

**The European Union: The clock is ticking for the RACHP Industry to make the transition from HFCs/HFOs to alternative refrigerants.**

**Speech by Russell Patten, Director General, EPEE, CRH2025 Shanghai, China April 2025**

# OUR MEMBERS

## CORPORATE MEMBERS

<b>A-GAS</b> TOGETHER WE CAN	<b>AGC</b>	<b>ARKEMA</b>
<b>Bitzer</b>	<b>CAREL</b>	<b>Carrier</b>
<b>Chemours</b>	<b>climalife</b>	<b>DAIKIN</b> DAIKIN CHEMICAL EUROPE
<b>DAIKIN</b>	<b>Danfoss</b>	<b>COPELAND</b>
<b>FUJITSU</b>	<b>Garrett</b> ADVANCING MOTION	<b>GREE</b>
<b>Johnson Controls</b> <b>HITACHI</b> Air conditioning solutions	<b>Honeywell</b>	<b>Johnson Controls</b>
<b>koura</b> An Orbia business.	<b>LENNOX</b>	<b>LG</b>
<b>MITSUBISHI ELECTRIC</b>	<b>MITSUBISHI HEAVY INDUSTRIES</b>	<b>Panasonic</b>
<b>Rheem</b>	<b>SAMSUNG</b>	<b>SOLVAY</b>
<b>UNIFLAIR</b>		

## ASSOCIATION MEMBERS

<b>AÇCE</b>	<b>AGORIA</b>	<b>AHRI</b> AIR-CONDITIONING, HEATING, & REFRIGERATION INSTITUTE
<b>AREA</b>	<b>ASERCOM</b>	<b>EFCTC</b> European Fluorochemical Technical Committee
<b>ehpa</b> european heat pump association	<b>FETA</b>	<b>Fachverband</b> Gebäude-Klima e.V.
<b>JRAIA</b>	<b>KRAJOWE FORUM CHŁODNICTWA</b>	<b>STEK</b>
<b>Uniclima</b>		

EPEE's membership is composed of over 40 members, including 28 companies as well as national and international associations. With 200+ manufacturing sites and research and development facilities across the EU, which innovate for the global market, EPEE member companies contribute to EU competitiveness.

# Role of RACHP sector in society



Industries



Transport refrigeration



Grocery stores



Homes



Hospitals



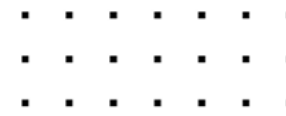
Offices and schools

Capacities range from less than 1 kW to several MW

Operating in harsh conditions and optimized for decades, and using a granularity of refrigerants

Our sector fulfills essential societal needs: **safe food supply and medicine**, productivity and comfort heating and cooling in homes, hospitals and offices, industrial **heating and cooling and process heating and cooling**, recovery of **waste heat** and **reduction of dependency on fossil fuels**.

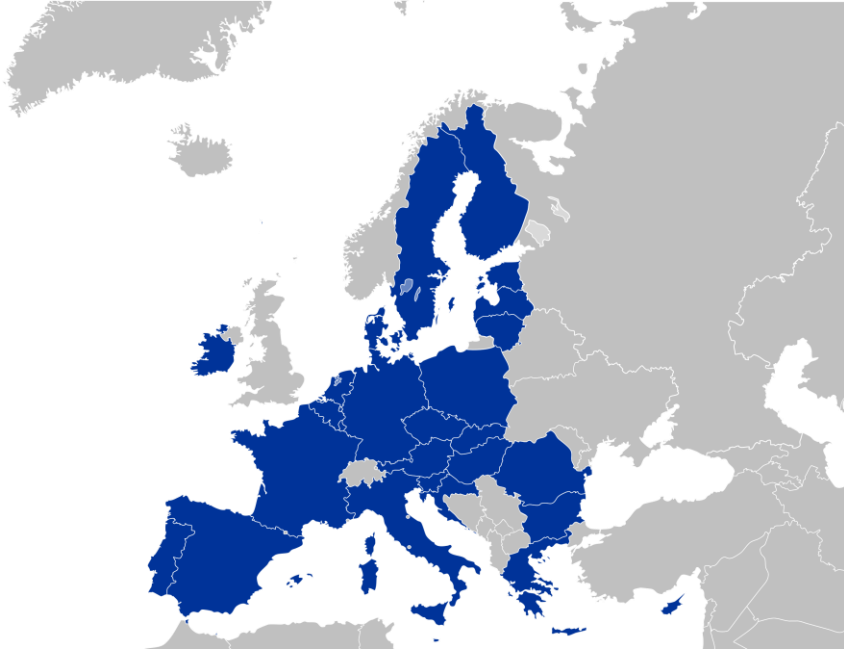
# Key content and Introduction



1. **What is the EU? Who makes European Union Regulation? What is the current Political context and is it supporting our industry?**
2. **The 3<sup>rd</sup> F-gas Regulation – came into force in in March 2024 – and is being implemented as we speak.**
3. **The draft PFAS Restriction proposal (to ban PFAS) – a cause of great uncertainty.**
4. **Overview on the future of refrigerants.**
5. **There are further and considerable barriers to the smooth transition from HFCs/HFOs to alternative refrigerants.**
6. **Concluding Remarks.**



# What is the EU? Who runs the EU & makes Regulations? And what is the current political context?



1. Situated in Western Europe, the EU is a bloc of 27 Countries economically and politically bound via an internal market and one external border. From Ireland in the West to Poland in the East and Finland in the north and Greece to the south...

2. Three Institutions run the EU: European Commission – the executive; The European Parliament – democratically voted in & a co-decision-maker; The Council of Ministers – the 27 countries as the other co-decision maker

3. We are currently 4 months in a NEW 5-Year Mandate with an ambitious Executive which wants to increase Europe's competitiveness supporting industry whilst wanting to maintaining high environmental standards

**The Refrigeration, Air Conditioning and Heat Pumps industry is not seen as a strategic industry sector and yet it is a key sector to bring about the decarbonization of the building sector and help Europe reach its net 0 target!**

# History of the EU F-gas Regulations

2006  
1<sup>st</sup> EU F-gas  
Regulation  
+ MAC Directive  
(EU) 842/2006

## Main measures:

- Certification + leak checking requirements
- MAC directive : Passenger Car AC GWP 150 limit

2014  
2<sup>nd</sup> EU F-gas  
Regulation  
(EU) 517/2014

## Main measures:

- F gas quota system (phase down)
- GWP limits on several products

2024  
3<sup>rd</sup> EU F-gas  
Regulation  
(EU) 573/2024

## Main measures:

- Steeper phase-down to meet Kigali Amendment targets;
- New product bans for higher GWP refrigerants;
- Extension of containment measures to HFOs and mobile equipment

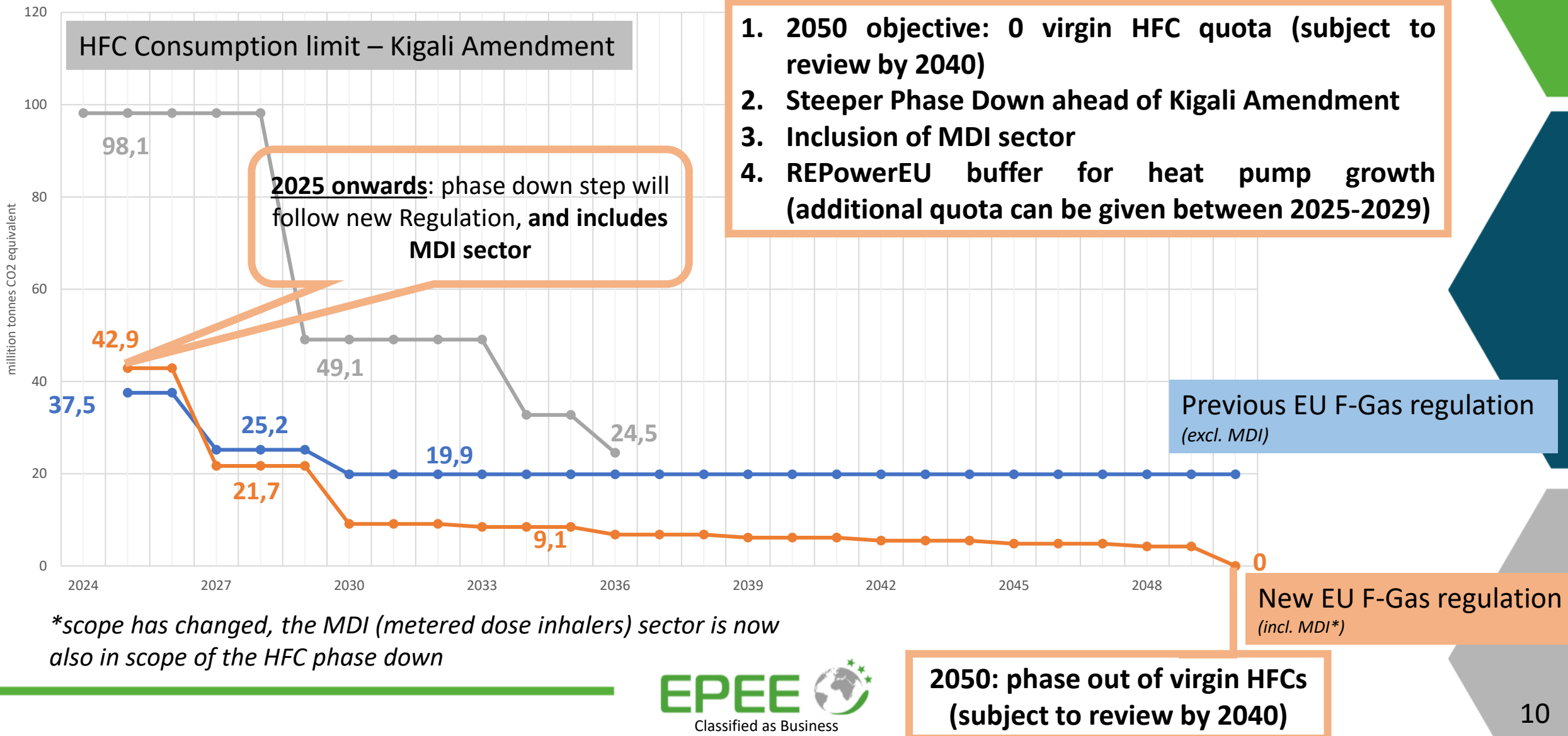
- The EU's HFC phase down (Kigali Amendment) is well ahead of its Montreal Protocol commitments.
- EU F-gas emissions are declining – in 2022 emissions decreased by 33% compared to 2014.



The F-Gas Regulation was published in February '24 and entered into force on 11th of March 2024. Several new / amended requirements were introduced.



# A.HFC Phase Down under the EU F-gas Regulation – Annex VII





## C. Placing on the Market Prohibitions – Annex IV

Mobile  
equipment

*'mobile' means normally in transit during operation*

**NO product bans on mobile equipment (MAC Directive remains unchanged)**

Stationary  
equipment

*'stationary' means not normally in transit during operation and includes moveable room air-conditioning appliances*

Several product bans are introduced for stationary equipment

Refrigeration

Self-contained  
systems

Split systems

Chillers

AC and HPs

Self-contained  
systems

Split systems

## C. Placing on the Market Prohibitions (EU) 573/2024 – Annex IV

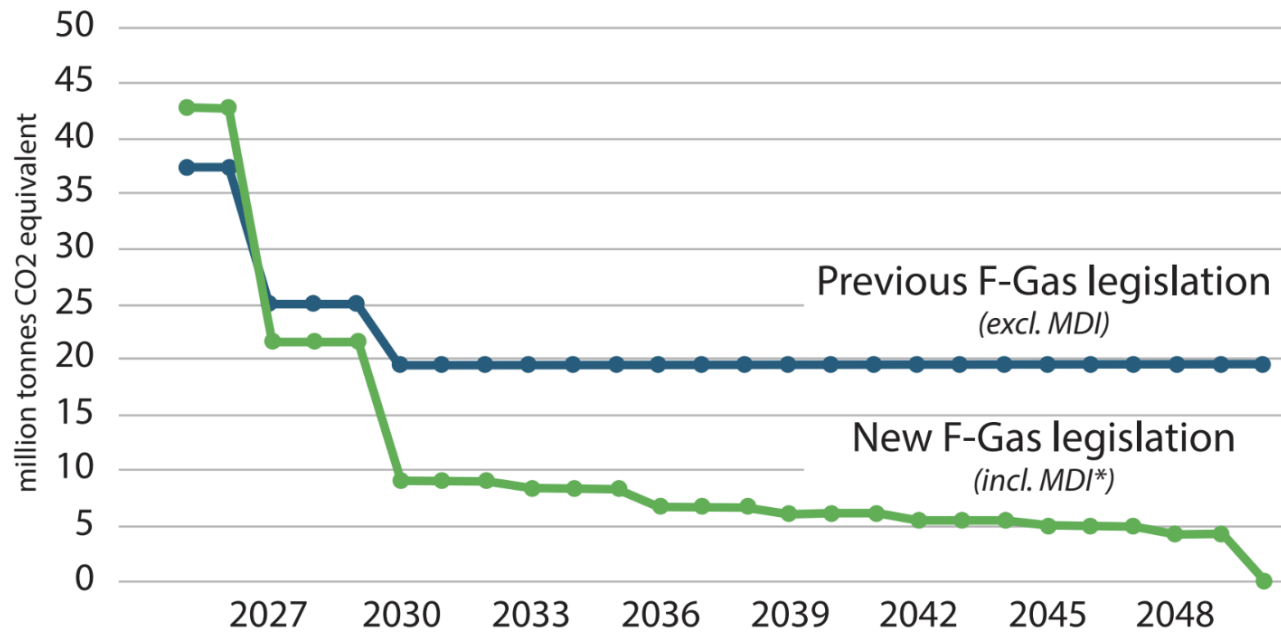
Bans on Stationary Refrigeration		Date of entry into force	
<ul style="list-style-type: none"> <li>Fridges/freezers for commercial with F-gas <math>\geq</math> <b>GWP150</b></li> <li>Any self-contained refrigeration equipment, excluding chillers, with F-gas <math>\geq</math> <b>GWP150*</b></li> <li>All other refrigeration equipment, excl. chillers, with F-gas <math>\geq</math> <b>GWP2500 (Except -50°C applications)</b></li> </ul>		1 Jan 2025	
Domestic refrigerators and freezers $\rightarrow$ <b>No F-gases*</b>		1 Jan 2026	
All other refrigeration equipment with F-gas $\geq$ <b>GWP150*</b>		1 Jan 2030	
Bans on Stationary Chillers (whose primary function is to cool a heat transfer fluid for refrigeration, process, preservation or comfort purposes)		Date of entry into force	
<ul style="list-style-type: none"> <li>Chillers <math>\leq</math> 12kW with F-gas <math>\geq</math> <b>GWP150*</b></li> <li>Chillers <math>&gt;</math> 12kW with F-gas <math>\geq</math> <b>GWP750*</b></li> </ul>		1 Jan 2027	
Chillers $\leq$ 12kW $\rightarrow$ <b>no F-gases*</b>		1 Jan 2032***	
Bans on Stationary <u>split</u> Air Conditioning & Heat Pumps	Date of entry into force	Bans on Stationary self-contained Air Conditioning & Heat Pumps	Date of entry into force
Single split with $<$ 3kg of HFCs $\geq$ <b>GWP 750</b>	1 Jan 2025	<ul style="list-style-type: none"> <li><math>\leq</math> 12 kW with F-gas <math>\geq</math> <b>GWP150**</b></li> <li>12-50kW with F-gas <math>\geq</math> <b>GWP150**</b></li> <li><math>&gt;</math> 50kW with F-gas <math>\geq</math> <b>GWP150**</b></li> <li><math>\leq</math> 12 kW <math>\rightarrow</math> <b>no F-gases**</b></li> </ul>	1 Jan 2027
Split $\leq$ 12 kW air-to-water with F-gas $\geq$ <b>GWP150*</b>	1 Jan 2027		1 Jan 2030
Split $\leq$ 12 kW air-to-air with F-gas $\geq$ <b>GWP150*</b>	1 Jan 2029		1 Jan 2032***
Split $>$ 12 kW with F-gas $\geq$ <b>GWP750*</b>	1 Jan 2033***		
Split $>$ 12 kW with F-gas $\geq$ <b>GWP150*</b>	1 Jan 2035***	<p>*except when required to meet safety requirements</p> <p>** If safety requirements apply, <b>GWP750</b> becomes the limit.</p> <p>*** review by 2030 to assess feasibility of post 2030 bans</p>	
Split $\leq$ 12 kW $\rightarrow$ <b>no F-gases*</b>			

# F-gas Regulation Revision Brochure

## NEW F-GAS REGULATION | 2024

(EU) 2024/573

A Guide for Producers and Users of F-gases



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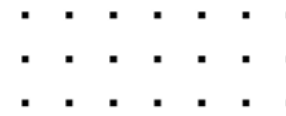


- The guide is publicly available on [EPEE's website](#);

# The PFAS restriction proposal

- 5 European countries made a proposal for a broad ban on all PFAS based on concerns for human health environment, covering some 10,000 substances. The file is managed by the European Chemicals Agency (ECHA).
- Full ban on manufacture, placing on the market and use after 18 months transition period or a full ban with time limited or unlimited derogations on specific uses.
- It would mean a full re-design of equipment and components as most F-gases and all fluoropolymers used by the sector are considered as PFASs (OECD chemical definition).
- ECHA needs to make a recommendation to the Commission which then makes a legislative proposal to be approved by Council & Parliament after which there will be an 18 months derogations...we do not expect anything before 2028 at the very earliest.

# OUR STARTING POINT



1. Our RACHP sector provides critical use applications enabling the European society and contributing to productivity, well-being, health and decarbonization of the energy supply.
2. Fluorinated gases already fulfil safety, efficiency, affordability and regulatory requirements. Alternative refrigerants, while already in use by a large number of EPEE members, are not suitable today for all applications in all conditions.
3. F-gas emissions are already well-handled, there is evidence of continuous progress in emission reduction, driven mainly by the F-gas Regulation, while recovery and reclamation of gases is on the rise.



# OUR STARTING POINT

In EPEE's view, a broad ban of F-gases in any future EU PFAS restriction is not justified as:

- The consequences of a full ban on PFAS outweigh the benefits i.e., it is not proportionate
  - The use of F-gases in our applications do not represent an unacceptable risk
  - It would disrupt the optimal refrigerant choice for new and existing equipment. A transition requires time and resources
- 
- Double regulation as the PFAS RP would overlap with the F-gas Regulation. The F-gas Reg restricts placing on the market, thereby limiting emissions and their environmental impact. Transparency is needed between the additional restriction of availability of low GWP refrigerants from PFAS RP vs. existing restriction from F-gas Regulation.
- 
- We believe a time unlimited derogation is needed for F-gases in RACHP applications, with a 10 years review clause.

# EPEE initial position (Sept 2023)

## For F-gases:

- - Full time-unlimited derogation for F-gases used in RACHP applications, with a review clause 10 years after EIF to assess efficiency/availability of alternatives, but also for:
- - Maintenance and refilling
- - Reclamation and recycling of refrigerants
- Exports of pre-charged equipment

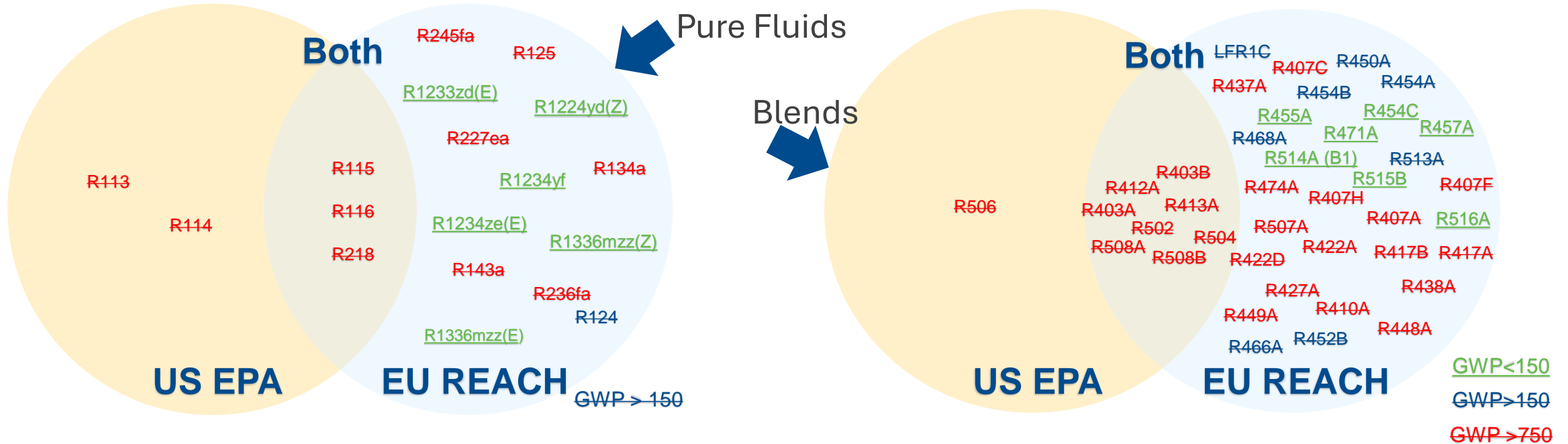
**A reconsideration of the concentration limits as the current value proposed may jeopardize the efforts to recover, reclaim and reuse refrigerants.**

## For fluoropolymers:

- - Full time-unlimited derogation for fluoropolymers used in RACHP applications, with a review clause 10 years after the EIF to assess availability and viability of alternatives, but also for:
- - Spare parts, waste treatment and exports

**A reconsideration of concentration thresholds to not hamper the circularity of components.**

**Classification as PFAS by the EU & EPA (US):  
Not much left after the F-gas Regulation**



## Pure Fluids outside PFAS

- All Naturals
- **R-32 – A2L: 675 GWP**
- R-13I1 – A1: <1 GWP
- R-152a – A2: 124 GWP
- R-1132a – A2: <1 GWP (AR6)
- R-1132(E) – (B2): <1 GWP (AR6)

## Blends outside PFAS

- R-429A – 16 GWP – A3: R-E170/152a/600a ( $60\pm1/10\pm1/30\pm1$ )
- R-430A – 110 GWP – A3: R-152a/600a ( $76\pm1/24\pm1$ )
- R-431A – 44 GWP – A3: R-290/152a ( $71\pm1/29\pm1$ )
- R-435A – 30 GWP – A3: R-E170/152a ( $80\pm1/20\pm1$ )
- LFR3B – 140 GWP – A1

# Use of fluoropolymers

Upcoming consideration of fluoropolymers in 'Sealing' is appreciated

Fluoropolymers used as material in physical components are **essential** for the functionality and tightness of RACHP products and other key technologies and industries, with unique characteristics:

Sealing to prevent the release of refrigerant into atmosphere

Temperature and pressure resistance

Persistence and chemical inertness

Unique electrical properties

Low friction that enables components to be more sustainable

Today there is no viable alternative that can fulfill all the same criteria with the same performances.

# Lack of alternatives to fluoropolymers

## Two possibilities:

- ➔ A return to previously used components, which were replaced for hazardous substances reasons (e.g. lead, RoHS)
- ➔ Development and implementation of potential options in some applications is likely possible but requires time and resources. Less likely for specific harsh applications.

The unlimited derogation included in the Proposal for “national safety standards and building codes” does not cover fluoropolymers, **equipment will not properly function without fluoropolymers.**



*Internal estimation of time for developing alternatives to fluoropolymers, based on industry experience, if an alternative is available and viable and meeting all requested technical specifications.*



# CONCERNS WITH THE PROPOSAL

**The assumption that F-gases are the biggest source of PFAS is not accurate**

- ☐ Incorrectly assumes that emissions will continually increase over time
- ☐ It also assume that all volumes of F-gases are fully emitted to the environment
- ☐ Far the figures from the EPEE EU HFC Industry Outlook model.



**No proper evaluation of effectiveness, enforceability, practicality and monitorability**

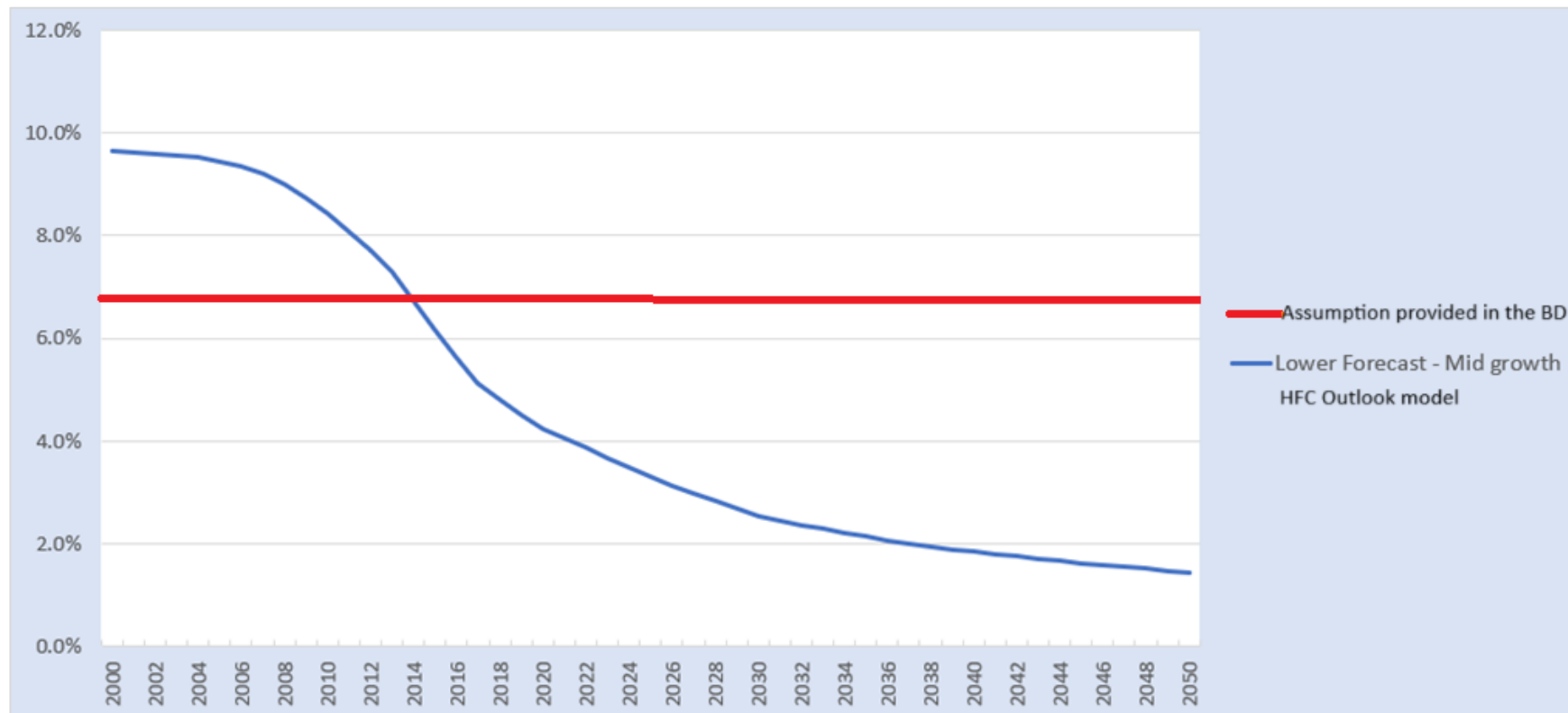
**Ignores existing UNEP longstanding knowledge and studies on the topic esp. breakdown**

- ☐ Trifluoroacetic acid (TFA) has been cited as the main reason for Dossier submitters to include fluorinated gases in the scope of the Restriction proposal. UN experts disagree: “Based on current data, the amount of TFA formed is too small to be a risk to the health of humans and the environment” / “..unlikely to cause adverse effects out to 2100”/ “..remains at concentrations that are well below those of toxicological concern.”
- ☐ Also have expertise on Alternatives and energy efficiency

➤ **Covering most F-gases under the PFAS legislation and all under the F-gas Regulation and Montreal Protocol creates uncertainty and misalignment. The characterization of the F-gas Regulation as ‘PFAS legislation’ is also incorrect**

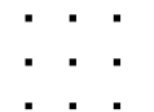
# Concerns over the emissions of F-gases

Leakage rates are assumed to be linear by the Dossier submitters (DS):



The DS assume a linear percentage of leakages which results in increasing absolute emissions, which is inaccurate because the F-gas Reg is decreasing emissions.

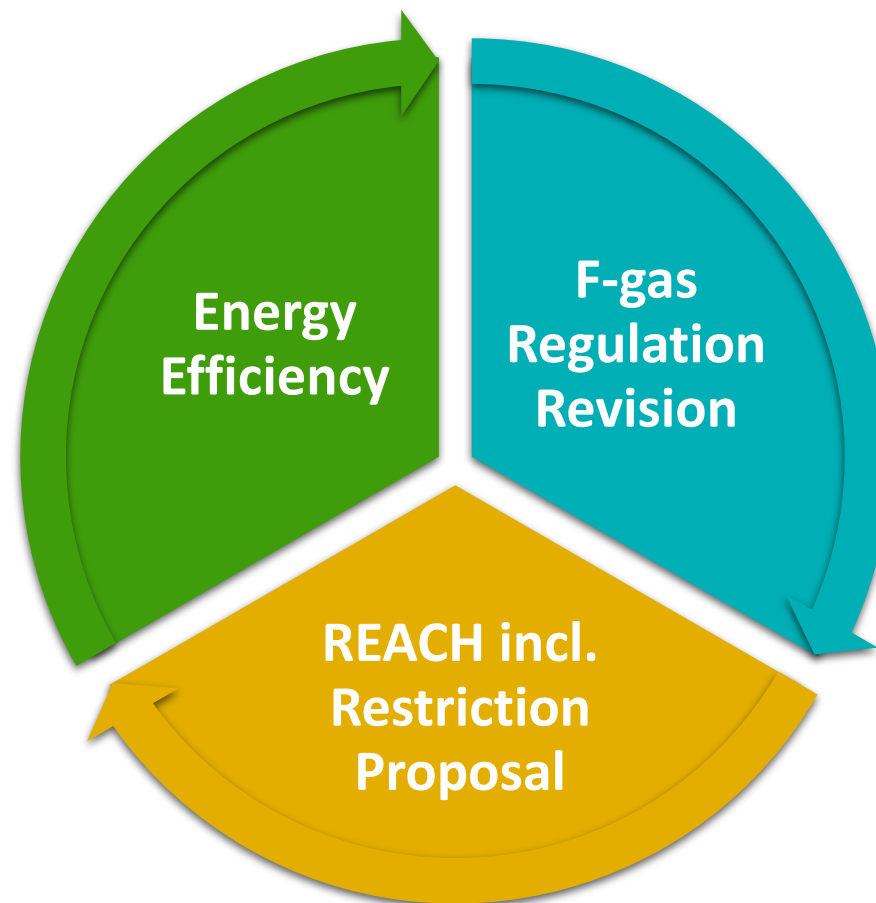
# CONSIDER: Interplay between PFAS and other files



**Energy Efficiency First Principle:** “taking utmost account of cost-efficient energy efficiency measures in shaping energy policy and making relevant investment decisions.”

So-called “natural refrigerants” cannot always guarantee the same level of:

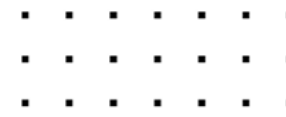
- **safety**
- **energy efficiency**
- **affordability**



**F-gas Regulation:**  
Entered into force 11 March 2024, further contains, accelerates the HFC Phase Down and transitions towards HFOs and non-fluorinated alternatives. The two first version of F-gas Regulations are in place since 2006/2014 and are considered to be very successful.

## **U-PFAS REACH Restriction:**

Refrigerants are registered and comply with the requirements of the REACH regulation + U-PFAS Proposal to restrict the use of PFAS including F-gases and equipment using fluoropolymers – ongoing legislative process. Expected date of implementation: 2028/29 and Entry into force 2030-31  
Proposal to restrict the use of PFAS including F-gases and equipment using fluoropolymers



# Overview on the future of refrigerants

## Rapidly Changing Mix of Refrigerants Used in the EU

- In 2010, **EU RACHP market was dominated by 3 refrigerants** and the average GWP of refrigerants used in 2010 was 2100: R-404A (GWP 3922); R-410A (GWP 2088); and HFC-134a (GWP 1430)
- In 2024, **the EU refrigerant quota in tonnes CO<sub>2</sub>e is <30% of the EU baseline**: growing re-use of recovered refrigerants makes an important contribution
- **By 2018 the EU HFC phase-down was below the Kigali target for 2028**: showing that technologies are available for a much faster Kigali phase-down
- **But there is still much to do in the EU to meet the tough new targets set in the 2024 EU F-Gas Regulation**



### Summary for EU Refrigeration Applications

- ✓ Many applications already using ultra-low GWP refrigerants (ammonia, CO<sub>2</sub>, HCs, HFOs)
- ✓ By 2030 virtually all refrigeration applications will be able to use either:
  - ultra-low GWP refrigerants
  - HFC-HFO blends with GWP under 150

## Summary for Air-Conditioning and Heat Pump Markets

- Good progress towards ultra-low GWP refrigerants in some parts of the market: large chillers, mobile air-conditioning in cars, small sealed equipment, small monobloc heat pumps
- Good progress away from high GWP R-410A to “medium” GWP refrigerants: HFC-32 and HFO-HFC blends
- Tough challenges to comply with proposed bans for split units < 12kW: ? how widely can propane be safely and efficiently used and ? are HFO-HFC blends with GWP < 150 suited for these applications
- It is vital that the refrigerant transition supports the maximum possible improvement in energy efficiency
- The GHG emissions from EU RACHP equipment in 2024 is as follows:
  - direct emissions (from HFC refrigerants) 30%
  - indirect emissions (from energy used) 70%
- In many applications good efficiency can be achieved with low GWP alternatives
- A key concern is when safety considerations limit the amount of refrigerant that can be used (e.g. for split air-conditioning units) with less refrigerant available it is difficult to achieve best energy efficiency

# On choice of refrigerant and alternatives

Many factors guide the choice of refrigerant for specific applications and locations:

- Compliance with climate legislation (e.g., F-gas Reg)
- Compliance with **energy efficiency**, i.e., fulfil the requirements of the Ecodesign provision while respecting the Energy Efficiency First principle
- Compliance with **safety requirements and standards**. These ensure that the equipment is put safely in operation and operated in a safe manner.

Alternatives	Constraints / impacts
R-717 (CO2)	High pressure equipment / Higher energy consumption depending on applications
R-744 (ammonia)	Toxic Excess ammonia in the environment also contributes to the acidification and eutrophication of ecosystems and to climate change
R-290 (propane)	Highly flammable > requires ATEX (for certain equipment) to be handled for logistics (highest costs) Cost of additional safety measures are underestimated in the GIZ study on splits; charge limitations not considered If emissions occur, will create Ozone in low atmosphere (as VOC).

# Further barriers to the transition, esp. for Heat Pumps

There are further and considerable barriers to the smooth transition from HFCs/HFOs to alternative refrigerants.



# Issues that we face: Demand barriers



## Electricity vs gas ratio.

The ratio between electricity per kWh and gas is still a challenge and determines the competitiveness of heat pump operating costs.

It is estimated that for a heat pump to remain cost-effective, the price of electricity has to not exceed three times the price of gas and oil.

However, the low gas price has harmed their competitiveness versus gas boiler technology, and the sharp decline of oil prices has even led to an upswing in oil boiler sales.





# Issues that we face: Demand barriers



## Upfront cost.

Heat pumps can be seen as a luxury and expensive equipment, increasing the upfront cost. If the demand and workforce is not prepared for the deployment, the upfront cost is not feasible for all citizens.

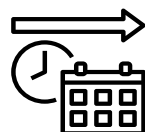
According to IEA, an air source heat pump costs around £10,000 (€11,500) to buy and install. Average upfront costs are around two to four times higher than gas boilers. It also states that heat pumps can save consumers money in the long run, while shielding them from price shocks.

Household savings were up to around €840 in Europe, according to a 2022 report. But, if no subsidies are given, poor households can't afford them.

## Demand barriers

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# Issues that we face: Demand barriers



Awareness of consumers.

The answer is simple, if heat pumps are seen as expensive equipment with no subsidies to support the upfront investment and gas is cheaper than electricity, why install them?

Tackling this perception is key to help the deployment.

## Demand barriers

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# Issues that we face: Workforce

- There is a current lack of trained installers.
- Impact on the grid with unpredictable peaks and over-dimensioned power supply.
- New challenges in terms of technologies and overall energy systems require new competences to be acquired: smart integration or use of non-fluorinated refrigerants.



**Harmonised Guidelines on training standards to then be implemented in all Member States.**

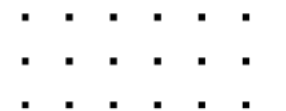
**Incentives to attract HVAC professionals to gain additional certifications.**



## Workforce

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# Concluding Remarks



- The shift to alternative refrigerants must not hinder the move away from fossil fuel heating. Continuous and timely market monitoring is essential to prevent delays in the heat pump uptake.
- A balanced strategy that integrates efficiency, safety, affordability, and low GWP is vital for harmonizing different legislative requirements.
- Export limitations on products manufactured only in the EU could affect **international market competitiveness**.
- Ensuring a shared understanding of the regulatory requirements and avoiding double regulation is critical to **avoid market confusion**.
- The European market is and should be an interesting market for Chinese manufacturers to sell quality, competitive, and conforming to EU legislation – hence the need to fully understand the regulatory context which is very complex...

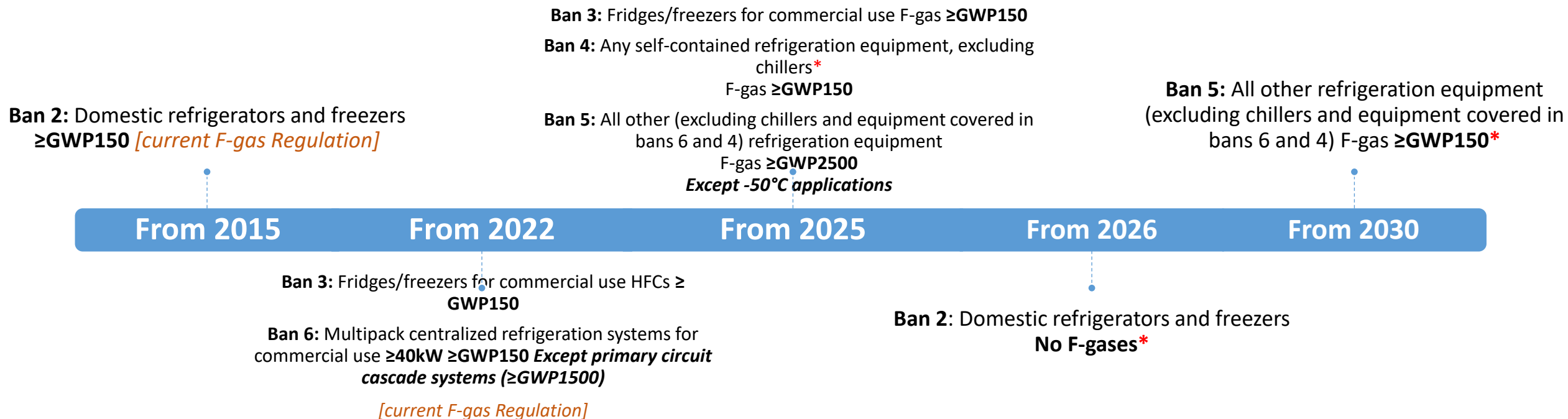
# Thank you for your attention!

Contact: [r.patten@epeeglobal.org](mailto:r.patten@epeeglobal.org)

# ANNEXES

# ANNEX - Placing on the Market Prohibitions (Annex IV) – Stationary Refrigeration

**'Refrigeration'** means the process of maintaining or lowering the temperature of a product, substance, system or other items





# ANNEX - Placing on the Market Prohibitions (Annex IV) Chillers

**'chiller'** means a single system whose primary function is to cool a heat transfer fluid (such as water, glycol, brine or CO<sub>2</sub>) for refrigeration, process, preservation or comfort purposes.

EPEE is working on a clarification of the definition to be submitted to the Commission.

**Ban 7:** Chillers  $\leq 12\text{kW}$   
F-gas  $\geq \text{GWP}150^*$

**Ban 7:** Chillers  $> 12\text{kW}$   
F-gas  $\geq \text{GWP}750^*$

**Impact assessment at  
the latest by 1 Jan 2030  
to check the feasibility  
for the post-2030 bans**

From 2027

From 2032

\*except when required to meet safety requirements

**Ban 7:** Chillers  $\leq 12\text{kW}$   
no F-gases\*

# ANNEX - Placing on the Market Prohibitions (Annex IV)

## Stationary AC & HP Self-contained

**'Heat pump'** means an equipment capable of using ambient heat and/or waste heat from air, water or ground sources to provide heat or cooling and is based on the interconnection of one or more components forming a closed cooling circuit in which a refrigerant circulates to extract and release heat

**'Air conditioning'** means the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness or distribution

**Impact assessment at the latest by 1 Jan 2030 to check the feasibility for the post-2030 bans**

\* If safety requirements apply, **GWP750** becomes the limit.

**Ban 8:** Self-contained AC & HP  $\leq 12$  kW  
F-gas  $\geq \text{GWP150}^*$

**Ban 8:** Self-contained AC & HP for 12-50kW  
F-gas  $\geq \text{GWP150}^*$

**Ban 8:** Self-contained AC & HP  $\leq 12$  kW  
**no F-gases\***

From  
2020

From 2027

From 2030

From 2032

**Ban 8:** Self-contained plug-in room air-conditioning equipment which is moveable between rooms by the end-user  
HFCs  $\geq \text{GWP150}$  [current F-gas Regulation]

**Ban 8:** Self-contained  $> 50$  kW  
F-gas  $\geq \text{GWP150}^*$

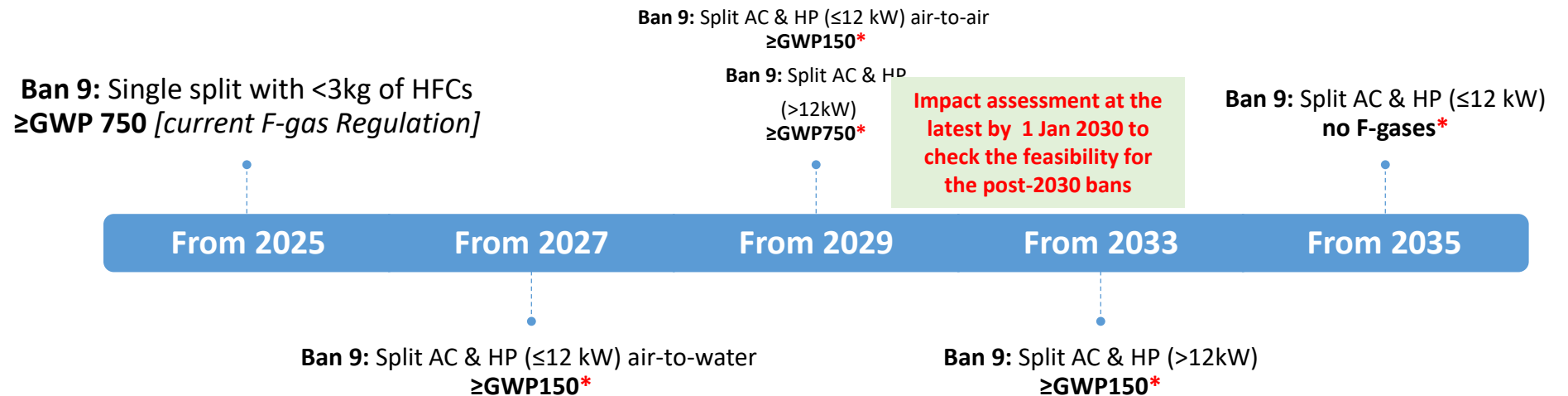
# ANNEX - Placing on the Market Prohibitions (Annex IV)

## Stationary Split AC & HP

**'Heat pump'** means an equipment capable of using ambient heat and/or waste heat from air, water or ground sources to provide heat or cooling and is based on the interconnection of one or more components forming a closed cooling circuit in which a refrigerant circulates to extract and release heat

**'Air conditioning'** means the process of treating air to meet the requirements of a conditioned space by controlling its temperature, humidity, cleanliness or distribution

\*except when required to meet safety requirements



# Progress in Refrigeration Markets (1)

## Domestic refrigerators and freezers

- new units have been using HC-600a (iso-butane, GWP = 0) for over 20 years
- HFC-134a completely banned in new units since 2015

## Other small hermetically sealed refrigeration equipment (e.g. for food retail)

- rapidly increasing use of HC-290 (propane, GWP = 0.02)
- growing use of HFC-HFO blends with GWP < 150

## Supermarket centralised refrigeration (e.g. 50 to 200 kW cooling capacity)

- growing use of R-744 (CO<sub>2</sub>, GWP = 1)
- growing use of HFC-HFO blends with GWP < 150

## Condensing units for commercial and industrial refrigeration (e.g. 5 to 20 kW capacity)

- growing use of R-744
- growing use of HFC-HFO blends with GWP < 150

## Large industrial systems (e.g. >200 kW)

- widespread use of R-717 (ammonia, GWP = 0)
- growing use of R-744 (CO<sub>2</sub>, GWP = 1)
- growing use of HFOs (GWP < 3) in industrial chillers
- some use of hydrocarbons in chillers and specialised refrigeration applications

## Transport refrigeration

- R-452A (GWP = 2140) widely used in place of R-404A (GWP = 3922)
- progress towards much lower GWP refrigerants not yet clear
- very small part of EU refrigerants market (0.7%)

# Progress in Air-conditioning and Heat Pump Markets (1)

## Large liquid chillers (for air-conditioning chilled water systems)

- growing use of HFOs such as HFO-1234ze (GWP = 1.37) and HFO-1233zd (GWP = 3.88)
- some use of R-717 (ammonia, GWP = 0), HC-290 (propane, GWP = 0.02) and R-718 (water, GWP = 0)

## Smaller liquid chillers (for air-conditioning chilled water systems)

- strong shift away from R-410A (GWP = 2088) to HFC-32 (GWP = 675) and HC-290
- potential for use of: HFO-HFC blends with GWP < 150; pure HFOs

## Small hermetically sealed air-conditioning equipment (e.g. moveable units, window units)

- significant use of HC-290

## Mobile air-conditioning in cars

- HFC-134a was banned in new cars after 2016
- most new cars in EU use HFO-1234yf (GWP = 0.5)
- a small proportion use R-744 (CO<sub>2</sub>, GWP = 1)

# Progress in Air-conditioning and Heat Pump Markets (2)

## Air-to-air split systems, <12kW (single split and small multi-split)

- strong shift away from R-410A (GWP = 2,088) to HFC-32 (GWP = 675)
- significant safety limits on use of HC-290 especially in 6 to 12 kW range and all multi-splits
- bans apply from 2029 (GWP>150) and from 2035 (no fluorinated refrigerants)
- pathway to 2029 and 2035 bans very unclear

## Air-to-air split systems, >12kW (large multi-split, VRF)

- growing shift away from R-410A to HFC-32
- bans apply from 2029 (GWP>750) and from 2033 (GWP>150)

## Air-to-water monobloc heat pumps <12 kW

- growing use of HC-290, HFC-32 and HFO-HFC blends
- bans apply from 2027 (GWP>150) and from 2032 (no fluorinated refrigerants)

## Air-to-water monobloc heat pumps 12 – 50 kW

- growing use of HFC-32, HFO-HFC blends and HC-290
- ban applies from 2027 (GWP>150)

## Ban Exemptions

All these bans have a possible exemption: **“except if required to meet safety requirements”**

And bans will be reviewed by 2030