

The background of the entire page is a photograph of a European Union flag that has been severely damaged. The flag is blue with twelve yellow stars arranged in a circle. The fabric is heavily frayed, with many of the stars missing or obscured by tears and holes. The flag is set against a light, possibly white, background that also shows some signs of wear and tear.

## EU F-Gas Regulation Handbook: Keeping Ahead of the Curve as Europe Phases Down HFCs



September 2015

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# Introduction

With the adoption of Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on Fluorinated Greenhouse Gases and Repealing Regulation (EC) No 842/2006 (hereinafter the “EU F-Gas Regulation”),<sup>(1)</sup> the European Union (EU) has set out an ambitious package of policies designed to reduce hydrofluorocarbon (HFC) emissions.

The EU F-Gas Regulation will compel a large-scale conversion to climate-friendly technologies in new equipment and products by 2030. In the process, it will transform the European economy with implications on producers, importers, distributors, manufacturers, operators, contractors and consumers. The successful implementation of the EU F-Gas Regulation also has implications for future efforts to negotiate and implement an HFC phase-down at the international level. Its phase-down schedule is significantly more ambitious than current amendment proposals to the Montreal Protocol.

There are several publications describing the main provisions of the EU F-Gas Regulation. The European Commission,<sup>(2)</sup> the United Kingdom (UK) government<sup>(3)</sup> and the European Association of Refrigeration, Air Conditioning and Heat Pump Contractors (AREA),<sup>(4)</sup> to name a few, have published guidance documents for stakeholders, which also provide useful summaries of the main obligations.

This publication seeks to take the additional step of describing where the HFC phase-down came from and what it means for the new European marketplace. It is intended to serve as a guide for companies and consumers affected by the EU F-Gas Regulation, underscoring the importance of remaining ahead of the curve. It outlines the main impacts, and details why producers, importers, exporters, operators, manufacturers, contractors and national authorities should take early proactive measures to ensure swift implementation.

# Chapter 1: The HFC Phase-Down

## I. How the HFC Phase-Down Works

The HFC phase-down is a progressive reduction of HFCs measured in CO<sub>2</sub>-equivalence (CO<sub>2</sub>e) made available on the EU market each year, starting in 2015 and running through 2030 and beyond.<sup>(5)</sup> Producers and importers are allocated annual quotas of HFCs (hereinafter referred to as “HFC quotas”) that are progressively reduced according to a reduction schedule.

### A. Reduction Schedule

From 2015 onwards, the total sum of the HFC quotas allocated to producers and importers cannot exceed the “maximum quantity” calculated for that calendar year.<sup>(6)</sup> The maximum quantity of HFC quotas available in 2015 corresponds to 100% of the annual average demand during 2009-2012, approximately 182.5 million tonnes (Mt) CO<sub>2</sub>e,<sup>(7)</sup> which is also referred to as the “baseline.” The maximum quantity or baseline is thereafter reduced by 7% in 2016, 37% in 2018, 55% in 2021, 69% in 2024, 76% in 2027 and 79% in 2030.<sup>(8)</sup>

The HFC phase-down is actually more stringent than it initially appears for those sectors that fall within its scope. This is because the maximum quantity of HFC quotas available on the market is adjusted downward from 2018 onwards to remove HFC quotas in exempt uses, estimated at approximately 8.5 Mt CO<sub>2</sub>e each year.<sup>(9)</sup> This makes the burden on non-exempt uses higher than it first appears (see Table 1 and Figure 1).

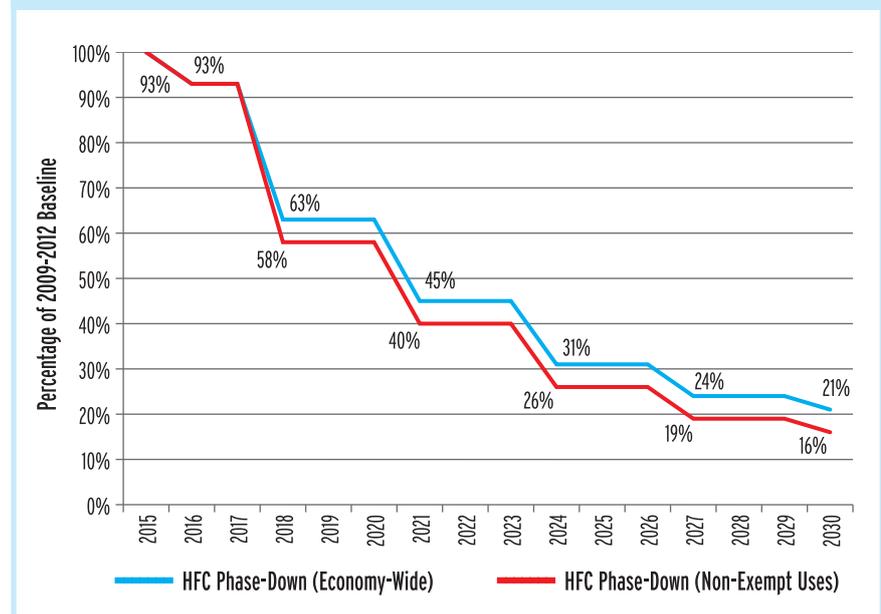
**Table 1:**  
Comparison of Maximum  
Quantity of HFC Quotas Available  
Economy-Wide and to  
Non-Exempt Uses

Years	HFC Phase-Down Schedule	
	Economy-Wide	Non-Exempt Uses
2015	100%	100%
2016-17	93%	93%
2018-20	63%	58%
2021-23	45%	40%
2024-26	31%	26%
2027-29	24%	19%
2030	21%	16%

“PRODUCERS” are companies that manufacture HFCs in the European Union. Producers place HFCs on the European market when they supply them to third parties or use them internally for their own account.

“IMPORTERS” are companies that import HFCs manufactured outside the European Union. Importers place HFCs on the European market upon release by customs for free circulation.

**FIGURE 1: HFC PHASE-DOWN: ECONOMY-WIDE VS NON-EXEMPT USES**



In total, the HFC phase-down will reduce cumulative HFC emissions by 1.5 gigatonnes (Gt) CO<sub>2</sub>e by 2030 and 5 Gt CO<sub>2</sub>e by 2050.<sup>(10)</sup>

The HFC phase-down will compel a near-complete transition away from HFCs in new equipment in almost all sectors by 2030. The remaining HFC consumption available from 2030 onward is expected to be used for servicing the installed base and in certain discrete applications where no alternatives exist. Decisions on the post-2030 reduction schedule will be made well before 2030.<sup>(11)</sup>

### B. Carbon Dioxide Equivalence

The HFC phase-down is defined in terms of (CO<sub>2</sub>e). The metric tonnage of HFCs that may be placed on the European market therefore depends on the global warming potential (GWP) of the HFC or blend in question.

For example, an importer with 10 Mt CO<sub>2</sub>e of HFC quotas can only place 2.5 tonnes of HFC-404A on the European market that year. See Table 2 for other examples.

HFC or Blend	Global Warming Potential	Quantity of HFC Equivalent to 10 Mt CO <sub>2</sub> e (tonnes)
HFC-23	14,800	0.6
HFC-404A	3,922	2.5
HFC-227ea	3,220	3.1
HFC-410A	2,088	4.7
HFC-407C	1,824	5.4
HFC-134a	1,430	6.9
HFC-32	675	14.8
HFC-152a	124	80.6

Table 2:  
Implications of Global Warming Potential under HFC Quota System

Unsaturated HFCs, sometimes referred to as hydrofluoroolefins (HFOs), such as HFC-1234yf, HFC-1234ze and HFC-1336mzz, do not require HFC quotas as they are contained in Annex II of the EU F-Gas Regulation.<sup>(12)</sup>

### C. Scope and Exemptions

The HFC phase-down operates economy-wide across the European Union. All stationary and mobile sectors in every EU Member State compete for the same pool of HFC quotas unless exempt. The HFC phase-down applies to bulk quantities of virgin HFCs, regardless whether produced within or outside the European Union. From 2017 onwards, all HFCs imported in pre-charged products and equipment are also included. Recycled and reclaimed HFCs are excluded from the scope of the HFC phase-down.

There are certain limited exemptions to the HFC phase-down. For example, it does not apply to producers and importers placing less than 100 tonnes CO<sub>2</sub>e of HFCs on the EU market in any given calendar year.<sup>(13)</sup> This equates to, for example, 69 kilogrammes of HFC-134a. The HFC phase-down also exempts HFCs used for the following purposes, assuming they are properly labelled:<sup>(14)</sup>

- quantities imported for destruction;
  - feedstock applications;
  - military equipment;
  - quantities exported out of the European Union;
  - certain semiconductor applications;
  - metered dose inhalers.<sup>(15)</sup>
- } Must be “supplied directly,” i.e. cannot be via third parties in the HFC supply chain.

HFCs purchased in bulk by a European manufacturer and subsequently placed in pre-charged equipment that is then exported outside the European Union are not exempt from the HFC phase-down.<sup>(16)</sup>

In addition to the exemptions above, following a substantiated request by an EU Member State, the European Commission may “exceptionally” authorise a time-limited exemption for up to four years for specific applications or categories of products or equipment where alternatives are unavailable or cannot be used for technical or safety reasons, or where a sufficient HFC supply cannot be ensured without entailing disproportionate costs.<sup>(17)</sup> Given its exceptional nature, it is not expected that this exemption will be used.

## II. Origins of the HFC Phase-Down

The HFC phase-down was based on the *AnaFgas* model developed for European Commission’s *Preparatory Study* for the EU F-Gas Regulation which, among other things, mapped out annual HFC demand in the European Union for each year from 2015 to 2030.<sup>(18)</sup> HFC demand consists of first fills in new equipment and refills in installed equipment.<sup>(19)</sup> Underpinning the *AnaFgas* model are two assumptions: penetration of low-GWP technologies in new equipment where technically and economically feasible, and full implementation of containment and recovery measures. These assumptions have important implications on HFC quota availability and HFC prices in the future.<sup>(20)</sup>

### A. Penetration of Low-GWP Technologies

The HFC phase-down assumes near-perfect market penetration of low-GWP technologies in new equipment.<sup>(21)</sup> This means that whenever a low-GWP technology can technically be installed instead of an HFC technology, it is assumed to have been installed and no HFC quotas for first fill or refills are needed for that piece of equipment.

The commercial refrigeration sector underscores the impact of this assumption. With respect to new centralised systems, approximately 19,000 medium-temperature and 18,000 low-temperature systems were installed in 2010, and annual new systems are expected to remain roughly the same for each year through 2030.<sup>(22)</sup> Table 3 shows the expected market penetration of low-GWP technologies in these new centralised systems (as a percentage of all new equipment in this sector), which not only highlights the need for a prompt transition but also speaks to the risks associated with delayed action.<sup>(23)</sup>

**Table 3:**  
Penetration of Low-GWP  
Technologies in New  
Centralised Systems

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>New Centralised Systems</b>	46%	61%	77%	93%	100%											

According to the *AnaFgas* model, 46% of all new multipack centralised refrigeration systems installed in 2015 should be relying on low-GWP technologies.<sup>(24)</sup> This increases to 100% in 2019, i.e. from 2019 onward all new multipack centralised systems should be relying on low-GWP technologies. The phase-down therefore assumes that HFC quotas are not required for these systems, neither for first fill or refill during their 12-year average lifetime. This means that any new HFC-based centralised refrigeration system installed in 2020, for example, will consume HFC quotas that were not anticipated. All other sectors and EU Member States are impacted by misguided technology choices.

The pace of market penetration of low-GWP technologies in new condensing units and stand-alone refrigeration systems are similar, with 100% of new systems expected to utilise low-GWP technologies by 2020.

Supermarkets and other cold food chain retailers may wonder, given the above, why the bans in this sector do not take effect earlier. In fact, the European Commission's *Preparatory Study* recommended banning all new HFC technologies with a GWP higher than 150 in this sector from 2020,<sup>(25)</sup> a recommendation which was supported by the European Parliament<sup>(26)</sup> and many EU Member States. Most policymakers recognised that bans, identified as the most effective measure in the 2006 EU F-Gas Regulation,<sup>(27)</sup> were essential signposts that would prevent unnecessary reliance on HFCs in new equipment when no longer needed. During the negotiations, however, a blocking minority of EU Member States succeeded in weakening bans in some of the key sectors, including refrigeration. This means that the European market will need to shift in these sectors without these clear market signals. A slower transition than originally envisaged will exacerbate HFC quota shortages and cause HFC prices to skyrocket, with disproportionate impacts on small- and medium-sized enterprises (SMEs).

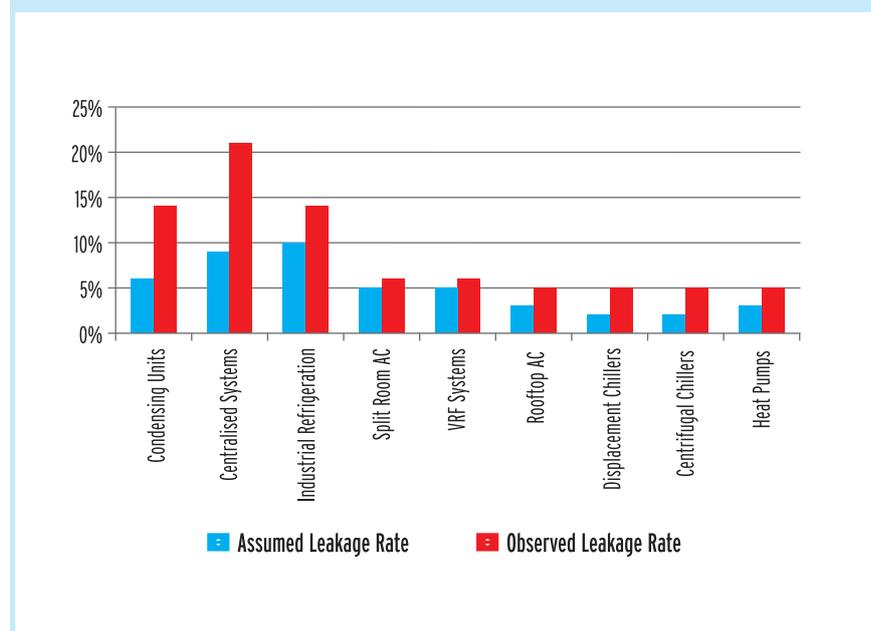
Operators and consumers should make every effort to make a quick transition away from HFCs to avoid paying excessive costs for unnecessary HFCs in the future.

## B. Full Implementation of Containment and Recovery Provisions

The HFC phase-down also assumes full implementation of containment and recovery provisions.<sup>(28)</sup> This means operators and contractors are assumed to take all precautionary measures to reduce leakage during use of the equipment and ensure recovery at its end of life. For this to happen, there must be the widespread adoption of best practices by operators and contractors, something that seems unlikely to occur in the near-term without further intervention given the historical "low degree of overall compliance" with these provisions.<sup>(29)</sup>

To date, containment provisions have not resulted in significant reductions in observed leakage rates. In order for observed leakage rates to match assumed leakage rates, significant improvements are required, shown in Figure 2.

FIGURE 2: OBSERVED LEAKAGE RATES COMPARED TO ASSUMED LEAKAGE RATES



Until leakage rates are reduced, the installed base of HFC technologies will consume more HFC quotas during servicing and maintenance than anticipated. This will have knock-on impacts on HFC quota availability and HFC prices.

The same holds true with recovery provisions. The HFC phase-down assumes 16% reclamation at end-of-life with the remaining 84% being emitted or destroyed.<sup>(30)</sup> While 16% reclamation seems reasonable, historical recovery rates indicate otherwise. The European Commission’s *Preparatory Study* found that 12 EU Member States did not even have reclamation facilities and, among those that did, low levels of reclamation and recycling were still found.<sup>(31)</sup> Recycling and reclamation are important safety valves for the HFC phase-down and increased recovery rates will be critical to its success.

National authorities should consider adopting maximum leakage rates and minimum precautionary measures to reduce leakage and mandatory producer responsibility schemes to promote recovery, as some EU Member States have already done.<sup>(32)</sup> This would facilitate the creation of a national recycling and reclamation market while minimising impacts within their borders.

### III. What the HFC Phase-Down Means

The HFC phase-down is intended to induce HFC quota shortages that will in turn increase HFC prices, making high-GWP HFC technologies less attractive from a cost perspective. In addition, given the assumptions underpinning the *AnaFgas* model, market opportunities will be limited for mid-GWP HFCs and blends in 2018 and beyond. Indeed, these lower-GWP HFCs are supposed to be leapfrogged in favour of truly low-GWP technologies, and their use, at least in new equipment, will only serve to exacerbate HFC quota shortages and HFC prices across the European Union.

#### A. Early HFC Quota Shortages

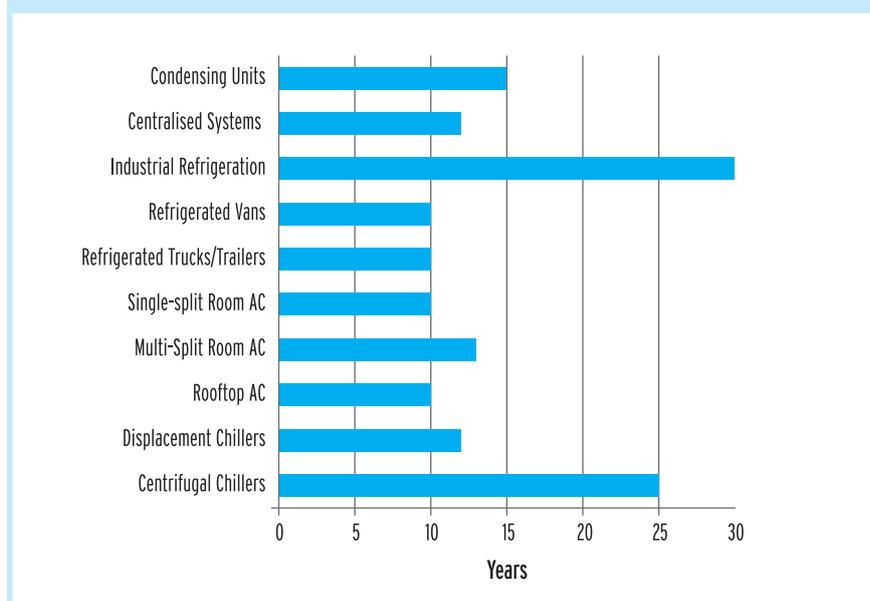
A confluence of factors beginning in 2017, not all of which were fully factored into the *AnaFgas* model, will likely reduce available HFC quotas across the European Union more quickly than anticipated by many operators and consumers. These are outlined in Table 4.

Table 4:  
Factors Impacting  
Availability of HFC Quotas

Year	Factor	Impact on HFC Supply or Demand
2017	Pre-Charged Equipment	Importers of pre-charged equipment must secure HFC quotas from 2017 onwards, increasing HFC demand by 13% with no corresponding increase in HFC quotas <sup>(33)</sup>
2018	Exempt Uses	HFC quotas for exempt uses are subtracted from the maximum quantity of HFC quotas in 2018 onwards - approximately 8.5 Mt CO <sub>2</sub> e per year-tightening the HFC phase-down further <sup>(34)</sup>
2018	HFC Phase-Down Step	37% reduction from the baseline in 2018 <sup>(35)</sup>
2020	Service Ban	The service ban enters into effect in 2020. This is expected to increase HFC demand by a total of 45 to 70 Mt CO <sub>2</sub> e during the years immediately before and after, although it will later result in additional reduction <sup>(36)</sup>
2021	HFC Phase-Down Step	55% reduction from the baseline in 2021 <sup>(37)</sup>

The first significant HFC quota shortages will be felt in late-2017 as pre-charged equipment is included within the scope of the HFC phase-down and stockpiles from previous years are depleted. In 2018, with the exclusion of exempt uses (8.5 Mt CO<sub>2</sub>e), the second reduction step (37%), and early compliance with the service ban, HFC quota shortages will begin in earnest. At this time, operators and consumers that have not already taken action may find themselves behind the curve, in particular those with newly installed equipment relying on mid- or high-GWP HFCs whose average lifetimes can be expected to extend well into the HFC phase-down (see Figure 3).

**FIGURE 3: AVERAGE LIFETIME OF CERTAIN HFC-BASED PRODUCTS AND EQUIPMENT**

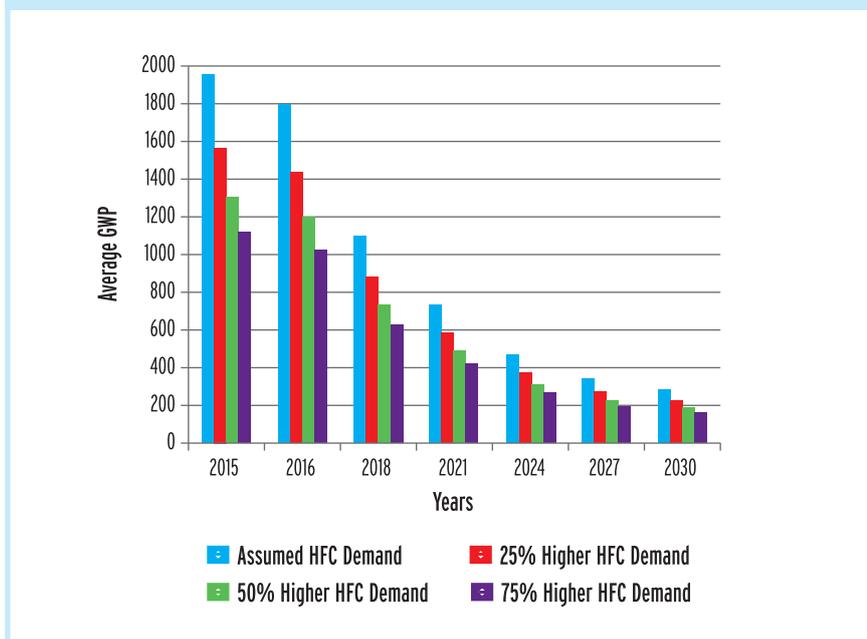


### B. Implications of a Slower Transition to Low-GWP Technologies in the Early Years

A slower transition to low-GWP technologies than originally envisaged in the *AnaFgas* model will increase HFC demand, which in turn will exacerbate HFC quota shortages and make the HFC phase-down more burdensome in future years. This can be demonstrated, rather simply, by calculating the average GWP of HFCs that would be compatible with the annual HFC demand (in metric tonnes of HFC refrigerant) and available HFC quotas (in CO<sub>2</sub>e) under various scenarios. Figure 4 shows the impact that a 25%, 50% and 75% increase in HFC demand higher than the amount assumed in the *AnaFgas* model would have on average GWP during the HFC phase-down.

WHO GETS HFCS FROM PRODUCERS AND IMPORTERS?  
WHOEVER IS PREPARED TO PAY THE HIGHEST PRICE!

FIGURE 4: IMPACT OF HFC PHASE-DOWN



If little action is taken to adopt low-GWP technologies early on, the average GWP of HFCs is dramatically reduced, with implications on the availability of HFCs to service existing equipment, underscoring the risk associated with unnecessarily locking in HFC technologies. Companies and consumers should exercise the utmost caution to avoid being saddled with unusable assets or skyrocketing costs.

The implication is clear. Companies and national authorities should take early concrete action to move away from HFCs or risk being behind the curve, competing for an ever-decreasing supply of HFC quotas that will increase costs during service and maintenance and possibly result in early retirement of equipment due to HFC quota shortages.

### C. HFC Price Premium

Simple economics dictates that when demand outpaces supply, price increases. The same holds true for HFC quotas, which the European Commission acknowledges “have a clear monetary value.”<sup>(38)</sup> This price increase for HFCs, unrelated to any increase in manufacturing costs of the fluorochemicals themselves, is referred to as the “HFC price premium.”

Producers and importers, by virtue of being title holder to HFC quotas allowing them to place certain quantities on the European market, are the indisputable beneficiaries of the HFC price premium. The German Federal Environment Agency (UBA) has calculated the potential HFC price premium (see Figure 5) under conditions that approximate the HFC phase-down.<sup>(39)</sup>

Since HFC quotas are grandfathered to a small number of producers and importers at no cost, i.e. given out for free, the HFC price premium represents a windfall profit for these companies in the billions of euros annually (see Figure 6).

In other words, free grandfathering will result in a significant transfer of wealth – approximately €32 billion from 2015 through 2030 – from European operators and consumers to mostly multinational HFC producers and importers.

FIGURE 5: HFC PRICE PREMIUM

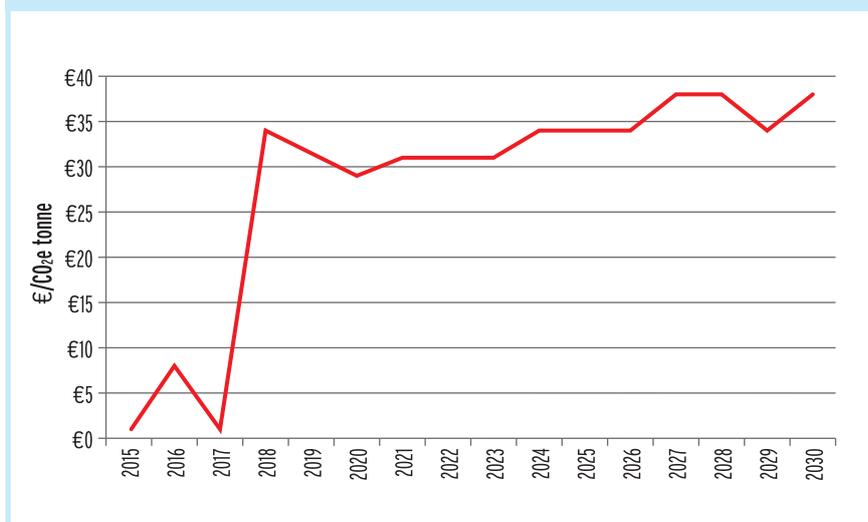
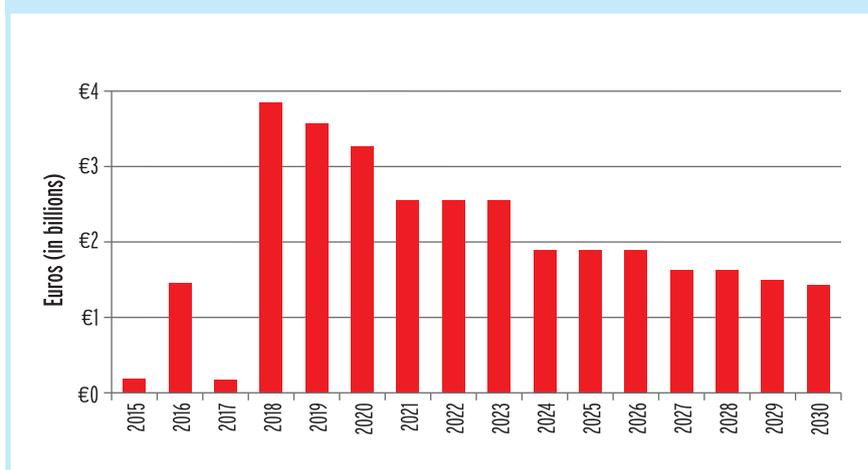


FIGURE 6: ANNUAL WINDFALL PROFITS TO PRODUCERS AND IMPORTERS



Short of early retirement or capital abandonment, operators and consumers with HFC technologies are locked into paying the HFC price premium. For example, current prices for HFC-134a are around €15-30 per kilogramme (kg), depending on whether wholesale or retail. At an HFC price premium of €30 per CO<sub>2</sub>e tonne, each kg of HFC-134a increases by €43 so that the total price for HFC-134a would be €58-73 per kg. The HFC price premium should therefore be factored into the purchase of new products and equipment, in particular when calculating annual costs related to servicing and maintenance in the future. Once factored in, HFC-free technologies are the clear choice from an economic perspective.

The estimates on the HFC price premium, however, do not capture the full picture. Other factors related to the nature of the HFC market could drive up the HFC price premium further, in particular:

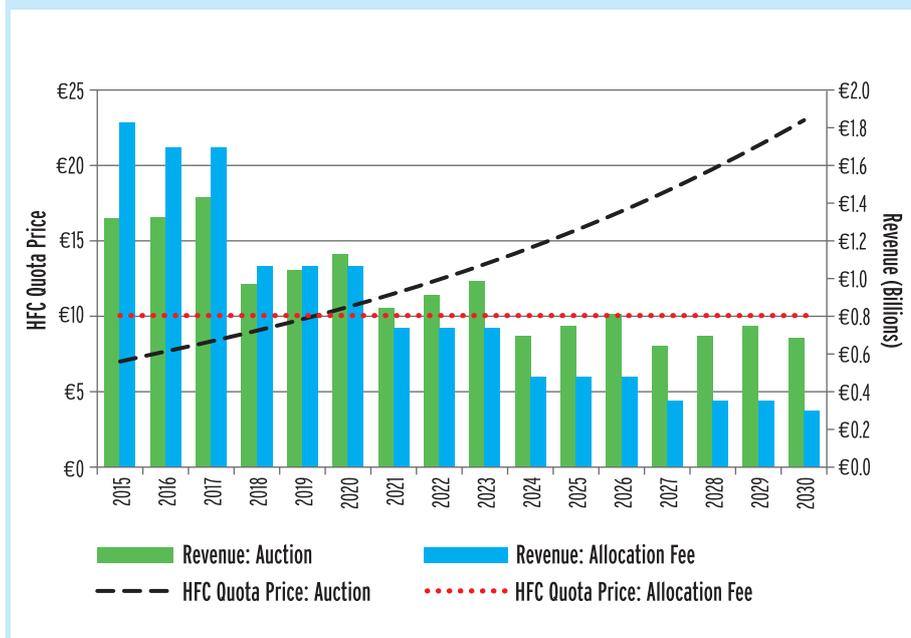
- The presence of monopoly power with respect to individual HFCs or blends; and
- The technical competition within any given portfolio offered by a producer or importer, such as the choice to promote various HFCs or blends over others, i.e. HFC-407F over HFC-404A.

#### HFC PRICE PREMIUM?

Within two weeks following publication of the EU F-Gas Regulation in the Official Journal of the European Union, the French fluorochemical producer Arkema announced an immediate 15% price increase for HFC-404A, HFC-407A, HFC-407C, HFC-410A, HFC-427A and HFC-507.

To address these windfall profits and generate revenue to offset implementation costs, the European Parliament supported an allocation fee of up to €10 per CO<sub>2</sub>e tonne.<sup>(40)</sup> Some EU Member States, most notably France and Denmark, also proposed an auction, with Denmark producing an analysis of the expected revenue from the auction (Figure 7).

FIGURE 7: HFC QUOTA PRICE AND REVENUE: ALLOCATION FEE VS AUCTION



### PURCHASE AGREEMENTS

Companies, especially SMEs, are strongly advised to avoid installing new HFC-based equipment to insulate themselves from the impact of the HFC phase-down. However, to the extent new HFC-based equipment is installed, companies are encouraged to sign agreements at the time of purchase guaranteeing access to HFCs at predetermined prices.

From 2015 to 2030, the allocation fee and auction would have recouped €13.4 billion and €14.9 billion respectively. This revenue was intended for redistribution back to EU Member States to offset, *inter alia*, implementation costs borne by operators, contractors and national authorities, which are estimated at well over a billion euros a year,<sup>(41)</sup> and to address disproportionate impacts on:

- **SMEs.** SMEs are considered less capable of absorbing the HFC price premium than their larger competitors and less likely to have long-term HFC purchase agreements at predetermined prices, and are more likely to secure HFCs from distributors on the retail market.
- **Eastern and Southern Europe.** EU Member States with economies in transition or recession, such as those in Eastern and Southern Europe, are expected to be outbid for HFC quotas by EU Member States with stronger economies and purchasing power.

Though an allocation fee and auction were not adopted in the EU F-Gas Regulation, a provision was included that requires the European Commission to assess the existing HFC quota allocation method of free grandfathering by mid-2017 for possible revision.<sup>(42)</sup> It is expected that the European Commission will give serious consideration to submitting a legislative amendment to fix the HFC quota allocation method. Until then, many EU Member States have already adopted or are exploring HFC taxes to achieve the same objectives.<sup>(43)</sup> In the meantime, operators and consumers should factor in the HFC price premium into the purchase of new HFC technologies.

## D. Impact on Mid-GWP HFCs and Blends

Although the EU F-Gas Regulation foresees ambitious cuts in HFC consumption over the next 15 years, chemical companies are now developing a range of mid-GWP refrigerants for the European market which are being presented as solutions to the implementation of the EU F-Gas Regulation. The simple truth is that the future is bleak for mid-GWP HFCs and blends in the European Union. In addition to being more expensive and often covered by patents, the HFC phase-down will not allow their widespread use in new products and equipment in most sectors from 2020 onward – thus placing a *de facto* ceiling on their market penetration. Indeed, rather than being a solution, mid-GWP HFCs and blends pose a threat to the HFC phase-down as their use will exacerbate HFC quota shortages and the HFC price premium beyond what is already expected. Given the long life-time of most of the equipment involved, mid-GWP HFCs and blends are, at best, very near-term transitional refrigerants and should only be considered as replacements for higher-GWP HFCs in existing equipment.

For example, Daikin Industries is heavily promoting HFC-32, with a GWP of 675, as an alternative refrigerant for the air-conditioning sector. Studies and trials show, however, that single-split AC systems relying on hydrocarbons (e.g. R290) achieve equal or greater efficiency and performance and at lower cost.<sup>(44)</sup> There is therefore a general consensus that, once outdated standards and safety legislation are revised to allow for greater market penetration, hydrocarbons should become the predominant refrigerants. Due to its GWP of 675, HFC-32 has an uphill battle to secure an appreciable market share in the mid-term, and it is expected to have a ceiling on the percentage of the European marketplace it can occupy in single-split AC systems. Manufacturers should not be misled by the 2025 ban on new single-split AC systems (3kg or less) which indicates a GWP under 750 is acceptable.<sup>(45)</sup> This ban was a politically negotiated compromise and is expected to have little impact beyond preventing the most egregious uses of refrigerants in this sector, such as HFC-410A; the actual refrigerant mix in new single-split AC systems will be dictated by the HFC phase-down and HFC-32 will soon be above the average GWP (see Figure 4).

Smart investors will take advantage of the emerging European marketplace for new single-split AC systems relying on hydrocarbons. In 2015, over 8 million new units will be placed on the European marketplace, of which approximately 85% will be imported.<sup>(46)</sup> This number increases to 9.8 million in 2030 with the imported share expected to remain about the same.<sup>(47)</sup> Assuming around 80% of these new single-split AC systems rely on hydrocarbons from 2020 onward, a reasonable assumption under the HFC phase-down, investing in hydrocarbon technologies today will ensure access to a sizeable market in the near future.

## IV. International Dimension

A parade of international diplomatic support for a global HFC phase-down now exists. This includes the Bali declaration in 2011, the Rio+20 and Bangkok declarations in 2012, the G20 summit in 2013 and the African Ministerial Conference on the Environment in 2015, among many others. It is well-accepted that the best course of action for a global HFC phase-down is to use the institutions and financial mechanisms of the Montreal Protocol, which has successfully phased out ozone depleting substances, the precursors to HFCs.

As of mid-2015, Parties have submitted four proposals to amend the Montreal Protocol to phase down consumption and production of HFCs. These proposals have been submitted by North America (Canada, Mexico and the United States of America), the Island States (the Federated States of Micronesia, Kiribati, Marshall Islands, Mauritius, Palau, Philippines, Samoa and Solomon Islands), the European Union and India. The Montreal Protocol is well-equipped to ensure flexibility for developing

### BUYER BE CAREFUL

The HFC phase-down was not designed to encourage the use of lower-GWP HFC blends in new refrigeration equipment, such as Chemours' Opteon™ and Honeywell's Solstice™. These lower-GWP HFCs and blends only make sense for specific purposes, such as when used as a drop-in or retrofit in installed equipment.

countries to cope with challenges that might arise from “leapfrogging” to low-GWP technologies, in particular by providing differentiated baselines, grace periods and reduction schedules in addition to financial assistance and technology transfer. Moreover, to respond to latest data and emerging technologies in order to achieve its goals, the Montreal Protocol has a unique adjustment mechanism that allows Parties to revise and accelerate reduction schedules as technologies develop.

Successful implementation of the EU F-Gas Regulation will inform and influence the global regulatory framework and choice of technologies made at the international level. The level of ambition in the EU F-Gas Regulation far exceeds any other national measure to date, and its successful implementation is particularly important since it will drive markets toward low-GWP technologies that will later be rolled out worldwide in order to achieve an HFC phase-down under the Montreal Protocol.



# Chapter 2: Producers & Importers

## I. HFC Quota Allocation

Each year, the European Commission allocates HFC quotas to producers and importers for the following calendar year. HFC quotas shall only be allocated to producers or importers that are established within the EU or which have mandated an “only representative” established within the EU for the purpose of compliance with the requirements of the EU F-Gas Regulation.<sup>(48)</sup> The only representative may be the same as the one mandated pursuant to Article 8 of Regulation (EC) No 1907/2006.<sup>(49)</sup>

Producers and importers that reported placing HFCs on the market during the previous reporting period (referred to as “incumbents”) receive HFC quotas at no cost via grandfathering.<sup>(50)</sup> Producers and importers which did not report during the previous reporting period (referred to as “new entrants”) may secure HFC quotas at no cost from the new-entrants reserve.<sup>(51)</sup> In addition, incumbents seeking additional quantities to their grandfathered amounts may also seek additional HFC quotas from the new-entrants reserve.<sup>(52)</sup> Incumbents and new entrants *cannot* carry over unused HFC quotas from one year to the next.<sup>(53)</sup> It is illegal for producers and importers to place more than their allocated HFC quota on the market, and the penalty for doing so is 200% of the amount by which the quota was exceeded.<sup>(54)</sup>

### A. Allocation via Grandfathering

Each year, 89% of HFC quotas are grandfathered to incumbents.<sup>(55)</sup> Grandfathering occurs in three-year allocation periods.

For the 2015-2017 allocation period, incumbents received HFC quotas based on the CO<sub>2</sub>e of the HFCs they reported placing on the market during the 2009-2012 period. This is referred to as their “reference value” (importers of HFCs in pre-charged equipment are not given a reference value).

For future allocation periods, reference values will be recalculated based on what producers and importers *actually* reported placing on the market from 1 January 2015 onwards. Incumbents continue on into the next three-year allocation period as incumbents and new entrants become incumbents.

Eleven per cent of the reference value for each producer and importer is placed in the new-entrants reserve, therefore over time the percentage of HFC quotas allocated to the original set of incumbents, as a percentage of their 2015 reference value, decreases more quickly than the reduction schedule in the HFC phase-down, as shown in Table 5.

**Table 5:**  
Decrease in HFC Quotas  
Allocated to Original List  
of Incumbents Due to  
New Entrants

Calendar Year	HFC Phase-Down Schedule	Grandfathered HFC Quotas
	% of 2015 Baseline	% of 2015 Reference Value
2015	100%	89%
2016-17	93%	82%
2018-20	63%	52%
2021-23	45%	30%
2024-26	31%	17%
2027-29	24%	11%
2030	21%	8%

Incumbents may seek to offset this decrease by securing additional HFC quotas via the new-entrants reserve, however there will be competition for HFC quotas from new entrants.

For the 2015-2017 allocation period, 79 incumbents received HFC quotas.<sup>(56)</sup>

## B. Allocation via the New-Entrants Reserve

Each year, 11 per cent of available HFC quotas are allocated via the new-entrants reserve.<sup>(57)</sup> New entrants must submit a declaration to the European Commission requesting HFC quotas via the new-entrants reserve within the time limit identified by the European Commission.<sup>(58)</sup> Before submitting a declaration, new entrants must also register in the electronic registry.<sup>(59)</sup>

Allocation via the new-entrants reserve is a multi-step process, according to the steps in Table 6.<sup>(60)</sup>

<b>Step 1</b>	The European Commission solicits declarations from interested parties on the quantities of HFC quotas sought for the next calendar year.
<b>Step 2</b>	The European Commission calculates the pro-rata share for each declarant and awards that amount of HFC quotas.
<b>Step 3</b>	If any HFC quotas remain and some declarants have not received the full amount requested under step 1, the European Commission again calculates the pro-rata share from the remaining HFC quotas and awards that amount. Step 2 is repeated until quotas equivalent to less than 500 tonnes of CO <sub>2</sub> e remain.

**Table 6:**  
Allocation Under  
New-Entrants Reserve

In 2015, 334 new entrants were awarded HFC quotas via the new-entrants reserve.<sup>(61)</sup>

## C. Transferring HFC Quotas

Producers and importers may transfer their HFC quotas at no cost or for a price to other producers, importers, or undertakings (undertaking here means a third party that is not the producer or importer transferring the HFC quota).<sup>(62)</sup> Special rules may apply when transferring HFC quotas to undertakings, depending on whether the producer or importer making the transfer is an incumbent or a new entrant:

- Incumbents may authorise an undertaking to use their HFC quotas without conditions.<sup>(63)</sup>
- New entrants may *only* authorise an undertaking to use their HFC quotas upon the condition that the HFCs are physically supplied to them.<sup>(64)</sup>

When an incumbent or new entrant authorises an undertaking to use their HFC quotas, those count against the total HFC quotas available to that incumbent or new entrant from the moment of authorisation.<sup>(65)</sup>

## D. Mandatory Registration in the Electronic Registry

The European Commission administers an electronic registry for tracking placement on the market, allocations and transfers. The electronic registry is a database that tracks the following activities:<sup>(66)</sup>

- allocation of the HFC quotas;
- transfer of HFC quotas to producers, importers or undertakings;
- declarations to the new-entrants reserve;
- producers, importers and undertakings supplying HFCs for exempt uses; and
- importers of pre-charged products and equipment.

All producers, importers and undertakings must register for the electronic registry with the sole exception being producers and importers placing less than 100 CO<sub>2</sub>e tonnes of HFCs or blends on the European marketplace in a calendar year.

To register with the electronic registry producers, importers and undertakings must contact the European Commission.

## II. Labelling

In order to facilitate its implementation, the HFC phase-down is supported by robust labelling requirements for producers and importers.

### A. Exempt Uses

For quantities of HFCs exempt from the HFC phase-down, producers and importers must identify the specific purpose of the HFCs in question and indicate that the contents of the container may only be used for that purpose, in particular whether for destruction,<sup>(67)</sup> export,<sup>(68)</sup> use in military equipment,<sup>(69)</sup> use in certain semiconductor applications,<sup>(70)</sup> use as feedstock,<sup>(71)</sup> and use in metered dose inhalers.<sup>(72)</sup>

### B. Recycled and Reclaimed HFCs

Producers and importers must label recycled and reclaimed HFCs as such with information on the batch number and the name and address of the recycling and reclamation facility.<sup>(73)</sup>

## III. Reporting

### A. Annual Reporting

Annual reporting is required by 31 March each year on production, importation, exportation, destruction and feedstock use during the previous calendar year from:

- Producers, importers and exporters of more than 100 metric CO<sub>2</sub>e tonnes or more;
- Undertakings authorised to use HFC quotas;
- Undertakings using 1,000 CO<sub>2</sub>e tonnes or more of HFCs as feedstock;
- Undertakings destroying 1,000 CO<sub>2</sub>e tonnes or more of HFCs; and
- Undertakings that placed 500 CO<sub>2</sub>e tonnes or more of unsaturated HFCs, i.e. HFC-1234yf, HFC-1234ze and HFC-1336mzz, on the market.

This information is reported to the European Commission.

### B. Independent Audit

Producers and importers placing 10,000 CO<sub>2</sub>e tonnes of HFCs on the market the previous calendar year must ensure the accuracy of their data is verified by an independent auditor accredited pursuant to Directive 2003/87/EC or accredited to verify financial statements in accordance with the legislation of the EU Member State concerned.<sup>(74)</sup>

## IV. HFC Production

### A. HFC Emissions during Production, Transport and Storage

Producers must take all necessary precautions to limit HFC emissions to the greatest extent possible during production, transport and storage, including HFCs produced as by-products.<sup>(75)</sup>

### B. Destruction or Recovery of HFC-23 By-Product

From 11 June 2015 onwards, producers and importers are prohibited from placing HFCs on the market unless evidence is provided that HFC-23 produced as a by-product during the manufacturing process has been destroyed or recovered for subsequent use in line with best available techniques, including during the manufacture of feedstocks and other inputs.<sup>(76)</sup> This requirement applies regardless of the quantity or intended use of the HFCs. The evidence must be provided, upon request, at the time of placing HFCs on the market.<sup>(77)</sup>

**Note:** The European Commission will publish guidelines, not available at the time of publication, defining what evidence producers and importers need to provide to show HFC-23 by-product destruction or recovery for subsequent use. HFC-23, which has a GWP of 14,800, is a known by-product of HCFC-22 which is used as a feedstock or other input during the manufacturing process of many fluorinated gases, including HFC-1234yf, HFC-32 and HFC-125, all of which are key components in many new blends and should therefore be avoided.

# Chapter 3:

## Manufacturers

### ADVERTISING ON PACKAGING

“Advertising” includes any text describing the qualities or functions of the product on its packaging.

The obligation to include this information in all types of advertising applies both to manufacturers and to retailers.

Manufacturers are primarily affected by provisions on labelling, pre-charged equipment and placing on the market restrictions for new equipment. In order to maintain competitiveness, manufacturers should strive to diversify their product lines as soon as possible so as to position themselves to be players in the emerging European market for low-GWP technologies.

### I. Labelling

#### A. Products and Equipment

Under the provisions of the EU F-Gas Regulation, manufacturers cannot place products and equipment on the market unless properly labelled. The sectors affected include refrigeration, air-conditioning, heat pumps, fire protection, aerosol dispensers, HFC containers, solvents, and organic rankine cycles.<sup>(78)</sup>

The label must be clearly legible and indelible, written in the language of the EU Member State concerned,<sup>(79)</sup> and be placed either adjacent to the service ports for charging or recovery or the part of the equipment containing the HFCs and blends.<sup>(80)</sup>

In addition to this, it must contain the following information:<sup>(81)</sup>

- reference that the product or equipment contains or relies upon HFCs for its functioning and, where applicable, that the HFCs are contained in hermetically sealed equipment;<sup>(82)</sup>
- accepted industry designation of the HFC in question or, if no such designation is available, the chemical name; and
- metric and CO<sub>2</sub>e quantity of HFC for which the equipment is designed as well as its GWP.

This information must also be included in instruction manuals.<sup>(83)</sup>

#### B. Foams and Pre-Blended Polyols

Manufacturers are also forbidden from placing foams and pre-blended polyols on the European marketplace unless properly labelled.<sup>(84)</sup> The label must clearly identify the HFCs using the accepted industry designation or, if no such designation is available, the chemical name.<sup>(85)</sup> In the case of foam boards, this information must be stated clearly and indelibly on the boards themselves.<sup>(86)</sup>

#### C. Advertising

Manufacturers of products, equipment, foams and pre-blended polyols must ensure that the above information is also included in “descriptions used for advertising.” This includes periodicals, billboards, websites and packaging.<sup>(87)</sup>

### II. Pre-Charged Equipment

Manufacturers that pre-charge their equipment with HFCs inside the European Union (hereinafter “EU manufacturers of pre-charged equipment”) and manufacturers and importing companies that pre-charge their equipment outside the European Union (hereinafter “non-EU manufactures of pre-charged equipment”) must meet three main obligations.

#### A. Reporting

From 2015 onwards, manufacturers importing pre-charged equipment must register with the electronic registry,<sup>(88)</sup> and manufacturers placing 500 CO<sub>2</sub>e tonnes or more of HFCs on the market during the previous calendar year must report their amounts placed on the market to the European Commission via the electronic registry.<sup>(89)</sup>

## B. Accounting

From 2017 onwards, HFCs in pre-charged equipment must have an HFC quota. How this occurs depends on whether the equipment was pre-charged inside or outside the European Union.<sup>(90)</sup>

### EU Manufacturers of Pre-Charged Equipment

EU manufacturers of pre-charged equipment will necessarily be using HFCs that have already been placed on the market. Thus there is a presumption that HFCs are already covered by an HFC quota and no further action is required.

### Non-EU Manufacturers of Pre-Charged Equipment

Non-EU manufacturers of pre-charged equipment must ensure the HFCs in their imported pre-charged equipment are covered by an HFC quota, which can be done in one of three ways:

1. **Via Export:** Where a producer or importer places HFCs on the EU market and those HFCs are subsequently exported abroad to the non-EU manufacturer of pre-charged equipment.
2. **Via an Incumbent:** Where a producer or importer which has been awarded an HFC quota as an incumbent authorises the non-EU manufacturer of pre-charged equipment to use its HFC quota.
3. **Via a New Entrant:** Where a producer or importer which has been awarded an HFC quota as a new entrant authorises the non-EU manufacturer of pre-charged equipment to use the HFC quota and subsequently supplies the corresponding quantities to the non-EU manufacturer.

## C. Documenting Compliance

From 2018 onwards, both EU and non-EU manufacturers of pre-charged equipment must fully document compliance and draw up a declaration of conformity by 31 March each year demonstrating that the HFCs in pre-charged equipment placed on the market the previous calendar year were accounted for by an HFC quota.<sup>(91)</sup> The accuracy of the documentation and declaration of conformity must be verified by an independent auditor accredited pursuant to Directive 2003/87/EC or accredited to verify financial statements in accordance with the legislation of the EU Member State concerned.<sup>(92)</sup> All documentation and declarations of conformity must be kept for a period of at least five years.<sup>(93)</sup>

## III. Placing on the Market Restrictions

The EU F-Gas Regulation prohibits certain HFC-based products and equipment from being placed on the market (i.e. they apply only to new equipment). These bans take various forms, with GWP thresholds of varying degrees, and should be understood as signposts in those sectors where it was determined technically and, more importantly, politically feasible to include them. Overall, there is a general sense of missed opportunity on the list of bans that were included in the EU F-Gas Regulation. While those that were included are important for setting those sectors on a pathway needed to achieve the HFC phase-down, many others were dropped for political reasons. Bans are indicators of where and when each sector needs to move, with some compelling the precise make-up of that sector from a certain date onward while others are designed to work in tandem with the HFC phase-down to mark the end point for moving that sector forward.

The EU F-Gas Regulation maintains the bans in the previous version (see Table 7) and introduces a number of new bans (see Table 8).

**Table 7:**  
Bans Carried Over From  
Previous Version of the EU  
F-Gas Regulation (2006)

Products and Equipment	Date of Prohibition
Footwear that contains fluorinated greenhouse gases	4 July 2006
Non-refillable containers for fluorinated greenhouse gases used to service, maintain or fill refrigeration, air-conditioning or heat-pump equipment, fire protection systems or switchgear, or for use as solvents	
Non-confined direct evaporation systems that contain HFCs and perfluorocarbons (PFCs) as refrigerants	4 July 2007
Fire protection equipment that contain PFCs	
Windows for domestic use that contain fluorinated greenhouse gases	
Tyres that contain fluorinated greenhouse gases	
Other windows that contain fluorinated greenhouse gases	
One-component foams, except when required to meet national safety standards, that contain fluorinated greenhouse gases with GWP of 150 or more	4 July 2008
Aerosol generators marketed and intended for sale to the general public for entertainment and decorative purposes, as listed in point 40 of Annex XVII to Regulation (EC) No 1907/2006, and signal horns, that contain HFCs with GWP of 150 or more	4 July 2009

**Table 8:**  
New Bans Introduced in the  
EU F-Gas Regulation (2014)

Products and Equipment	Date of Prohibition
Domestic refrigerators and freezers that contain HFCs with GWP of 150 or more	1 January 2015
Technical aerosols that contain HFCs with GWP of 150 or more, except when required to meet national safety standards or when used for medical applications	1 January 2018
Stationary refrigeration equipment that contain, or whose functioning relies upon, HFCs with GWP of 2500 or more except equipment intended for application designed to cool products to temperatures below - 50 °C	
Movable room air-conditioning equipment (hermetically sealed equipment which is movable between rooms by the end user) that contain HFCs with GWP of 150 or more	1 January 2020
Extruded polystyrene (XPS) foams that contain HFCs with GWP of 150 or more except when required to meet national safety standards	
Refrigerators and freezers for commercial use (hermetically sealed equipment) that contain HFCs with GWP of 2500 or more	
Refrigerators and freezers for commercial use (hermetically sealed equipment) that contain HFCs with GWP of 150 or more	
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 1500 may be used	1 January 2022
Foams that contain HFCs with GWP of 150 or more except when required to meet national safety standards	1 January 2023
Single split air-conditioning systems containing less than 3 kg of fluorinated greenhouse gases that contain, or whose functioning relies upon, fluorinated greenhouse gases with GWP of 750 or more	1 January 2025

The prohibitions do not apply to equipment for which it has been established in Directive 2009/125/EC, also referred to as the “Ecodesign Directive,” that lifecycle CO<sub>2</sub>e emissions are lower due to energy efficiency than those from equivalent equipment not relying on HFCs.<sup>(94)</sup> To date, no such cases have been established.

National authorities should consider adopting additional bans at the national level in those sectors that can be converted wholly to low-GWP technologies. In its *Impact Assessment*, the European Commission provided a list of sectors where its consultants recommended including bans. In essence the majority of sectors could convert to low-GWP technologies in new equipment by 2020, and this should be the starting point for national authorities interested in protecting their manufacturers and consumers from undue reliance on HFC technologies.<sup>(95)</sup>

# Chapter 4: Operators

Operators must ensure compliance with provisions on containment and recovery of HFCs and blends, meaning that they must make sure that contractors installing, servicing, maintaining, repairing and decommissioning their equipment are certified and records are being maintained. As the HFC phase-down progresses, the new European marketplace will reward those operators who are successful in reducing leakage rates from HFC-based equipment, and those who switch to low-GWP technologies when purchasing new equipment will be shielded from unexpected consequences.

## I. Leakage Control

### A. Use of Certified Personnel

Operators of HFC technologies must ensure that any installation, service, maintenance, repair or decommissioning is performed only by certified personnel.<sup>(96)</sup> Leakage checks and end-of-life recovery must also be performed by certified personnel.<sup>(97)</sup>

### B. Intentional and Unintentional Release

In the EU F-Gas Regulation, the legal requirements to prevent the intentional and unintentional release of HFCs have been strengthened, in particular:

- The intentional release of HFCs and blends, unless technically necessary for their intended use, is prohibited. Leak testing qualifies as an intentional release, and operators should use alternative gases, where possible, or recover the emitted HFCs and blends to the extent it is technically feasible and does not entail disproportionate costs.
- Operators are required to take all precautions that are technically and economically feasible to prevent the unintentional release of HFCs.<sup>(98)</sup>

The prohibition on intentional releases and the requirement to take precautionary measures to prevent unintentional releases apply to both operators and the contractors performing work on their behalf.<sup>(99)</sup>

### C. Leakage Checks

Periodic leakage checks are required for certain types of equipment, namely stationary refrigeration equipment, stationary air-conditioning equipment, stationary heat pumps, stationary fire protection equipment, refrigeration units of refrigerated trucks and trailers and organic rankine cycles.<sup>(100)</sup>

The frequency of the leak checks is now based on the CO<sub>2</sub>e of the refrigerants in the equipment (see Table 9).<sup>(101)</sup>

**Table 9:**  
Frequency of Leakage  
Checks Based on Charge  
Size in CO<sub>2</sub>e

Charge Size	Frequency of Leakage Check	
	No Leak Detection System Installed	Leak Detection System Installed
less than 5 CO <sub>2</sub> e tonnes*	N/A	N/A
5 to less than 50 CO <sub>2</sub> e tonnes	at least every 12 months	at least every 24 months
50 to less than 500 CO <sub>2</sub> e tonnes	at least every 6 months	at least every 12 months
500 CO <sub>2</sub> e tonnes	at least every 3 months	at least every 6 months

NOTE: \*For hermetically sealed equipment, leakage checks are not required unless the equipment contains 10 tonnes of CO<sub>2</sub>e or more, provided the equipment is labelled as hermetically sealed.<sup>(102)</sup>

The use of CO<sub>2</sub>e instead of metric weight means that the frequency of leakage checks for some equipment increases (see Table 10). Operators should perform an audit of their installed base to identify the frequency of leakage checks for each piece of equipment under the new legislation.

Frequency of Leakage Checks**	Previous Version	EU F-Gas Regulation		
	Old Threshold	New Threshold	HFC-404A	HFC-134a
Annual	3 kg	5 CO <sub>2</sub> e tonnes*	1.27 kg	3.5 kg
Every 6 Months	30 kg	50 CO <sub>2</sub> e tonnes	12.7 kg	35 kg
Every 3 Months	300 kg	500 CO <sub>2</sub> e tonnes	127 kg	350 kg

NOTE: \*For hermetically sealed equipment, leakage checks are not required unless the equipment contains 10 tonnes of CO<sub>2</sub>e or more, provided the equipment is labelled as hermetically sealed.<sup>(103)</sup>

\*\* Leakage check frequency is halved if automatic leakage detection system is installed.

**Table 10:**  
Comparison of Old and New Requirements on Frequency of Leakage Checks

Operators must repair leaks “without undue delay” once detected and have the equipment checked by certified personnel within one month of repair.<sup>(104)</sup> “Without undue delay” should be understood to mean during the same installation, service, maintenance or repair that the leak was detected.

#### D. Leakage Detection Systems

Leakage detection systems are required in most types of equipment containing 500 tonnes of CO<sub>2</sub>e or more, and must be checked periodically to ensure their proper functioning (see Table 11).<sup>(105)</sup>

Equipment Containing 500 tonnes of CO <sub>2</sub> e or more	Leakage Detection System	
	Required Installation	Frequency of Check
Stationary Refrigeration	1 January 2015	12 months
Stationary Air Conditioning		
Stationary Heat Pumps		
Stationary Fire Protection		
Electrical Switchgear	1 January 2017	6 years
Organic Rankine Cycle	1 January 2017	12 months

**Table 11:**  
Obligation to Install Leakage Detection System

## II. Service Ban on High-GWP HFCs in Larger Refrigeration Equipment

Under the terms of the “service ban,” from 2020 onwards the use of HFCs with a GWP of 2,500 or more to service or maintain refrigeration equipment with a charge size of 40 tonnes of CO<sub>2</sub>e or more is prohibited.<sup>(106)</sup> The service ban does not apply to the use of recycled and reclaimed HFCs as long as certain conditions are met:

- **Recycled HFCs or Blends:** Recycled HFCs or blends must have been recovered from existing refrigeration equipment and can only be used by the undertaking that carried out their recovery or the undertaking for which the recovery was carried out.<sup>(107)</sup>
- **Reclaimed HFCs or Blends:** Reclaimed HFC or blends may be used provided they have been labelled with information on the batch number and the name and address of the reclamation facility.<sup>(108)</sup>

The service ban exempts refrigeration systems used in military applications or those designed to cool products to temperatures below -50° Celsius.<sup>(109)</sup> The European Commission may also issue an exemption for technical or safety reasons or due to disproportionate costs.<sup>(110)</sup>

How to Respond to the Service Ban
<p>Operators of refrigeration equipment with charge sizes corresponding to 40 tonnes of CO<sub>2</sub>e or more have three options:</p> <ul style="list-style-type: none"> <li>• <b>Continue:</b> use existing equipment and gas until 2020, and then use reclaimed or recycled gas, if available, until 2030.</li> <li>• <b>Convert:</b> retrofit and refill the equipment to run on HFCs with a GWP lower than 2,500.</li> <li>• <b>Replace:</b> install new equipment that uses lower-GWP gases.</li> </ul> <p>Operators should strive to ensure that all new refrigeration equipment relies on low-GWP refrigerants with immediate effect, and at the very least avoid HFCs with a GWP of 2,500 or more.</p> <p>There are many good reasons for operators to proactively convert or replace equipment before the ban is in place.</p> <p><b>First</b>, conversion to a medium range GWP refrigerant reduces direct emissions from larger refrigeration equipment by 50% to 70%, leading to a dramatic reduction of an operator’s carbon footprint.<sup>(111)</sup></p> <p><b>Second</b>, the replacement gases with a GWP lower than 2,500 are reported to improve energy efficiency over the standard HFC-404A by 7% to 12% for medium temperature (MT) systems and by 2% to 5% for low-temperature (LT) systems, resulting in a 1-to 3-year payback period for the refill under current HFC prices.<sup>(112)</sup></p> <p><b>Third</b>, the service ban increases HFC demand by 45 to 70 MT CO<sub>2</sub>e in the years before and after 2020<sup>(113)</sup> when the HFC price premium is expected to rise steeply. Early-stage conversions will therefore reduce refill costs and prevent capital abandonment.</p> <p><b>Fourth</b>, there is no guarantee that a robust recycling and reclamation market will develop and, in any event, it is likely to be relatively small. Operators with large estates (e.g. large supermarket chains) are advised to explore internal recycling schemes, which provide greater predictability and the possibility of staggering their conversions over time.</p> <p>EU Member States can also reduce potential negative impacts of the service ban by taking certain initiatives. Foremost is the promotion of national producer responsibility schemes to facilitate a reclamation market for HFC-404A. To date, little reclamation has taken place in most EU Member States and, unless this changes soon, the service ban will lead to early retirement and capital abandonment.</p>

### III. Recovery

#### A. Stationary Equipment and Refrigerated Trucks and Trailers

Operators must ensure the recovery of HFCs, i.e. their recycling, reclamation or destruction, for all stationary equipment and refrigerated trucks and trailers (see Table 12).<sup>(114)</sup>

Table 12:  
Legal Obligation on  
the Recovery of HFCs

Mandatory	“To Extent Technically Feasible and Does Not Entail Disproportionate Costs”
Stationary Refrigeration	
Stationary Air-Conditioning	
Stationary Heat Pumps	All Other Equipment
Refrigerated Trucks and Trailers	
Stationary Equipment Containing Solvents	
Stationary Fire Protection Equipment	

Operators must ensure this recovery is carried out by “natural persons that hold the relevant certificates,” meaning individuals who received training and certification via a certification programme established by an EU Member State and received a certificate following successful completion of an evaluation process.<sup>(115)</sup> Existing certificates and training attestations remain valid in accordance with the conditions under which they were originally issued.<sup>(116)</sup> When recovery is delegated to third parties, reasonable steps must be taken to ensure that the party to whom recovery is delegated holds the necessary certificates to perform the required task.<sup>(117)</sup>

## B. All Other Products and Mobile Equipment

Operators must ensure the recovery of HFCs, i.e. their recycling, reclamation or destruction, for all other products and mobile equipment where it is “feasible and does not entail disproportionate costs.”<sup>(118)</sup> Operators must ensure this recovery is carried out by “appropriately qualified natural persons,” as determined by the EU Member State concerned.<sup>(119)</sup> The sole exception is air-conditioning equipment in motor vehicles that, because it falls within the scope of the Mobile Air Conditioning (MAC) Directive, simply requires the person undertaking the recovery to provide an attestation from a training programme established by the EU Member State concerned.<sup>(120)</sup>

## C. Residual Gases in Containers

Any person using an HFC container immediately prior to its disposal must arrange for the recovery of the residual gases therein.<sup>(121)</sup>

## IV. Record Keeping

Operators must maintain records for each piece of equipment subject to leakage checks.<sup>(122)</sup> In particular, the records must specify for each piece of equipment:

- the quantities and type of HFCs installed;
- the quantities of HFCs added during installation, maintenance or servicing;
- the quantities of recycled or reclaimed HFCs used, including the name and address of the recycling or reclamation facility and, where applicable, the certificate number;
- the quantity of recovered HFCs used;
- the identity of the persons who installed, serviced, maintained, repaired or decommissioned the equipment, including, where applicable, their certificate number;
- the dates and results of the checks; and
- the measures taken to recover and dispose of the HFCs in the case of decommissioning.

Unless these records are maintained in a database set up by the national authorities of the EU Member State concerned, the records must be kept by operators for at least five years and made available on request to national authorities or the European Commission.<sup>(123)</sup>

### Recommendations for Operators

#### Installation of New Equipment

- Review refrigeration and air-conditioning procurement plans.
- Discuss refrigerant options with manufacturers of natural-refrigerant technologies and contractors.
- Install low-GWP technologies relying on natural refrigerants in new equipment whenever possible.

#### Operation of Existing Equipment

- Review historical leakage rates and implement leakage management programmes.
- Retrofit larger refrigeration equipment relying on HFC-404A as soon as possible while HFC quotas are still plentiful.
- Secure long-term contracts for provision of HFCs at predetermined prices.

#### Safe Handling and Management

- Provide technical staff with training in the use of natural refrigerants.
- Indicate to outside contractors the need for familiarity with new low-GWP refrigerants.

**Important Note:** Information on safe and commercially proven low-GWP alternatives in each sector can be found at <http://www.cooltechnologies.org/>. Natural refrigerants can meet nearly all human needs formerly met by HFCs.



# Chapter 5: Contractors

Contractors must be certified and be aware of the provisions affecting operators to ensure compliance. In addition, as the HFC phase-down progresses, there will be a growing demand for European contractors trained to install, service, maintain, repair and decommission natural-refrigerant technologies. In order to take full advantage of these opportunities, contractors should make it a priority to familiarise themselves with natural-refrigerant technologies and seek training on their safe handling and use.

## I. Prevention of HFC Emissions

Contractors are under a legal obligation to “take all precautionary measures to prevent leakage” of HFCs and blends,<sup>(124)</sup> and are prohibited from intentional releases, such as during leak testing.<sup>(125)</sup> In addition, any person using an HFC container immediately prior to its disposal must arrange for the recovery of the residual gases therein.<sup>(126)</sup>

When assigning tasks to a third person, the contractor shall “take reasonable steps to ascertain that the latter holds the necessary certificates for the required tasks.”<sup>(127)</sup>

## II. Mandatory Certification Programmes and Training

Certified personnel carrying out certain tasks, and those undertaking such tasks for them, must be certified pursuant to a certification programme that includes training and an evaluation process (see Table 13).<sup>(128)</sup>

**Table 13:**  
Tasks Requiring  
Certified Personnel

Equipment	Installation, Servicing, Maintenance, Repair or Decommissioning	Leak Checks	Recovery
Stationary Refrigeration Equipment	✓	✓	✓
Stationary Air-Conditioning Equipment	✓	✓	✓
Stationary Heat Pumps	✓	✓	✓
Stationary Fire Protection Equipment	✓	✓	✓
Refrigeration Units of Refrigerated Trucks and Trailers	✓	✓	✓
Electric Switchgear	✓		✓
Stationary Equipment that Contains Solvents			✓

For air-conditioning equipment in motor vehicles falling under Directive 2006/40/EC, it is only required that contractors and undertakings complete a relevant training course.<sup>(129)</sup>

All certification programmes and training must also include information on natural refrigerants and the existing regulatory requirements for working with natural-refrigerant technologies.<sup>(130)</sup> In addition, training must be available to contractors wishing to update their knowledge on the applicable regulations and technical standards, to know the requirements pertaining to the containment, recovery and safe handling of equipment, or to receive information on relevant technologies to replace or reduce the use of HFCs and blends.<sup>(131)</sup>

Training certificates which were obtained under the previous regulation remain valid in accordance with the conditions under which they were originally issued.<sup>(132)</sup>

### III. Record Keeping

#### A. Required Information

Contractors must maintain records for each piece of equipment subject to leakage checks.<sup>(133)</sup> In particular, the records must specify for each piece of equipment:

- the quantities and type of HFCs installed;
- the quantities of HFCs added during installation, maintenance or servicing;
- the quantities of recycled or reclaimed HFCs used, including the name and address of the recycling or reclamation facility and, where applicable, the certificate number;
- the quantity of recovered HFCs used;
- the identity of the persons who installed, serviced, maintained, repaired or decommissioned the equipment, including, where applicable, their certificate number;
- the dates and results of the checks; and
- the measures taken to recover and dispose of the HFCs in the case of decommissioning.

Unless these records are maintained in a database set up by the national authorities of the EU Member State concerned, the records must be kept by certified personnel for at least five years and made available on request to national authorities or the European Commission.<sup>(134)</sup>

#### B. Information on Purchasers

Contractors and wholesalers supplying HFCs must establish records with minimum information on the purchasers, in particular: (i) the certificate numbers of the purchasers, and (ii) the quantities of HFCs purchased. These records must also be maintained for at least five years.<sup>(135)</sup>

#### Training in the Use and Safe Handling of Natural Refrigerants

Several associations provide training to contractors in the installation, service, maintenance, repair and decommissioning of natural-refrigerant technologies. These include, but are not limited to:

- European Association of Refrigeration, Air Conditioning and Heat Pump Contractors (AREA): <http://www.area-eur.be/>
- Real Alternatives Europe: <http://www.realskillseurope.eu/>
- Cool Concerns: <http://www.coolconcerns.co.uk/>

The United Nations Environment Programme (UNEP) has also produced a number of information fact sheets, including:

- Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: Flammable Refrigerants<sup>(136)</sup>
- Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: Higher Pressure Refrigerants<sup>(137)</sup>
- Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: Higher Toxicity Refrigerants<sup>(138)</sup>

# Chapter 6:

## National Authorities

National authorities are primarily responsible for the implementation and enforcement of the EU F-Gas Regulation, in particular with respect to oversight of and communication with operators, manufacturers, and contractors. As the HFC phase-down progresses, the ability of national authorities to anticipate the impact of the HFC phase-down and craft national measures to ease the transition to low-GWP technologies will be crucial in helping their companies and economies cope with HFC quota shortages and the HFC price premium.

### I. Compliance and Enforcement

The HFC phase-down is administered by the European Commission, but compliance with and enforcement of the other provisions are largely the domain of national authorities.

National authorities provide crucial oversight to ensure that, for example:

- producers, importers and exporters properly label consignments or receptacles containing HFCs and blends, and provide evidence of HFC-23 by-product destruction and recovery upon placing them on the market;
- manufacturers properly label and advertise HFC-based products and equipment and desist from placing new equipment on the market where this is prohibited;
- operators perform regular leakage checks, install leakage detection systems where necessary, maintain records for each product and piece of equipment, and desist from the use of HFCs or blends during service and maintenance where this is prohibited; and
- contractors have valid certificates and maintain records for each product and piece of equipment.

In order to facilitate compliance and enforcement, EU Member States are required to lay down rules on penalties applicable to infringements and are obligated to take all measures necessary to ensure implementation. Penalties must be effective, proportionate and dissuasive, and notified to the European Commission by 2017.<sup>(139)</sup>

### II. Training and Certification

EU Member States are required to maintain certification programmes, including training and an evaluation process, for all persons carrying out the tasks outlined in Table 14.<sup>(140)</sup>

**Table 14:**  
Training and  
Certification Programmes  
in EU Member States

Equipment	Installation, Servicing, Maintenance, Repair or Decommissioning	Leak Checks	Recovery
Stationary Refrigeration Equipment	✓	✓	✓
Stationary Air-Conditioning Equipment	✓	✓	✓
Stationary Heat Pumps	✓	✓	✓
Stationary Fire Protection Equipment	✓	✓	✓
Refrigeration Units of Refrigerated Trucks and Trailers	✓	✓	✓
Electric Switchgear	✓		✓
Stationary Equipment that Contains Solvents			✓

Certification programmes must meet minimum requirements and specify for each type of equipment the required practical skills and theoretical knowledge of the certified person.<sup>(141)</sup> These minimum requirements are set out in previous Commission Regulations and remain in effect until superseded:

- Commission Regulation (EC) No 303/2008: Stationary Refrigeration, Air-Conditioning and Heat Pump Equipment;<sup>(142)</sup>
- Commission Regulation (EC) No 304/2008: Stationary Fire Protection Systems and Fire Extinguishers;<sup>(143)</sup>
- Commission Regulation (EC) No 305/2008: High-Voltage Switchgear;<sup>(144)</sup> and
- Commission Regulation (EC) No 306/2008: Gas-Based Solvents from Equipment.<sup>(145)</sup>

For air-conditioning equipment in motor vehicles falling under the MAC Directive, EU Member States must only ensure that training has been completed.<sup>(146)</sup> The minimum requirements for training are set out in Commission Regulation (EC) No 307/2008.<sup>(147)</sup>

These certification programmes and training are required to cover the following elements:<sup>(148)</sup>

- applicable regulations and technical standards;
- emission prevention;
- recovery of HFCs;
- safe handling of equipment of the type and size covered by the certificate; and
- information on relevant technologies to replace or reduce the use of HFCs and their safe handling.

Given the expected proliferation of natural-refrigerant technologies, EU Member States must provide information on natural refrigerants and ensure that the existing regulatory requirements for working with natural-refrigerant technologies are available upon request.<sup>(149)</sup> If existing certification programmes and training do not cover these minimum requirements, they must be adapted.<sup>(150)</sup>

EU Member States must notify the European Commission of their certification and training programmes by 1 January 2017.<sup>(151)</sup>

### III. Producer Responsibility Schemes

Without prejudice to the obligations already in place for the recovery of HFCs from products and equipment covered under Directive 2012/19/EU, also known as the Directive on Waste Electrical and Electronic Equipment or “WEEE Directive”, national authorities must encourage the development of producer responsibility schemes for the recovery and recycling, reclamation and destruction of HFCs. Producer responsibility schemes are already operating in Denmark, Sweden and Germany, and those schemes could serve as models in other EU Member States.<sup>(152)</sup> The requirement to encourage the development of producer responsibility schemes is designed to address the lack of destruction and recycling facilities in many EU Member States and facilitate economies of scale from organised recovery operations at the national level.

### IV. Collection of Emissions Data

EU Member States are required to establish reporting systems for sectors covered under the EU F-Gas Regulation with the objective of obtaining emissions data.<sup>(153)</sup>

# Annex 1

## Key Terminology

For most of the terminology used herein, definitions can be found in Article 2 of the EU F-Gas Regulation. The following key terms are provided below for convenience.

**Hydrofluorocarbons (HFCs):** the substances listed in section 1 of Annex I, or mixtures containing any of those substances.

**Producer:** a company that manufactures HFCs in the European Union; producers place HFCs on the European market when they supply them to third parties or use them internally for their own account.

**Importer:** a company that imports HFCs manufactured outside the European Union; importers place HFCs on the European market upon release by customs for free circulation.

**Carbon Dioxide Equivalence (CO<sub>2</sub>e):** a quantity of greenhouse gases, expressed as the product of the weight of the greenhouse gases in metric tonnes and of their global warming potential.

**Operator:** the natural or legal person exercising actual power over the technical functioning of products and equipment covered by the EU F-Gas Regulation; an EU Member State may, in defined, specific situations, designate the owner as being responsible for the operator's obligations.

**Placing on the Market:** means supplying or making available to another party in the European Union for the first time, for payment or free of charge, or using for its own account in the case of a producer, and includes customs release for free circulation in the European Union.

**Undertaking:** any natural or legal person who:

- (a) produces, uses, recovers, collects, recycles, reclaims, or destroys fluorinated greenhouse gases;
- (b) imports or exports fluorinated greenhouse gases or products and equipment that contain such gases;
- (c) places on the market fluorinated greenhouse gases or products and equipment that contain, or whose functioning relies upon, such gases;
- (d) installs, services, maintains, repairs, checks for leaks or decommissions equipment that contains, or whose functioning relies upon, fluorinated greenhouse gases;
- (e) is the operator of equipment that contains, or whose functioning relies upon, fluorinated greenhouse gases;
- (f) produces, imports, exports, places on the market or destroys gases listed in Annex II; or
- (g) places on the market products or equipment containing gases listed in Annex II.

**Competent Authority:** the government body in the EU Member State charged with oversight and enforcement of the EU F-Gas Regulation.

**Recovery:** the act of collecting HFCs from products, containers and equipment during service or maintenance or prior to disposal of the products and equipment.

**Reclamation:** the act of recovering used HFCs from equipment and reprocessing to match the equivalent performance of virgin substances.

**Recycling:** the act of recovering HFCs from equipment and cleaning through a basic process.



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- 1 Official Journal of the European Union, OJ L 150, pp. 195-230 (20 May 2014) (hereinafter referred to as the "EU F-Gas Regulation").
- 2 See European Commission, DG Climate Action, *EU Legislation to Control F-Gases*, available at [http://ec.europa.eu/clima/policies/f-gas/legislation/index\\_en.htm](http://ec.europa.eu/clima/policies/f-gas/legislation/index_en.htm) (last visited 31 May 2015).
- 3 See UK Government, Department for Environment, Food & Rural Affairs and Environment Agency, *Requirements of the 2014 EU Fluorinated Greenhouse Gas (F-Gas) Regulation, Including the Phasing Out of HFCs and Product Bans*, available at <https://www.gov.uk/government/collections/eu-f-gas-regulation-guidance-for-users-producers-and-traders> (last visited 31 May 2015).
- 4 European Association of Refrigeration, Air Conditioning and Heat Pump Contractors, *AREA F-Gas Guide: A Practical Guide on the Application of the New F-Gas Regulation to Refrigeration, Air Conditioning & Heat Pump Contractors (Edition 1, October 2014)*, available at [http://www.area-eur.be/system/files/Documents/AREA%20guidelines%20Fgas%20-%20Master%201%20\(FINAL\).pdf](http://www.area-eur.be/system/files/Documents/AREA%20guidelines%20Fgas%20-%20Master%201%20(FINAL).pdf) (last visited 24 August 2015).
- 5 Regulation (EU) No 517/2014, Article 15 and Annex V.
- 6 Regulation (EU) No 517/2014, Article 15(1).
- 7 Regulation (EU) No 517/2014, Annex V.
- 8 Regulation (EU) No 517/2014, Annex V.
- 9 See Regulation (EU) No 517/2014, Annex V; see also SKM Enviros, *Review of EU HFC Phase-Down Profiles: Evaluation of Future EU HFC Requirements under F-Gas Regulation Proposals* (undated), pp. 12-13.
- 10 European Commission, *Climate Action – Fluorinated Greenhouse Gases*, available at [http://ec.europa.eu/clima/policies/f-gas/index\\_en.htm](http://ec.europa.eu/clima/policies/f-gas/index_en.htm) (last visited 23 May 2015).
- 11 European Commission, *Impact Assessment: Review of Regulation (EC) No 842/2006 on certain fluorinated greenhouse gases* (Commission Staff Working Paper), SWD(2012)0364 (hereinafter "Impact Assessment"), p. 159.
- 12 Compare Regulation (EU) No 517/2014, Article 2(1) and (2) with Regulation (EU) No 517/2014, Annex I and II.
- 13 Regulation (EU) No 517/2014, Article 15(2).
- 14 Regulation (EU) No 517/2014, Article 15(2).
- 15 Regulation (EU) No 517/2014m Article 15(2)(f).
- 16 Regulation (EU) No 517/2014, Article 15(2)(c); see also *Impact Assessment*, p. 155 ("exporters of EU-produced products or equipment containing HFCs face a certain competitive disadvantage since the HFC needed for their products is included in the scope of a phasedown scheme").
- 17 Regulation (EU) No 517/2014, Article 16(4).
- 18 Öko-Recherche et al., *Preparatory Study for a Review of Regulation (EC) No 842/2006 on Certain Fluorinated Greenhouse Gases, Final Report (September 2011)* (hereinafter "Preparatory Study"), Annex III; *Impact Assessment*, pp. 156-162.
- 19 *Preparatory Study*, pp. 17-20.
- 20 *Preparatory Study*, Annexes III and V; see also *Impact Assessment*, pp. 156-162.
- 21 See *Preparatory Study*, Annexes III and V.
- 22 SKM Enviros, *Phase Down of HFC Consumption in the EU – Assessment of Implications for the RAC Sector Final Report* (Version 11, September 2012) (hereinafter "SKM Enviros Report"), pp. 81-82.
- 23 *Preparatory Study*, Annex V, p. 247. **Note:** Maximum penetration rates were assigned for various low-GWP technologies for the years 2015, 2020 and 2030. These include cascade systems relying on a combination of hydrocarbons, CO<sub>2</sub> or HFC-1234yf as well as transcritical CO<sub>2</sub> systems. Together, those low-GWP technologies were projected to be able to satisfy 45% of demand for new installations in the EU in 2015, and 125% and 310% of demand for new installations in the EU in 2020 and 2030, respectively. Assuming linear growth in the market penetration of low-GWP technologies between 2015 and 2020, the earliest date for which a ban could have been adopted in this sector is 2019 and, for this reason, the *Preparatory Study* therefore recommended banning all new systems with a GWP of 150 or more from 2020 onwards. See *Impact Assessment*, p. 115.
- 24 *Preparatory Study*, Annex V, pp. 247 (linear market penetration assumed).
- 25 *Impact Assessment*, p. 115.
- 26 See European Parliament, *Report of 27 June 2013 on the Proposal for a Regulation of the European Parliament and of the Council on Fluorinated Greenhouse Gases* (COM(2012)0643 – C7-0370/2012 – 2012/0305(COD)), Amendment 84.
- 27 European Commission, *Report from the Commission on the Application, Effects and Adequacy of the Regulation on Certain Fluorinated Greenhouse Gases (Regulation (EC) No 842/2006)* (September 2011), p. 6.

- 28 See *Preparatory Study*, Annexes III and V.
- 29 Report from the Commission on the Application, Effects and Adequacy of the Regulation on Certain Fluorinated Greenhouse Gases (Regulation (EC) No 842/2006), p. 4.
- 30 *Impact Assessment*, p. 159
- 31 *Preparatory Study*, pp. 120-123; *Impact Assessment*, p. 208.
- 32 See *Preparatory Study*, pp. 50-58.
- 33 Regulation (EU) No 517/2014, Article 14; see also *European Commission, Non-Paper on F-Gas Regulation Review: Covering HFCs Imported in Equipment in the Context of the HFC Phase-Down* (undated) (11% in 2013 increasing to 18% in 2030); *European Commission, Update of Non-Paper: Covering HFCs Imported in Equipment in the Context of an HFC Phase-Down* (undated).
- 34 Regulation (EU) No 517/2014, Annex V and Article 15(2).
- 35 Regulation (EU) No 517/2014, Annex V.
- 36 Winfried Schwartz, *Extra Note on HFCs with Very High-GWP in the Current F-Gas Legislation* (6 May 2013), p. 3 (this can be mitigated by the use of recycled and reclaimed HFC-404A, depending on the actual development of a recycling and reclamation market).
- 37 Regulation (EU) No 517/2014, Annex V.
- 38 European Commission, *Decision of the Secretary General pursuant to Article 4 of the Implementing Rules to Regulation (EC) No 1049/2001*, Ref. Ares(2015)1383239 (30 March 2015), p. 2.
- 39 Umweltbundesamt (Federal German Environment Agency), *Maßnahmen zur Verbesserung der Marktdurchdringung klimafreundlicher Technologien ohne halogenierte Stoffe vor dem Hintergrund der Revision der Verordnung (EG) Nr. 842/2006* (May 2015), p. 111 (underlying data provided).
- 40 See European Parliament, *Report of 27 June 2013 on the Proposal for a Regulation of the European Parliament and of the Council on Fluorinated Greenhouse Gases* (COM(2012)0643 – C7-0370/2012 – 2012/0305(COD)), Amendment 68 (allocation fee was set at €30 per CO<sub>2</sub>e tonne).
- 41 *Preparatory Study*, pp.154-155.
- 42 Regulation (EU) No 517/2014, Article 21(5).
- 43 See Umweltbundesamt (Federal German Environment Agency), *Maßnahmen zur Verbesserung der Marktdurchdringung klimafreundlicher Technologien ohne halogenierte Stoffe vor dem Hintergrund der Revision der Verordnung (EG) Nr. 842/2006* (May 2015), pp. 122-166; see also United Nations Environment Programme, *Submissions by Parties on the Implementation of Decision XIX/6* (26th Meeting of the Parties to the Montreal Protocol), UNEP/OzL.Pro/26/INF/4 (30 September 2014).
- 44 See e.g. Technology and Economic Assessment Panel, *Decision XXIV/7 Task Force Report Additional Information to Alternatives on ODS* (Draft Report), Volume 2 (May 2013), pp. 33-35; Technology and Economic Assessment Panel, *Decision XXIV/7 Task Force Report Additional Information to Alternatives on ODS* (Final Report), Volume 2 (September 2013), p. 66; *Preparatory Study*, Annex V, p. 254; Daniel Colbourne and Jürgen Usinger, *Natural Refrigerants- Safe, Efficient and Reliable Use as Alternatives to HFC* (31 Oct 2015), available at <http://conf.montreal-protocol.org/meeting/mop/mop-27/pubs/Observer%20Publications/03c%20HA%20Presentation%20GIZ.pdf> (last visited 4 Nov 2015).
- 45 Regulation (EU) No 517/2014, Annex III.
- 46 SKM Enviro, pp. 98-101.
- 47 SKM Enviro, pp. 98-101.
- 48 Regulation (EU) No 517/2014, Article 16(5).
- 49 Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).
- 50 Regulation (EU) No 517/2014, Article 16(1).
- 51 Regulation (EU) No 517/2014, Article 16(2).
- 52 Regulation (EU) No 517/2014, Article 16(4).
- 53 Regulation (EU) No 517/2014, Article 15(1).
- 54 Regulation (EU) No 517/2014, Article 25(2).
- 55 Regulation (EU) No 517/2014, Annex VI.
- 56 Commission Implementing Decision of 31 October 2014 determining, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council on fluorinated greenhouse gases, reference values for the period 1 January 2015 to 31 December 2017 for each producer or importer who has reported placing on the market hydrofluorocarbons under Regulation (EC) No 842/2006 of the European Parliament and of the Council (*notified under document C(2014) 7920*).

- 57 Regulation (EU) No 517/2014, Articles 16(5).
- 58 Regulation (EU) No 517/2014, Article 16(2).
- 59 Regulation (EU) No 517/2014, Articles 16(2) and 17.
- 60 Regulation (EU) No 517/2014, Annex VI.
- 61 See e.g. Gluckman Consulting, *EU F-Gas Regulation Guidance Information Sheet 17: F-Gas Producers, Importers and Exporters* (December 2014).
- 62 Regulation (EU) No 517/2014, Article 18(1).
- 63 Regulation (EU) No 517/2014, Article 18(2).
- 64 Regulation (EU) No 517/2014, Article 18(2).
- 65 Regulation (EU) No 517/2014, Article 18(2).
- 66 Regulation (EU) No 517/2014, Article 17.
- 67 Regulation (EU) No 517/2014, Article 12(7).
- 68 Regulation (EU) No 517/2014, Article 12(8).
- 69 Regulation (EU) No 517/2014, Article 12(9).
- 70 Regulation (EU) No 517/2014, Article 12(10).
- 71 Regulation (EU) No 517/2014, Article 12(11).
- 72 Regulation (EU) No 517/2014, Article 12(12).
- 73 Regulation (EU) No 517/2014, Article 12(6).
- 74 Regulation (EU) No 517/2014, Article 12(6).
- 75 Regulation (EU) No 517/2014, Article 7(1).
- 76 Regulation (EU) No 517/2014, Article 7(2).
- 77 Regulation (EU) No 517/2014, Article 7(2).
- 78 Regulation (EU) No 517/2014, Article 12(1).
- 79 Regulation (EU) No 517/2014, Article 12(4).
- 80 Regulation (EU) No 517/2014, Article 12(4).
- 81 Regulation (EU) No 517/2014, Article 12(3).
- 82 Regulation (EU) No 517/2014, Article 12(3).
- 83 Regulation (EU) No 517/2014, Article 12(13).
- 84 Regulation (EU) No 517/2014, Article 12(5).
- 85 Regulation (EU) No 517/2014, Article 12(5).
- 86 Regulation (EU) No 517/2014, Article 12(5).
- 87 Regulation (EU) No 517/2014, Article 12(13).
- 88 Regulation (EU) No 517/2014, Article 17(1).
- 89 Regulation (EU) No 517/2014, Article 19(4).
- 90 Regulation (ECU) No 517/2014, Article 14(1).
- 91 Regulation (EU) No 517/2014, Article 14(2).
- 92 Regulation (EU) No 517/2014, Article 14(2).
- 93 Regulation (EU) No 517/2014, Article 14(2).
- 94 Regulation (EU) No 517/2014, Article 11(2).
- 95 *Impact Assessment*, pp. 112-121.
- 96 Regulation (EU) No 517/2014, Article 3(4).
- 97 Regulation (EU) No 517/2014, Article 3(4).
- 98 Regulation (EU) No 517/2014, Article 3(1)-(2).
- 99 Regulation (EU) No 517/2014, Article 3(1)(general prohibition on intentional releases); Regulation (EU) No 517/2014, Article 3(4).
- 100 Regulation (EU) No 517/2014, Article 4(2).
- 101 *Compare Regulation* (EC) No 842/2006, Article 3 with Regulation (ECU) No 517/2014, Article 4.
- 102 Regulation (EU) No 517/2014, Article 4(2); see also Regulation (EU) No 517/2014, Article 2(11) (“Hermetically sealed equipment” is defined as “equipment in which all fluorinated greenhouse gas containing parts are made tight by welding, brazing or a similar permanent connection, which may include capped valves or capped service ports that allow proper repair or disposal, and which have a tested leakage rate of less than 3 grams per year under a pressure of at least a quarter of the maximum allowable pressure”).
- 103 Regulation (EU) No 517/2014, Article 4(2); see also Regulation (EU) No 517/2014, Article 2(11) (“Hermetically sealed equipment” is defined as “equipment in which all fluorinated greenhouse gas containing parts are made tight by welding, brazing or a similar permanent connection, which may include capped valves or capped service ports that allow proper repair or disposal, and which have a tested leakage rate of less than 3 grams per year under a pressure of at least a quarter of the maximum allowable pressure”).

- 104 Regulation (EU) No 517/2014, Article 3(3).
- 105 Regulation (EU) No 517/2014, Article 5.
- 106 Regulation (EU) No 517/2014, Article 13(3).
- 107 Regulation (EU) No 517/2014, Article 13(3).
- 108 Regulation (EU) No 517/2014, Article 13(3) ; *see also* Regulation (EU) No 517/2014, Article 12(6).
- 109 Regulation (EU) No 517/2014, Article 13(3).
- 110 Regulation (EU) No 517/2014, Article 13(3) ; *see also* Article 11(3).
- 111 SKM Enviro, p. 61.
- 112 SKM Enviro, p. 61.
- 113 Winfried Schwartz, *Extra Note on HFCs with Very High-GWP in the Current F-Gas Legislation* (6 May 2013), p. 3.
- 114 Regulation (EU) No 517/2014, Article 8(1).
- 115 Regulation (EU) No 517/2014, Article 8(1); *see also* Regulation (EU) No 517/2014, Article 10.
- 116 Regulation (EU) No 517/2014, Article 10(7).
- 117 Regulation (EU) No 517/2014, Article 10(11).
- 118 Regulation (EU) No 517/2014, Article 8(3).
- 119 Regulation (EU) No 517/2014, Article 8(3).
- 120 Regulation (EU) No 517/2014, Articles 8(3) and 10(5); *see also* Commission Regulation (EC) No 307/2008.
- 121 Regulation (EU) No 517/2014, Article 8(2).
- 122 Regulation (EU) No 517/2014, Article 6(1)
- 123 Regulation (EU) No 517/2014, Article 6(2).
- 124 Regulation (EU) No 517/2014, Article 3(4).
- 125 Regulation (EU) No 517/2014, Article 3(1)(general prohibition on intentional releases).
- 126 Regulation (EU) No 517/2014, Article 8(2).
- 127 Regulation (EU) No 517/2014, Article 10(11).
- 128 Regulation (EU) No 517/2014, Article 10(1)-(4).
- 129 Regulation (EU) No 517/2014, Article 10(2).
- 130 Regulation (EU) No 517/2014, Article 19(3)(e) and (8).
- 131 Regulation (EU) No 517/2014, Article 10(9).
- 132 Regulation (EU) No 517/2014, Article 10(7).
- 133 Regulation (EU) No 517/2014.
- 134 Regulation (EU) No 517/2014, Article 6(2).
- 135 Regulation (EU) No 517/2014, Article 6(3).
- 136 United Nations Environment Programme, *OzonAction Fact Sheet: Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: Flammable Refrigerants* (July 2015) available at [http://www.unep.fr/ozonaction/information/mmcfiles/7746-e-Factsheet\\_SafeUseofHCFCAlternativesRefrigerationandAir-conditioning-FlammableRefrigerants\\_2015.pdf](http://www.unep.fr/ozonaction/information/mmcfiles/7746-e-Factsheet_SafeUseofHCFCAlternativesRefrigerationandAir-conditioning-FlammableRefrigerants_2015.pdf).
- 137 United Nations Environment Programme, *OzonAction Fact Sheet: Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: Higher Pressure Refrigerants* (July 2015), available at [http://www.unep.fr/ozonaction/information/mmcfiles/7747-e-Factsheet\\_SafeUseofHCFCAlternativesRefrigerationandAir-conditioning-HigherPressureRefrigerants\\_2015.pdf](http://www.unep.fr/ozonaction/information/mmcfiles/7747-e-Factsheet_SafeUseofHCFCAlternativesRefrigerationandAir-conditioning-HigherPressureRefrigerants_2015.pdf).
- 138 United Nations Environment Programme, *OzonAction Fact Sheet: Safe Use of HCFC Alternatives in Refrigeration and Air-Conditioning: Higher Toxicity Refrigerants* (July 2015), available at [http://www.unep.fr/ozonaction/information/mmcfiles/7748-e-Factsheet\\_SafeUseofHCFCAlternativesRefrigerationandAir-conditioning-HigherToxicityRefrigerants\\_2015.pdf](http://www.unep.fr/ozonaction/information/mmcfiles/7748-e-Factsheet_SafeUseofHCFCAlternativesRefrigerationandAir-conditioning-HigherToxicityRefrigerants_2015.pdf)
- 139 Regulation (EU) No 517/2014, Article 25(1).
- 140 Regulation (EU) No 517/2014, Article 10(1) and (4).
- 141 Regulation (EU) No 517/2014, Article 10(5).
- 142 Commission Regulation (EC) No 303/2008 of 2 April 2008 Establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, Minimum Requirements and the Conditions for Mutual Recognition for the Certification of Companies and Personnel as regards Stationary Refrigeration, Air Conditioning and Heat Pump Equipment Containing Certain Fluorinated Greenhouse Gases available at <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R0303>.

- 143 Commission Regulation (EC) No 304/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, Minimum Requirements and the Conditions for Mutual Recognition for the Certification of Companies and Personnel as regards Stationary Fire protection Systems and Fire Extinguishers Containing Certain Fluorinated Greenhouse Gases *available at* <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R0304>.
- 144 Commission Regulation (EC) No 305/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, Minimum Requirements and the Conditions for Mutual Recognition for the Certification of Personnel Recovering Certain Fluorinated Greenhouse Gases from High-Voltage Switchgear, *available at* <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R0305>.
- 145 Commission Regulation (EC) No 306/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, Minimum Requirements and the Conditions for Mutual Recognition for the Certification of Personnel Recovering Certain Fluorinated Greenhouse Gas-Based Solvents from Equipment, *available at* <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R0306>.
- 146 Regulation (EU) No 517/2014, Article 10(2).
- 147 Commission Regulation (EC) No 307/2008 of 2 April 2008 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, Minimum Requirements for Training Programmes and the Conditions for Mutual Recognition of Training Attestations for Personnel as regards Air-Conditioning Systems in Certain Motor Vehicles Containing Certain Fluorinated Greenhouse Gases, *available at* <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R0307>.
- 148 Regulation (EU) No 517/2014, Article 10(3).
- 149 Regulation (EU) No 517/2014, Article 10(9).
- 150 Regulation (EU) No 517/2014, Article 10(1).
- 151 Regulation (EU) No 517/2014, Article 10(10).
- 152 Regulation (EU) No 517/2014, Article 9 *see also* Directive 2012/19/EU.
- 153 Regulation (EU) No 517/2014, Article 20.



ATIONS OF VAPOR IS  
CENTRAL

- Avoid breathing high concentrations of vapor
- Use with sufficient ventilation to keep employee exposure below recommended limits, especially in enclosed spaces
- Contact of liquid with eyes and prolonged skin exposure
- Protective gloves
- Containers above 150 PSI (10 MPa) or 100 PSI (7 MPa) or 100 PSI (7 MPa)



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