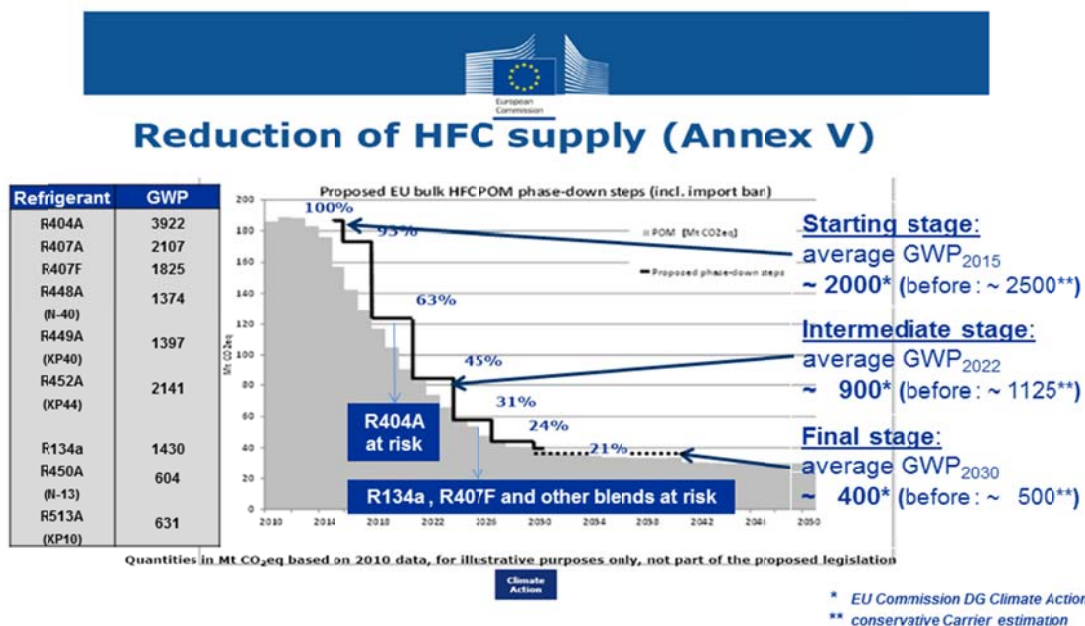


Carrier Commercial Refrigeration (CCR) Europe

Introduction:

The new F-Gas regulation EU/517/2014 entered into force on the 9th June 2014 and will become effective in January 2015. From this time, a "cap and phase-down" mechanism will gradually reduce the availability of new fluorinated greenhouse gases (F-Gases), and in particular hydrofluorocarbons (HFCs), in the 28 European Union (EU) countries. Figure 1 shows the timeline and the individual reduction steps of this phase-down, which will result in a 79% reduction of HFC supplies by the year 2030.

Company position on the new EU F-Gas Regulation (EU / 517/2014)



For the first time, the new regulation imposes restrictions on the volume of HFCs that can be produced and imported. The restrictions relate to the total placement of bulk HFCs (in tonnes of CO₂ equivalent) on the market, and will primarily affect those substances that have the highest global warming impact based on their direct emission potentials. As a result, there will be a move away from HFCs that have a medium-to-high Global Warming Potential (GWP). It is expected that decreased availability will quickly lead to significant price increases for higher-GWP HFCs.

In addition to the phase-down, the regulation will place restrictions and bans on the use of HFCs in certain applications (see annex), which will effectively mean the phase-out of high GWP HFC refrigerants such as R404A and R507.

With some minor exceptions, elements of the previous F-Gas regulation (EC/842/2006) such as record keeping, leak tests and certification of companies and personnel remain mostly unchanged.

In light of this regulatory development, we consider it our duty as a responsible refrigeration system manufacturer and service provider to inform our customers, as investors and operators of commercial refrigeration systems, with recommendations for action.

The following questions and answers are intended to assist in your future-decision making processes and to act as a guide on Carrier's position in the context of the new F-Gas regulation.

Question 1:

Do HFCs have a realistic future as refrigerants for the food retail industry?

Answer 1:

Only partially. A customer investing in a refrigerating system using a medium- to high-GWP refrigerant today is likely to experience significant refrigerant cost increases and procurement difficulties over the course of an average 15 year system life cycle due to the phasedown of these substances.

There is an ever-increasing demand for HFCs, including demand from industries outside of refrigeration. When considering the total HFC demand, it is likely that refrigerants with a calculated average GWP of around 500 would be required in 2030 to ensure that suppliers will be able to comply with their allocated HFC supply quotas. The phase-down restrictions reinforce the formal bans, such as the ban on the use of refrigerants with a GWP \geq 2500 in stationary applications in the year 2020.

Owners and operators can avoid these risks and uncertainties by selecting refrigeration systems that do not use HFC refrigerants.

Carrier therefore recommends that its customers invest in well-established and future-proof natural refrigerant carbon dioxide (CO₂) solutions, such as its CO₂OLtec™ refrigeration systems. CO₂OLtec use CO₂ refrigerant, which has a GWP of just 1 and is not subject to the F-Gas regulation. CO₂OLtec refrigeration systems operate in a transcritical booster configuration and achieve significant energy savings compared to conventional HFC systems due to the excellent thermodynamic properties of CO₂. Even in areas where yearly average ambient temperatures exceed 15 degrees Celcius, CO₂OLtec™ systems offer an energy efficiency performance that is equal to, or better than, equivalent HFC systems.

CO₂OLtec™ refrigeration systems can be used throughout Europe. They are perfectly suited to supermarket refrigeration, are

efficient, future-proof, and provide attractive life-cycle costs.

Also, the fact that CO₂ is classified as an A1 refrigerant means that operators and investors can have confidence in using a substance which is non-flammable and has lower toxicity.

Question 2:

Can I still safely invest in hybrid solutions, and specifically in R134a / CO₂ cascade systems, without the risk of facing costly changes in the future as a result of the new F-Gas regulation?

Antwort 2:

From today's perspective, R134a / CO₂ cascade systems will not be directly affected by the service ban of 2020, nor will they be prohibited by the ban of high GWP HFCs in new stationary refrigeration systems in 2020. The ban of HFCs with GWP greater than 150 in new multipack centralized refrigeration systems from the year 2022, however, will prohibit the installation of direct R134a / CO₂ cascade systems, which are the most common type of cascade refrigeration system in the food retail industry today. Indirect R134a / CO₂ cascade systems will still be permitted, however these would incur significantly higher investment and energy costs compared to direct systems, due to an additional brine system required to deliver medium-temperature cooling.

In 2020, the refrigerant R134a, with a GWP of 1430, would be considered a high-GWP refrigerant and will be subject to related price pressure. Moreover, the F-Gas regulation is scheduled for review once again in 2017; a process which may result in additional, tighter restrictions on HFC use.

In light of the above, we do not currently consider R134a / CO₂ cascade systems as future-proof.

Question 3:

What can be expected from the next generation of fluorinated refrigerants? Will they meet the stringent conditions of the new F-Gas regulation (EU/517/2014)?

Answer 3:

The regulation indicates a GWP limit of 150 for many applications in the future. Today, no efficient synthetic refrigerant alternatives are available that comply with the A1 safety classification. However a new A2L safety classification was recently introduced, and a number of the new HFC alternatives meet its requirements. The A2L classification is described as "mildly flammable," so these substances need to comply with product and building safety codes for flammable refrigerants.

Most refrigeration systems in food retail are multipack compressor systems connected to extensive piping networks with refrigerant charges of several hundred kilograms. A large portion of these refrigeration systems is installed on the sales floor, in publicly accessible areas. Under these circumstances, refrigerants with an A2L safety rating are not permitted today and will likely remain restricted in the future.

Use of these A2L substances would either require systems to be designed with a very small refrigerant charge or as indirect systems. Neither of these alternatives is attractive in our opinion, since the first would result in a large heat input to the shop floor via numerous small autonomous systems, while the second would mean an increased energy demand and thus lower energy efficiency.

Apart from stand-alone, plug-in chiller and freezer display cabinets, we do not currently envisage a practical use for new A2L refrigerants in the typical refrigeration applications of food retailers.

Question 4:

Existing refrigeration systems often have to be extended to cater for additional fixtures, even though there is no spare capacity available. What is Carrier Commercial Refrigeration's recommendation in this situation?

Answer 4:

The recommended course of action for extending an existing refrigeration system depends largely on the amount of additional capacity needed. For cooling capacities above 20kW we would always recommend a natural refrigeration solution from our CO2OLtec™ product range. However, for smaller capacity requirements, the capital costs of a cutting-edge natural refrigerant solution can still be quite high compared to traditional HFC-based refrigeration systems, and these costs are less likely to be recovered over the period of the system life cycle. In this scenario, small and hermetically sealed HFC refrigeration systems will still prove to be useful, however it is important to select HFCs with the lowest possible GWP. From today's perspective, we recommend as suitable alternatives the refrigerants R134a and R410A for medium-temperature applications, and R407F for medium- and low-temperature applications.

Question 5:

R404A multipack compressor systems represent by far the largest proportion of existing refrigeration systems in the food retail sector. With a ban on the use of virgin R404A in stationary refrigeration systems from the year 2020, what measures should owners and operators take in the short to medium term to ensure the continued safe operation of these systems?

Answer 5:

A "standard" recommendation is not possible because the installed base of R404A equipment is so diverse. Nevertheless, we can provide the following information.

From a purely technical point of view, almost all R404A refrigeration systems can be adapted to operate with the refrigerant R407F. Our experience so far tells us that this does not result in any issues with system operation.

From a commercial point of view however, a proactive and early transition to R407F is only advisable if attractive return on investments can be achieved based on the following criteria:

- Is the remaining lifetime of the system longer than the return on investment period?
- Is a low temperature refrigeration capacity reserve of up to 15% available?
- A significant price increase for R404A compared to R407F is likely.
- The introduction of GWP based F-Gas taxes is possible.
- Supply shortages for new R404A may arise.
- A sufficient supply of reclaimed or recycled R404A may not be available.

There will of course be other aspects to consider, but the above items should assist in making an informed decision about whether to convert your existing refrigeration systems from R404A to other refrigerant alternatives.

An alternative to refrigerant conversion is the option of using reclaimed or recycled R404A, which can still be used up until 2030 for service and maintenance purposes. Of course, this approach assumes that newer systems can be adequately sustained by R404A obtained from older systems reaching the end of their lifecycle. The older systems should then be replaced with CO2 systems to achieve a carbon footprint that is as low as possible.

Making the right decision depends on a large and varied number of criteria, and we would therefore advise individual consultations with our relevant sales and service organizations.

SOURCE:

EU/517/2014: Annex III, Article 2, 13 (excerpts)

ANNEX

Bans relating to commercial plug-in chillers and freezers



11. Refrigerators and freezers for commercial use (hermetically sealed equipment)	that contain HFCs with GWP of 2 500 or more	1 January 2020
	that contain HFCs with GWP of 150 or more	1 January 2022

Abstract from EU-Regulation No EU/517/2014 on fluorinated greenhouse gases (Annex III, 11)

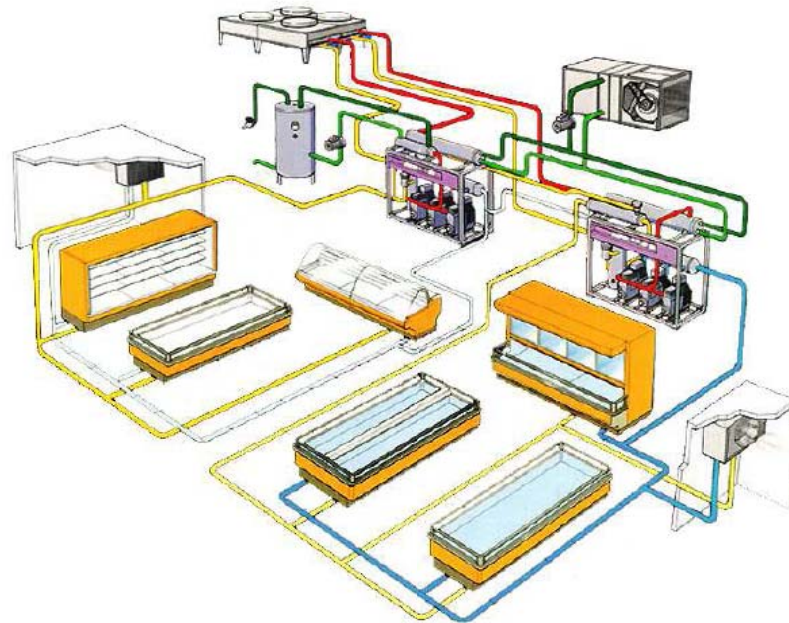
Prohibition on the sale of:

Commercial plug-in refrigerators and freezers with hermetically sealed circuits using certain HFC refrigerants, as detailed below.

1st January 2020: HFC refrigerants with a **GWP > 2500** prohibited.

1st January 2022: HFC refrigerants with a **GWP > 150** prohibited.

Bans relating to stationary refrigeration equipment



<p>12. Stationary refrigeration equipment, that contains, or whose functioning relies upon, HFCs with GWP of 2 500 or more except equipment intended for application designed to cool products to temperatures below -50°C</p>	<p>1 January 2020</p>
---	-----------------------

Abstract from EU-Regulation No EU/517/2014 on fluorinated greenhouse gases (Annex III, 12)

Prohibition on the sale of:

Stationary refrigeration systems using certain HFC refrigerants, as detailed below.

1st January 2020: HFC refrigerants with a **GWP > 2500** prohibited.

Does not apply to systems designed to cool products below -50°C .

Bans relating to centralized refrigeration systems



13. Multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 150 or more, except in the primary refrigerant circuit of cascade systems where fluorinated greenhouse gases with a GWP of less than 1 500 may be used

1 January 2022

Abstract from EU-Regulation No EU/517/2014 on fluorinated greenhouse gases (Annex III, 13)

Prohibition on the sale of:

Centralized multipack refrigeration systems with a cooling capacity ≥ 40 kW that contain certain HFC refrigerants, as detailed below.

1st January 2022: HFC refrigerants with a **GWP > 150** prohibited.

(38) 'primary refrigerant circuit of cascade systems' means the primary circuit in indirect medium temperature systems where a combination of two or more separate refrigeration circuits are connected in series such that the primary circuit absorbs the condenser heat from a secondary circuit for the medium temperature;

Abstract from EU-Regulation No. EU/517/2014 on fluorinated greenhouse gases (Article 2: (38))

Does not apply to refrigerants within the **primary refrigerant circuit** of **indirect cascade systems**, where **HFC refrigerants** with a **GWP up to 1500** may still be used.

Bans relating to service & maintenance



3. From 1 January 2020, the use of fluorinated greenhouse gases, with a global warming potential of 2 500 or more, to service or maintain refrigeration equipment with a charge size of 40 tonnes of CO₂ equivalent or more, shall be prohibited.

This paragraph shall not apply to military equipment or equipment intended for applications designed to cool products to temperatures below – 50 °C.

The prohibition referred to in the first subparagraph shall not apply to the following categories of fluorinated greenhouse gases until 1 January 2030:

- (a) reclaimed fluorinated greenhouse gases with a global warming potential of 2 500 or more used for the maintenance or servicing of existing refrigeration equipment, provided that they have been labelled in accordance with Article 12(6);
- (b) recycled fluorinated greenhouse gases with a global warming potential of 2 500 or more used for the maintenance or servicing of existing refrigeration equipment provided they have been recovered from such equipment. Such recycled gases may only be used by the undertaking which carried out their recovery as part of maintenance or servicing or the undertaking for which the recovery was carried out as part of maintenance or servicing.

Abstract from EU-Regulation No EU/517/2014 on fluorinated greenhouse gases (Article 13, clause 3)

1st January 2020: Prohibition on the use of virgin HFC refrigerants with a **GWP > 2500** for service and maintenance activities on all refrigeration systems with a charge size of 40 tonnes CO₂-equivalent or more (as an example, 10kg of R404a has a CO₂ equivalent of 40 tonnes).

Mobile and stationary refrigeration...

- Household refrigeration equipment
- Commercial refrigeration equipment/systems
- Industrial refrigeration systems

Does not apply to systems designed to cool products below -50°C.