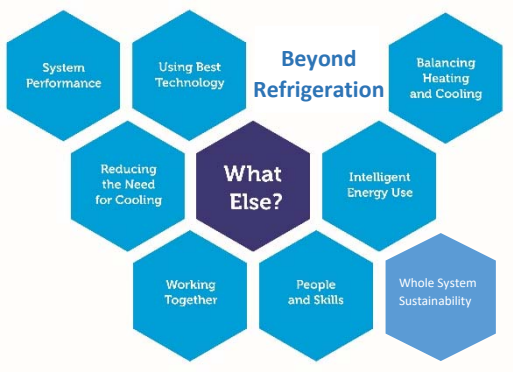
Net Zero Beyond Refrigeration
Selection of Refrigerant - Policy Brief 3

"Strategies to support users of refrigeration, air conditioning and heat pump technologies to achieve carbon reduction through effective policy implementation, financial incentives, and emissions monitoring."



Our objective is to provide policy makers with

- expert advice from Institute of Refrigeration professionals on effective solutions to aid the move to net zero
- the information needed to ensure that policy decisions take into account the interrelation of heating and cooling needs
- realistic and achievable opportunities, solutions, targets and goals for users in this sector
- the necessary depth of understanding of total life cycle and sustainable operation
- advice for non-technical specialists responsible for high level net zero strategies within BEIS and DEFRA / DFE and devolved nations.

Policy Brief 3 – Selection of Refrigerant

The IOR Environment Working Group has identified a number of key areas for supporting the path to net zero (www.ior.org.uk/beyondrefrigeration). However, underlying any cooling and many heat pump operations is a vapour compression system that uses a refrigerant as a working fluid. Equipment owners, operators and advisors are making purchasing decisions that influence the selection of refrigerant and equipment being installed now and in use well into the future. To support net zero targets the IOR recommends that equipment designers, purchasers, owners and operators implement a policy that requires the selection of a refrigerant with the lowest GWP possible.

With the on-going phase down and quota restrictions on HFC refrigerants having the greatest impact on the availability of higher GWP refrigerants as well as certain use bans under national regulations, there are very good commercial and environmental reasons for moving to low GWP refrigerants.

The IOR Guidance Note 37 "Refrigerant Selection" available from www.ior.org.uk gives a more complete explanation of all the criteria that should be adopted in selecting the most appropriate refrigerant for the application.

Note: a future policy brief will cover whole system sustainability and take into account embodied carbon, breakdown of chemicals, the circular economy etc. However these issues should also be taken into account when selecting a suitable refrigerant.

International policy frameworks

Selection of refrigerant has been continually debated since the commercialisation of refrigeration technology. Recent amendments to the Montreal Protocol (particularly the Kigali Amendment, which seeks to phase down the production and consumption of hydrofluorocarbons HFCs), the issuance of EU and UK ozone and F-gas Regulations, as well as the wider discussion over "net zero", encourages the selection of low GWP refrigerants. However, many of the low GWP options have additional safety and/or cost implications associated with them, and therefore selection of refrigerant is not usually straightforward.

Refrigerant selection must be approached through several steps, considering environmental and legal obligations, safety requirements, efficiency, material compatibility and availability of components, availability of competent technicians and the refrigerant itself.

1. Selecting the Refrigerant with the Lowest Possible GWP

	Current measures	Policy mechanisms
Policies are needed to ensure owners of cooling equipment are required to select the refrigerant with the lowest possible GWP	✓ It is often possible to use a refrigerant with a GWP of 10 or less (i.e., carbon dioxide, ammonia, hydrocarbon or HFO), but this may not always be practical. ✓ The IOR recommends that systems and equipment should only be installed using refrigerants with a GWP over 300 where a low GWP option with equal or better efficiency is not available. ✓ Systems using "medium" or "high" GWP refrigerants should not be purchased or installed unless there is no lower GWP alternative for the application. (See references below for definition of low, medium and high) ✓ Where equipment using a refrigerant with a GWP greater than 300 is currently in use, a plan should be in place to replace the system at end of life with a lower GWP refrigerant wherever possible	✓ Review of the F Gas Regulations ✓ BREEAM to be updated with more stringent requirements

2. Environmental and Legal obligations

	Current measures	Policy mechanisms
Ensure compliance with national legislation which restricts the use of certain refrigerants in certain applications	✓ Legislation prohibits certain refrigerants for particular equipment and applications. ✓ The Ozone-Depleting Substances Regulation prohibits substances with a significant ozone depleting potential, such as CFCs, HCFCs and others. ✓ Under the Fluorinated Greenhouse Gases Regulations 2019 HFCs with a GWP above certain thresholds are prohibited from various types of equipment.	✓ Review of the F Gas Regulations ✓ Property Energy Efficiency Rating Scheme

3. Safety Measures

	Current measures	Policy mechanisms
Various Regulations may influence selection of refrigerant for certain applications addressing safety, pressure, flammability, toxicity and other risks	✓ Safety Regulations, such as Pressure Equipment Safety Regulations 2016, Supply of Machinery (Safety) Regulations 2008 and Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016. In general, such regulations do not prohibit the use of any substances that may be used as refrigerants, but systems using refrigerants with higher operating pressures, higher toxicity or flammability can become more expensive due to enhanced safety and risk assessment requirements. ✓ Safety standards (such as EN 378, EN 60335-2-40, EN 60335-2-89) and Regulations such as ADR tend to be more prescriptive and can disallow certain refrigerants being used for particular installations. However, safety standards are not mandatory provided alternative means can be used to satisfy the requirements of the safety regulations.	✓ Introduction of mandatory refrigeration related safety legislation (as in Germany) ✓ HSE/DEFRA to prepare specific recommendations for safe use of lower flammability refrigerants for key applications to build customer confidence ✓ ADR (vehicles and transport) not to be restrictive.

4. Refrigerant Availability

	Current Policy Mechanisms	Possible policy mechanisms
With the phase down and quota restrictions imposed by the F gas Regulation/Kigali, certain high GWP refrigerants will have limited availability in the future.	✓ F Gas Regulation quota restrictions based on GWP values are driving the use of lower GWP refrigerants	✓ Incentivise replacement or use of lower GWP refrigerants ✓ Recycle and reuse incentives such as "take back" schemes

5. Technician Competence

	Current Policy Mechanisms	Possible policy mechanisms
Given the wide variety of refrigerant' characteristics, technicians are struggling with competency required to work on all refrigerants in any type of equipment	✓ There is no mandatory training for refrigerant handling other than for HFC "F-Gases". ✓ Voluntary registration schemes exist such as ACRIB Skillcard which identify competence in different refrigerant handling and require regular updating ✓ Voluntary CPD training is available to national standards	✓ F Gas Regulations to mandate training for all greenhouse gases (i.e. hydrocarbons, HFOs, carbon dioxide) ✓ A mandatory national registration scheme is required so that equipment users and purchasers can be certain of the competence of technicians ✓ Building Safety Regulation competency requirements

6. Materials and Component Compatibility

	Current Policy Mechanisms	Possible policy mechanisms
Components and materials must be selected to be compatible with the refrigerant in use	✓ Materials such as oils, elastomers, plastics, etc. must be compatible with the refrigerant used in the system. Compatibility can refer to chemical stability (absence of strong chemical reactions), miscibility and solubility with oils and structural stability (minimal changes in properties due to adsorption). These are usually considered at screening stages before commercialisation of the refrigerant. ✓ System components should be suited to the refrigerant used. Some components may be unavailable for certain refrigerants and particular types of systems. This may be related to legal and safety requirements. Using refrigerants with components that are not approved for their use can lead to system failure, invalidating warranties and against legal requirements.	✓ Manufacturing standards to take into account compatibility with low refrigerants ✓ Waste Electrical and Electronic Equipment

References

- IOR Guidance Note 37 on Selection of Refrigerant www.ior.org.uk gives a more complete explanation of all the criteria that should be adopted in selecting the most appropriate refrigerant for the application.
- UNEP Kigali Amendment (https://ozone.unep.org/kigali-amendment-implementation-begins)
- The "low GWP" classification is included in the UNEP RTOC reports. GWP values above 300 are classed as "medium" or "high" in the RTOC classification. https://ozone.unep.org/sites/default/files/2019-04/RTOC-assessment-report-2018_0.pdf
- IPCC 4thAssessment Report AR4 https://www.ipcc.ch/assessment-report/ar4/
- BS EN 378-1:2016+A1:2020 https://shop.bsigroup.com/products/refrigerating-systems-and-heat-pumps-safety-and-environmental-requirements-basic-requirements-definitions-classification-and-selection-criteria-1
- EU F-gas revision (https://f-gas-regulation-review-2022.eu/)
- Cold Chain Federation https://www.coldchainfederation.org.uk/future-of-transport / Target 1: No transport refrigeration units (TRUs) to be sold into the UK market containing refrigerants with a GWP of more than 300 by 2025. Target 2: No transport refrigeration units (TRUs) operating on UK roads should use refrigerants with a GWP of more than 300 by 2035 (in line with the Kigali amendment of the Montreal protocol).

Further policy briefs are planned, and this document will be updated as necessary

Check www.ior.org.uk/beyondrefrigeration for updates

Beyond Refrigeration - Background and Scope

- The Institute of Refrigeration (IOR) is the specialist professional engineering charity body for expert individuals working in this sector. It has a global reputation for independent technical advice and innovation. Its members provide services to users of cooling and heating services including manufacturing, supply, installation, service and maintenance, consultancy, and inspections
- Refrigeration, Air Conditioning and Heat Pump (RACHP) technologies are used to provide essential services in food production, distribution, storage and retail, industrial cooling processes in manufacturing, the climate control in

spaces, such as datacentres, IT rooms, offices, shops, leisure facilities and hospitality, as well as pharmaceutical and healthcare facilities, amongst others.

- Heating and cooling in the UK are estimated to account for 10Mt CO2e direct emissions from refrigerant use and 87Mt emissions from energy use to heat buildings.
- The sector is estimated to contribute to the UK economy through employment of around 70,000 people directly in manufacturing and service roles. It is estimated that the direct impact of cooling on the UK economy is £43Bn.

IOR Beyond Refrigeration Critical Issues and Ambitions

1. *Reducing the Need for Mechanical Cooling and Heating*

Our ambition is that policy should support businesses to consider mechanical refrigeration technology as a last resort instead of relying on "business and usual" purchasing and specification practices. This will mean the need to incentivise widespread adoption of net zero alternatives to mechanical cooling.

2. *Achieving Best System Performance*

Our ambition is that purchasers of new equipment and users of existing equipment should be supported to achieve the greatest possible reduction in energy demand and ongoing use, without compromising reliability.

3. *Balancing Heating and Cooling*

Our ambition is that policy will support the use of opportunities currently available to maximise heat recovery, sharing and storage across different business activities using heating and cooling.

4. *Making Use of Best Available Technology*

Our ambition is that the whole sector will rapidly adopt the best available, closest to net zero heating and cooling options as dominant technologies.

5. *Use Energy Intelligently*

Our ambition is for 100% renewable energy and zero carbon energy systems providing maximised efficiency, flexibility, and support grid stability.

6. *Developing the Best People and Skills*

Our ambition is that everyone involved in cooling and heating systems purchasing, maintenance or operation, has adequate technical understanding and responsibility for championing net zero.

7. *What else? Whole System Sustainability*

Our ambition is that everyone involved in cooling and heating systems purchasing, maintenance or operation has adequate technical understanding and responsibility for championing net zero.