

Striking the right balance between safety, energy efficiency, climate change and environment on PFAS: the case of Fluorinated Gases

Marco Perfetti, PhD

Regulatory Advocacy Manager, Chemours

Chair of the European Fluorocarbons Technical Committee (EFCTC)

7 October 2026 - MAVESZ Vegyipari Konferencia

Chemours at a Glance



Founded
2015

Net Sales in 2025
\$5.8 Billion

Employees
5,700

HQ
Delaware

NYSE
CC

Strong Presence in Europe



Chemours employs ~1000 people in the EU

Chemours Netherlands BV in Dordrecht is one of the most important production locations in Europe for fluoropolymers / fluoroelastomers and a loading and blending facility for refrigerants

In **Belgium** our Mechelen site serves as a production facility for coatings, housing a coatings lab and a Nafion™ lab. Our Antwerp (Kallo) site is the Center of Expertise for Customer Excellence and Logistics for Chemours in the EMEA region

In **Spain**, our offices in Asturias are covering Finance, HR; Procurement, Legal, IT, and Project Analysis

Our Businesses



THERMAL & SPECIALIZED SOLUTIONS



TITANIUM TECHNOLOGIES



ADVANCED PERFORMANCE MATERIALS



Agenda

- What are F-gases?
- PFAS Restriction process: timeline and status quo
- Industry reaction to ECHA SEAC consultation
- Proportionality assessment for F-gas applications



What are F-gases?

Critical Materials for Critical Applications: F-gases



F-Gases provide functionality to a wide range of applications: their unique properties enable widespread use despite geographic and Europe's ambient temperature differences

F-Gases are required for a full toolbox across many applications – they provide the best combination of environmental, safety and economic benefits



Thermal
insulation



Refrigeration



Data center
cooling



Air Conditioning
and Heat Pumps



Solvents
and Propellants

F-Gases are an Essential Part of the Toolbox

Superior safety and environmental profile

	HFOs	HFCs	CO ₂	NH ₃	HCs
Non or low flammability	x	x	x	x	
Low toxicity	x	x	x ₍₁₎		x
Ultra-low GWP	x		x	x	x
Mechanical & chemical safety	x	x			x

(1) CO₂ (R-744) Acute Toxicity

ATEL (Acute Tox exposure limit) is 30,000ppm (3%), 3x lower vs ATEL of HFO-1234yf (Ref.: ASHRAE SP34)

Significant benefits

Optimized total cost of ownership (TCO)



- Investment, maintenance and operational costs
- Favorable energy efficiency (TEWI) and resource efficiency
- 15–20-year equipment lifetime

Dedicated value chain



- Specialized & extended value chain has been established for several industries, including F-gas recovery and reclaim measures
- After market: producer-distributor-wholesaler-service/installer-end user
- Thousands of SME wholesalers & installers rely on F-gases

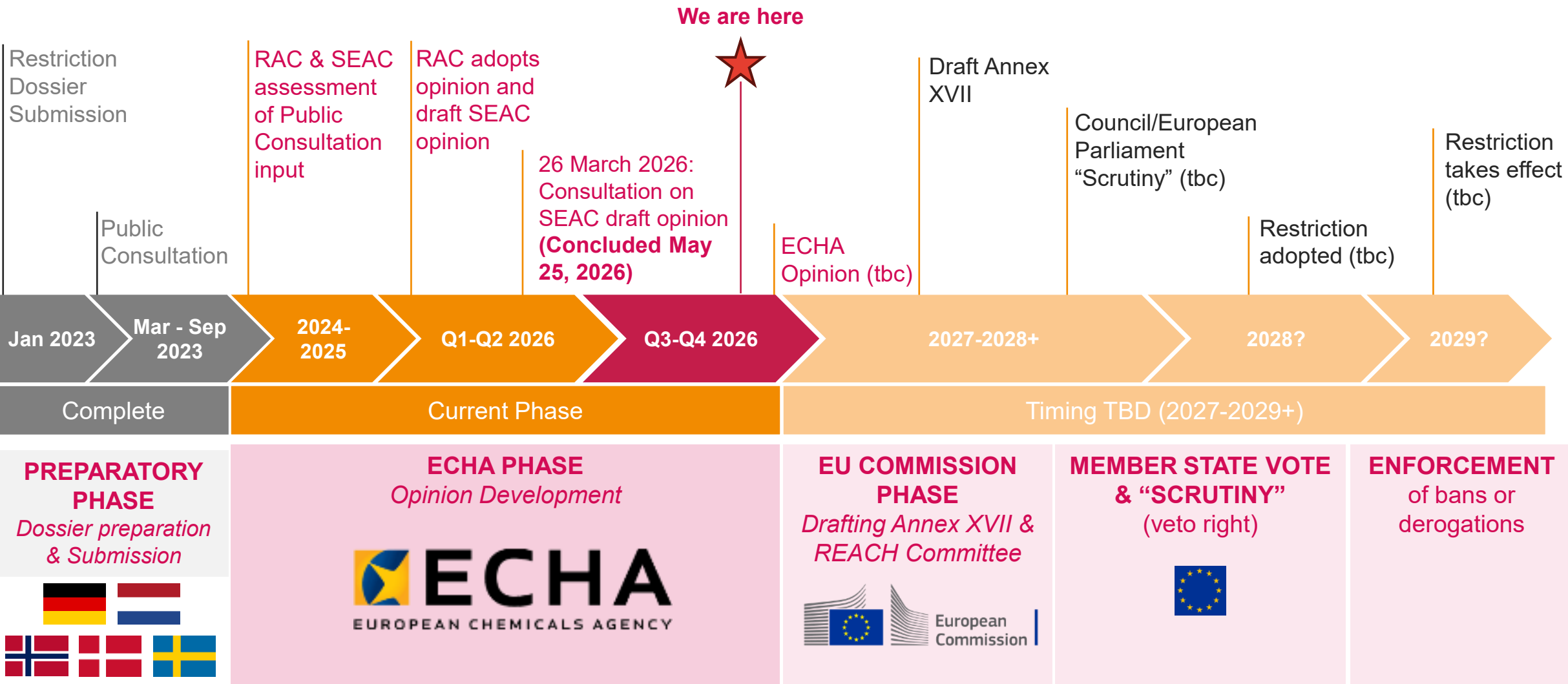
Circularity



- F-gases have high end-of-life value
- F-gases are circular: if properly recovered and the end-of-life and reclaimed, they can be reused in applications for indefinite times
- Positive effect on emission reduction at end-of-life

PFAS Restriction process: Timeline and Status quo

EU REACH PFAS Restriction Process Timeline



Key content of SEAC draft opinion for F-gases



Overlap with existing regulation

- Substantial **overlap** with the EU F-gas Regulation
- SEAC considers a REACH restriction still necessary, to complement the product bans under the F-gas Regulation
- SEAC stresses the need for **explicit alignment to avoid double regulation** and regulatory gaps

Derogations

- **Time-limited derogations** (typically 5 or 12 years) where alternatives exist but are not deployable at entry into force (e.g., industrial RACHP, 2-phase immersion cooling, transport MAC, high-voltage switchgear)
- **Time unlimited derogations** for maintenance and refilling of existing RACHP, fire-suppression and switchgear equipment. Without such derogations, SEAC expects disproportionate safety risks and premature scrapping of equipment

Availability of alternatives

- **High substitution potential** for most new stationary applications, where non-PFAS alternatives are already used
- **Low substitution potential** for:
 - Industrial uses for RACHP
 - MAC and transport refrigeration
 - Safety-critical applications (fire suppression, aircraft uses),
 - Switch gears applications

Proportionality

- **A blanket ban on F-gases under PFAS restriction would not be proportionate**
- Most environmental benefits for F-gases are already delivered by the F-gas Regulation, while a non-aligned REACH restriction would lead to very high costs, safety concerns, and limited additional benefits

The additional data submitted during the SEAC consultation might affect the content of the final SEAC opinion. SEAC stresses the lack of data in the original proposal and cannot provide a quantitative socio-economic assessment for the F-gas sector.

Industry reaction to ECHA SEAC consultation

What industry says about proportionality of a ban on F-gases: Summary of responses to SEAC*



A full ban risks being legally and economically disproportionate relative to the environmental risk addressed

ACEA, #10785

An ERM assessment for EPEE found that continued use with emission control is the most proportionate, cost-effective scenario

EPEE, #10888

EHPA supports a differentiated, application-based approach aligned with the F-gas Regulation

EHPA, #11312

Current proposal is disproportionate, with costs significantly outweighing benefits

Euredia, #10798

More risk-based, control measures are needed to deliver emissions reduction while preserving existing value chains

BVKMW, #10428

A workable regulatory proposal should allow the continued use of F-gases in applications where emissions can be effectively managed and reduced to an acceptable level, and where clear safety concerns prevent substitution

EFCTC, #11352

*The slide includes selected excerpts and summaries of SEAC comments. It is intended to highlight key points relevant to this discussion and does not provide a complete account of the submission

What industry says about the analysis of alternatives to F-gases: Summary of responses to SEAC*



No PFAS-free drop-in alternative exists for R-1234yf. 13-years for EVs **and 20-years** for other vehicles are needed to allow development, validation and industrialization of alternatives
(ACEA, #20641)

MAC CO₂ systems are inherently more complex because its critical operational temperature is lower than R-1234yf, and at temperatures above 30 deg C it requires significant overengineering and **increased energy consumption, reducing vehicle range**
(German Association of the Automotive Industry, #20650)

In commercial and industrial refrigeration and chillers, **non-PFAS alternatives often face flammability, high-pressure, cost, efficiency or capacity limitations**. For transport refrigeration non-PFAS alternatives remain limited and face safety, efficiency, **scalability and certification challenges**
(EPEE, #21139, #20649)

Need of **granular, application-specific derogations**, ranging from 0-12 years for heat pump monoblock systems and **time-unlimited** (with review clause) for most split systems
(EHPA, #11312)

RACHP
(Stationary)

MAC

Data center cooling

Advanced AI and high-density data centers increasingly depend on **two-phase direct-to-chip and immersion cooling technologies** using fluorinated fluids
(SEMI Europe, #21577)
(ESIA, #21682)

A time-unlimited derogation with a review clause and containment measures is needed. Restricting PFAS cooling technologies could **add 500-800 GWh/year of electricity demand** in the EEA and jeopardize investments in AI, cloud computing and semiconductor manufacturing
(Redacted, #21785)

Regarding economic feasibility, a switch to alternative natural refrigerants entails significant **cost increases** that can range **between 25 to 50%**, driven by safety systems, specialized components, ATEX/Seveso compliance, obtaining permits, and the complexity of project development
(Euroheat&Power, #10436)

*The slide includes selected excerpts and summaries of SEAC comments. It is intended to highlight key points relevant to this discussion and does not provide a complete account of the submission

A Sustainable Solution: Regulate Emissions, Don't Ban Products

- **Differentiation in PFAS is necessary: Fluoropolymers and fluorinated refrigerants** do not pose an unacceptable risk and can be responsibly managed
- The proposed regulatory approach is overly complex, disproportionate, and risks undermining Europe's industrial competitiveness and strategic autonomy
 - **Exemption with robust emission reduction strategies at production, use phase and waste management** is a pragmatic solution that addresses concerns on PFAS pollution
- Fluoropolymers:
 - Timeless derogation with emission control in production (FPG Manufacturing 2.0 ongoing)
 - Long-term: Develop a BREF in EU Industrial Emission Directive
- F-gases:
 - Support a time-unlimited derogation for less emissive uses under controlled conditions (e.g., maximum leak rate, mandatory tracking and reclaim)
 - Extended derogations for those applications/uses for which there is a significant socio-economic impact associated with the transition to non-fluorinated alternatives

EFCTC position regarding the PFAS Restriction (I)

EFCTC's regulatory objective - A continued use scenario

Possible risk management options should:

- Focus on **risk management** in balance with **continued use** where required, where acceptable emission levels can be achieved
- Align with **Regulatory Framework already in place** and build further on it. The sector is well regulated and experienced to address emissions according to the F-gas Regulation, ELV Regulation, WEEE Directive...
- Assure measures are **enforceable, monitorable and proportionate**



EFCTC position regarding the PFAS Restriction (II)

EFCTC's regulatory objective - A continued use scenario

Continued use

with conditions defined in REACH legal Text

- Continued use where safety concerns, technical or economic limitations prevent substitution
- Applications with lower and controllable emissions which can be substantially reduced, which would necessitate specifying maximum allowable leak rates
- **Conditions to be defined in REACH legal Text:**
 - To be defined by European Commission together with Sector and downstream users

Time-limited derogation: extended where necessary

- Applications where an immediate ban will have a strong socio-economic impact
- Acceptable emission reductions cannot be guaranteed
- **Derogation should be longer depending on**
 - Technical feasibility
 - Economic feasibility
 - Availability



Proportionality assessment for F-gas applications

EPEE ERM study on proportionality and socio-economic assessment for Stationary RACHP applications

Key outcome: continued use with Risk Management Measures (RMMs) is the most proportionate option

€20/kg

Cost per kg PFAS avoided —
4.6× better than a full ban
(€92/kg)

€4.6 bn

GVA impact 2030–2050 — 8×
lower than a full ban (€36.7 bn)

39%

PFAS emissions avoided —
more than a ban with
derogations (30%), at one-tenth
the cost

~42,800

Jobs preserved in 2030,
compared with a full ban

There is no one-size-fit-all solution.

No single alternative refrigerant can safely, efficiently and economically replace F-gases across all RACHP applications.

Source: ERM, Socio-Economic Assessment & Analysis of Alternatives for F-gas Uses in HVACR Applications, commissioned by EPEE, May 2026

[EPEE identifies the most effective and affordable pathway to reduce PFAS emissions from F-gas refrigerants](#)

Technical Working Group Report on emission reduction for Mobile Air Conditioning

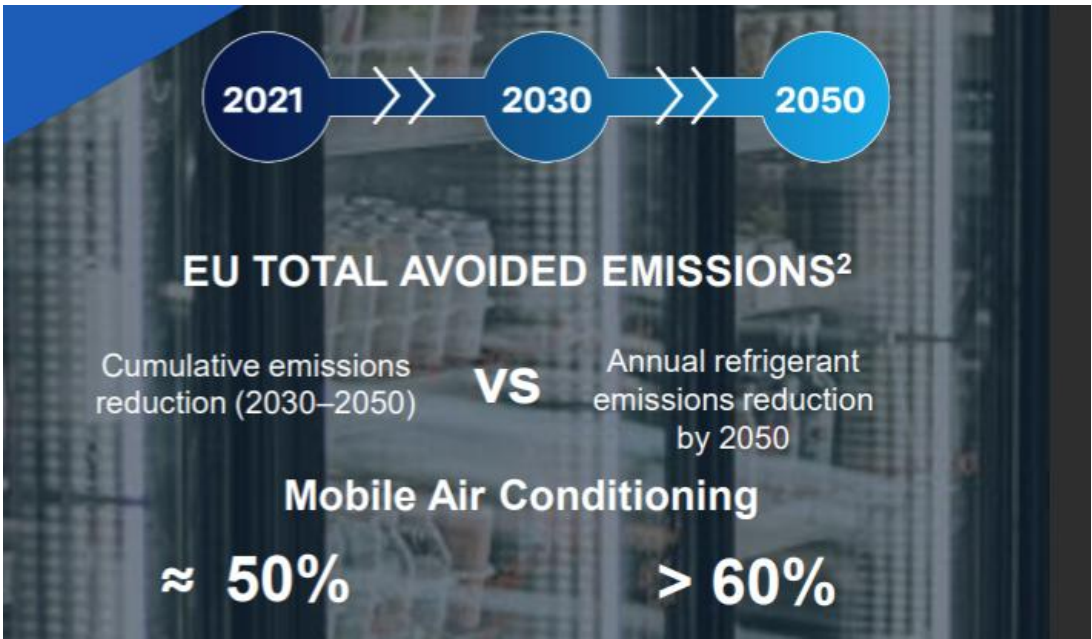


Key outcome:

Prevent 180,000 tons of emissions between 2030-2050 leading to a >60% annual emission reduction by 2050 with negligible net costs for consumers

Full report available [here](#)

Stakeholders involved: Chemours / Solstice®, automotive OEMs, Service Networks, Suppliers, Recyclers, and Policymakers.



How we get there					
	Advanced Leak Detection UV dye & vacuum Testing AC health monitoring Early detection = immediate impact	Robust Vehicle Design Improved sealing technologies Electric compressors Lower leakage over vehicle life	Mandatory Repairs Fix the leak, not just top-up Eliminates repeat emissions	Reclamation & Recycling High-effective recovery equipment Reuses refrigerant in a close-loop	Industry Standards & Collaboration Shared benchmarks Scalable across Europe Enables consistent enforcement

Take-home messages



- **F-gases are critical enablers** for refrigeration, air conditioning, heat pumps, transport cooling and data center applications, delivering a unique balance of safety, performance, energy efficiency and climate benefits
- Several industry's contributions to SEAC on F-gases show that **viable non-fluorinated solutions are not yet available across many uses**, with significant technical, safety, efficiency, scalability and certification challenges still to be addressed
- Industry evidence supports a **proportionate, application-specific approach**, recognizing that restrictions should reflect the availability of technically and economically feasible alternatives and avoid unintended consequences for climate, energy and industrial objectives
- The most effective path forward is to **regulate emissions rather than ban products**, combining application-specific derogations with robust measures on containment, leak prevention, recovery and reclaim

A science-based and proportionate regulatory framework can reduce emissions while preserving access to the technologies needed for Europe's energy transition, food supply chain, digital infrastructure and industrial competitiveness

Thank you!