European Partnership for Energy and the Environment

SHORT PAPER ON
THE BENEFITS OF HFC REFRIGERANTS

What are HFCs

The fluorinated industrial gases fall into three groups; Hydrofluorocarbons (HFCs), Perfluorinated Carbons (PFCs) and Sulphur Hexafluoride (SF6). They are widely used in everyday applications such as refrigerators, air conditioning systems, thermal insulation and medical sprays. The fluorine constituent gives them distinct environmental and safety benefits. (non-ozone depleting, low toxicity and low flammability) for everyday use.

However, their high Global Warming Potential (GWP) has raised environmental concerns and these three groups were therefore included in the basket of six greenhouse gases identified in the Kyoto Protocol, together with carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O).

The members of the Hydrofluorocarbon (HFC) family in use today are non-flammable, energy efficient, recyclable and have a very low toxicity. HFCs are used as a replacement for ozone depleting substances such as CFCs and HCFCs. They do not deplete the ozone layer because they contain no chlorine.

Where are HFCs used?

They are used in domestic and commercial refrigeration where refrigeration plays a vital role in the food chain - in the food retailing , food transport both long distance containers, and local delivery and cold storage. Another major use is air conditioning including automotive and many other vital applications e.g. hospitals. They are also used in the semiconductor industry, electrical grid operators, the fire fighting industry, the health care sector, magnesium smelters, aerosols and the building construction sector.

Energy efficiency

Carbon Dioxide (CO2) is by far the largest contributor to greenhouse gas emissions arising from man's activities. Direct emissions of HFCs are tiny by comparison. Therefore the impact on climate of any HFC technology must be considered in terms of the "direct" emissions of greenhouse gases and the "indirect" emissions from the generation of energy used over the expected life of the product. The indirect emissions are usually far more significant than direct emissions (except in locations where electricity is generated from hydropower, nuclear, wind or solar).

So when an application is made more energy efficient, less energy is consumed and thus less CO2 is emitted. HFCs are superior refrigerant with favorable thermodynamic properties so that, on an equivalent safety and cost basis, HFC-based technologies provide superior energy efficiency efficiencies than any other alternatives.

Direct Emissions

Steps have been taken by the refrigeration and air conditioning industries to reduce leakages. New safety standards such as EN378 insist on annual surveys of equipment above a certain size, and it is no longer permissible deliberately release any HFC material into the atmosphere.

HFCs vs flammable refrigerants

New design of components, use of benign secondary refrigerants in occupied areas together with the introduction of requisite safety features can help to manage the safety concerns introduced by flammable

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refrigerants. However, in many cases, the addition of the safety considerations compromises operating efficiencies, and hence greenhouse gas emission.

Furthermore, the need to manage the inherent safety risks associated with hydrocarbons and ammonia also increases equipment costs (about 30%).

HFCs are inherently safe in use. Non-toxic and nonflammable HFCs allow simpler design and therefore lower costs. This is a strong motivator as HFC equipment provides for needs in the home, in public buildings, transportation, etc where there is significant exposure to people. While other flammable alternatives can have systems that provide adequate safeguards for use, the potential still is present for serious incidents with respect to maintenance practices.

Ozone depletion
ODP of HFCs is zero so they don't contribute to ozone depletion.

Life cycle
Life cycle metrics such as Life Cycle Climate Performance (LCCP) or Total Equivalent Warming Impact (TEWI) are found to best quantify overall climate
change impact of various options. HFC-based technologies emerge as best choices in many applications

Atmospheric persistence
HFCs have the attribute of relatively short atmospheric lifetime compared with CFCs they replace or with CO2.CO2 produced in the generation of electricity persists in the atmosphere for centuries, while HFCs when emitted persist only for 7-15 years.

Side impacts
Developing countries are still very dependent on CFCs which are known to be damaging to the ozone layer, as well as having a much higher global warming index than HFCs. There is now a gradually occurring shift to HFCs. It is imperative that these countries do not receive a signal that HFCs are not viable which would justify their continued use of the ozone-depleting CFCs.

Responsible use of HFCs
HFCs have unique properties that make them attractive for a variety of applications. However, there is a justified concern that such uses might proliferate to the extent that HFC emissions will grow rather than level out. This is particularly true as refrigeration and air conditioning becomes widely used in more countries. For this reason it is important that HFCs are only applied where their use is justified, and where direct emissions can be properly controlled. Use of flammable and or toxic refrigerants having very low global warming impact may be an option for industrial systems, and very small charge systems, where, by replacing CFCs they have a positive effect in emission reduction. Likewise, the phase out of HFC car air conditioners under the F-Gas Directive, which are prone to leakage, should stimulate the development of Carbon Dioxide as a refrigerant. If it is possible to apply this refrigerant in an energy efficient and commercially viable way in some applications in the future, this could offset HFC growth in other areas.

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