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New Study on PFAS Refrigerants: It Is Worth Taking a Closer Look

A critical assessment by

VDKF – Association of German Refrigeration and Air-Conditioning Contractors
Federal Technical College for Refrigeration and Air-Conditioning Technology
BIV – Federal Guild Association of the German Refrigeration Plant Engineering Trade

A recent study commissioned from Öko-Recherche by Deutsche Umwelthilfe, the European Environmental Bureau and ChemSec examines the quantities of PFAS-containing fluorinated gases that could continue to be used in the future despite the new EU F-gas Regulation. The authors conclude that the F-gas Regulation alone does not adequately address the environmental problems associated with PFAS.

Reduce TFA releases as far as possible

To avoid any misunderstanding from the outset, the following critical assessment of the study does not mean that VDKF, the Federal Technical College and BIV are fundamentally opposed to further restrictions on fluorinated refrigerants. Where technically suitable alternatives are available and can be used safely, where their use is economically viable, and where they do not reduce energy efficiency or increase overall greenhouse gas emissions, refrigerants with the lowest possible environmental impact should always be used.

In particular, releases of trifluoroacetic acid (TFA) into the environment must be reduced as far as possible. In our view, however, a differentiated and comprehensive assessment is essential. Substitution only makes environmental sense if, taking into account safety, energy consumption, direct and indirect emissions, and the entire life cycle of the equipment, it genuinely results in a lower environmental impact. This assessment must be conducted on an application-specific basis and should not be based solely on the chemical classification of a refrigerant.

Not an open-ended study

First, there is a fundamental criticism: according to its own description, the study was designed to provide evidence to further support the case for tighter restrictions on F-gases. This does not constitute an open-ended research question.

What additional environmental effects, technical limitations and socioeconomic consequences would result from imposing a PFAS restriction on fluorinated refrigerants in addition to the F-gas Regulation? This is precisely the question that the study does not answer.

Long-term forecast subject to uncertainty

There is also a methodological limitation acknowledged by the authors themselves. The projections are largely based on studies carried out as part of the evaluation of the previous F-gas Regulation and the impact assessment for the revised legislation.

However, the amended F-gas Regulation (EU) 2024/573 includes additional placing-on-the-market prohibitions and an HFC phase-out that differs from the assumptions made at the time. The study explicitly states that these changes have not been fully incorporated into the projections used.

Mobile air-conditioning is the main factor

The study's central finding initially appears remarkable. Although the climate impact of the F-gases used is falling drastically as a result of the phase-down and prohibitions, approximately 40 kt of PFAS F-gases would continue to be used annually in the EU in the coming years despite the F-gas Regulation, with approximately 24.6 kt still being used in 2050.

An important point is that 20.18 kt, or approximately 82% of the quantity forecast for 2050, is attributable to mobile air-conditioning systems. Passenger cars and light commercial vehicles alone account for 18.05 kt, or approximately 73%.

The quantities of PFAS described in the study are therefore predominantly driven by vehicle air-conditioning, which is regulated only partly by the F-gas Regulation and mainly by the Mobile Air-Conditioning Directive 2006/40/EC.

The picture is different for stationary refrigeration. In this sector, the quantity of PFAS refrigerants is expected to fall from 9.63 kt in 2020 to just 0.85 kt in 2050, representing a reduction of more than 90%. Only 0.33 kt is forecast for each of the commercial refrigeration and industrial refrigeration sectors.

The study therefore documents the extent of the transformation already brought about by the F-gas Regulation and technological change. It also shows that most of the remaining quantity of PFAS F-gases forecast for 2050 will not be attributable to traditional stationary applications, but to mobile air-conditioning. According to the PFAS background document, this sector has been granted 12 years longer than the stationary refrigeration and air-conditioning sector to transition to PFAS-free refrigerants.

Refrigerant demand is not the same as refrigerant emissions

Another critical issue is the metric used. The study primarily considers refrigerant demand in kilotonnes. However, the quantity of a substance used is not the same as the quantity actually released into the environment.

An assessment would need to give greater consideration to leakage rates, maintenance-related emissions, recovery, end-of-life treatment and the actual formation of TFA.

A recent analysis of more than 300,000 stationary refrigeration and air-conditioning systems monitored in Germany through the VDKF industry software VDKF-LEC shows an average annual leakage rate of only 1.00%. Refrigerant demand should therefore not be equated with actual refrigerant emissions.

For a robust environmental assessment, the quantities actually released and their rate of TFA formation would need to be taken into account.

Absolute and relative shares

According to the study, PFAS-containing fluorinated gases account for 99.8% of the remaining quantity of F-gases forecast for 2050. However, this share is not increasing because greater quantities of PFAS refrigerants are being used.

On the contrary, according to the study, the absolute quantity of PFAS-containing fluorinated gases will fall from approximately 41 kt in 2025 to approximately 25 kt in 2050. Their percentage share increases only because other F-gases, such as R32, decline even more sharply.

The statement that PFAS will “dominate” the remaining market in the future is mathematically correct. However, without considering the simultaneous decline in absolute quantities, it conveys an incomplete or even misleading picture.

New and existing installations must be considered separately

Another essential distinction concerns new and existing installations. The study considers both the initial charging of new installations and the refrigerant required for the maintenance and servicing of existing installations.

For new installations, the choice of a natural or another PFAS-free refrigerant can already be taken into account during the planning and design stages. By contrast, switching refrigerants in existing installations is often technically impossible without replacing essential components or the entire installation.

If the refrigerant originally intended for maintenance and repair were no longer available, this could result in a technically sound and fully operational installation having to be replaced prematurely.

This distinction is particularly important when assessing the economic and environmental consequences of additional PFAS regulation. Costs, resource consumption and environmental impacts should therefore be assessed separately for new and existing installations.

Conclusion

The current EU F-gas Regulation already recognises that HFO refrigerants, despite their low global warming potential, cannot be classified as environmentally friendly. The refrigeration and air-conditioning sector is not fundamentally opposed to the restrictions already introduced on the use of these refrigerants.

However, the considerable imbalance between the restrictions applying to stationary refrigeration and air-conditioning on the one hand, and those applying to mobile air-conditioning on the other, raises significant doubts about the true environmental policy objective of the underlying study.

The study shows that PFAS-containing refrigerants will not disappear entirely despite the F-gas Regulation. However, it does not demonstrate that this creates an equal need for additional regulation across all applications.

For the “refrigeration” application area, the study forecasts a reduction of approximately 91%. A sound assessment should therefore clearly distinguish between mobile and stationary applications. In addition to the quantities used, it should consider actual emissions, TFA releases, safety, energy efficiency, technical substitutability and the situation of existing installations.

Such a differentiated approach is likely to be more effective than a blanket assessment of all refrigeration, air-conditioning and heat-pump applications.

Contact

Christoph Brauneis
Tel.: 01520 2006037
Email: christoph.brauneis@vdkf.de

VDKF – Association of German Refrigeration and Air-Conditioning Contractors, Lobby Register No. R000401

BIV – Federal Guild Association of the German Refrigeration Plant Engineering Trade, Lobby Register No. R002460
Federal Technical College for Refrigeration and Air-Conditioning Technology

www.vdkf.de

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