FETA position paper on the issues surrounding per- and polyfluoroalkyl substances (PFAS).

Introduction

FETA represents the refrigeration, air-conditioning and heat pump (RACHP) industry in the UK.

The RACHP industry is a major user of **F-Gases**, which include hydrofluorocarbons (HFCs), hydrofluoroolefins (HFOs) and hydrochlorofluoroolefins (HCFOs). Some of these products fall under the OECD definition of PFAS. There are significant concerns about the possible inclusion of F-Gases in a broad based PFAS restriction proposal, as this could lead to significant unintended consequences and seriously jeopardise UK and international climate change and energy goals.

Executive Summary

The broad definition of PFAS groups around 10,000 chemicals under one description. Within this group there are different categories of risk from different chemicals, and it seems like an over-simplification to treat them all in the same way. We strongly support looking at these chemicals in risk-based assessment, based on structural similarity.

We would also stress that **F-gases** are **already regulated** under the extremely successful **F-Gas Regulation (both in the UK and EU)**, and we believe this provides the **most** suitable framework to control these products, taking into account safety, energy efficiency, environment, and health.

Careful consideration also needs to be given to the impact of a blanket ban of all PFAS on competitiveness and innovation in the UK.

It should also be noted that a ban on all PFAS could have serious implications on the UK Governments published plans to reach Net Zero by 2050.

F-Gases are already regulated under the UK F Gas Regulation

What is the F-Gas Regulation?
The F-Gas regulation was originally developed in the EU and has been carried over into UK law. It is widely recognised as one of the most successful environmental regulations. Many F-Gases have a high

impact on global warming if they leak from systems, and the first F-Gas Regulation introduced in 2006 was successful in stabilising F-Gas emissions – which would otherwise have grown significantly – through control/leakage measures and specific use restrictions. The revised 2014 F-Gas Regulation went further and introduced additional requirements to control emissions and use. This approach has proved to be highly successful in moving the industry away from the higher impact products, towards the use of products with low or zero impact.
In the EU by 2030, it is expected that F-Gas emissions will be reduced by two-thirds compared to 2014 levels on a tonnes of CO_2 equivalent basis. The expected cumulative emission savings are 1.5 Giga tonnes of CO_2-equivalent by 2030 and 5 Giga tonnes by 2050.
The F Gas regulation is currently under review in the UK (and EU) with a view to continuing the good work it has already done.

Can additional restrictions be justified?

- From an environmental perspective, the purpose of the F-Gas Regulation is to prevent F-Gases from being released to the environment and to gradually reduce their consumption through the phase-down mechanism and targeted use restrictions. The Regulation is already highly successful, and it can be further improved during the current review process, for example by mandating re-use (recovery, recycling, and reclamation) provisions to all types of refrigerants, including HFOs and non-fluorinated gases to address the full lifecycle of refrigerants. The industry is already moving to use refrigerants which have a much lower impact on the environment. Additional restrictions of PFASs (including F-Gases) would not be justified given the existing regulations.

- There are a number of non-fluorinated refrigerants, which are alternatives to F-Gases, which for safety and energy efficiency reasons are not suitable for all uses. The phase-down mechanism within the F-Gas Regulation provides the required flexibility to the market to select the best suited refrigerants for a given application from a safety, technical feasibility, efficiency, environmental and cost perspective.

- It is a well-known fact that some F-Gases break down into Trifluoroacetic Acid (TFA) if released into the environment. Besides the fact that the F-Gas Regulation is geared towards preventing the release of F-Gases into the environment, there is scientific evidence from UNEP's Scientific Assessment Panel (SAP) which states that "the current and estimated future concentrations of TFA and its salts resulting from degradation of HCFCs, HFCs, and HFOs do not pose any known significant risk to human or ecosystem health". Other documents covering this issue are available on the EFCTC website at TFA as an atmospheric breakdown product - Fluorocarbons

- Implementability, enforceability and manageability aspects need to be considered. The F-Gas Regulation provides a framework in that respect with a dedicated quota system and enforcement measures within the UK market. The latter can further be strengthened and improved as part of the review process currently under way.

- Introducing additional restrictions for PFAS would risk causing inconsistency with the existing regulatory requirements, add unnecessary administrative burden for those responsible for the monitoring activities and lead to disproportionate cost compared to the avoided risks

- It must be possible to monitor the results of the implementation of the proposed measures establishing a PFAS restriction. Such monitoring may include the follow up of the amounts of substance manufactured and imported, the concentration of the substance in preparations, as

well as the measuring of the relevant emission and/or exposure levels. The F-Gas Regulation already provides the ground for such monitoring and can be further strengthened.

Regulations pertaining to F gases

As well as the UK F Gas regulation, F Gases are already covered by several additional standards and regulations.

EN 378 Safety and Environmental Standard
EN 60335-2-40 Product Standard
EN 60335-2-89 Product Standard
EN ISO 22712 Standard on competence of personnel
DSEAR – Dangerous Substances and Explosives Atmospheres Regulations
PE(S)R – Pressure Equipment Safety Regulations

Restricting F-Gases under REACH could have unintended consequences

Including F-Gases in a broad PFAS restriction proposal could have unintended consequences for the refrigeration, air-conditioning and heat pump (RACHP) sector. In particular, it could negatively impact on the large supply chain that would be inadvertently affected by a such a broad restriction.

A PFAS restriction must be manageable and consider the characteristics of the industry sectors concerned. The RACHP market is a very fragmented market with a large supply chain and downstream users. A study carried out in 2012 by the research firm SKM Enviros, on behalf of the European Partnership for Energy and the Environment (EPEE), demonstrated that the RACHP market can be split into at least 43 sub-sectors, with each of these sub-sectors having different characteristics including the type of technology used, the market size, rates of market growth, life-time expectance, refrigerant type, charge and leakage rates, energy efficiency, capital cost, etc. A broad restriction of F-Gases would not be able to consider these aspects, impacting companies and users across industry.

Taking the example of Commercial Refrigeration demonstrates the variety of applications, even within one market sector. For example, a supermarket operator will have different requirements from a small convenience store owner, the technologies used are different and the type of contractor working on the installation will differ as well. In the case of the convenience store, the systems will not get much attention (it will probably run until there is a failure), and it will be installed by a small or very small installer company (often family owned). In the case of the supermarket, there will be a large central system at the heart of the store's operation. A much bigger installation company will undertake installation, service, and maintenance.

Other sub-sectors will have similar challenges: for example, chillers are used to service critical infrastructure such as data centres and hospitals. In these applications, technologies require the ability to service different operating conditions, system sizes and other site-related criteria such as safety. For these systems, different refrigerants may be used and have different properties. The nature and size of these systems often require or have on-site maintenance personnel, or higher levels of maintenance that help to prevent emissions

Restricting F-Gases would have an impact on safety and socio-economic aspects

F-Gases are essential for the safe operation of RACHP equipment

- F-Gases were originally introduced due to their excellent safety features which made them safer to use as refrigerants compared to the highly flammable, highly toxic, or high-pressure alternatives previously used. While the situation is continuously evolving, there are still safety limitations associated with the use of many non-fluorinated gases.
- Safety during installation, servicing, decommissioning and end of life is covered in the UK by the Dangerous Substances and Explosive Atmospheres Regulation. This means an installation, servicing or waste treatment company has the duty to protect the safety of its employees. Despite necessary precautions, it is impossible to reduce the risks to zero when flammable products are used due to possible human errors. In the case of highly flammable refrigerants such as hydrocarbons, such accidents have serious consequences. F-Gases have been used for decades and due to their characteristics pose a much lower risk compared to hydrocarbon alternatives.

Socio-economic aspects for the RACHP sector

- There are many thousands of companies in the UK that are involved in the RACHP sector. They range from OEMs, gas distributors and wholesalers through to SMEs. There are currently more than 50,000 engineers and over 8500 individual companies certified according to the F-Gas Regulation.
- A REACH restriction on top of the F-Gas Regulation's restrictions and phase down would be disproportionate and could drive out a large number of these companies from the market, leading to major unemployment, less options for end users when it comes to installations and higher overall prices for products and installations. In addition, since very few installers are currently trained for the use of non-fluorinated refrigerants, a PFAS restriction would further exacerbate this effect, adding an increased risk of accidents and additional safety concerns given some of the alternatives available.
- The secondary effects of any PFAS restriction could lead to issues in the supply and storage of food. The list is of course much longer, and the total impact is certainly still completely underestimated.

Risks of inconsistency with European and international law

The proposed broad PFAS restriction could cause inconsistencies with other UK legislation, as well as with international law and the criteria established within the Montreal Protocol and its Kigali Amendment.

The risks of a double regulation

A PFAS restriction as the most extreme measure, if applied to all PFAS including F-Gases, would be disproportionate, because the F-Gas Regulation already establishes F-Gas restrictions and bans. We feel that two pieces of legislation cannot apply to a broad category of substances without causing prejudice to each other and we would call for a more consistent approach.

International commitments within the Kigali Amendment

With the F-Gas Regulation, the EU has pioneered the Kigali Amendment to the Montreal Protocol, which is expected to avoid up to 0.4 °C of global warming by 2100, and further important opportunities exist to push the UK climate agenda.
Ultra-low global warming potential (GWP) fluorinated gases (HFOs) are essential to make this happen. As developing countries are preparing their Kigali HFC phase-down management plans (KPMPs), lower GWP HFCs and HFOs will have a major role to play to achieve the phase-down objectives. Restricting F-Gases in the UK could therefore have an impact on the major climate benefits of the Kigali Amendment to the Montreal Protocol.

Restriction of F-Gases could impact on the UK Governments Net Zero plans.

The UK wants to achieve climate neutrality by 2050. Lower GWP HFCs and HFOs are essential to decarbonise the heating and cooling sector in a safe, reliable, and cost-efficient way. A wide ranging PFAS restriction could jeopardize this important achievement, given that heating and cooling represent half of the final energy consumption in UK.

With over 70% of total GHG emissions in the UK related to energy production and consumption, transitioning to renewable energies, and increasing energy efficiency are crucial to achieve carbon neutrality Heat pumps, whether residential or industrial, in buildings or powering district heating and cooling systems, will have a major role to play, as will thermal storage, waste heat recovery and demand side flexibility.

The carbon emissions saved by moving away from fossil fuels far outweigh any impact from continued use of some F Gases in heat pumps.

Key messages:

- Carbon neutrality can only be achieved with a combination of measures, including the reduction of direct F-Gas emissions via the F-Gas Regulation, improved operation, control and maintenance, improved efficiency of new equipment, reduced cooling demand and decarbonisation of the grid.
- Heating is currently still mainly based on fossil fuels. Heat pumps play a crucial role to decarbonise heating, potentially creating a large “negative emission offset”.
- To ensure the broad deployment of heat pumps, all types of refrigerants will be needed, including lower GWP HFCs and HFOs to provide safe, reliable, and cost-efficient solutions adapted to application and local circumstances.

Alternatives to F Gases

Most F Gases do have alternatives, but **none** that are universally comparable in all of the following criteria:

- Performance
- Energy efficiency
- Toxicity
- Flammability
- Total cost of ownership

The following section elaborates on all these elements as well as outlining some of the known consequences of restricting F-Gases. However, many consequences are not known and there is a substantial possibility of regrettable substitution, as returning to the status quo before the introduction of innovative HFCs and HFOs is also not an option.

Some of the known effects could be:

Environmental
No alternative is at the same time low-GWP, non-toxic and minimally flammable with the same efficacy. Some industry estimates place the number of CO_2 equivalent emissions saved by the switch to low and ultra-low GWP refrigerants at over 120 million tonnes CO_2eq over the last 5 years, which is the same as bringing over 5,000 wind turbines online per year for those 5 years.
The mobile air conditioning product lines that use HFO refrigerants have significant environmental benefits, in line with the UK's climate goals. The UK Build Back Greener Strategy aims to reduce GHG emissions in transport, where a large proportion of total emissions comes from road transport (automobiles), by 76-86% by 2050.

Economic
The investments made by thousands of companies in bringing new, low-GWP alternatives to the markets will be lost. These investments are in the range of hundreds of millions of pounds.

Societal
Jobs as well as overall UK competitiveness is at stake and the UK's legislated target of net zero by 2050 could be jeopardized if the most appropriate technologies are not available for the value chain.

What are the alternatives?

Air conditioning and refrigeration equipment designs vary widely, from very small to very large, as does the amount of refrigerant used in each system. Domestic refrigerators may use only a few hundred grams of refrigerant, whereas large commercial building air conditioning chillers or supermarkets may use thousands of kilograms. Operating temperatures also vary widely from very low for frozen food, medium temperature for fresh food, milder temperatures for comfort cooling, and higher temperatures for heat pumps and industrial heat pumps. These parameters all impact on refrigerant choice, with the goal of selecting a refrigerant with the highest operating efficiency and lowest environmental and health impacts for each application.

To make an appropriate selection, refrigerants are evaluated for their capacity to cool or heat at the desired operating condition, the efficiency at which they operate (how much electrical energy is required for cooling or heating) and their flammability and toxicity to meet applicable standards.

Alternatives have been developed to replace certain HFC refrigerants that have relatively high global warming potential. Some non-fluorinated refrigerants (ammonia, hydrocarbons, carbon dioxide) have found use in air conditioning, refrigeration, and heat pump applications. However, they each have limitations which prevent universal use:

• Ammonia (NH_3) has been used for many years and is used in industrial applications where highly trained workforces can manage its high acute toxicity. However, ammonia use is restricted by applicable standards for residential homes, offices, or supermarkets due to the toxicity risk should a system leak occur. Due to ammonia's hygroscopic nature, it migrates to moist areas of the body, including the eyes, nose, throat, and moist skin and may cause severe burn injuries. Skin and respiratory-related diseases are aggravated by exposure and even fatality at higher concentrations. Furthermore, ammonia vapors are a fire and explosion hazard at concentrations between 16% and 25%. Mixtures involving ammonia contaminated with lubricating oil from the system, however, may have a much broader explosive range.

• Hydrocarbons (for example propane, isobutane) are efficient refrigerants and suitable in very small charge systems such as domestic refrigerators or small commercial refrigerators. However, due to their very high flammability, their use is restricted by applicable standards for larger charge systems. Due to the fire safety risk associated with hydrocarbons, refrigerant charge sizes are significantly restricted by these standards.

• Carbon dioxide (CO_2) is a high capacity, but significantly lower efficiency refrigerant at moderate temperatures such as air conditioning and medium temperature refrigeration. Efficiency is critically important as the climate impact of a refrigerant needs to consider the electricity usage over its lifetime. Carbon dioxide is suitable in systems with low operating temperatures such as frozen food in supermarket cascade systems, where it can operate more efficiently. CO_2 is now widely used in the supermarket refrigeration market.

The phase-down of HFCs under the UK F-Gas regulation is being achieved due to the development and introduction of lower GWP HFCs, HFC/HFO mixtures and HFOs which are required for many air conditioning and refrigeration systems, where the charge size is too large for hydrocarbons or ammonia and higher efficiency than carbon dioxide is needed.
In the past several years a new family of fluorinated refrigerants has been developed called HFOs. HFOs have very low global warming potential (often GWP <1). In the pure form, or blended with HFCs, they provide high efficiency and performance very similar to the refrigerants they replace, and they have low or no flammability. Low or non-flammability allows the necessary larger refrigerant charge sizes to be used safely and non-flammable blends may be suitable for existing equipment designs of for retrofit. The opportunity for retrofit of existing systems can contribute to the HFC phase-down and have immediate environmental impact.

In summary, the different refrigerant options discussed can be classified as follows:
• Non or low flammability: NH_3, HFCs, HFOs, CO_2
• Low toxicity: HCs, HFCs, HFOs, CO_2
• Ultra-low GWP: NH_3, HCs, HFOs and HFO/HFC blends, CO_2
• Mechanical safety: NH_3, HFCs, HFOs

Only HFOs/HFCs meet all the criteria required for safe and energy efficient operation and HFOs and HFCs are necessary to ensure that manufacturers and users have the full range of products to meet the needs of industry to provide safe, efficient solutions with low environmental impact. Using HFOs,

fluorochemical refrigerant suppliers are able to provide effective alternatives to match the performance of the previous generation, high GWP HFCs.