Supporting European Sustainability and Competitiveness: An Alternative Approach to the Proposed EU Restriction on PFAS (F-Gases)

September 2023

Introduction

In February 2023, authorities in Denmark, Germany, the Netherlands, Norway, and Sweden submitted a proposal to the European Chemicals Agency (ECHA) that calls for a complete phase-out of the manufacture, import, sale, and use of per- and polyfluorinated substances (commonly known as PFAS). PFAS are a class of thousands of chemicals, each with different safety profiles and uses.

While Chemours recognizes the concerns raised by the Dossier Submitters with the safety profiles of some PFAS, Chemours does not agree with the proposed restriction or grouping. The Annex XV report does not objectively identify and assess a complete range of potential restriction or regulatory management options (it only assesses the appropriateness of a ban), nor does it clearly demonstrate that the proposed restriction is the most appropriate means to regulate the potential risks of PFASs. Additionally, the proposed restriction—which includes fluorinated gases (F-gases) and specialty fluids—uses a grouping approach based on chemical structure and fails to justify the need of a case-by-case approach for F-gases, making the inaccurate assumption that all PFAS substances, including F-gases, share the same hazard and risk profile.

The EU has proven, science- and risk-based methods to regulate PFAS and other chemicals effectively; however, the current approach by the Dossier Submitters will block effective, safe, and already regulated technologies completely by instituting a widespread ban. For example, F-gases, such as Hydroflurocarbons (HFCs), low global warming potential Hydrofluoroolefins (HFOs), and HFO blends—have the potential to be banned due to the atmospheric degradation profile (trifluoracetic acid (TFA)) of some F-gases. These technologies are safely being used across the EU, are essential to achieving the EU Green Deal goals, and are successfully regulated under the F-Gas Regulation in the EU and the Montreal Protocol globally.

Before discussing alternative restriction options, it is important to understand the critical role F-gases play in our society. F-gas applications go far beyond comfort cooling; F-gases power the world's largest industries and value chain—from automotive, aerospace, and advanced electronics to constructions, HVACR, and data centres. These chemistries are critical for the EU to achieve its ambitions, to realising next generation computing speeds, enabling electric vehicles, fostering circularity, and achieving decarbonisation.

Chemours supports a science-based regulation to PFAS, which recognizes many of the Dossier Submitter and civil societies concerns regarding certain PFAS substances. However, not all PFAS are the same, nor should they be regulated in the same way, given the vast differences in structure and risk. PFAS can and are, safely used across many applications. As experts in the manufacture, properties, and applications of F-gases and specialty fluids, Chemours and its Thermal & Specialized Solutions (TSS) business are committed to take an active, responsible, and constructive role in the proposed restriction process to facilitate the development of a coherent approach to the regulation of PFAS.

Considering the emission reduction objective of the proposed PFAS restriction, we believe that controlling F-gas emissions under the existing (and the upcoming strengthened) regulatory framework would effectively and proportionately minimize their emissions and enable the continued, safe use of these critical technologies to advance decarbonization, electrification, global climate targets, and much more. In the sections that follow, we will outline how and why we believe this is a more appropriate restriction approach.

Science-Based Regulation is Critical to Achieving EU Ambitions & Competitiveness

Chemours and the EU ultimately share the same objective: working towards a successful and more sustainable future. However, achieving that requires science-based, targeted regulation that effectively promotes sustainable innovation.
F-gases and TFA are substances that have been proven safe for their intended uses and they are complemented by robust datasets showing that a quantitative risk assessment – and not a case-by-case approach – can be performed to derive safe concentration levels for both human health and the environment.
The grouping approach currently presented in the Restriction Dossier would undermine years of legislative and scientific precedent in regard to F-gases: the hazard and risk profiles of F-gases and TFA is demonstrably different from those of the 'model PFAS' (such as PFOA, PFOS, PFNA and PFDA) used by the Dossier Submitters to justify a case-by-case concern and a grouping approach is not scientifically sound when applied to the F-gas 'PFAS sub-group'. A one-size-fits-all PFAS ban would significantly harm the EU's innovation power, jeopardise innovation and investment in critical technologies,and threaten to undermine the EU's global competitiveness. Europe deserves a PFAS-regulation that protects global competitiveness, harnesses innovation power, and supports the sustainable transformation in the EU.

TFA

TFA—which is an atmospheric degradation product of some F-gases—is not classified as a Persistent Bioaccumulative Toxic (PBT) or a very Persistent and very Bioaccumulative (vPvB) substance according to the criteria set forth under the REACH Regulation. TFA is a naturally occurring substance that is found in seawater and soil—in fact, more than 95% of TFA found in oceans today is from natural sources.[i] Other manmade sources of TFA, include pharmaceutical agricultural products, specifically from the breakdown of specific fertilizers and herbicides, as well as sewage treatment processes where it is formed during the breakdown and ozonation of some effluents. Only certain F-gases degrade into TFA (at varying yields) and it occurs only when unintentionally emitted into the atmosphere. Emissions can be minimized through the existing risk management measures for F-gas emission reduction, which can be further strengthened under the F-gas-specific legislation. As the UN Environmental Program EEAP report stated, "The properties of TFA indicate that it should not be included in this class [PFAS] for the purposes of generic regulatory risk assessment[ii]… To regulate these substances as a class (as has been suggested) is not

[i] Page 197, United Nations Environment Programme, Environmental Effects Assessment Panel (UNEP, EEAP) (2014): Environmental Effects Of Ozone Depletion And Its Interactions With Climate Change: 2014 Assessment. Available at: https://ozone.unep.org/sites/default/files/2019-05/eeap_report_2014.pdf
[ii] *Environmental Effects of Stratospheric Ozone Depletion, UV Radiation, and Interactions with Climate Change*, UNEP 2022 Assessment Report, pg. 279

scientifically defensible and TFA should be treated as a unique chemical for the purposes of regulation."[iii]

There is a better way: a coherent science-based regulatory approach, that includes scientific analysis of individual PFAS compounds and that acknowledges key distinctions between the thousands of types of PFAS and sub-families—including their very different physical and chemical properties, health and environmental profiles, uses, and benefits—and the fact that F-gases can be manufactured, contained during use and recycled at end of life responsibly in a way that decreases emissions to the environment to the lowest possible levels allowed by technology. A scientific driven approach, using the current regulatory framework would lead to a future where the use of safer, better-performing chemicals will fortify the European economy and advance progress toward important policy priorities, without undermining health and wellbeing.

Significant Emission Reduction Is Possible Without a Ban, Enabling Circularity

TSS has submitted to ECHA a series of documents outlining an alternative restriction framework not considered in Annex XV that is more proportionate, efficient, cost-effective, and focused on emission reduction. Given our technical expertise, access to data and test methodology, and our position within the value chain, TSS is uniquely positioned to propose a comprehensive and credible alternative approach (see Conclusion for summary).

F-gas emissions are already addressed (i.e., minimized) by existing operation conditions and risk management measures under REACH and the F-gas regulation. The currently proposed restriction is a disproportionate measure considering the low-risk of PFAS contamination by F-gases, and the EU's ability to effectively regulate under the REACH regulation and the F-gas-specific legislation.

A more proportionate, efficient, and scientifically-sound approach is strengthening existing Risk Management Measures (RMMs) across all relevant life-cycle stages, including:

- End-of-life Management (e.g., reclaim and circularity);
- Required inspection intervals (e.g., testing for leaks);
- System design architecture improvements; and/or
- Certification of technicians.

The implementation of the additional risk management measures mentioned above could be facilitated by a voluntary commitment which involves all actors of the F-gas supply chain, including manufacturers/importers, distributors, downstream users, research institutes and trade associations. Chemours supports the initiative to establish a stakeholder platform involving such actors to develop the measures described above (such as the set-up of certification systems) in a collaborative and constructive manner together with authorities and regulators.

F-gases are manufactured, used, and can be effectively reclaimed, and recycled within closed operating systems across most applications. With enhanced end of life management, inspections, emission control, and system design requirements, F-gas emissions from equipment and applications can be significantly reduced, thus minimizing the indirect TFA

[iii] *Environmental Effects of Stratospheric Ozone Depletion, UV Radiation, and Interactions with Climate Change,* UNEP 2022 Assessment Report, pg. 292

emissions. Through specific regulations, such as the F-Gas Regulation, the MAC Directive or the End-of-life of Vehicles Directive (EU Directive 2000/53/EC), F-gases emissions have been significantly reduced. As an example, for F-gases, the leakage data presented at the ECA meeting in February 2021 (Poland) clearly show a leak rate reduction for refrigeration equipment from about 16% in 2016 to less than 4% in 2020. Additionally, the VDKF German association reported a significant reduction of leak rate for the RACHP sector from 3.20% in 2017 to 1.35% in 2021[iv].

Additional or enhanced conditions of use—through monitoring, record-keeping, Extend Producer Responsibility (EPR) schemes, progressive increase of reclaim, and improved emission control—would continue this downward emission trend more rapidly and ensure the full circularity potential of F-gases is realized.

F-gases are Critical to a Range of European Industries—Exclusion or Derogation is Vital

F-gases are used in applications because of their unique combination of performance, efficiency, safety, and sustainability. While alternatives exist in some applications, they simply cannot match the performance and safety across climates and applications. Since each case is different, one-size-fits all regulation is not feasible.

For example, industrial gases, often called “naturals,” are not viable alternatives due to reduced energy and resource efficiency, performance limitations (across climates and applications), safety concerns (such as flammability, toxicity, and asphyxiation), lack of circularity, and increased operating costs. These may seem like surmountable challenges, but when you conisider the unintended consequences of the energy efficiency alone, the need for F-gas exclusion or derogation becomes quite clear:

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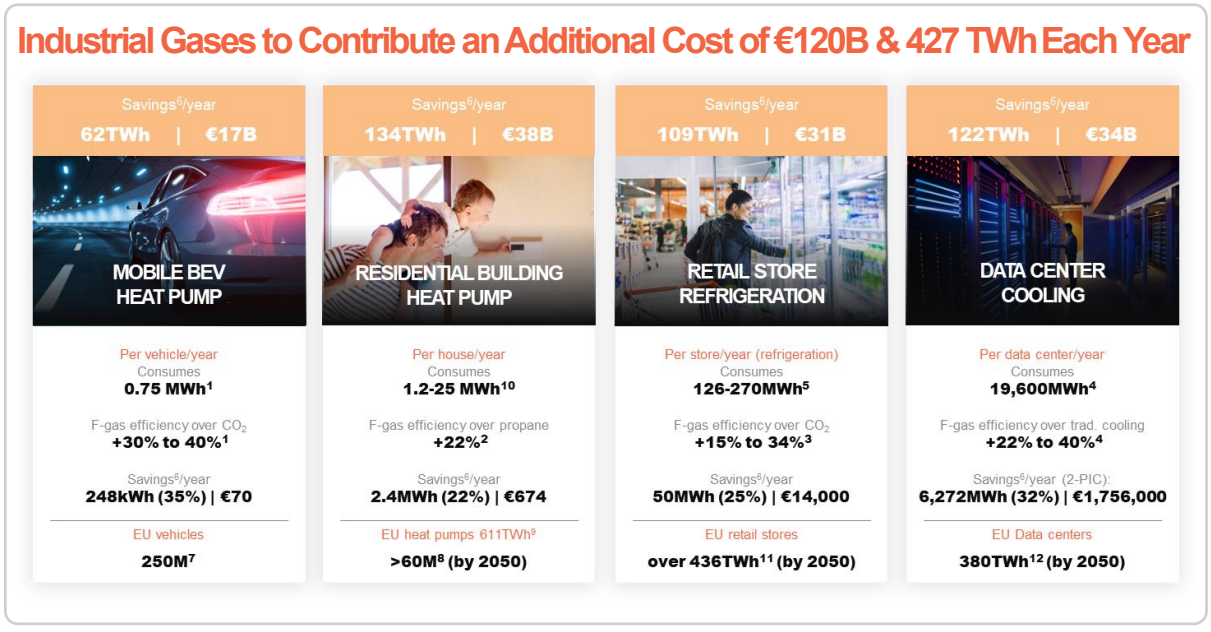

[iv] VDKF Verbandszeitung Juli- August (2022)

[v] Cost & TWh References (continued on page 5):

[1] Chemours internal analysis

[2] https://www.opteon.com/en/support/resource-center/leading-efficiency-in-heating

[3] https://iifiir.org/en/fridoc/performance-cost-and-emissions-comparison-of-refrigeration-systems-142461 and https://iifiir.org/en/fridoc/theoretical-study-using-low-gwp-blends-in-various-refrigerant-144302

Conclusion

Attempting to regulate all PFAS, including F-gases, in such a broad and general way would discard decades of accepted regulatory assessment practice and drive unintended, adverse consequences resulting in a regulatory precedent that will stifle the European economy, make Europe more dependent on third countries for critical materials, and—above all—undermine EU's Green Deal, technology, and economic goals. Moreover, F-gases have undergone rigorous international regulatory assessment and been deemed safe for their intended use throughout their lifecycle. Grouping all PFAS together doesn't accurately reflect the actual risks, uses, and related risk management measures for each substance.

Our key recommendations on the appropriate regulatory measures to address PFAS in the FGAS sector

Chemours has identified the following proposals, which are presented in order of priority, in terms of the strength of their justification, and that, for instance, requests for derogations only apply in the event that F-gases remain within the scope of the proposed restriction *and* where a phase-out continues to be preferred by regulators over alternative, more proportionate, approaches to F-gas regulation. Therefore we ask ECHA to consider the following hierarchy of arguments/asks:

1. **F-gases do not pose an unacceptable risk at the EU level and hence should not be included in a REACH restriction:** For a restriction to be justified, it needs to be demonstrated that the use of F-gases generates unacceptable risks which need to be addressed at the EU level. However, Chemours' analysis demonstrates that F-gases do not possess the properties which the Dossier Submitters have identified as sources of concern justifying regulatory action towards PFASs generally. Accordingly, the analysis demonstrates that all F-gases (current and future) fulfilling the PFAS definition used by the Dossier Submitters should be exempt from the scope of this restriction because there is no risk to be addressed at the EU level. Similarly, F-gas degradation products, such as TFA, should be exempted, given that the risks to human health and the environment are *de minimi*s.

2. **F-gas emissions should be managed under the existing legislative framework**: Instead, all F-gases should be regulated under the existing (and future) regulatory framework for F-gases, which includes the F-gas Regulation (current and future), the MAC Directive, the End-of-Life of Vehicles Directive, the WEEE Directive and the Waste Framework Directive, and which already has the objective of minimizing F-gas emissions to the environment, progressively and in a cost-effective

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[v] Cost & TWh References Continued:

[4] https://liquidstack.com/content/uploads/2022/05/2022-Case-Study.pdf

[5] https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5adf40ec8&appId=PPGMS#:~:text=It%20is%20shown%20that%20supermarkets,400%2D600%20kWh%2Fm2

[6] https://www.euronews.com/next/2023/03/29/energy-crisis-in-europe-which-countries-have-the-cheapest-and-most-expensive-electricity-a

[7] https://www.acea.auto/publication/report-vehicles-in-use-europe-2023/#:~:text=In%202021%2C%20the%20EU%20passenger,8.2%25)%20%E2%80%93%20see%20page%204

[8] https://www.ehpa.org/press_releases/europe-to-add-over-43-million-heat-pumps-by-2030-providing-heat-to-half-its-buildings/#:~:text=The%20total%20heat%20pump%20stock,will%20also%20provide%20renewable%20cooling

[9] https://www.woodmac.com/press-releases/europe-to-install-45-million-heat-pumps-in-the-residential-sector-by-2030/#:~:text=Heat%20pumps%20represent%20one%20of%20the%20most%20significant,to%20five%20million%20a%20year%20in%20the%202030s

[10] https://learnmetrics.com/how-much-power-does-a-heat-pump-use/#:~:text=In%20heating%20mode%2C%20a%20heat,to%202160%20kWh%20per%20month

[11] https://www.topten.ch/sites/default/files/flyer%20pdfs/058_JRC_Report.pdf with a CAGR of 4.5% from 2007 until 2050 (similar to 2002-2006) with 65.83 TWh in 2007

[12] https://www.ucc.ie/en/eri/news/data-centres-a-view-from-europe.html with a CAGR ot 5% (similar to 2010-2018) with 76.8 TWh in 2018

[13] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Electricity_production,_consumption_and_market_overview

manner. As a result, a restriction under REACH, with the same objective is not necessary or helpful.

3. **Further F-gas emission reductions are best achieved through additional management measures**: If the current (and future) regulatory framework for F-gases is considered to be insufficient to ensure the safe use of F-gases, and further (and faster) emissions reductions are warranted, additional risk management measures are a much more cost-effective way of securing them, rather than a ban. Such measures include mandatory recovery at end-of-life, minimum inspection (leak-testing) intervals, improved technician training and improvements to system design standards to further reduce leaks. All of these measures have been demonstrated to be feasible and practicable and most of which already exist in some EU Member States.

4. **Exemption based on minimal yield of persistent degradation products**: F-gases degrading to a persistent substance (such as TFA) with a molar yield below 10% should be exempt because these make a negligible contribution to the global TFA budget**.** F-gases degrading to a persistent substance (such as TFA) with a molar yield above 10% (not covered by this exemption) should be subject to the derogation conditions presented under point 5.

5. **If a REACH restriction (ban) covering F-gases is to be implemented, sector-specific derogations should be included to avoid disproportionate impacts to society:** Should F-gases remain in scope and a phase-out is preferred to minimization via additional risk management measures, despite any proportionality considerations, the following derogations will be required to avoid disproportionate socio-economic impacts on society.

Existing equipment using F-gas technologies

- Existing equipment which uses F-gases cannot be retrofitted to use alternative refrigerants. Therefore, a ban on F-gases would prevent this equipment being serviced and maintained, and lead to premature retirement. A **permanent derogation** is therefore justified to avoid the unnecessary costs of replacing this equipment. (This justification was used by the Dossier Submitters for their proposed derogation 5i, although this derogation was time-limited and restricted to existing HVACR equipment only.)

Stationary HVACR and transport refrigeration applications

- There are significant performance limitations associated with the alternatives to F-gases in stationary especially where larger charge sizes are necessary and in transport applications. It might be possible to overcome these problems through engineering developments, but this will take time and resources. A **minimum 12-year derogation** is suggested to allow this to happen.
- A review should be undertaken before the end of the derogation period, to ensure that the necessary substitution activity has been successful. If not, a further extension of the derogation would be justified to avoid disproportionate costs in future.

Mobile air conditioning and heat pumps (EV/hybrid mobile air conditioning/heat pumps) (M1[vi] and N1[vii]), and ICE mobile air conditioning vehicles (M1 and N1)

- There are fundamental problems with using F-gas alternatives in electric vehicles AC and heat pumps, due to safety concerns and poor performance, especially at higher ambient temperatures. **A derogation**[viii] for F-gases in these applications is therefore justified.
- ICE vehicles are subject to phase out over a period of time which means investment in new MAC systems which do not use F-gases will never be commercially viable (even if it were possible). **A derogation** for F-gases in ICE MAC applications is therefore justified.
- It is not possible to specify a meaningful (evidence-based) time-limited derogation/transition period because it is not clear that alternatives can ever be economically competitive. Hence the costs of a ban are expected to remain disproportionate for the foreseeable future.

Foam-blowing agents (Foam-blowing agents in expanded foam sprayed on site for building insulation; Foam-blowing agents in expanded foam for all applications where the foam is not sprayed on site for building insulation)

- HFO-blown spray foam exhibits exceptional thermal resistance and high density compared with alternative blowing agents and materials, and hence provides much better insulation in a given amount of space. The fundamental disadvantages of alternatives will never be overcome. A **derogation** for F-gases in this application is therefore justified.
- It is not possible to specify a meaningful (evidence-based) time-limited derogation/transition period because it is not clear that alternatives can ever be economically competitive. Hence the costs of a ban are expected to remain disproportionate for the foreseeable future.

Two-phase immersion cooling applications

- Two-phase immersion cooling based on F-gases is the technology which will support the next generation of data centers and electric vehicle powertrain thermal management. Alternatives are far less effective and would result in significant increases in energy use and cost. A ban on F-gases in these applications would also make the EU less competitive in this key market, driving data centers and high-speed computing investment to countries where this technology can still be used. A **derogation** for F-gases in this application is therefore justified.
- It is not possible to specify a meaningful (evidence-based) time-limited derogation/transition period because it is not clear that alternatives can ever be economically competitive. Hence the costs of a ban are expected to remain disproportionate for the foreseeable future.

Industrial high temperature heat pumps (HTHP) and organic Rankine cycle (ORC) applications;

- HFOs already offer energy efficient solutions for a broad range of HTHP technology across the different temperature and application requirements, without the problems exhibited by alternatives, such as narrow range of application or high flammability. We assume that 50% of waste heat cannot be recovered without the use of F-gases; this would

[vi] Passenger cars, taxi cabs, motor caravans

[vii] Pick-up trucks and vans with a weight below 3.5 tonnes

[viii] It is not possible to specify a meaningful (evidence-based) time-limited derogation/transition period because it is not clear that alternatives can ever be economically competitive. Hence the costs of a ban are expected to remain disproportionate for the foreseeable future.

result in significant increases in energy use and cost. A **derogation** for F-gases in this application is therefore justified.

- It is not possible to specify a meaningful (evidence-based) time-limited derogation/transition period because it is not clear that alternatives can ever be economically competitive. Hence the costs of a ban are expected to remain disproportionate for the foreseeable future.

For all other F-gas applications, such as MDI; fire protection; propellants; cold plate technology; and the use of solvents in critical cleaning, semiconductor process cooling, and carrier fluids, we believe extended derogations are necessary to allow for a safe and successful transition to alternative technologies, and we defer to the recommendations of the sector experts.