

LESSONS LEARNED

FROM THE EU F-GAS REGULATION





## → Executive Summary

The new EU F-Gas Regulation came into force in January 2015 and brought in several new elements, the most important being the HFC phase-down system. EPEE, representing the heating, cooling and refrigeration industry in Europe, provides an overview in this paper of lessons learned from the European experience for countries which are currently considering different options to achieve the Kigali HFC phase-down steps.

**1. The basics:**  
Leak tightness (containment) and skills (competence) should be the basis of any measure targeting the reduction of F-Gas emissions.

**2. Data and communication:**  
Governments should make informed decisions and reach out to the entire supply chain to ensure successful design and implementation of regulation.

**3. Governance:**  
The phase-down principle works but requires excellent governance.

**4. Alignment:**  
When combining different measures, they need to be aligned and their respective role clearly communicated to the market.

**5. Anticipation:**  
Building codes and standards need to be ready for and aligned with national legislation.

**6. Resources:**  
Recovery, recycling, and reclamation of gases are crucial elements to achieve HFC consumption and emission reductions.

**7. Indirect emissions:** Energy efficiency should not be compromised by F-Gas rules and needs to be addressed in dedicated legislation.



Delegates celebrate the adoption of the Kigali Amendment to the Montreal Protocol.

Photo courtesy the Rwanda Environment Management Authority (REMA).

# I. Introduction

In light of the Kigali Amendment on the global phase-down of HFCs, which will enter into force on 1st January 2019, countries have started investigating adequate political measures to achieve the HFC consumption reduction steps as set out in the Amendment. In parallel, energy efficiency has become a top priority to cater for globally growing needs of HVACR equipment while ensuring its sustainability, given that the largest share of emissions by HVACR equipment is related to energy use (indirect emissions) rather than to the refrigerant itself (direct emissions).

In the EU, the first F-Gas Regulation entered into force in 2006 along with the Mobile Air Conditioning Directive (MAC Directive – 2006/40/EC) which is a separate piece of legislation and introduced a GWP limit of 150 for air-conditioning systems in passenger cars. The 2006 F-Gas Regulation focussed on containment (tight installations) and competence (installer skills) as key principles combined with a few ‘sectoral’ bans and a ban of the use of non-refillable containers. Its successor, the 2015 EU F-Gas Regulation introduced a new element on top of these two key principles – the HFC phase-down – as well as some additional measures such as ‘sectoral’ bans based on the GWP limit of HFCs in some specific applications.

This paper has been produced by EPEE, the voice of the heating, cooling and refrigeration industry in Europe, to provide an overview of lessons learned from the European experience for countries which are currently considering different options to achieve the Kigali HFC phase-down steps.

Note that it is important for those countries looking at the European example to keep in mind that, as always, one size does not fit all, and so rules aimed at reducing HFC emissions have to be adapted to the specificities of each market. Developed and developing markets have different characteristics and need tailor-made measures, considering many different factors including size of market, type of market (low volume consuming, relying on imports, manufacturing base, etc.) and its players.



## II. What are the main pillars of the EU F-Gas Regulation?

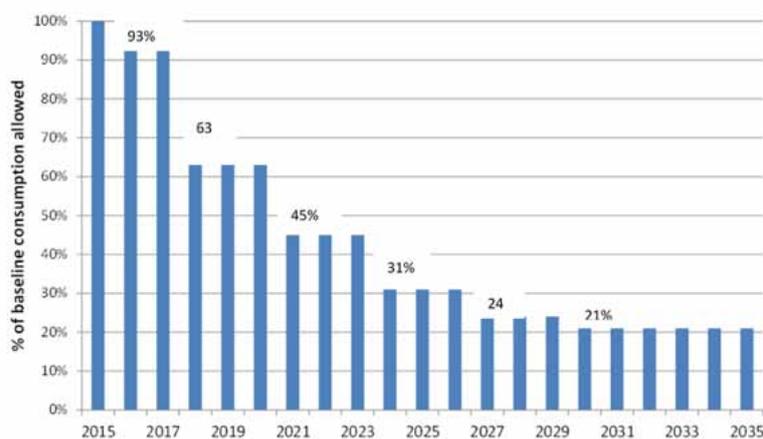
The EU F-Gas Regulation is a legislative instrument aiming to protect the environment by reducing emissions of fluorinated greenhouse gases. To do so, the Regulation

- a. establishes rules on containment, use, recovery, reclaim and destruction of fluorinated greenhouse gases;
- b. establishes rules on the competence of installers handling fluorinated greenhouse gases;
- c. imposes conditions on the placing on the market of specific products and equipment that contain, or whose functioning relies upon, fluorinated greenhouse gases;
- d. imposes conditions on specific uses of fluorinated greenhouse gases; and
- e. establishes CO<sub>2</sub>-equivalent consumption limits for the placing on the market of hydrofluorocarbons ('HFC phase-down').

The gases covered by the EU F-Gas Regulation are fluorinated greenhouse gases: HFCs, PFCs and SF<sub>6</sub> and other greenhouse gases that contain fluorine (listed in Annex II of the regulation). Unsaturated HFCs (also known as HFOs) have reporting obligations but are not part of the phase-down regime.

The main new element of the 2015 EU F-Gas Regulation is the HFC phase-down, a stepped approach where the consumption of HFCs placed on the EU market – expressed in CO<sub>2</sub>-equivalent – is progressively reduced with the objective to reduce HFC emissions. The EU has set very ambitious targets: by 2030, HFC consumption must be reduced by 79% which is expected to cut the EU's F-Gas emissions by two thirds compared to the average of 2009-2012.

The HFC phase-down started in 2015 and is intended to steer innovation and ensure a move towards refrigerants with a lower global warming potential (GWP), a reduction of refrigerant virgin quantities used or a combination of both. It will impact the entire value chain, from the producers of refrigerants to the manufacturers of equipment, its installers and its users.



HFC phase-down steps as set out in the ANNEX V of the F-Gas Regulation

For more detailed information about the EU F-Gas Regulation, please consult the EPEE website which includes our FAQ as well as relevant links to information provided by the EU Commission and EPEE members.



## III. How does the EU HFC phase-down work?

The EU HFC phase-down is based on CO<sub>2</sub>-equivalents – calculated by multiplying the metric quantity of refrigerants with the GWP of each refrigerant. Thus, it particularly impacts refrigerants with a high GWP.

The higher the GWP of a refrigerant, the higher the amount of CO<sub>2</sub> equivalent it represents for a given quantity, and the more it will come under pressure by the phase-down reduction steps. This means that the EU HFC phase-down does not ban specific HFCs but increases the pressure on high GWP HFCs.

Alongside using HFCs with a lower GWP value, the following options contribute to achieving the phase-down steps: **reducing leakages, reducing the quantities (charge sizes) of HFCs, increasing the recycling and reclaim of HFCs and avoiding the use of HFCs altogether.**

To implement the HFC phase-down, the European Commission allocates quotas in tonnes CO<sub>2</sub> equivalent to importers and producers of bulk gases. Quotas are not allocated to manufacturers and importers of products and equipment containing fluorinated gases. The latter undertakings must assure compliance with the quota system in other ways, through a declaration of conformity and, for importers, the use of authorisations unless they are below an annual threshold of 100t CO<sub>2</sub> equivalent. More information about the HFC phase-down and how it works can also be found in the EPEE FAQ .

To ensure compliance with the phase-down, the European Commission has set up an HFC Registry enabling the traceability of quota. Registration is mandatory for all companies covered by the quota mechanism, from bulk gas importers and producers through to equipment importers, etc.

More information about the HFC Registry can be found here:  
[https://ec.europa.eu/clima/policies/f-gas/reporting\\_en](https://ec.europa.eu/clima/policies/f-gas/reporting_en)



The higher the Global Warming Potential of an HFC, the higher the quantity of CO<sub>2</sub>-equivalent 1 kg of refrigerant represents.



## IV. Lessons learned

### Preliminary remarks

As explained in the previous chapter, the EU HFC phase-down is based on a robust and mandatory mechanism with clearly identified obligations for the concerned market players. It is therefore bound to achieve the desired HFC consumption reduction albeit with a growing risk of illegal trade (see lesson #3). Having said this, it must always be remembered that the behaviour of the various involved stakeholders is governed by a combination of regulation and market forces. In other words: if proactive action on the phase-down requirements is too slow, compliance will be forced by refrigerant shortages and price increases. This is what happened in the EU and what

could have been avoided if more upfront action had been taken – bearing in mind that this does not only relate to the behaviour of market players but also to the regulatory context (e.g. the readiness of building codes, see also lesson #5).

The following “lessons learned” address this phenomenon, pointing to concrete measures to facilitate smooth and non-disruptive HFC consumption reduction steps and, what is even more important, emission reductions – which are the ultimate objective of the EU F-Gas Regulation (and the Kigali Amendment).



# 1. THE BASICS

Leak tightness (containment) and skills (competence) should be the basis of any measure targeting the reduction of F-Gas emissions

Before the EU F-Gas Regulation entered into force in 2015, Europe had put in place its predecessor, the 2006 EU F-Gas Regulation<sup>1</sup>, which already focussed on leak tightness (via containment measures) and skills of installers and service technicians (via certification schemes). Experience shows that these measures result in multiple benefits next to the reduction of direct refrigerant emissions, such as:

- **Energy Efficiency:** Ensuring the correct refrigerant charge (i.e. avoiding any losses) is a key condition for the energy efficient operation of a system, meaning that indirect emissions related to energy use will decrease as well;
- **Cost Effectiveness:** Leak tight equipment means reducing cost. First, because no additional refrigerant will be needed to top up leaky systems, second because it will save energy and third because in the longer-term system repair and break down costs including consequential damage will be avoided.
- **Safety:** Leak tight equipment is key for safe operation, which is even more important when flammable gases are used.

### How to achieve containment?

Leak tightness is the result of a combination of factors including design, quality of manufacturing and quality of installation and maintenance. Furthermore, to support leak tightness, the 2006 and 2015 EU F-Gas Regulation introduced the following main requirements:

- Regular leak checks and installation of leak detection equipment for larger systems;
- Training and certification of undertakings and its employees handling F-Gases;
- Labelling of equipment containing F-Gases.

**→ In practice, we can see that the principle of better containment and competence works very well and remains one of the cornerstones of efforts to reduce HFC emissions – as was already demonstrated by the 2006 EU F-Gas Regulation.**

Any country wanting to put in place measures addressing HFC emissions should therefore start with containment as a basis – without containment, a phase-down mechanism cannot work. Strengthened containment rules directly lead to a reduction not only of consumption but more importantly of emissions into the atmosphere. They are key elements to ensure that the migration to lower GWP gases happens in an orderly way, considering the trade-offs faced by manufacturers when choosing a new gas: safety, energy efficiency, GWP and cost of the fluids and systems.

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<sup>1</sup> Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases

## 2. DATA AND COMMUNICATION

### Governments should reach out to the entire supply chain to ensure successful design and implementation of regulation

Heating, cooling and refrigeration are indispensable for a comfortable and safe life in today's society and F-Gases are a crucial element of such equipment. Therefore, it is important that governments reach out to the entire value chain from 'end-users' of F-Gases such as supermarkets, hospitals, hotels, etc. through to manufacturers of HVACR equipment, service technicians and installers. Any political measure taken should never jeopardize the safe and energy efficient operation of HVACR equipment over its lifetime.

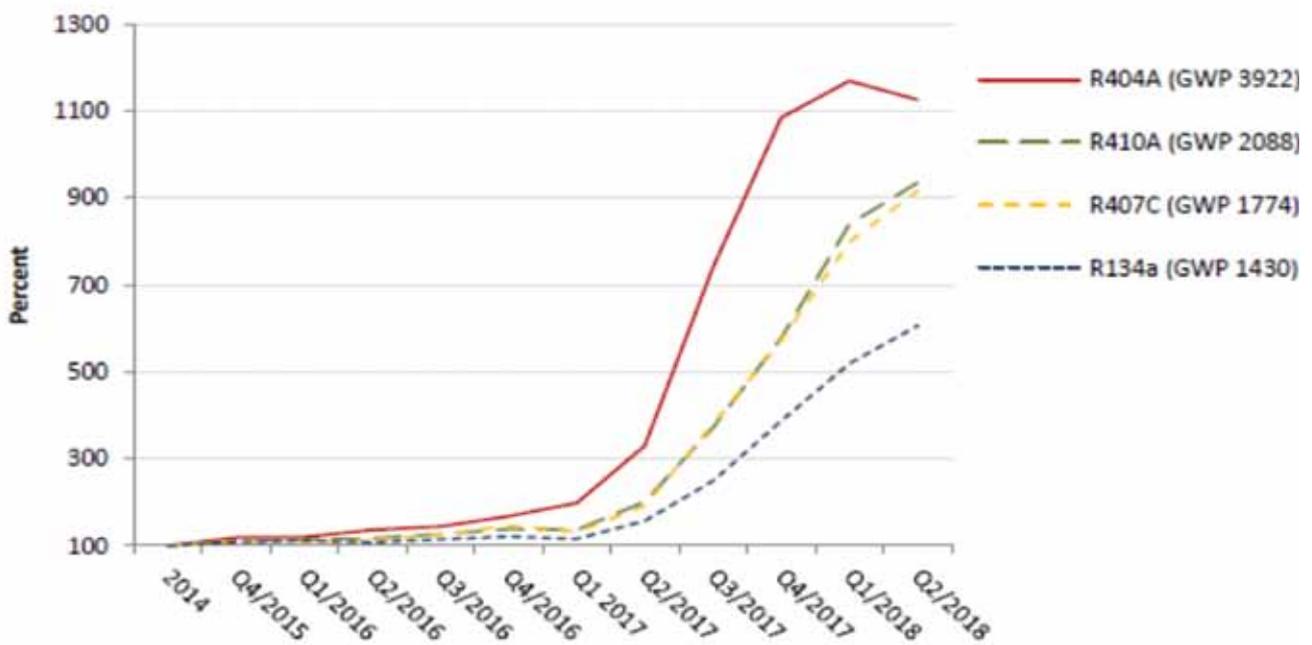
**→ To ensure this is the case, close cooperation between governments and stakeholders across the entire value chain as mentioned above, is crucial to ensure a full understanding of the market and to avoid unintended consequences.**

In the EU, several preparatory studies were carried out before deciding on the 2015 EU F-Gas Regulation. For example, EPEE commissioned a comprehensive study to SKM Enviro (Ray Gluckman)<sup>2</sup> providing a detailed analysis of the HVACR market segments including key factors such as refrigerants used, lifetime of equipment, typical leakage rates, charge sizes, expected penetration rates of alternative solutions etc. According to this study, the phase down steps as designed were challenging, but feasible. However, to work smoothly, it would have required a good understanding and timely action by all stakeholders, which, in practice, has not been the case in all sectors.

Once a new regulation is in force, communication remains of key importance to ensure that all stakeholders are well-informed and understand the new requirements. In the EU, not all stakeholders are well connected – for instance, certain stakeholders are small family owned companies across the 28 EU Member States which are not necessarily members of national trade associations. For others, F-Gases may simply not be their business focus, etc. Therefore, numerous stakeholders were not fully aware of the obligations (particularly of the phase-down) of the EU F-Gas Regulation being in effect since 2015. This led to delayed market activities – for example, high GWP refrigerants such as R-404A and R-507A continued to be used, although several lower GWP alternatives were already available – and consequently to significant refrigerant shortages, extreme price increases and a growing risk for illegal trade.

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<sup>2</sup>Phase Down of HFC Consumption in the EU – Assessment of Implications for the RAC Sector, FINAL REPORT, SKM Enviro 2012



Source: Ökorecherche 03/2018, Monitoring of HFC prices in the EU

→ That is why considerable effort must be put into communication to ensure that all relevant stakeholders are aware of the new provisions, how these will impact them, and why they should anticipate compliance. Not only governments, but each actor in the value chain can play a role in ensuring that the news reaches all those stakeholders concerned

For example, following the entry into force of the EU F-Gas Regulation, EPEE started the "Gapometer" project, which defines a route towards implementation of the phase-down and identifies the biggest risks of gaps between requirements and reality. When undertaking a market survey as part of the Gapometer

project, we found that action to stop using high GWP refrigerants so far has been far too slow in the EU to achieve a smooth implementation of the phase-down as designed. Consequently, EPEE joined forces with three other leading associations in the HVACR sector – AREA, ASERCOM and EFCTC – to call upon European installers to stop using high GWP refrigerants (particularly R-404A, R-507A) in the equipment they install. The associations are reaching out to installers with a brochure that has been translated in all the official languages of the European Union. However, it takes time to spread the message – more time than expected. Therefore, regulations must be realistic in anticipating such sort of delays.

## 3. GOVERNANCE

### The phase-down principle works but requires excellent governance

As explained already in chapter II & III, the EU chose a quota based HFC-phase-down as the main mechanism to achieve the desired HFC consumption reductions, where quota is allocated to producers and importers of bulk HFCs ('top-down' approach).

The situation in other regions of the world is different in the sense that the Kigali Amendment – which was not in place when the EU F-Gas Regulation entered into force – already sets out the consumption reduction steps that need to be achieved in the countries that have ratified it. **The focus in these countries is therefore on the measures to be put in place to achieve these goals rather than on the decision about the reduction steps as such.** However, even if the Kigali Amendment sets out the HFC consumption reduction steps and even if those may only kick-in in the medium / long-term, it is crucial that countries plan ahead and introduce adequate measures early enough in time to be ready when the reduction steps will occur and ensure an orderly transition.

→ **If opting for a top-down quota-based phase-down mechanism, as is the case of the EU, there are some experiences that are worth sharing:**

- **Communication:**

As explained in lesson #2, the importance of extensive communication cannot be stressed enough. First, the principle and the mechanism of progressively reducing CO<sub>2</sub>-equivalents need to be thoroughly explained to stakeholders to avoid a false feeling of security. The EU HFC phase-down allows some flexibility for the market to react, but this flexibility must not be understood as an excuse for non-action. Second, the technicalities of quota allocation, authorisations, etc. need dedicated explanation and guidelines to avoid any misunderstandings or unclarities and to ensure that quota is not wasted.

- **Flexibility:**

The European Commission expected the HFC phase-down to trigger a move towards lower GWP refrigerants by increasing the pressure on high GWP gases. However, experience shows (see example of lesson #2) that some built-in flexibility allowing legislators and stakeholders to adapt to market situations and avoid unintended consequences (with an impact on safety, energy efficiency, etc.) could therefore be beneficial to ensure a successful HFC consumption reduction.



- **Design:**

As explained in chapter II and III, the EU F-Gas Regulation is based on a top-down mechanism where quota is allocated to producers and importers of bulk HFCs. It is worth mentioning in this context that HFCs are not only imported and exported as bulk but also in pre-charged equipment. Countries with local manufactures are recommended to address those imports and exports of equipment to protect the competitiveness of manufacturers of pre-charged equipment.

- **Enforcement:**

As for any legislation, enforcement is key for success. In terms of the EU HFC phase-down mechanism, a lack of enforcement would completely undermine the phase-down principle and with it the goals of the F-Gas Regulation. With growing pressure due to the huge cuts of HFC consumption in the context of the EU HFC phase-down, latest evidence shows that illegal imports of high GWP refrigerant R-404A are increasingly becoming a threat for the successful implementation of the phase-down. It is therefore of key importance that stakeholders only buy refrigerants from reliable sources and that governments put in place adequate market surveillance and penalty schemes.

- **Anticipation:**

As said, the situation in Europe at the time of the negotiation of the EU F-Gas Regulation was different in the sense that the Kigali Amendment did not exist back then, i.e. the shape of the EU HFC consumption reduction still had to be decided as well as the measures to achieve it. Today, the Kigali Amendment sets out the steps of the desired consumption reduction for countries that ratify it, which is why these countries can focus on the required political measures to achieve these goals. Nevertheless, to avoid critical situations, shortages, etc. it is highly recommended for countries to put in place measures early enough to anticipate the required consumption reduction steps. That is if measures only kick in at the time when the first reduction step is required, it will be too late for the market to adapt and ensure an orderly, safe and energy efficient transition.

**Having said this, it needs to be remembered that the EU quota based, top-down HFC phase-down mechanism is only one of many different methods to achieve HFC consumption reductions. As an example, Japan has adopted a different, bottom-up, modulated approach where the phase-down steps result from sector-based restrictions. Governments need to evaluate what sort of approach is best suited to their respective countries, taking into account their countries' and markets' specific characteristics (see also chapters I & V).**



## 4. ALIGNMENT

When combining different measures, they need to be aligned and their respective role clearly communicated to the market

Alongside the EU HFC phase-down and the measures on containment and competence as explained in the beginning of this paper, the EU F-Gas Regulation imposes certain conditions on the placing on the market of specific products and equipment using fluorinated greenhouse gases. These conditions are also known as 'sectoral' bans, meaning that certain GWP thresholds apply for specific product categories. For example, as of 2020, HFCs with a GWP above 2500 will be banned in stationary refrigeration equipment. The European Commission introduced several of such GWP limits in an attempt to set signposts in support of the phase-down. Some of these GWP limits kick in after the HFC consumption reduction steps as required by the EU HFC phase-down. For example, the GWP limit of 2500 will apply as of 2020 whereas a major reduction step occurred already in 2018.

**→ While opinions are diverging as to whether GWP limits ('sectoral' bans) are necessary in addition to the phase-down and when they should kick in, there are two important take-aways from the EU experience: if GWP limits are applied on top of a quota based phase-down mechanism, firstly, these must be co-ordinated to allow market players to manage the transition in a practical and cost-effective manner, and secondly, it needs to be made very clear to stakeholders that the phase-down mechanism will force the market to move. However, if market players do not make these changes in due time, unintended consequences such as refrigerant shortages and massive price increases can be expected. In other words: 'sectoral' bans cannot be used as an excuse for market players to hold back on necessary action whilst they wait for the bans to kick in. Once again, communication is crucial for success.**



## 5. ANTICIPATION

Building codes and standards need to be ready for and aligned with national legislation

As explained, the EU F-Gas Regulation puts forward measures to reduce the use of HFCs with a higher GWP and to promote the use of lower GWP alternatives. However, the lower the GWP of a refrigerant, the more likely it will be flammable.

In practice this means that in some market sectors lower GWP alternatives exist but cannot be used in equipment as building codes do not allow for it because they are flammable. Indeed, building codes are enshrined in national, regional and sometimes even local rules, often related to fire safety. If a building code prohibits the use of flammable refrigerants, then it is simply not allowed to use them.

**→ Buildings codes can be a barrier to the implementation of HFC consumption reduction steps. They must therefore be revised in time to be ready for new legislation.**

It is also worth mentioning safety standards in this context as these are important references and are often used as practical guidance, a code of good practice or, if it is a harmonized standard, as a possible method to demonstrate compliance with legislation. Even if they are not binding – as opposed to building codes and regulations – an understanding of safety standards is highly recommended. National and international standardization committees are currently working on adapting relevant standards to the increased use of flammable refrigerants taking into account, among others, various research programs worldwide to scientifically assess the conditions for the safe use of flammable refrigerants.



## 6. RESOURCES

Recovery, recycling, reclaim and reuse of gases are crucial elements to achieve HFC consumption and emission reductions

The EU F-Gas Regulation increased the opportunities for recovery and reuse of gas. Indeed, recycled and reclaimed gases can make an important contribution to achieving the phase-down as they are not covered by the quota system and considered as valuable resources helping to reduce the pressure on the market.

**→ Recovery, recycling, reclaim and reuse should be part of any legislation aiming to reduce the consumption and emission of HFCs.**

The experience in the EU shows that due to the HFC phase-down, there is increased interest in using recycled and reclaimed gases. In addition, according to the F-Gas Regulation venting refrigerants into the atmosphere is explicitly prohibited and subject to penalties. At the end of lifetime of equipment or when retrofitting existing installations, the refrigerant must be recovered for re-use or destruction.

**→ To effectively reuse HFCs, an adequate infrastructure is required allowing to recycle and reclaim refrigerants. Moreover, waste legislation needs to allow for the transport of used refrigerants across borders in case individual countries do not have adequate reclaim facilities. Careful monitoring of reclaimed product is required, particularly of imports, to ensure that virgin product is not being placed into cylinders labelled “claimed”. Buying from reputable suppliers will minimise this risk. Finally, there are very little data available about the quantities of recycled refrigerants. Better data would allow for better adaptation to the requirements of the market.**



## 7. INDIRECT EMISSIONS

### Energy efficiency should not be compromised by F-Gas rules and should be addressed in dedicated legislation

This point is only indirectly related to lessons learned from the EU F-Gas Regulation. It is mentioned nevertheless in this paper because despite all efforts to move towards lower GWP refrigerants and, by doing so, reducing direct emissions from HVACR equipment, it is a well-known fact that the largest share of emissions is due to the energy use of equipment. These emissions are also known as indirect emissions and represent far more than three quarters of overall emissions of HVACR equipment.

While the EU F-Gas Regulation is strictly related to reducing direct HFC emissions, there are several policy measures in place in the EU that are dedicated to reducing the energy use of HVACR equipment, or, in other words, increasing its energy efficiency, such as:

- **Ecodesign:** Sets minimum energy efficiency requirements for products, also known as MEPS (Minimum Energy Performance Standards). If MEPS are not reached, products are not allowed to be placed on the EU market. This measure is intended to create a “push” effect where manufacturers are “pushed” to bring to market energy efficient products.

- **Energy labelling:** Showcases the energy efficiency of a product by means of a scale (A to G, green to red) and is meant to inform and motivate consumers to buy the most energy efficient product. This measure is intended to create a “pull” effect, where consumers are “pulled” towards energy efficient products.

- **Energy Performance of Buildings (EPBD):** Puts the emphasis on the buildings and systems and aims to accelerate the cost-effective renovation of existing buildings, the deployment of smart technologies as well as technical buildings systems / building automation with the vision of a decarbonised building stock by 2050.

→ **Legislation dedicated to reducing direct HFC emissions and legislation dedicated to increasing energy efficiency (i.e. reducing indirect emissions) should be well-aligned and mutually consistent. For example, when designing the HFC phase down, the need for refrigerants that allow for higher energy efficiency should be considered to ensure smooth implementation. If this is not the case, regulations on F-Gases could even turn out to be counter-productive in terms of overall greenhouse gas emissions.**



## → Conclusions

There is no doubt that the HVACR industry has a lot to offer to ensure a comfortable and safe life in today's society in a long-term sustainable manner. It has been innovating and will continue to do so, making considerable investments to respond to the growing needs of tomorrow and to provide consumers with products that are top of the line, energy efficient and sustainable. Legislation can be an important driver to scale up these developments, but it is crucial that it takes into account market realities to be truly successful.

In this sense, it should be stressed that the ultimate objective of the EU F-Gas Regulation is to reduce emissions of HFCs with the HFC phase-down as one of its main measures to reduce their consumption. However, there are complimentary tools to reduce emissions that can be extremely effective. Policy makers should always keep this in mind when designing policy measures to reduce F-Gas emissions and **give a high priority to these complimentary measures that directly target emissions, such as leak tightness ("containment measures"), recovery, recycling and reclaim of refrigerants as well as the reduction of charge sizes.**

That being said and as pointed out in the previous chapter, the overwhelming share of emissions from HVACR equipment are those related to the energy used to operate the systems. **That is why additional, dedicated measures to increase energy efficiency are so important.** These can target products and buildings as shown in the examples in the previous chapter and can go much further than this. There is low hanging fruit such as regular service and maintenance of equipment, but also systematic monitoring of systems' operation, building automation and control, smart systems with demand response allowing for a better and more efficient integration of renewables energies into the wider system, and much more which would go beyond the scope of this paper.



The voice of the heating,  
cooling and refrigeration industry

## ABOUT EPEE

The European Partnership for Energy and the Environment (EPEE) represents the refrigeration, air-conditioning and heat pump industry in Europe. Founded in the year 2000, EPEE's membership is composed of 48 member companies, national and international associations from Europe, Asia and North America.

EPEE member companies realize a turnover of over 30 billion Euros, employ more than 200,000 people in Europe and also create indirect employment through a vast network of small and medium-sized enterprises such as contractors who install, service and maintain equipment.

EPEE member companies have manufacturing sites and research and development facilities across the EU, which innovate for the global market.

As an expert association, EPEE is supporting safe, environmentally and economically viable technologies with the objective of promoting a better understanding of the sector in the EU and contributing to the development of effective European policies. Please see our website ([www.epeeglobal.org](http://www.epeeglobal.org)) for further information.

## ANY OTHER QUESTIONS?

CONTACT US AT

**EPEE – European Partnership for Energy and the Environment**

Avenue des Arts, 46 · 1000 Brussels · Belgium

Tel : +32 (0) 2 732 70 40 · Fax : +32 (0) 2 732 71 76

[secretariat@epeeglobal.org](mailto:secretariat@epeeglobal.org) · [www.epeeglobal.org](http://www.epeeglobal.org)

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