

Refrigerants: a key challenge for the heat pump sector

Heat pumps are highly energy-efficient and low-carbon heating equipment that play a key role in achieving carbon neutrality in the building sector. Their climate performance can however still be improved by using refrigerants with a lower Global Warming Potential than those that are currently used. The European Union aims to foster this movement with the recent revision of the “F-Gas” regulation.



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About refrigerants

Since the signing of the Montreal Protocol in 1987 and of the Kyoto Protocol in 1997, various regulations have been implemented at both European and national levels to limit the environmental impact of the various types of refrigerants used in the refrigeration, air conditioning, and heat pump sectors.

These regulations led the European heat pump manufacturers to new improvements in thermodynamic systems operation and maintenance and to make substantial R&D investments, which resulted in significantly reducing the climate impact of refrigerants.

Current refrigerants can either be HFCs (hydrofluorocarbons), HFOs (hydrofluoroolefins), hydrocarbons, or mixtures, and their Global Warming Potential (GWP) varies widely (table 1).

R32 is currently the most widely used refrigerant in heat pumps but it may gradually be replaced by HFOs and non-fluorinated refrigerants.

GHG emissions related to refrigerants used in heat pumps

The TEWI (Total Equivalent Warming Impact) is defined as the sum of the refrigerant’s direct CO₂ emissions and of the indirect CO₂ emissions resulting from the primary energy consumed by the heat pump.

In a 90 m² house with heat losses of 15,000 kWh/year, the TEWI of an average medium-temperature air-to-water heat pump operating on R32 amount to 14 tCO₂eq over 17 years of operation. Only 7%, or 0.4 tCO₂eq, of these emissions are caused by the refrigerant.

Recent revision of the “F-Gas” regulation

The European regulation on fluorinated greenhouse gases, also known as “F-Gas”, was first published in 2006, and revised a first time in 2014. The new 2024/573 regulation entered into force on March 11, 2024. It strengthens existing measures regarding:

- Training and certification of operators and technicians;
- Containment and leakage checking;
- Extension of certain provisions to mobile applications;
- Ban on placing certain equipment on the market;
- Use of certain fluorinated refrigerants;
- Progressive phase-out of HFCs;
- Recovery and Reclaiming;
- Combating refrigerant smuggling;
- Controlling imports and exports of products and equipment.

Following this new regulation, only refrigerants with very low direct greenhouse effects may be placed on the market. The regulation also sets the

Type	Refrigerant	PRP _(AR4)
HFC	R410A	2 088
	R134a	1 430
	R32	675
HFO	R1234ze	1,37
	R1234yf	0,501
Non-fluorinated	R744 (CO ₂)	1
	R717 (NH ₃)	0
	R290 (propane)	3

Table 1: Main refrigerants used in heat pumps.

threshold of GWP<150 as the reference for heat pumps.

A major point of this new regulation is the revised agenda for the reduction of HFC quotas, with a new and lowered starting reference for the placing of HFC on the market and the introduction of a zero HFC target by 2050 (figure 1).

These provisions will encourage companies to recover, reclaim and reuse refrigerants at the end of an appliance's life. The European Commission has also introduced safeguard measures:

- Each year, the European Commission will analyse the impact of the reduction of HFC quotas on the refrigerants' prices, on the development of alternatives, and on the deployment of heat pumps (RePowerEU);
- If the growth of the heat pump market is hampered due to the number of quotas being insufficient, additional quotas may be made available, up to 4.4MtCO₂eq in 2025-2026, and up to 1.MtCO₂eq in 2027-2029.

What are the next steps?

A majority of industries are working on deploying low-GWP refrigerants. **Air-to-water heat pumps are already switching to new refrigerants, in particular propane (R290).**

However, new refrigerants with low-GWP are in majority inflammable. This means technicians would have to undergo new training to safely install, handle and maintain those refrigerants and heat pumps, which would require time and investment from companies.

At the latest on January 1st, 2030, the European Commission will publish a report on the impacts of this new regulation. It is crucial for the sector to collect and report information and data to competent authorities, so that their analysis can be based on accurate feedback.

Too often, evaluations of GHG emissions only focus on the refrigerants' GWP. It is crucial to change this approach, and to consider the environmental impact of heat pumps over their whole life cycle. The use of the TEWI by public authorities could be the most appropriate indicator to assess the cumulative environmental impact of heat pumps. ●

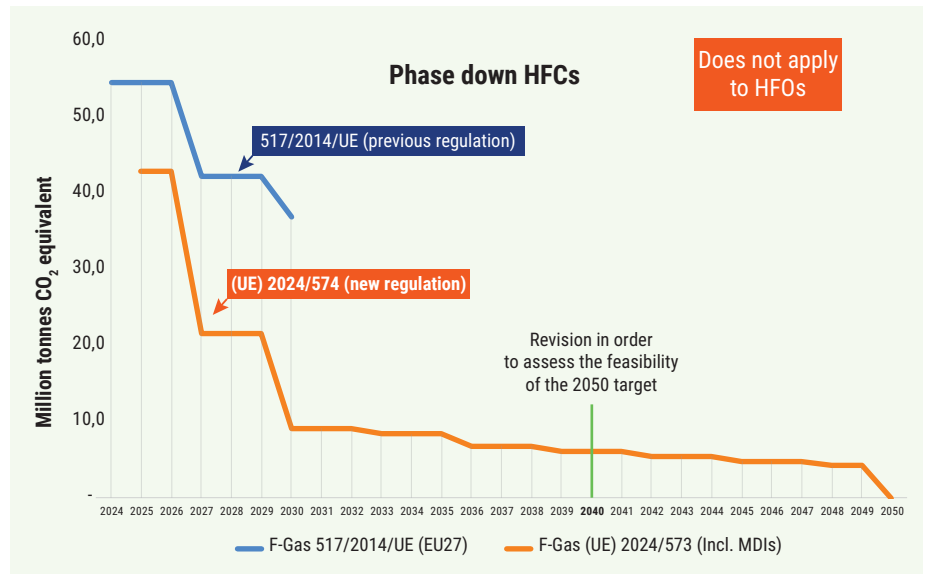
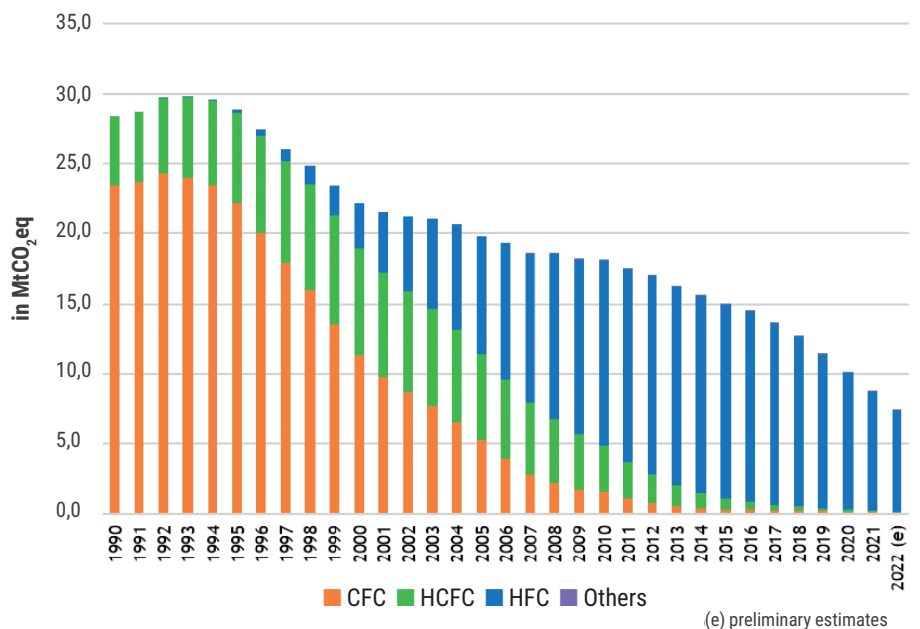


Fig. 1: The new F Gas regulation sets very ambitious goals for the HFC related emissions.

Source: AFCE.



Evolution of the emissions from fluorinated gases in mainland France in tCO₂eq (1990-2022).