

**Interreg**



**Sudoe**

KET4F-Gas

***Roadmap for  
the Public  
Administrations  
in charge  
of waste  
management***





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# *Fluorinated Gases Management: An environmental necessity*

KET4F-Gas is a European project that aims at the reduction of the environmental impact of fluorinated greenhouse gases (F-gases) in the SUDOE area using Key Enabling Technologies (KETs) to facilitate companies and waste managers to comply with European Union (EU) F-Gas regulations. The main objective of this project is to help the implementation of the most efficient option for the separation and recovery of F-gases used in refrigeration and air conditioning equipment. The KET4F-Gas solution is based on the most efficient treatment systems and designed according to the principles of green chemistry.



[www.KET4F-Gas.eu](http://www.KET4F-Gas.eu)

Climate change is already a reality that affects the entire planet. Global temperature is raising every year, mostly due to the increasing concentrations of atmospheric greenhouse gases (GHG). Although carbon dioxide (CO<sub>2</sub>) accounts for at least two-thirds of the global GHG emissions, F-gases such as the families of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs), as well as sulphur hexafluoride (SF<sub>6</sub>), are also major contributors to global warming. While the majority of GHGs are by-products of several processes, like the combustion

of fossil fuels, F-gases are a family of man-made gases widely used for several industrial applications (e.g. air-conditioning systems, industrial refrigeration, fire extinguishants, solvents).

Since the development of refrigerants in the 19th century, continuous research has been performed aiming to develop more efficient, less dangerous, and more environment-friendly compounds. However, despite the efforts made so far, the emissions of these gases continue to represent a great environmental problem:

***F-gases represent about 2% of the total GHGs emissions in the EU.***

***F-gases are powerful GHGs, showing a global warming potential (GWP) up to 23000 times greater than CO<sub>2</sub>.***

***The EU28 countries emitted in 2016 the astonishing amount of 110000 million tonnes of CO<sub>2</sub>-eq of F-gases.***

***The F-gases emissions have increased a 60% since 1990.***

***HFCs emissions are projected to grow by nearly 140% between 2005 and 2020.***

***Even if some compounds have a short-life cycle, some can remain in the atmosphere for thousands of years.***

***The uncontrolled use of HFCs can lead to these gases to represent a total 12% of the GHGs emissions by 2050, as the global energy demand for cooling equipment is expected to triple by 2050 due to global warming.***



The use of F-gases, if controlled correctly, can also have benefits:

***F-gases are widely used because they are not toxic from a chemical point, not very reactive, and non-flammable.***

***F-gases are valuable materials, especially suitable for recycling and reclamation due to their high stability***

***Only 1% of F-gases are collected at the end of their life cycle in Europe (about 1200 tonnes in 2015) even though recycling units do exist. This means that there is a great window of opportunity of improvement for reclaimed F-gases and their integration into EU circular economy market.***

***F-gases are man-made compounds which can be improved, recycled safely and re-used, improving the energy efficiency of the systems and their overall cost-effective life cycle. If done correctly, F-gases environmental impact can be reduced to a minimum under the EU circular economy principles.***

***Reclaimed F-gases are not subject to additional taxation, while new alternatives, because of their status as new products, are protected by industrial patents, which represent an additional cost for their use.***

***F-gases selective recycling is fundamental to reduce the industry's dependence on higher GWP refrigerants, reduce overall prices and alleviate the pressure on the whole market chain.***

The EU transition towards fourth-generation refrigerants, with low GWP, is underway. Great efforts have been made in the research on natural refrigerants (with toxicity and/or flammability problems), hydrofluoroolefins (HFOs, with efficiency energy problems), HFCs with lower GWP, and on HFC-HFO blends (with low toxicity and null flammability). Some HFC-HFO blends are already replacing HFCs in commercial and industrial refrigeration.

The actual lack of developed technologies to recycle F-gases dramatically affects the refrigeration sector because most F-gases are incinerated, thereby increasing the atmospheric emissions of these gases. This said, there is a fundamental necessity to not only reduce the release of F-gases into the atmosphere but also to separate and recycle pure HFCs at the end of the refrigeration and air conditioning equipment life, to reuse and recycle in the subsequent production of fourth-generation

refrigerants, applying circular economy. The research on technologies based on environmentally benign materials that efficiently capture, separate, and recycle F-gases is vital to develop sustainable processes to reduce the environmental impact of refrigerants based on F-gases. The environmental impact resulting from the release of F-gases is prompting the development of these new technologies to recover and recycle them. The adaptation to climate change is a key climate policy in the EU and the development of green technologies, such as the efforts done by KET4F-Gas, is encouraged.

Following the global tendencies, the data from the European Environmental Agency shows that the F-gas emissions and removals in France and Spain have increased substantially since 1990 (France +43.6% and Spain +51.5%). However, the latest data related to 2018 show that the SUDOE area has slightly reduced



their emissions (this is official data that does not include the emissions coming from the illegal market as they are not declared): Portugal -4.6%, France -4.0% and Spain -1.8%. This reduction is due to efforts of these national governments that have put in place a set of fiscal, regulatory, voluntary and informative measures following the Global agreements and, more specifically the European regulations that are described in chapter 2.

Despite these preliminary first steps, a reshape of thinking needs to be set in place to tackle cost-efficiently the adaptation to the F-gas phase-down in the

SUDOE area, stop the advance of illegal trade, correct practices in the waste management of F-gases and optimize the recycling efforts. For these Southern European regions there is a special great room for improvement as the recycling percentages are extremely low. This is a great opportunity for SUDOE waste managers and companies to optimize their systems, comply with F-gas regulations to avoid penalties, and adapt and contribute to the market of the future under circular economy principles.





## **Main takeaways:**

*International and European legislations limit the use of F-gases, control their production, release and management, and incentivise the development of a new generation of refrigerants with lower GWP.*

*F-gases are man-made compounds which can be improved, recycled safely and re-used, improving the energy efficiency of the systems and their overall cost-effective life cycle. If these actions are done correctly, F-gases environmental impact can be reduced to a minimum under the EU circular economy principles.*

*SUDOE areas are specially affected by Global Warming and have a great room for improvement as the recycling percentages are extremely low.*

## Chapter 2:

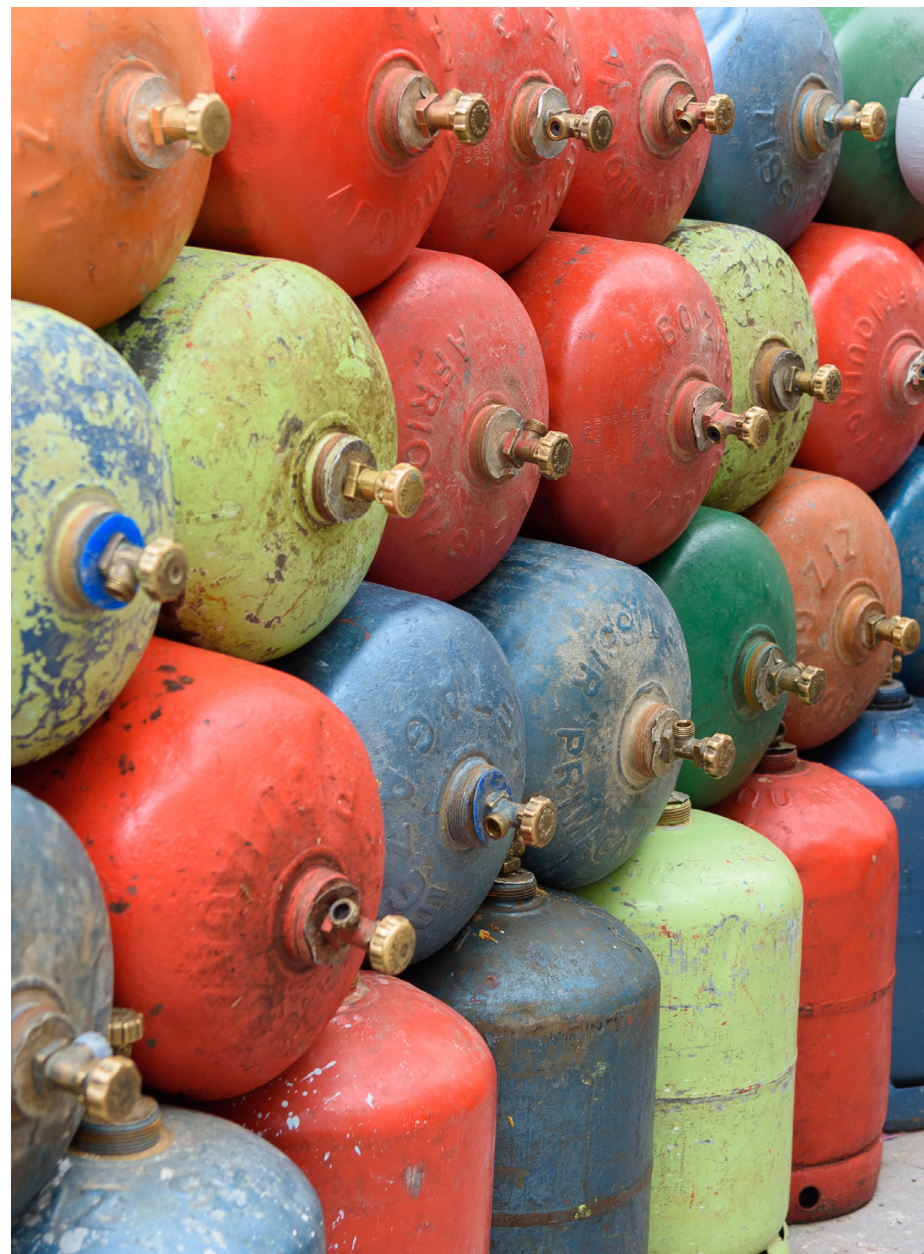
# *EU and SUDOE national legislation to control F-gases: A global outlook from policy to market*

The EU has become in recent years a reference in the fight against climate change and in the mitigation of the HFC impact on the atmosphere. It is a priority for the European Commission the development of technologies and research initiatives, such as KET4F-Gas, that help to efficiently separate and recycle HFCs at the end of the refrigeration and air conditioning equipment life, to reuse and recycle them in the subsequent production of fourth-generation refrigerants following the principles of the circular economy. The venting of refrigerants into the atmosphere is explicitly prohibited and subjected to penalties. At the end of equipment's lifetime or when retrofitting existing installations, the refrigerant must be recovered for re-use or destruction.



At an international level, there are two environmental policy regimes regarding the management of HFCs. On the one hand, the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol (1987) determined the phasing-out of ozone depleting substances, such as chlorofluorocarbons (CFCs) with the objective to “protect human health and the environment against the adverse effects resulting from modifications in the ozone layer”. On the other hand, the Kyoto Protocol and the Paris Agreement aiming at stabilizing “greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system”. According to the agreements of the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the 525/2013 EU regulation for the monitoring of emissions of greenhouse gases, each country committed to elaborate an Inventory of GHGs emissions, reporting all details concerning the type of emitted substances and economic activity related with the emissions.

The European Union has gone a step forward and it has imposed additional strong regulations to the international agreements to control the manufacture and utilization of F-gases. The first F-Gas Regulation was the so-called *Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases*, created under the EU Low Carbon Roadmap agenda that aimed at reducing emissions stemming from F-gases. The directive that is currently in place is the *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*. This new regulation included additional requirements and fully replaced the regulation set in place in 2006. This new directive reformulates drastically the way industry deals with F-gases and it introduces new mechanisms to ensure an effective emission reduction. The gases mainly affected by this EU Regulation are HFCs, PFCs and SF<sub>6</sub> (F-gases). It needs to be taken into ac-



count that the phase-down provisions only affect HFCs. Unsaturated HFCs are an exception as they are not included in the phase-down but are subjected to reporting obligations.

The HFC phase-down will gradually reduce the availability of these gases in the European market through the allocation of quotas by the European Commission following the target of decreasing HFC consumption in 79% by 2030. This is an extraordinary effort that will impulse industry and users towards the transition to refrigerants with a lower GWP and to solutions under the circular economy principles such as recycling.

This directive regulates the use of F-Gases in new equipment, their maintenance and their recovery and correct treatment at the end of the system's life. This said, the F-gas regulation does not apply in three scenarios: (i) when alternative gases are not available, (ii) if the energy efficiency gains during the operation generate emissions that are lower than an equivalent system that does not contain HFC and (iii) if the use of technically feasible and safe alternatives would

result in disproportionate costs.

Regarding the alternatives to F-gases, the EU is making a transition towards fourth-generation refrigerants, with low GWPs with special focus on HFCs with lower GWP, hydrofluoroolefins (HFOs), and on blends of traditional HFCs with HFOs. However, for the EU it is a priority not only the search for F-gases alternatives but also the development of technologies, such as KET4F-Gas, that help to efficiently separate and recycle HFCs at the end of equipment or refrigerant blends lifetime, to reuse and recycle in the subsequent production of fourth-generation refrigerants following the principles of the circular economy.

Operators and the overall supply-chain actors are required to prevent emission of F-gases by all means necessary, including their recovery, reclaim or destruction during the system operation and at the end of the equipment's life. The HFC phase-down has led to an increased interest in the use of recycled and reclaimed gases. Indeed, the release of F-gases into the atmosphere is explicitly prohibited and is subject to penalties. At the end of the equipment's life or when retrofitting



existing installations, F-gases must be recovered for re-use or destruction. The level of the penalties for infraction are defined by each EU Member State, however, the European Commission ensures that the sanctions must be effective, proportionate and dissuasive. By 2017, all EU Member States had to introduce the 2014 F-Gas Regulation into national law.

EU directives, such as the 2014 F-gas Directive, are a legal act that needs to be incorporated into national law by EU Members before a giving certain deadline and the EU must be notified about it. This type of legal act sets out goals that Member States must achieve while giving them the discretion as to how to reach them.

► **Portugal** made the transposition of the 2014 F-gas Directive on 30 November 2017 in their Diário da República, Executive Order nº 145/2017. The Agência Portuguesa do Ambiente is the competent authority to study the relevance of containment measures for the correct recovery and reclaim of F-Gas equipment at the end of the life of products and equipment

that contain F-gases for their recovery and reuse or for their recovery, in order to minimize the impacts associated with its end-of-life management.

► **In Spain**, the transposition of the EU legal act took place on 17 February 2017 through a Royal Decree Law 115/2017. This decree establishes that the recovery of F-gases from refrigeration and air conditioning equipment and their correct management are mandatory and that these interventions must be performed by maintenance companies, through accredited operators. The recovery, recycling and destruction of F-gases must be carried out during repair and maintenance of the equipment and before its disassembling. The penalties derived from inadequate F-gases management are significant. In the first place, it should be noted that Law 22/2011 on waste and contaminated soils establishes the general legislative framework on waste, defining various types of infraction, such as dumping or sale of waste.

The Spanish government has also implemented fiscal measures such as



a tax regime on the use of F-gases created under the article 5 of the Law 16/2013. However, part of the quantity can be reimbursed if the correct waste management of the equipment is certified. There is also a voluntary agreement for the correct use and management of SF<sub>6</sub> and of systems containing this gas, done by the Ministry of Agriculture, AFBEL, REE and other stakeholders to reduce the emissions of SF<sub>6</sub>.

► **In France**, the national F-Gas regulation is essentially contained in articles R. 543-75 to R. 543-123 of the environment code and in the decrees of February 29, 2016 and in the French Climate Plan presented in July 2017. It is worth mentioning the Fluorinated Gases Observatory that has the mission to control

the quantities of different types of F-gases put on the market, used, recycled or destroyed and to control actors in the sectors concerned, in particular in the refrigeration and air-conditioning sector. At the non-state level, the French regulation imposes obligations on distributors of refrigerants that perform, in a professional capacity, any operation requiring the handling of refrigerants. Producers of refrigerants and equipment pre-loaded with refrigerants must recover them at no additional cost, process them or have them processed in authorized facilities on the national territory or abroad to allow their reuse in accordance with the requirements of their original specifications, or to have them destroyed in case of impossibility of compliance or prohibited reuse.



## *Recycling, reusing and reclaiming: Why is it important for waste managers and operators?*

There is an urge to not only reduce F-gases emissions into the atmosphere but also to separate, recycle and reclaim pure HFC at the end of the refrigeration and air conditioning equipment life. Due to the new quota system set by the European Commission, it is essential, in order to maintain sufficient quantities of virgin refrigerant available, that significant effort is made in recycling existing stock wherever possible. The more refrigerant gas recycled (that has previously been placed on the market), the less virgin refrigerant is needed and, consequently, the pressure on the supply chain to maintain stocks and supplies is lower. This is a key point since the HFCs phase down becomes a reality, leading to an increase in the prices of new virgin refrigerants. Where recycling is not possible or practical then reclamation should be considered.

In 2018, the first significant reduction on the quota took place, reaching a

value of 37%. Considering the next reduction comes in 2021, the industry's ability to reduce, recycle and innovate becomes fundamental. Indeed, under the F-Gas regulations, only refrigerants that are newly 'placed on the market' are included in the quotas, meaning the use of recycled products will reduce the industry's dependence on higher GWP refrigerants. Up until now, the recycled refrigerants have represented a small part of the total used each year, primarily because new refrigerants were available at a low cost. The reclamation and reuse of recovered and recycled gases should be a key focus for the industry to help ensure a secure refrigerant supply. The research on technologies based on environmentally benign materials that efficiently capture, separate, and recycle F-gases is vital to facilitate the transition of the industry to the new restricted EU market.





## Main takeaways:

*The EU 2014 F-gas directive reformulates drastically the way industry deals with HFCs and introduces new mechanisms to ensure an effective emission reduction. The gases mainly affected by this EU Regulation are HFCs, PFCs and SF<sub>6</sub>: F-gases.*

*The 2014 F-gas regulation implies the effective phase-down of HFCs. This gradually reduces the availability of these gases in the European market through the allocation of quotas by the European Commission following the target of decreasing HFC consumption by 79% in 2030.*

*Operators and the overall supply-chain actors are required to prevent emission of F-Gases by all means necessary, including its recovery, reclamation or destruction during the system operation and at the end of the equipment life and are subject to penalties for non-compliance with the national transposition of 2014 F-Gas regulation.*

*Considering that the next reduction of the F-Gas quota size comes in 2021, the industry's ability to reduce, recycle and innovate becomes fundamental. Indeed, under the F-Gas regulations, only refrigerants that are newly 'placed on the market' are included in the quotas, meaning the use of recycled products will reduce the industry's dependence on high GWP refrigerants.*

## Chapter 3:

# *Recommendations of good practices in the management and handling of F-gases*

In recent years, the development of efficient and sustainable technologies to manage and recycle F-gases has been a race against time to ensure that all stakeholders involved in the handling of these gases, from operators to Public Administrations, avoid their emissions, contributing actively to the fight against climate change. Public Administrations have a fundamental role to play in achieving these goals.



## *Guidelines to the Public Administration for the efficient management of F-Gases*

The national authorities of the EU are responsible for implementing and enforcing EU legislation on F-gases. As the phases and stages that mark such legislation progress, the authorities' capacity to react must increase, activating national measures that help to anticipate the impact they will have on their companies and their economies. Therefore, the national authorities should promote the development of producers responsibility programs to ensure the efficient recovery, recycling and destruction of HFCs.

To help understanding what are the obligations and responsibilities of the stakeholders dedicated to the distribution, marketing and ownership of fluids and equipment containing F-gases, the public administration will provide a supervision mechanism that will be crucial to ensure the compliance with the provisions established by the European Commission. Public Administrations must also promote the application of good practices through recommendations that must always be taken into account.



## ***Recommendations for refrigerant manufacturers, distributors and users***

***Importers of fixed and mobile refrigeration, air conditioning and heat pump appliances must ensure that all HFCs preloaded in the appliances are counted for the purposes of the quota system.***

***Importers must register on the HFC registry and issue declarations of conformity upon import, as well as ensure that compliance is fully documented and verified.***

***Importers of products or equipment that contain F-gases must submit an annual report on imports made no later than March 31 of the year following importation.***

***Producers, importers and operators must clearly legibly and indelibly label the devices that contain F-gases or whose operation depends on it.***

***Manufacturers must duly advertise HFC-containing products and equipment and have to ensure that they are installed in appropriate locations.***

***F-gases may only be sold to companies that have the corresponding certifications or to companies that employ people who hold an official certificate or training certification.***

***Appliances that are not hermetically sealed and that are charged with F-gases may only be sold to the end user when proof is provided that the installation will be carried out by a certified company.***

***The gases must be exclusively transported and stored by companies duly authorized for such activities.***

***The supplying companies will keep an updated registry on the buyers. Likewise, the operators of the equipment that must undergo leakage control will also establish and maintain a data record for each equipment.***

## ***Recommendations for F-gases operators***

***Every person carrying out the installation, maintenance, repair or disassembly operations and leak control of the equipment or installations that contain F-gases or carrying out the recovery of these gases, must be duly certified according to the certification programs and training established by each member state.***

***To achieve a correct handling of F-gases, it is necessary to carry out both periodic supervisions and preventive and corrective equipment maintenance.***

***Operators of appliances that contain F-gases must take precautions to avoid possible leaks. Likewise, when a leak is detected, the operators have to repair it without any delay.***

***All operations, acquisitions, transfers, loading of the system, recovery or delivery to an authorized manager must be recorded in the corresponding registry book, including the amount of gas involved in the process.***

***When F-gas recovery, extraction or discharge operations are carried out:***

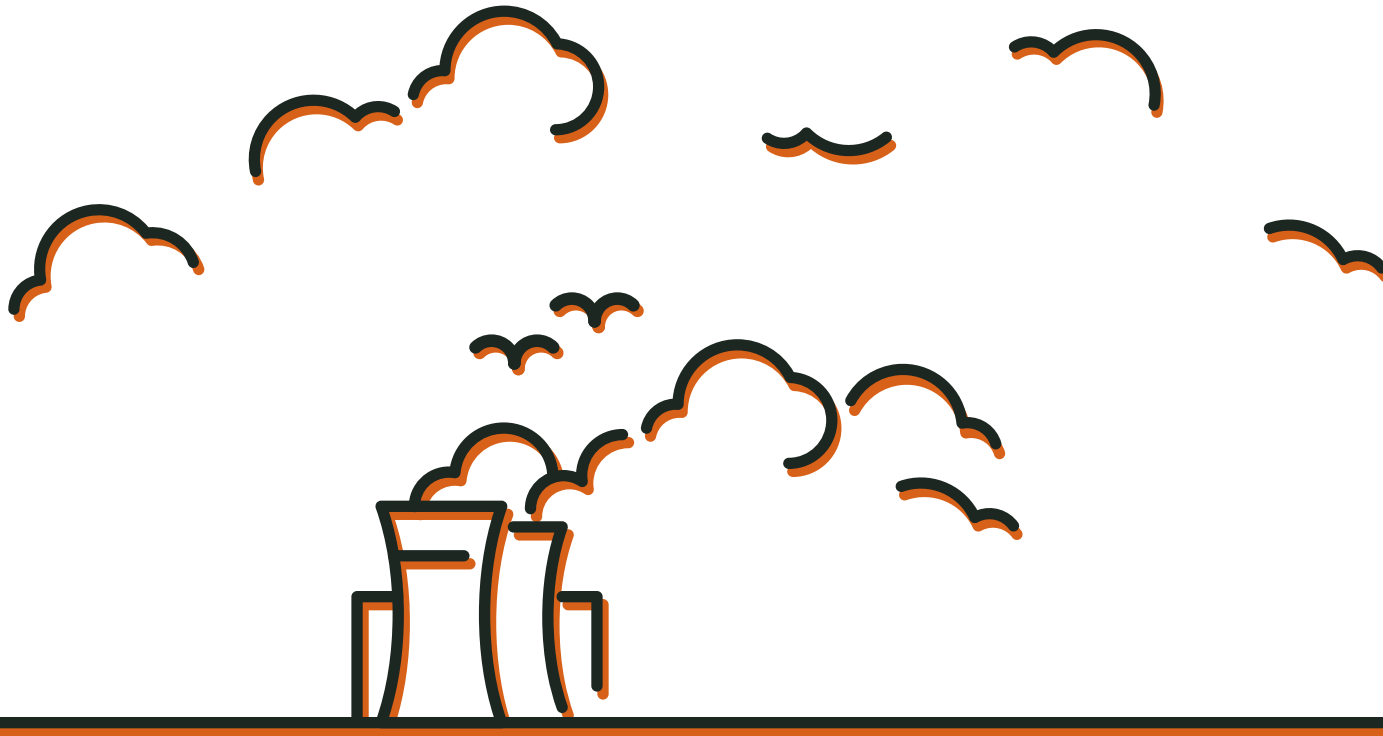
- ***A hermetic equipment will be used and a purge will be performed at the end of the operation to check that the system does not contain any residual refrigerant.***
- ***The amount of F-gas handled will be counted.***
- ***Before carrying out any type of manipulation, it will be verified that the equipment is clean and optimal for storing gases, without physical damage and free of corrosion. In addition, it will be necessary before introducing gas into a refrigeration system to carry out the corresponding tightness and pressure tests.***

***F-gases must be stored in suitable containers for the characteristics and qualities of each gas.***

## ***Recommendations for the correct management of F-gases at the end of their lifetime***

***Every person carrying out the installation, maintenance, repair or disassembly operations, control the leaks of the devices or installations that contain fluorinated gases or carrying out the recovery of F-gases will be responsible for taking the necessary measures to ensure the effective recycling, recovery or destruction of F-gases when they are no longer operational. The companies have the legal obligation to manage F-gases through an authorized waste manager.***

- ***The F-gases contained in products or equipment may be recovered by duly qualified personnel, provided that it is technically feasible, in order to guarantee their recycling and thus avoid disposal, when appropriate.***
- ***In order to manage waste, the management company must resort to the competent public administration in environmental matters to verify the necessary requirements to carry out the activities.***
- ***It is necessary that the waste managers of equipment containing F-gases be provided, to the extent that they request it, with the appropriate information for dismantling, thus allowing the identification of the different components.***



## ***Main takeaways:***

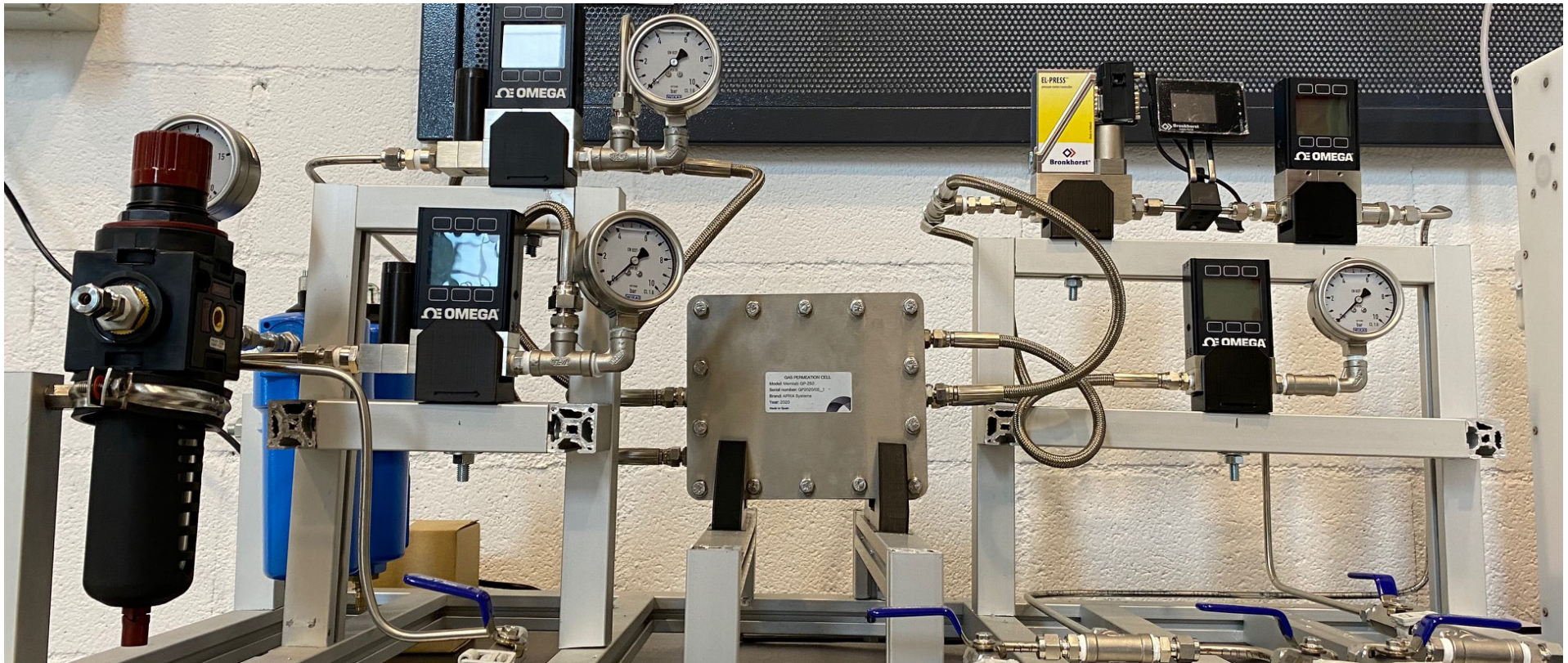
***The latest regulations adopted by the EU establish an ambitious package of measures to reduce F-gases emissions. This legislation imposes a large-scale application of climate-friendly technologies to equipment and products.***

***During this transition, all actors involved in the production, import, and distribution, manufacturers, contractors, and consumers will be affected and all together must join forces to negotiate and implement the reduction of F-gases at an international level.***

## Chapter 4:

# *Benefits of the project KET4F-GAS*

The presented KET4F-Gas prototypes will provide many advantages to waste managers, as they represent a realistic alternative to current recovery, transport and incineration process. The possibility of recycling R-32 with a minimum purity of 98% weight will permit to reuse this gas as many times as desired. In addition, the two prototypes presented in this guide have relative low implementation cost and represent a huge benefit from an environmental perspective.



## Benefits of the system

KET4F-Gas new recovery systems for refrigerant R-410A have plenty of advantages as they allow a full reuse of R-32 gas at low cost. The main benefits are listed here.



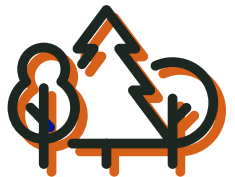
### High purity rates:

Both prototypes present high purities of at least 98% weight for R-32.



### Low environmental cost:

The new prototypes are clean technologies whose life cycle analysis reveals a saving of more than 60% in terms of greenhouse gas emissions when compared to a benchmark case where R-410A is not recovered.



### Low materials cost:

In both cases, the membranes and the adsorbents have low prices in the market.

## Other benefits

The most important benefit of using these technologies is the possibility to recover and reuse the lower Global Warming Potential (GWP) R-32, considering the current European regulation that will prohibit the fabrication of new hydrofluorocarbons with high GWP in refrigeration equipment. These technologies

represent a short-term alternative during the transition towards newer refrigerants with lower GWPs.

Assuming a horizon time of 10 years, the benefits in terms of environmental impact can be summarized in the following numbers:



**An approximate quantity of 3200 kg of R-410A can be treated for separation.**



**The main environmental cost** is in terms of CO<sub>2</sub> emissions, which are low, in a range of **6 to 8 kg CO<sub>2</sub> emitted per kg R-32 recovered.**



Considering that the GWP of R-410A is 2088, the environmental saving of avoiding its production-**makes this technology a 60-70% greener than any current alternative and more than 95% better in terms of ozone depletion.**

## Implementation Costs

**The Implementation Costs of the KET4F-Gas system** will depend on the refrigerant flow that needs to be treated per day. However, in general terms, the design of the operation units does not require expensive equipment, as all materials needed

have a low cost. The capital costs are a function of the dimensions of the unit to treat more or less gas. **The operational costs are in the range of 32€ per kg R-32 recovered.**



## ***Main takeaways:***

***The KET4F-Gas prototypes represent a realistic alternative to current recovery, transport and incineration processes***

***The most important benefit of using these technologies is the possibility to recycle and reuse R-32 gas, considering the current European regulation that will prohibit the fabrication of new hydrofluorocarbons with high Global Warming Potential in refrigeration equipment. The possibility of recovering R-32 with a purity of 98% weight will permit to reuse them as many times as desired, with a minimal loss.***

***The implementation costs will depend on the refrigerant flow that needs to be treated per day. However, in general terms, the design of the operation units does not require expensive equipment, as all materials needed have a low cost.***

## Chapter 5:

## FAQ

- ***What are the global and European regulatory frameworks on HFC?***

The requirements imposed by international regulations are clear:

**The Kigali Amendment to the Montreal Protocol on HFC (2016)**: 197 industrialized countries pledged to reduce by 45% the use of HFCs by 2024 and by 85% by 2050. Taking this into account, developing countries will begin to cap and reduce their consumption of HFC starting in 2024.

**The EU regulation 517/2014 on F-Gases and phase-out of HFC (2014)**: planned the phasing out of the placing on the market between 1995 and 2015 of the CFC and HCFC F-gases and the category of gases with a GWP greater than 2500, in particular HFC. The reduction requirements by 2024 of the European Regulation are stronger than those of the Kigali Amendment: 69% against 45%. By 2025, a schedule for gradually decreasing the placing on the market of these substances is set in place to reduce emissions in 21% compared to the period 2009-2012.

**The European quota system for placing HFC on the European market**: as from 2017, all HFC refrigeration, air conditioning and heat pump equipment are covered by a quota mechanism. This quota allocation is re-evaluated every three years.

- ***What is the monitoring of the application of the European regulations on F-gases?***

All European operators must report annually all movements of the year in question by fluid type (stored-purchased-recycled-regenerated-destroyed). The European Commission will publish in December 2020 a report on the availability of HFCs on the market. In 2022 a global report including a forecast of HFC demand until 2030 and beyond will be released.

- *Are there penalties for non-compliance with the EU regulation on the recycling need of F-gases?*

Yes. In the transposition to National Law of the EU regulation 517/2014 on F-gases non-compliance with obligations relating to recovery and correct treatment systems containing F-gases is subject to penalties. The amount to be paid for each sanction is decided by each Member State.

In **Portugal**, sactions for non-compliance can go from 2000 to 48000 Euros for a natural person and from 15000 to 48000 Euros for a legal person. In case of severe infraction, fine quantities can go up to 37500 Euros for a natural person and up to 2500000 for a legal person.

In **Spain** the sanctions for these infractions can range from economic sanctions, which range between 901 and 1750000 euros, through the disqualification or revocation of the authorization to practice professionally on a temporary basis between 1 and 10 years, to temporary closure or definitive.

In **France**, in case of infraction, the companies will face a fine up to 3000 € maximum, or the double in the event of recurrence.

- *Why is it important for waste managers and operators the correct treatment of F-gases?*

Apart from the penalties stated above, due to the new quota system set by the European Commission, it is essential, in order to maintain sufficient quantities of virgin refrigerant available, that significant effort is made in recycling existing stock whenever possible. The more refrigerant gas recycled (that has previously been placed on the market), the less virgin refrigerant is needed and, consequently, the pressure on the supply chain to maintain stocks and supplies is lower and the increases in the prices of refrigerants is avoided. Improving the reclamation and reuse of recovered products should be a key focus for the industry to help secure refrigerant supply.

- *Why the KET4F-Gas Software can be a solution for waste managers and operators?*

This tool is available to everyone in four different languages (English, French, Portuguese, and Spanish) and it is free of charge. It allows the user to classify waste, identify treatment technologies for F-gases mixtures and determine their Global Warming Impact.

- ***What do the KET4F-Gas system prototypes consist of?***

The KET4F-Gas prototypes consist of an adsorption column and of a membrane system.

- ***Can the KET4F-Gas system prototypes be placed in premises of a waste management facility?***

Yes, these technologies are easy to apply in a waste management facility due to the small amount of space required, and due to their modularity and scalability. Moreover, these systems require low maintenance and have long lifetime.



# *Do you have any question? Contact us!*

KET4F-Gas is a European project co-funded by the Interreg Sudoe Programme through the European Regional Development Fund (ERDF). Coordinated by the NOVA School of Science and Technology of NOVA University of Lisbon (FCT NOVA), the partnership currently involves other 13 partners and 6 associated partners from Portugal, Spain, France and United Arab Emirates.

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*This Roadmap for the Public Administrations in charge of waste management has been developed under the coordination of Fundación Empresa-Universidad Gallega (FEUGA), together with FCT NOVA.*

*FCT NOVA, FEUGA, Institut Quimic de Sarrià (IQS), University of Cantabria (UC), Xunta de Galicia, APRIA, EnviEstudos, University of Vigo (UVigo), University Clermont Auvergne (FRE) and FUNDECYT-PCTEX have participated in the elaboration and edition of this roadmap.*

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## PARTNERSHIP



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