EASE Technical Contribution to the European Chemicals Agency's Public Consultation on the Annex XV Restriction Report for PFAS

September 2023

INTRODUCTION

In January 2023, a group of EU member states collectively submitted a proposal for restrictions to the European Chemicals Agency (ECHA) concerning per- and polyfluoroalkyl substances (PFAS). PFAS are chemicals known for their exceptionally high persistence, which has raised concerns about potential adverse effects on both the environment and human health. ECHA describes this proposal as the broadest in history, potentially affecting around 10,000 PFAS variants. Consequently, the impact of such a ban would extend to various PFAS compounds, regardless of their individual uses and effects.

PFAS compounds find extensive applications across a wide range of products and industries, including energy storage. In certain cases, viable alternatives are either unavailable or require additional time to develop fully. Acknowledging this complexity, ECHA is currently conducting a consultation on the proposed restrictions to gather input from stakeholders, including missing uses. This input aims to better understand the potential ramifications of the ban and explore possible exemptions when non-PFAS alternatives are not available.

The following text presents the response of the European Association for Energy Storage (EASE) to this consultation.

EU SURVEY PUBLIC CONSULTATION QUESTIONNAIRE

Note: Questions on certain topics were not addressed as they are not directly relevant to the energy storage sector, outside of EASE scope, or as EASE does not have a position on these issues.

Section III: Non-confidential documents

General Comments:

Select the relevant boxes that cover the content of your comments and provide your non-confidential comments below

☐ Scope or restriction option analysis

☐ Hazard or exposure

☐ Environmental emissions

☐ Baseline

☐ Description of analytical methods

☒ Information on alternatives

☐ Information on benefits

☒ Other socio economic analysis (SEA) issues

☒ Transitional period

☒ Request for exemption

It is important to consider and expand upon the concept of "essential uses" within the context of PFAS for society, as proposed in the European Commission's communication of October 14, 2020, titled "Chemicals Strategy for Sustainability Towards a Toxic-Free Environment." This approach recognizes that the application of PFAS in industrial processes can be highly complex, necessitating a thorough evaluation of the technical functionality of each PFAS compound and the suitability of alternative substances.

The electric industry plays a pivotal role in helping the EU achieve its decarbonisation objectives: electrification of transportation, industry and end uses combined with massive use of renewable energy as a primary energy source are pillars of the energy transition. Meeting these objectives will not be possible without the contribution of batteries and other critical components from the electric industry. Safeguarding this role involves ensuring uninterrupted access to crucial components and substances, particularly in the form of fluoropolymers. Several studies (Chemours, 2021; Henry et al., 2018; EPA, 2021) have concluded that fluoropolymers do not pose significant risks to human health or the environment. These studies demonstrate that the majority of fluoropolymers meet the OECD criteria for classification as "polymers of low concern" (PLC). Therefore, it is recommended to exclude these fluoropolymers from the list of PFAS compounds affected by the proposed ban.

Considering the electric sector's essential role for society, particularly in achieving decarbonisation goals, it is advisable to incorporate a 13,5 years derogation with a review clause (implying an extension of the derogation if non-PFAS alternatives are still unavailable after at least 10 years) or special regime within the PFAS restriction. This would apply to any article or mixture containing PFAS that contributes to facility safety, electrical supply security, as well as renewable and low-carbon electric production methods.

The current PFAS proposal could significantly impact the implementation of certain energy storage technologies, primarily batteries, which are vital to ecological transition and decarbonisation in electricity production. Thus, it is suggested that a transitional period of at least 13.5 years be established for certain compounds where non-PFAS alternatives are not yet available, provided that such alternatives exist, aligning with the deadlines proposed by the authors of the initial proposal. This duration would allow ample time for research and industry to identify efficient and secure alternatives to PFAS for various battery technologies. Other compounds, as detailed in the below answers, should currently be subject to a time-unlimited derogation from a ban, considering the low risk to the public and the complete lack of alternatives to sustain the technologies in question. Moreover, it is suggested to implement a timely reassessment policy in light of technology and market situation. Furthermore, for uses for energy storage technologies benefiting from derogations, a mechanism should be established to reassess the derogation period if no substitution meeting equivalent safety or production efficiency properties are available within the specified timeframe.

Specific Information Requests

1:

Sectors and (sub-)uses: Please specify the sectors and (sub-)uses to which your comment applies according to the sectors and (sub-)uses identified in the Annex XV restriction report (Table 9). If your comment applies to several sectors and (sub-)uses, please make sure to specify all of them.

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In practice, the proposed restriction would impact the entire electricity sector due to the essential role of PFAS in equipment required for the optimal operation of installations within this sector. This includes equipment like photovoltaic panels, wind power rotors, electrolysers, and fuel cells used in hydrogen production, as well as in thermal and decarbonised heat systems, heat pumps, batteries, switchgear, gaskets, and lubricants in nuclear power plants.

In the electric sector, just as in numerous other industrial domains, PFAS-containing equipment (e.g., seals, lubricants) serves crucial functions, especially in terms of heat and corrosion resistance. Moreover, such equipment contributes extensively to the secure generation of low-carbon electricity. For example, PFAS-containing materials play pivotal roles in sealing, operating backup pumps and other operations. Additionally, PFAS are indispensable in semiconductor manufacturing, making a ban on these substances a threat to the progression toward smart technologies.

6:

Missing uses – Analysis of alternatives and socio-economic analysis:

Several PFAS uses have not been covered in detail in the Annex XV restriction report (see uses highlighted in blue and orange in Table A.1 of Annex A of the Annex XV restriction report). In addition, some relevant uses may not have been identified yet. For such uses, specific information is requested on alternatives and socio-economic impacts, covering the following elements:

a. The annual tonnage and emissions (at sub-sector level) and type of PFAS associated with the relevant use.
b. The key functionalities provided by PFAS for the relevant use.
c. The number of companies in the sector estimated to be affected by the restriction.
d. The availability, technical and economic feasibility, hazards and risks of alternatives for the relevant use, including information on the extent (in terms of market shares) to which alternative-based products are already offered on the EU market and whether any shortages in the supply of relevant alternatives are expected.
e. For cases in which alternatives are not yet available, information on the status of R&D processes for finding suitable alternatives, including the extent of R&D initiatives in terms of time and/or financial investments, the likelihood of successful completion, the time expected to be required for substitution (including any relevant certification or

regulatory approvals) and the major challenges encountered with alternatives which were considered but subsequently disregarded.

f. For cases in which substitution is technically and economically feasible but more time is required to substitute:
   i. the type and magnitude of costs (at company level and, if available, at sector level) associated with substitution (e.g. costs for new equipment or changes in operating costs);
   ii. the time required for completing the substitution process (including any relevant certification or regulatory approvals);
   iii. information on possible differences in functionality and the consequences for downstream users and consumers (e.g. estimations of expected early replacement needs or expected additional energy consumption);
   iv. information on the benefits for alternative providers.
g. For cases in which substitution is not technically or economically feasible, information on what the socio-economic impacts would be for companies, consumers, and other affected actors. If available, please provide the annual value of EU sales and profits of the relevant sector, and employment numbers for the sector.

PFAS Use in Lithium-ion Battery Technology (Main PFAS used: Polyvinylidene Fluoride (PVDF) PTFE (polytetrafluoroethylene) and Lithium bis(trifluoromethylsulfonyl)amide (LiTFSI)):

a. Classical lithium-ion batteries consist of two electrodes (a cathode and an anode) immersed in a liquid electrolyte and separated by a polymeric separator. This separator permits the passage of ions while preventing the flow of electrons (acting as an electronic insulator). Each electrode comprises three main components: the electroactive material, conductive carbon, and binder.

The main application of PFASs is as an electrode binder, exemplified by Polyvinylidene Fluoride (PVDF). PVDF, a homopolymer of Vinylidene Fluoride, possesses excellent chemical and mechanical properties. PTFE may also be used as a binder for Li-ion technology with dry process.

Within the manufacturing process of traditional Li-ion cells, PVDF is primarily used in the cathode and anode slurry-making processes.

Moreover, in primary Lithium batteries, PTFE is used as a binder and both PTFE and FEP serve as gasket and washer materials within the SO2 and SOCL2 substances of the electrolytes.

While Polyimidazoles and fully chlorinated PVC hold potential as alternatives in certain cases, more research is necessary before testing and final qualification.

LiTFSI serves also as an electrolyte salt, especially for the solid-state batteries. This salt enables electrochemical communication between the electrodes by enabling the exchange of lithium ions. Additionally, for Lithium primary batteries, the use of PFAS salts has enhanced stability, performance, and safety compared to traditionally used Perchlorates.

Despite extensive efforts from academia and industry to discover potential replacements for PVDF, PTFE, FEP, and LiTFSI, there are currently no viable alternatives available.

Therefore, Li-on batteries cannot operate without PFAS today.

In summary, a ban on PFAS would make the use of batteries impossible.

b. Currently, suppliers of batteries without PVDF as a binder for the positive electrode are not available.

c. Due to costs and environmental concerns of the NMP solvent used to dissolve PVDF, battery manufacturers are gradually trying to shift from PVDF to hydrophilic binder materials, such as Styrene Butadiene rubber (SBR) copolymers. These materials can be used across various Li-ion cell chemistries mainly for the negative electrode with graphite anode without altering electrochemical properties. Although the replacement of PVDF with aqueous binders is desirable, and many cell manufacturers are working towards it, the goal hasn't been achieved yet for the positive electrode, and suppliers of PVDF-free batteries are not currently available. Despite intensive research since 15 years to find, in particular, lower-cost alternatives, no breakthrough solution was found to be conclusive mainly due to the high pH of slurry with NCA and NMC active materials. Furthermore, no detailed roadmap has been provided by cell suppliers regarding the availability of such batteries.

Given the fact that any innovation in electrochemistry needs to assess long-term ageing processes, we estimate that the discovery, qualification and implementation of PFAS alternatives will take at least 15 years.

Considering the critical role of binder and electrolyte salts in commercially available batteries and in upcoming solid state batteries, a derogation of at least 13.5 years should be set in accordance with ECHA's proposed deadlines. These recommendations provide the necessary time for R&D and industry to try replacing PFAS components in Lithium-ion battery technology without hindering the demand for batteries during the energy transition.

PFAS Use in Redox-Flow Battery Technology (Main PFAS used: Perfluorosulfonic acid (PFSA, Nafion), Polyvinylidene Fluoride (PVDF), Fluoroelastomer (FKM, FPM)):

d. Redox flow batteries (RFBs) are rechargeable batteries where electroactive molecules are dissolved in electrolytes and flow through an electrochemical cell, directly converting chemical energy into electrical energy. RFBs show promise for stationary energy storage due to their efficiency, cost-effectiveness per unit energy, prolonged energy storage, and extended lifetimes. They enhance grid stability and are composed of 2 electrolyte reservoirs that circulate electrolytes through an electrochemical cell stack. Each cell features an anode, cathode, and ion exchange membrane separator, facilitating ion diffusion while preventing electrolyte cross-mixing.

In the realm of membrane manufacturing for RFBs, the fluorinated membrane remains dominant, notably in the context of Vanadium redox flow batteries (VRFBs). Research also explores fluorine-free materials like Poly(ether ether ketone) (PEEK) as alternatives to Nafion. However, such alternatives are still under development and not commercially available, and a comprehensive technological roadmap for fluorine-free membranes is lacking. Polyvinylidene fluoride (PVDF) is widely used for the pump-magnetic coating and sensor connection because of its acid and oxidation-resistant properties. Fluoroelastomer (FKM, FPM) is employed for gaskets with resistance to high temperatures for thermal stability. Similar material containing PFAS is heavily used in the electrolyte production process, such as the vanadium electrolyte in the context of VRFBs.

e. Redox flow batteries represent a promising technology for long-term energy storage. The current technology relies on PFAS and lacks alternative materials. Considering the critical role of certain PFAS in commercially available flow batteries, a 13,5 years derogation with a review clause (implying an extension of the derogation if non-PFAS alternatives are still unavailable after at least 10 years) should be established for compounds like Nafion (PFSA), Polyvinylidene Fluoride (PVDF), Fluoroelastomer (FKM, FPM). To enable research and industry to identify PFAS alternatives, redox flow battery technology should remain commercially viable, especially taking into consideration its contribution to energy decarbonisation.

PFAS Use in Solid State Batteries (Main PFAS used: PVDF, PTFE, LiTFSI):

a. PFAS are crucial to solid-state electrolytes, particularly in solid-state batteries using polymer, ceramic sulfide, and ceramic oxide electrolytes. Lithium-metal-polymer (LMP) solid-state batteries utilize polymers as electrolytes. PVDF or PTFE, as a binder, reinforces the electrolyte for mechanical strength, making it integral to the future development of these batteries.

b. For these technologies, there are no foreseeable replacements for the PFAS used.

PFAS Use in Metal Air Batteries (Main PFAS used: PTFE):

a. Metal air batteries, which include zinc air and iron air chemistries, are batteries which operate by having oxygen in the air react with a metal anode inside the cell. PTFE membranes allow air to enter while preventing alkaline electrolyte leakage due to PTFE's hydrophobic and permeability properties.

b. There are no identified alternatives to replace the PFAS used in this scenario. In-depth research would require a minimum of 10 years.

Moreover, it is suggested to implement a timely reassessment policy in light of technology and market situation. Furthermore, for uses for energy storage technologies benefiting from derogations, a mechanism should be established to reassess the derogation period if no substitution meeting equivalent safety or production efficiency properties are available within the specified timeframe.

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About EASE

The European Association for Storage of Energy (EASE) is the voice of the energy storage community, actively promoting the use of energy storage in Europe and worldwide. It supports the deployment of energy storage as an indispensable instrument within the framework of the European energy and climate policy to deliver services to and improve the flexibility of, the European energy system. EASE seeks to build a European platform for sharing and disseminating energy storage-related information and supports the transition towards a sustainable, flexible and stable energy system in Europe.

For more information please visit www.ease-storage.eu

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Disclaimer

This response was elaborated by EASE and reflects a consolidated view of its members from an energy storage point of view. Individual EASE members may adopt different positions on certain topics from their corporate standpoint.

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