PFASs, Tonnage Bands]

- On page 5, section 2.1, we believe it is important to note that commercial sensitivity makes tonnage bands very difficult to estimate. There are a handful of global PFPE base oil producers, with only one producing in the EU. To prevent 'double counting,' we suggest separating PFPE base oil producers from PFPE Lubricant formulators. The process for PFPE (& PTFE) raw material production is very different from that of subsequent lubricant formulation – this will have implications for emissions and exposure scenarios. This suggestion also applies to Section 3.3 Number of production sites: (for both PFPE and PTFE).

[Page 6, 2 Main PFASs, Tonnage Bands]

- *Table 2. Total PFAS and main substances or substance groups identified, and size of the EU market* projects that the EU market for PFPE lubricant is "<1000T," however this does not reconcile with our understanding of the data. When combining our internal knowledge of lubricant sales in the EU and information from purchased market reports, we expect this estimate to be closer to 5.1.1c which would drop "Total PFAS" (and the number listed in the report) to 5.1.1c. We recommend revisiting this data set for accuracy.

[Page 6, 2.2 Main PFASs, Import/Export]

- We recommend a review of data included on page 6, in section 2.2 on Import / Export. The report estimates that 90% of lubricants used in the EU are manufactured in the EU; however, Chemours, Daikin, and NOK all sell PFPE-based oil in the EU that is not made in the EU. The leading EU producer of PFPE is 5.1.1c. It is well-known that 5.1.1c exports globally, but we do not know their production capacity or export quantities. In recent years, there has also been an uptick in the EU importation of PFPE base oils from emerging Chinese producers. International trade in articles containing PFPE/PTFE-based lubricants is extensive - in cars, commercial aircraft, military equipment, medical equipment, electronic devices, industrial machinery, etc. Thus, the assertion that 90% of

lubricants used in the EU are also made in the EU does not match our recollection of publicly available facts and we recommend reconsideration of this section.

[Page 7, 3 Manufacturing & market price + market development]

- Section 3.1 on market price asserts that fluorinated lubricants account for less than 1% of the overall lubricants market in terms of tonnage. We would add that the market share of PFPE based lubricants (defined as >60% by wt content PFPE) is much less than 1% by tonnage – and our estimates suggest 5.1.1c This would include lubricants utilizing low-levels of PFAS materials (for example: as additives) could increase this number to 5.1.1c. Also note, that depending on the specialist nature of the application and the volume used, the market price for PFPE based lubricants can be assumed as 100 to 1000 times the cost of traditional hydrocarbon (mineral oil) based lubricant. We recommend folding in this context to ensure a comprehensive understanding of the data.
- In section 3.1 on market development, it is worth noting and clarifying that PTFE Micro powders are also produced by direct polymerization in aqueous solutions or fluorinated solvent carriers. This production process does not require irradiation.
 - The report also points to the "use of granular PTFE in glide applications" as a niche use. Still, it would be helpful to understand what is meant by "glide applications" to appreciate the provided data fully.
- Page 7, section 3.2 incorrectly suggests that PTFE micropowder is only produced by "irradiation or thermal processing of granular PTFE." We want to clarify that this product also occurs via direct polymerization (i.e., 5.1.1c without "irradiation" and recommend including this context for accuracy.

[Page 8, 3.3 Manufacturing & market price + market development, number of production sites]

- Page 8, section 3.3 indicates that "no information is provided on the number of lubricant production or formulation sites." However, 5.1.1c potentially the world's largest PFPE producer, is the only significant producer in the EMEA 5.1.1c, and there are at least 10+ formulators in the region. We recommend including this context.

[Page 8, 4 Emissions]

- In Section 4 on Emissions, we recommend separating emissions from raw material (chemical process) production and lubricant formulation (blending).
 - *Table 4. Yearly emissions in the EU by vector (tonnes), including projections for BAU (Business As Usual)*, suggests PTFE was not commercialized before 2010. However, we can trace the sale of dried micropowders from DuPont back to at least the 1980s (and perhaps even further). We suggest revisiting this data set to ensure it reflects the most accurate historical accounting.

[Page 11, 4.1 Emissions, Emissions product manufacturing]

- Section 4.1 on Emissions product manufacturing suggests that formulation of PFPE based oils and greases is done at elevated temperature, which is incorrect. Water is not used in PFPE based lubricant formulation process. PFPEs, PFPE additives, and PTFE micropowders have extremely low volatility at normal (ambient) formulation temperature. Virtually nothing is lost by air emissions. PFPE lubricants have a very high value; therefore, great effort is made to avoid spillages/leaks. We recommend revising this passage to ensure it has proper justification for emissions factors.
- *Table 5. Key assumptions and justifications for calculating emissions during manufacturing include Environmental Release Category* includes numbers for formulation into a mixture that suggests "2.5%w.w to air and 2% w.w to wastewater." However, later in the report, Section 5.1 indicates,

"Industry stakeholders generally state that very limited emissions of PTFE and PFPEs are expected during production/formulation of lubricants. Less than 1% loss can be assumed..." This is accompanied by a footnote, indicating they "conservatively assumed higher values based on SPERCs." We recommend revisiting and reconciling both excerpts within the body of the report.

[Page 12, 4.2 Emissions Product Use]

- In *Table 7. Key assumptions and justifications for calculation of emissions during product use*, we recommend the following amendments:
 - In-use (sealed articles): Since with PFPE based lubricants, most automotive and aviation applications are inside the body of the vehicle, consider changing the categorization of outdoor/indoor applications. Even if automotive applications are classed as outdoor, we estimate 30% outdoor and 70% indoor as a more likely split that reconciles with general data.
 - In-use (open applications) Emission Factors: It would be helpful to understand how PFPE or PTFE-based lubricants can be released to air in outdoor applications such as bike chains.
 - Waste – Selection of pathways: We recommend revising how PFPE base lubricants (not including PTFE's) are denoted as primarily being within electrical or electronic equipment. This assertion may be correct for PFAS fluoropolymer electrical insulation but does not track for PFPE-based oils and greases.
 - Further, we suggest splitting lubricant waste from components in industrial applications into two categories: 1) Components that are lubricated for life –
 - Category 1 components are generally collected and disposed of in a controlled manner at their 'end-of-life.' Metal and plastic components usually are sent for recycling. In the case of metal components, the lubricant would be thermally consumed as part of the recycling process.
 - and 2) Lubricants replaced at service intervals –
 - Category 2: Spent oils are drained from equipment, collected, and can be recycled. If badly contaminated, used oils are generally sent for incineration. Spent greases are usually collected and disposed of by incineration as hazardous waste.
 - Lubrication of automotive components are subject to vehicle 'end-of-life' control measures. We recommend including or considering this context for awareness and accuracy.

[Page 15, 5.1 Exposure, General]

- Page 15, section 5.1 indicates, "Very limited emissions of PTFE and PFPEs are expected during production/formulation." Production of PFPE, production of PTFE, and formulation of PFPE greases are distinct production processes and should not be grouped and should be treated separately for emissions, exposure, and waste assumptions. These processes are also inappropriately combined in Section 5.2. Furthermore, we don't anticipate emissions from lubricant formulation but would expect some losses from residual oil coating in pails and drums and residual coatings on the batch production vessels, mixers, and package filling equipment. The number of losses will vary depending on container and batch sizes. Therefore, we would offer formulation "losses" as the appropriate term rather than "emissions," given the formulation of PFPE based lubricants. We suggest updating this language for clarity.
 - The report also indicates that less than 1% loss can be assumed, but "this will most likely go to a (hazardous) waste fraction." We recommend reviewing language here as "hazardous waste"

does not appear appropriate in this context, and PFPE oils and greases are generally not classified as hazardous waste.

- We would also note that 'open'/total loss' applications are typically industrial inside applications - such as chains for industrial ovens, film stretching rails, etc. The 'lost' lubricants stay within the building and are regularly cleaned away from the machine and treated as industrial waste. The exception is consumer bicycle chain lubricants, but this should account for <5% of the total 'open'/'total loss' application volume.
- Also, PFPE greases are not typically recycled - individual application volumes are small, and the spent grease is tough to remove and recycle. Used oils from industrial equipment lubricated by PFPE oil contained in a tank or sump can be recovered. A typical example would be vacuum pump gearboxes. Oil is drained when equipment requires a maintenance overhaul. Collected oils can be filtered and purified to remove contaminants and the grease re-used. Specialist companies exist for the oil recovery service. We recommend that this context be considered and included for accuracy on the issue of waste, recovery, and recycling.

[Page 16, 5.2 Exposure to workers]

- For 'Cleaning' within section 5.2 on exposure to workers, we recommend separating it into different categories: 1) PFAS solvents are used to clean mass-manufactured parts (such as electronic components). This is commonly done in specialist sealed equipment - solvents are recovered and re-used. 2) PFAS solvents can be used to clean components previously lubricated with PFPE based oils and greases (for inspection or possible re-use). This is relatively uncommon and typically takes place in an industrial or professional setting.

[Page 17, 6.1 and 6.2 Alternatives, General and Alternatives to PFPE]

- On page 17, sections 6.1 and 6.2 indicate, "literature discusses various potential alternatives to PTFE without clearly stating in which application such alternatives could in practice substitute" and "no literature discussing possible alternatives to PFPE lubricants has been identified." Our understanding suggests there are no suitable alternatives, as no other lubricants have the combined high-temperature stability and chemical inertness of fluorinated options.

[Page 18, 6.3 Alternatives, Alternatives to PTFE]

- *Table 9. Overview of the specified alternatives to micro powder and granular PTFE* notes silicone thickened polyurea as a potential alternative in certain applications but indicates a lack of data and reference material. We would be remiss to not note that the life span of PFPE-based lubricants is 21 times longer than shear-stable polyurea and approximately 60 times longer than the life span of conventional polyurea lubricants.

Construction Products – Comments on Consultation Report Summary

Throughout the document, the acronym "EFTE" is incorrectly used. The correct acronym is ETFE, which stands for ethylene tetrafluoroethylene. Additionally, it is unclear whether FEP (Fluorinated Ethylene Propylene) as well as FKM (Fluorocarbon-based Fluoroelastomer) are included in the category "other fluoropolymer substances" used throughout Section 4: Emissions product manufacturing and product use. Chemours suggests adding these substances to the major groupings for polymeric fluorochemical substances and clarifying their inclusion in the tables.

[Page 3, 1. Uses/Applications]

- *Page 3, Table 1.* Within the sub-level category of "building and construction", "coated fiber glass and fabrics" (PTFE dispersion used as dome covering in large buildings) should be added.

[Page 6, 2.1 Main PFAS, Tonnage Bands]

- *Page 6, Table 2.* Table 2 uses the term of “acrylate based side chain fluoropolymer”, incorrectly qualifying acrylate based side chains as fluoropolymers. The correct term would therefore be “acrylate based side chain polymers”.
- *Page 6, Table 2.* Table 2 states that Chemours manufactures or imports PVDF containing construction products or PVDF for use in construction products. This is incorrect. PVDF is not part of the Chemours portfolio.
- *Page 6, Table 2.* Table 2 does not take into account that FKM are part of the Chemours portfolio.
- *Page 6, Table 2.* Table 2 does not provide additional information on HFP(Hexafluoropropene). HFP is a colorless, pressurized liquid cataloged as a highly toxic material. HFP is a key raw material, a monomer that is reacted to make a polymer, in fluoropolymers like FEP and FKM, not used in its pure form in the construction industry.

[Page 7, 2.1 Main PFAS, Tonnage Bands]

- *Page 7, Table 3.* Table 3 makes the distinction between granular and micropowder PTFE. Chemours suggests adding fine powder PTFE in addition to these.

[Page 8, 3.1 Manufacturing & market price + market development, Market price]

- *Page 8, Section 3.1.* The Section 3.1 on manufacturing and market price, including market development, does not provide any information on the market price. Chemours suggests referencing the Fluoropolymer 5.1.1c
5.1.1c
- *Page 8, Section 3.2.* The section 3.2 on PTFE micropowders claims that insufficient data has been identified to help provide market splits. Chemours identified thermoplastics, elastomers, paints and coatings as main markets for micropowder PTFE.
- *Page 8, Section 3.2.* The section 3.2 wrongly claims that micropowder PTFE could substituted by granular PTFE. Due to its high molecular weight, granular PTFE cannot be used as a substitute for micropowder PTFE. PTFE molecules need to be broken down by specific processes.
- *Page 8, Section 3.2.* The section 3.2 considers “ETFE-powders” to be commercial grade. ETFE- Fine Powder is not a commercial grade neither used in Construction. Chemours assumes that the paper is referring to PTFE Fine powder based on the information of Table 1. This is the main reason the market is challenging to estimate. PTFE fine powder is commonly used in sealant tape for water & gas pipes and electrical cables.

[Page 9, 3.3 Manufacturing & Market Price + Market Development, Production Sites]

- *Page 9, Section 3.3.* The section 3.3 claims that there is no exact information given on the number of production sites. Chemours suggests referencing the Fluoropolymer 5.1.1c
report. 5.1.1c

[Page 19, 7 Alternatives]

- *Page 19, Table 12.* Table 12 includes the subuse/function category of “architectural fabrics”. Within the subuse/function category of “architectural fabrics”, Chemours suggests adding the following: wire and cable, tape for water and gas pipes and electrical cables, valves and flowmeters as well as heat exchangers. Within the PFAS category of “architectural fabrics”, Chemours suggests adding the fluoropolymers FEP, PTFE, PFA and ETFE.
- *Page 19, Table 12.* Table 12 includes “cotton and other natural fibres” in the “Non PFAS alternative?” category of the subuse/function category of “architectural fabrics”. Within the “advantage/disadvantage” section, Chemours suggests adding the characteristic of “very flammable materials”.
- *Page 19, Table 12.* Table 12 includes “polypropylene” in the “Non PFAS alternative?” category of the subuse/function category of “fluoropolymer tube lining”. Within the “advantage/disadvantage” section, Chemours suggests adding the characteristic of “reduced chemical resistance at higher temperatures”.

Food Contact Materials and Packaging – Comments on Consultation Report Summary

[Page 3, Introduction]

- On Page 3, the introduction previews the report and notes that it investigates the use of PFAS in food contact materials (FCM) and Packaging, and specifically how PFAS are primarily used to confer oil and grease resistance through non-stick surfaces. However, there is a clear distinction in PFAS chemistry depending on application properties we recommend capturing: oil and grease resistant food-contact paper products are based on the surface application of fluorotelomer-based side-chain fluorinated polymers (SCFPs). In contrast, non-stick properties of material coatings for consumer cookware and industrial are based on fluoropolymers.
- Throughout the report, the use of fluorinated polymer processing aids (PPAs) in the production of extruded polyolefin packaging film appears to be inadequately described. We recommend reviewing PPA mentions to ensure accurate denotation.
 - We believe it would be helpful to add the context that fluoroelastomers are also used as polymer processing aids in producing extruded polyolefin films that are, amongst others, used in food packaging.

[Page 3, 1.1 Uses/Applications, Packaging]

- Page 3, section 1.1 on applications lists the main uses for Packaging. Note that the provided uses can be expanded to include the following:
 - On food packaging – FFS tubes, Pouches, Frozen food, a Milk container, stretch + shrink films, and Other food packaging;
 - On Polyolefin consumer packaging – Plastic films for health and hygiene, Pharmaceutical, Bagging, Drums;
 - and on Polyolefin Feed packaging – Pet food, Agricultural feed, Silage, Greenhouse films, Silage films, Other (generic) packaging, and Non-food/feed applications.

[Page 3, 1.2 Uses/Applications, Consumer Cookware]

- Page 3, 1.2 on consumer cookware lists the applications for non-stick coatings as frying pans, ovenware, saucepans, cooking plates in electric gadgets. We recommend also noting consumer bakeware – including cake tins, bread-loaf tins, etc.

[Page 4, 1.3 Uses/Applications, Industrial Applications]

- Page 4, section 1.3 on industrial applications notes that one of the primary uses for PFAS in food processing is to provide a non-stick coating to conveyor belts, using fluoropolymers such as PTFE or polyvinylidene fluoride (PVDF). However, fluoropolymers are also widely used in industrial bakeware molds and trays because they provide long-lasting oil & fat-free mold release. PTFE impregnated glass cloth is also commonly used in food contact applications as a release agent. We recommend including this context, so the provided list of uses and applications is comprehensive.

[Page 4, 1.3 Uses/Applications, Industrial Applications]

- Page 4, section 1.3 on industrial applications lists the uses for food contact industrial applications and notes that one of the primary uses for PFAS in food processing lines is to provide a non-stick coating to conveyor belts, using PTFE or polyvinylidene fluoride (PVDF). Since the report also lists several other uses, and we recommend noting that FEP, PFA, and FKM are being used in these applications as well.
 - Other uses are listed as ovenware (including recoating services) and a variety of components: Seals, O-rings, gaskets; Tubing and pipes; Expansion joints; Valves and fitments; Conveyor belting, chutes, guiding rails, rollers, funnels, and sliding plates; Tanks, funnels, roller

(etc.) linings; Blades of knives and scissors; Springs; Filter membranes and sensor covers; and Lubricants.

- Moreover, this category should also include piping and tubing for drinking water applications, including fluoroelastomer polymer processing aids (PPAs – polymer processing aids) used in industrial plastic applications. For example, Polyethylene pipes used as Irrigation pipes and Water transportation pipes; Polyethylene tanks used in Drums and Containers, and Liners used as Geomembrane or in Fabrics.

[Page 4, 2.1 Main PFAS Substances, Packaging]

- Page 4, section 2.1 on Packaging states that most substances are “telomeric fluorosurfactants,” either as such or as side-chains of polymers. This is inaccurate and confusing. The specific chemistry and use need to be clearly and specifically described in the report. Side-chain fluorinated polymers (SCFPs) are a surface coating water, oil and grease repellent applied to paper used in packaging. In contrast, fluoroelastomers serve a completely different function (polymer processing aid, PPA), facilitating the extrusion of polyolefin films.

[Page 4, 2.2 Main PFAS Substances, Consumer Cookware]

Page 4, section 2.2 on consumer cookware also suggests that HFPO-DA (the fluoropolymer polymerization aid, PA, chemical compound commonly referred to as Gen-X) is present in the finished fluoropolymer coated cookware product, which is incorrect. Please note: In an independent test conducted by the Danish Consumer Council THINK Chemistry, it was evaluated whether fluorinated substances were released from frying pans to food. “16 commercial frying pans were tested from different manufacturers, filled with olive oil and placed in an oven at 200°C for 30 minutes. Olive oil extracts were analyzed for 22 specific fluorine substances and for total organic fluorine. No detectable fluorinated substances were released.” “Chemistry in frying” June 18, 2018 (utilizing Google Translate) <https://kemi.taenk.dk/test/test-kemi-i-stegepander>.

- Also, we understand the fluoropolymer coatings (ETFE, ECTFE, and PVDF) listed in section 2.2 are not used in the consumer product applications listed in section 1.2 (frying pans, ovenware, saucepans, cooking plates). The report also mentions fluorosilicones, fluorosiloxanes, and perfluoroelastomers under the PFA category, which is incorrect. PFA is an acronym for a specific type of fluoropolymer (perfluoroalkoxy).

[Page 5, 2.3 Uses/Applications, Industrial Applications]

- Page 5, section 2.3 on industrial applications also includes perfluoroelastomers (aka FFKM) but does not describe the fluoroelastomers (FKM) used to make o-rings and seals. We recommend FKM be added here for accuracy.

[Page 8, 3.3 Manufacturing & Market Price + Market Development, Industrial Applications]

- Page 8, section 3.3 on industrial applications notes that there is potential for growth in the market for PFAS, particularly on the component side (rather than coatings) given stricter legislation on food quality and the use of more severe conditions for cleaning and sterilization of food processing equipment. We agree and would add that growth is also expected in the industrial bakeware segment, due to the temperature extremes and sticky ingredients.

[Page 15 – 17, 5.1 Emissions product manufacturing and product use, packaging consumer cookware and industrial applications]

- Page 15: There is an ambiguous reference to “numerous examples” online suggesting that “10% or more” of the coating on consumer cookware is removed during use exposing the bare metal. If cookware is used properly under the “Use and Care” specifications from the manufacturer, there should be no film removal to bare metal. Further, the calculation at the bottom of the page for emissions to environment from this loss of coating uses the total tonnage/year of Consumer and

Industrial applications (bottom of page 11), while the paragraph above mentions only “consumer websites”. This entire section is unclear and should be revisited and/or removed.

- Page 17, Table 10: Table 10 lists possible emissions for “Recoating Industrial Cookware” which is not defined in Table 10. The assumption is that the number provided in Table 10 comes from the extrapolation of data from Table 9, which is described as values that “should be regarded as indicative only” given the high degree of uncertainty. The source provided for pans recoated in Sweden (in Table 9) is listed as “RIVM, 2020B”. Upon review of the indicated source document, there appears to be no discussion of recoating of fluoropolymer cookware in Sweden. The two examples noted in the document are recycling of expanded polystyrene boards and rubber granules used as infill materials. Because of the admitted high degree of uncertainty in these numbers and because it does not appear that the correct source is cited, we suggest that the emissions estimates for “Recoating Industrial Cookware” be revisited and/or removed.

[Page 19, 8.3 Alternatives, Industrial Applications]

- Page 19, section 8.3 on industrial application lists synthetic rubbers (e.g., seals, gaskets, pipes, tubes for liquid processing, etc.) as a viable alternative replacement for fluoropolymer and fluoroelastomer PFAS. However, non-fluorinated synthetic rubbers as an alternative to FKM (o-ring, gaskets, seals, etc.) would not have the chemical resistance and temperature requirements necessary for quality performance, especially in the chemical industry and industry settings with food-contact applications. In the absence of fluoroelastomers, the use of synthetic rubbers would result in severe corrosion, leaks, and severe environmental emissions and create significant risk for employees and public health.

[Page 20, 9.1 Economic impacts in case of a full PFAS ban, Packaging]

- For page 20, section 9.1 on Packaging, our review of this section suggests that it is missing critical information about polymer processing aids in producing extruded olefin polymers. A complete PFAS ban including fluorinated polymer processing additives (PPAs) in plastic applications will have a significant cost impact.
 - This includes a decrease of production rate by 30 to 50%, which results in additional costs for the consumer; an increase of scrap due to process instabilities, low yields for recycle scrap with additional costly processing steps; an increase in the use of plastic material. Also, the absence of polymer processing aids will require a re-design of the resin to process well, but at the expense of the physical properties.
 - For the sub-use of a non-PFAS polymer processing additive (PPA), there are no competitive or practical alternatives currently available as other materials may create processing issues such as poor welding, migrating to surface, or smoke generation that would complicate operations.

[Page 19, 8.2 Alternatives, Consumer Cookware]

- Page 19, section 8.2 on consumer cookware lists alternatives including ceramic, silicone coatings, stainless steel, silicone bakeware (not just coated), and anodized aluminum. However, additional context is necessary to evaluate each material as a reliable alternative.
 - Ceramic does not have long-term non-stick performance. If silicone oil is used to enhance the non-stick, this will migrate over time and is therefore not food contact compliant. Further, the sol-gel product is applied in a highly flammable solvent, creating a risk when used on an industrial scale. In contrast, PTFE-based coatings are all water-based.
 - Un-coated stainless steel does not react well to chlorine (i.e., salt). It is not non-stick, and therefore cooking without fat & oil is not possible, limiting consumer options for healthier cooking.

- Anodized aluminum cannot be used in a dishwasher, and it will need a coating.
- Copper is another alternative that is not a food contact compliant material. The threshold level is set at 0.6% in cast aluminum, according to the EN 601:1994 standard, making pure Copper an unsuitable replacement.
- Page 19, section 8.2 on consumer cookware also claims that several alternatives to the use of fluoropolymer-coated cookware are already available on the consumer market, and in some cases, have significant market share. However, there is substantial evidence that good quality fluoropolymer-coated options will outlast ceramic coatings, which in turn will be outlasted by, for example, stainless steel pans. Fluoropolymer coatings not only outlast ceramic coatings, but their non-stick performance is also better than ceramic coating. Further, since ceramic coated cookware has a much shorter service life than PTFE coated cookware, this means that the life cycle analysis for emissions is on the side of PTFE. Nearly five sol-gel coated pans are needed for every PTFE coated pan, tilting the overall CO₂ balance in favor of PTFE coated cookware.
 - Also, in general, high-quality PTFE coatings are reinforced and applied to already shaped cookware of a particular metal thickness (above 2.03 mm). Their dry-film thickness varies from 35 - 60 microns. Low-end cookware is made from thin metal disks (up to 1.6 mm) coated and then pressed into their final shape. Therefore, the coatings are thin (up to a max of 25 microns, but 10-15 microns is common) and cannot contain reinforcements.

[Page 22, 10.3 Methods used and uncertainties, Industrial applications]

- Page 22, section 10.3 on industrial applications states that recoating can result in gaseous emissions or to releases to water depending on how the coating is removed. However, the assumption that emissions from recoating release into air or water with all methods are false. When the coating is removed by abrasive stripping or grit or water blasting, the waste generated from abrasive stripping, grit, or water blasting is solid form, and fluoropolymers are insoluble in water. Therefore, emissions cannot be assumed to end up in water and air. It will most likely end up as insoluble waste in soil. We recommend reconciling the text with this information to ensure accuracy.

[Page 23, 11 Annex, Tonnage & Emissions]

- Page 23 includes a chart on tonnage and emissions by sub-use but does not include source citations for all data estimates. It would be helpful to have sources.
 - For the sub-use of Packaging, it would also be helpful to clarify if this refers to “plastic packaging” used in Food-contact applications in EEA or all-plastic Packaging used in EEA.
 - We also recommend reporting the categories as they are stated in AFW, 2017 (page 35, table 3.6) -- food & pharmaceuticals (3,000mt), Valves, stainless steel piping, tubing, filters; seals, gaskets, and other standard; fluid handling components, paper; tableware, conveyor belts, labware; products and Packaging.
 - The chart also includes expected trend growth rates but does not identify the source for these estimates. We recommend providing the source citations as some of the data does not reconcile with our understanding of the public record. For example, the expected trends are listed at 10-20% CAGR, but for o-rings and seals used in food-contact applications typically experience standard growth at GDP rate.

[Page 24-25, 11 Annex, Alternatives]

- On page 24-25, the chart on potential non-PFAS alternatives to replace coating material fails to note that this would, at the same time, increase the use of associated solvents. We also recommend the inclusion or consideration of several nuances or clarifications, including:

- For the sub-use of consumer cookware alternatives, the report includes superhydrophobic coatings and notes that there is a nanoscopic layer that can resist water. However, it is not immediately clear if this product is widely available. We recommend including context to that effect.
- For the sub-use of consumer cookware alternatives, the report lists enameled cast iron / seasoned cast iron as an alternative base material and non-stick coating. However, cast iron is not a non-stick alternative. We recommend revisiting for accuracy.
- For the sub-use of consumer cookware alternatives, the report lists fully ceramic cookware (not just coated) as an alternative base material. However, ceramic cookware cannot be used on all types of stoves due to cracking risks. We recommend including context to that effect.
- For the sub-use of consumer cookware alternatives, the report lists carbon steel as an alternative base material, uncoated. However, carbon steel may not be food contact approved. We recommend including context to that effect.
- For the sub-use of consumer cookware alternatives, the report lists anodized aluminum as an alternative base material that may be coated. However, anodized aluminum steel cannot be used in dishwashers. We recommend including context to that effect.
- For the sub-use of consumer cookware alternatives, the report lists Copper as an alternative base material, uncoated. However, carbon steel may not be food contact approved. We recommend including context to that effect.
- For the sub-use of industrial applications, the report lists synthetic rubbers and similar compounds as an alternative to fluoropolymer and fluoroelastomer PFAS. However, this substitute is untenable, particularly for the chemical industry or industrial settings with food-contact applications and in the transportation sector, including automotive, aerospace, and heavy-duty. There are no alternatives to PFAS that have the chemical resistance and temperature requirements necessary for this application. The use of alternatives in the absence of PFAS will result in severe corrosion, leaks, and severe environmental emissions, posing a significant risk for employees and public health. We recommend folding including these risks for context and accuracy.
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Petroleum and Mining – Comments on Consultation Report Summary

[Page 7, 1 Introduction]

- We would find it helpful to state specific PFAS compounds by group, subgroup, or name, being clear, specific and descriptive, so all stakeholders understand how PFAS is viewed in this context. Absent this clarity, some of the statements regarding the properties of PFAS can be misconstrued or are simply false because they are not applicable for every single member of the chemical class.
 - For example, the report notes that PFAS has the unique physiochemical properties of “high mobility.” This statement is factually untrue for all PFAS and highlights why it is so important to use clear, specific, and descriptive terminology. For example, fluoropolymers are included and described in parts of the report, fluoropolymers are not mobile in the environment. This point is elaborated upon by OECD (2021) ([https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/CBC/MONO\(2021\)25&docLanguage=en](https://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/CBC/MONO(2021)25&docLanguage=en)).

- The report also asserts that “a number of PFAS are known to display toxic and/or bio-accumulative health effects” However, not all PFAS are created equal, and the class cannot be evaluated as homogenous. In this context, it is also critical to underscore that the dose determines the toxin. The provided excerpt can be misinterpreted without disclosing more context about health effects, dosage, or the animal or human study in which these findings were had. As for health effects in humans, some studies purport to show relations to PFAS exposure but not necessarily causation – and that is a nuance worth clarity.

[Page 15, 3.2.1 Fluoropolymer, Use in oil and gas sector]

- According to the 5.1.1c total Fluoropolymers expected to be consumed by 2023 in Western and Easter/Central Europe is approximately 5.1.1c tons, respectively. However, section 3.2.1 of the report pegs current consumption figures at 70,000 to 150,000 tons, which is significantly higher than the 5.1.1c projection of 5.1.1c tons. We recommend reviewing this information for accuracy and ensuring it reconciles with public accounting. 5.1.1c
- The report also states that, based on the estimated range of the tonnage for fluoropolymers used annually in the petroleum and mining sector in Europe, there are approximately €5.25 to €11.25 million of sales per year. With estimated total sales of 3500 to 7500 tonnes per year, €5.25 million comes out to an average price of €1.5 per kg for fluoropolymers. This estimate is significantly lower than the average price of fluoropolymers. We recommend reviewing the data set as this calculation suggests that either the volume or sales value may be incorrect.

[Page 21, 4.2.1 Emissions of PFAS to the environment, Approach]

- For emissions from fluoropolymers, the report includes a breakdown of estimates for the proportion of total fluoropolymer used containing different concentrations of monomeric PFAS, based on various assumptions. However, the report does not articulate any basis for the assumptions made, leaving content at a very speculative level. Additional clarity and context on this matter would be helpful.

[Page 28, 4.3.1 Emission estimates time-series, Overview of approach]

- In section 4.3.1, the report estimates that the industry would require a minimum of 10+ years to transition towards producing alternative materials for fluoropolymers. However, the report also admits that the likelihood of identifying a viable alternative to fluoropolymers is low. Thus, proposing a transition time of 10+ years is not consistent with the report’s own admission.

[Page 34, 5.2 Alternatives identified in the oil and gas sector]

- Section 5.2 lists potential alternatives for fluoropolymer materials in the oil and gas sector, including steel and other metal alloys, non-metal materials, nylon, and different fluorine-free polymers. However, none of these alternatives have the thermal stability, chemical resistance, corrosion resistance, and/or insulating property that fluoropolymers have. Therefore, there are no viable alternatives. We recommend amending this section or including this context for total clarity and accuracy. Note, this caveat is already noted on page 35, Table 5.1 on fluoropolymers stating, “Alternatives may not be suitable for some applications and may not meet the same functionality in the required conditions.” The same caveat may be appropriate in section 5.2.

[Page 38, 6 Summary]

- The summary section states that alternatives for each of the three main applications of PFAS in this sector have been identified and are available on the market. However, this is not the case for fluoropolymers. The conclusion that there are suitable alternatives is also inconsistent with both the feasibility assessment articulated by report authors in section 5 and the Table included on Page 38 that explains the risks associated with a transition. We recommend revisiting this language for accuracy and clarity.

Cleaning Agents – Comments on Consultation Report Summary

[Page 4, 3. PFAS concentrations]

- **Floor polish**. For Floor polish applications, end-use concentrations of PFAS in cleaning compositions, polishes and waxes generally can be in the range of 75-200 ppm.
- **Glass cleaners and cleaning optical devices**: Concentrations between 100-1000 ppm are typical.
 - For the concentrations significantly below 10 ppm, an intended functional role seems doubtful. In our observation, if the concentration is below 25 ppm, short chain fluorosurfactants (Ethoxylates and Phosphates) mentioned in the above applications role is compromised due to lack of ability to reduce surface tension which is critical to impacting wettability and leveling power.

[Page 5, 8. Alternatives]

- Even though we can use hydrocarbon or silicone-based surfactants as alternatives to short chain fluorosurfactants to lower surface tension in these applications, there is a poor balance between performance and cost. short chain fluorosurfactants provide greater/superior wetting power/lower surface tension at lower use rate/cost when compared to hydrocarbon or silicone-based surfactants in these applications.