Interview

# F-Gas phase-out: Europe as role model for the USA

In Europe, the F-Gas Regulation sets out a controlled phase down of F-Gas refrigerants up to 2030. This is a substantial undertaking that is being monitored closely in the USA. Monika Witt, eurammon Chairwoman, and Dave Rule, President of the International Institute of Ammonia Refrigeration (IIAR), report on the situation in their regions and reveal new trends in sustainable refrigeration.

**1. Europe and the USA: who has the better approach for the F-Gas phase-out?**

**Dave Rule (IIAR):** Although the programmes differ in the USA and Europe, the goals are the same. President Obama has indicated that the USA will basically be following the path taken by the EU. One difference is that in addition to statutory legislation, the economic factor plays a great role in the USA and has an extreme effect in triggering the development of new, economically attractive technologies. The USA have signed the Montreal Protocol and are thus obligated to proceed with the phase out of HCFC refrigerants with R-22 being the main one of interest. This is the one that is requiring lots of transition in the US now, and where the decreased supply will drive up costs forcing an industry change. The U.S. is also moving to include F-Gases (HFCs) in the Montreal Protocol and is working with other countries towards this goal to follow Europe's lead. These actions are sending signals to U.S. industry that restrictions on HFCs are likely in the future.

**Monika Witt (eurammon):** In Europe, the phase-out is in full swing, with natural refrigerants already providing economically appropriate alternatives for all applications. It therefore makes logical sense for other countries and companies to follow suit. Once natural refrigerants become established in the USA for a range of different applications and this changeover has proven its economic adequacy, it is conceivable that the USA may even catch up or overtake Europe, given the huge impact of the economic component over there.

**2. Research activities over the last ten years have focused on energy efficiency and sustainability. Where does the journey go from here? What about smart grids? What contribution can the refrigeration industry make here?**

**Monika Witt (eurammon):** Regarding energy efficiency Europe has already done a lot in recent years. Considerable work has gone into optimising equipment and components. Controlling the systems as efficient as possible, particularly at part load, will become more important in the future. The key question at the moment is how to make power grid coordination and control as intelligent as possible, and how to bring about efficient storage of alternative energy fed into the system in the interests of constant availability. One example is that when feeding solar and wind energy into the power grid, there are times when there is more power available than the customers need. In stormy or very sunny weather companies with cold storage facilities can use this excess capacity to operate compressors and reduce temperatures where possible. A win-win situation for the electric utility and the company: On the one hand the power grid is relieved and on the other hand cold storage companies get electricity at special rates. Another important point is that smart grids increasingly bring together companies generating refrigeration and those needing heat. In practice, this refers to district heating companies or vegetable producers who settle in the neighbourhood of a refrigeration producing company, where they can put the unused waste heat to good use for their own purposes.

**Dave Rule (IIAR):** Smart grids are also starting to play a significant role in the USA. However, over and beyond this there is still an enormous need to catch up when it comes to energy efficiency. Applications with natural refrigerants for refrigeration and air-conditioning systems have a special role to play here. Ammonia for example is the most efficient refrigerant of all. Combined with new building designs, this results in vast potential for saving energy. The trend for cold storage warehouses in the USA is moving away from the former flat, often rambling buildings to much higher structures that are tightly packed with greatly improved insulation. Many have computerised access and delivery systems that often operate without human intervention. This saves space and prevents the building from heating up unnecessarily.

**3. The situation and market in the USA differ from the framework conditions in Europe. What do you hope to gain from international exchange between the associations?**

**Dave Rule (IIAR):** Primarily we're looking at sharing know-how between the individual regions, with direct information about trends and developments emerging in the industry throughout the various economic areas. Another aspect is possibly even more important in our joint global commitment to natural refrigerants, and that is to support the implementation of safety standards in other regions where training and qualification is given less priority than in Europe. The IIAR is highly committed in this respect and provides extensive training materials and a full range of ANSI approved Standards developed to improve building codes and ensure ammonia systems are designed, installed and operated safely.

**Monika Witt (eurammon):** Our joint central task is to ensure the safe operation in the long term of all systems that run on natural refrigerants. The most important message that we as a global network can convey with particular efficiency is that ammonia refrigeration systems are safe when built and operated according to the prevailing standards.

**Appendix**

**Hydrocarbons**

Refrigeration plants using hydrocarbons like propane (R290, C3H8), propene (R1270, C3H6) or iso-butane (R600a, C4H10) have been in operation all over the world for many years. Hydrocarbons are colourless and nearly odourless gases that liquefy under pressure, and have neither ozone depletion potential (ODP = 0) nor significant direct global warming potential (GWP < 3). Thanks to their outstanding thermodynamic characteristics, hydrocarbons make particularly energy efficient refrigerants. Hydrocarbons are flammable; however, with current safety regulations, refrigerant losses are near zero. Hydrocarbons are available cheaply all over the world; thanks to their ideal refrigerant characteristics, they are commonly used in small plants with low refrigerant charges.

**Ammonia ($NH_3$)**

Ammonia has been successfully used as a refrigerant in industrial refrigeration plants for over 130 years. It is a colourless gas, liquefies under pressure, and has a pungent odour. Ammonia has no ozone depletion potential (ODP = 0) and no direct global warming potential (GWP = 0). Thanks to its high energy efficiency, its contribution to the indirect global warming potential is also low. Ammonia is flammable and is toxic to skin and mucous membranes. However, its ignition energy is 50 times higher than that of natural gas and ammonia will not burn without a supporting flame. Due to the high affinity of ammonia for atmospheric humidity it is rated as “hardly flammable”. Ammonia is toxic, but has a characteristic, sharp smell which gives a warning below concentrations of 3 mg/m$^3$ ammonia in the air. This means that ammonia is evident at levels far below those which endanger health. Furthermore, ammonia is lighter than air and therefore rises quickly.

**Carbon dioxide ($CO_2$)**

Carbon dioxide has a long history in refrigeration, extending back to the mid-19th century. It is a colourless gas that liquefies under pressure, with a slight sour odour and taste. Carbon dioxide has no ozone depletion potential (ODP = 0) and negligible direct global warming potential (GWP = 1) when used as a refrigerant in closed cycles. It is non-flammable, chemically inert and heavier than air. Carbon dioxide is narcotic and harmful to human health at moderate high concentrations. Because carbon dioxide has a lower critical temperature than other refrigerants, recent research has focused particularly on optimizing system design, and more and more effective refrigeration plants are being developed to close this gap. Carbon dioxide is available in abundance, and there is no need for recycling or waste disposal.

**Ozone Depletion and Global Warming Potential of Refrigerants**

| | Ozone Depletion Potential (ODP) | Global Warming Potential (GWP) |
|---|---|---|
| Ammonia (NH3) | 0 | 0 |
| Carbon dioxide (CO2) | 0 | 1 |
| Hydrocarbons (Propane C3H8, Propene C3H6, Iso-Butane C4H10) | 0 | <3 |
| Water (H2O) | 0 | 0 |
| Chlorofluoro-hydrocarbons (CFCs) | 1 | 4680–10720 |
| Partially halogenated chlorofluorocarbons (HCFCs) | 0.02–0.06 | 76–12.100 |
| Per-fluorocarbons (PFCs) | 0 | 5820–12010 |
| Partially halogenated fluorinated carbons (HFCs) | 0 | 122–14310 |

**Ozone Depletion Potential (ODP)**

The ozone layer is damaged by the catalytic action of chlorine and bromine in compounds, which reduce ozone to oxygen when exposed to UV light at low temperatures. The Ozone Depletion Potential (ODP) of a compound is shown as an R11 equivalent (ODP of R11 = 1).

**Global Warming Potential (GWP)**

The greenhouse effect arises from the capacity of materials in the atmosphere to reflect the heat emitted by the Earth back onto the Earth. The direct Global Warming Potential (GWP) of a compound is shown as a CO2 equivalent (GWP of a CO2 molecule = 1).

**About eurammon**

eurammon is a joint initiative of companies, institutions and individuals who advocate an increased use of natural refrigerants. As a knowledge pool for the use of natural refrigerants in refrigeration engineering, the initiative sees as its mandate the creation of a platform for information sharing and the promotion of public awareness and acceptance of natural refrigerants. The objective is to promote the use of natural refrigerants in the interest of a healthy environment, and thereby encourage a sustainable approach in refrigeration engineering. eurammon provides comprehensive information about all aspects of natural refrigerants to experts, politicians and the public at large. It serves as a qualified contact for anyone interested in the subject. Users and designers of refrigeration projects can turn to eurammon for specific project experience and extensive information, as well as for advice on all matters of planning, licensing and operating refrigeration plants. The initiative was set up in 1996 and is open to companies and institutions with a vested interest in natural refrigerants, as well as to individuals e.g. scientists and researchers.
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