



INTERNATIONAL INSTITUTE OF REFRIGERATION

Intergovernmental organisation for the development of refrigeration

177, boulevard Malesherbes, F-75017 Paris, France

Tél. 33-(0)1 42 27 32 35 - Fax 33-(0)1 47 63 17 98 - E-mail: iifiir@iifiir.org - Web www.iifiir.org

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Didier Coulomb

1. The environmental challenge

Refrigeration is at the heart of two major threats to the environment: ozone depletion and global warming. These causes of concern have led to two different protocols, the Montreal and Kyoto protocols, and both should be treated with greater international coordination; both are related, and what is done to alleviate one has repercussions on the other, for better or for worse.

Most refrigerating systems use vapour-compression technology which is likely to remain the dominating trend in the near future. These systems use refrigerants, some of which have a negative effect on the atmosphere if the equipment is not sufficiently tight or if the refrigerants are not properly recovered especially when disposal of the equipment takes place:

- CFCs and, to a certain extent, HCFCs, contribute to depletion of stratospheric ozone;
- CFCs, HCFCs and HFCs are potent greenhouse gases which cause global warming. However, their global warming potential can be very different, refrigerant by refrigerant.

The “natural” refrigerants (air, water, ammonia, CO₂, hydrocarbons) do not have a significant direct impact on the environment. They have no impact on the ozone layer and no impact (air, water, ammonia) or a very low impact (CO₂, hydrocarbons) on global warming.

Refrigeration technologies are very energy-consuming, thus indirectly contributing to the emission of large amounts of CO₂. When including air conditioning, they account for about 15% of worldwide electricity use. Energy efficiency, which varies according to the units and refrigerants used, is therefore an essential element to take into consideration.

Electricity is mostly produced with fossil fuels, with the exception of certain countries and energy consumption globally represents about 80% of the total global warming impact of refrigeration plants.

Following the Montreal Protocol in 1987 on the protection of the ozone layer, new HFC refrigerants have been developed in order to replace CFCs and HCFCs which are ozone-depleting substances.

CFCs are more potent greenhouse gases than HCFCs and HFCs. Their removal in industrialized countries and now in developing countries thus had and will continue to have positive effects in the reduction of global warming too.

2. The current situation

The ozone-layer is now stabilized. New measures will enter into force following the Montreal Protocol: The use of CFCs has decreased a great deal and is to be completely phased out by 2010. However, it certainly needs more controls in order to prevent illegal trading in CFCs and to recover the old refrigerants: CFC banks are still important. The use of HCFCs in order to replace CFCs has increased a lot in developing countries. HFCs have already partially replaced CFCs and HCFCs in most developed countries and HCFCs will probably be banned in developed countries before 2020 (and even before in Europe). The date of the official ban for HCFCs is 2030 for developed countries and 2040 for developing countries.

The ozone layer should recover between 2050 and 2065. But even if the result is quite satisfactory, more and more countries (and also non-governmental organizations) want to implement stricter measures.

The challenge of global warming is ahead of us. Several general objectives have been set up, especially in Europe, in order to meet obligations related to the Kyoto Protocol. But their impact is essentially in industry (quotas of CO₂ emissions). The building and the transport sectors do not really have restrictions now. However, nobody now denies the huge impact of global warming on human life. A lot of new measures will be soon implemented, especially in Europe; the European Commission for example wants to reduce the emissions by 20-30% by 2020 and 60-75% by 2050.

How can this be done?

Certainly, a reduction of the energy consumption of buildings, cars, trucks ... is necessary and will have an indirect impact on the energy consumption of refrigeration units which are parts of them.

But there could also be pressure to reduce the emissions of greenhouse gases other than CO₂, and particularly refrigerants, even if their quantity (in equivalent CO₂ emissions) is much less important than CO₂ emissions: This is certainly easier to achieve than to change people's lifestyles. And the refrigeration industry has already proved its ability to do this (cf. the success of the Montreal Protocol and consequently the positive impact on global warming thanks to the phase out of CFCs). This could be the price of success.

Several countries in Europe have already decided to ban certain refrigerants. The IIR has always preferred an approach which could lead to more innovative initiatives, with more responsibilities for companies, such as the F-gas regulation. It is largely because of such an approach that chemical companies recently proposed new HFCs with little global warming potential, which can be accepted according to the new European Directive (F-gas) in mobile air conditioning. There will be competition with the CO₂ solution. But competition is a very good way of obtaining the most efficient solutions.

3. Recommendations

- Increasing research into refrigerants, in particular natural refrigerants and development of novel environmentally-friendly refrigeration technologies.

Even if progress has been made in new chemical refrigerants with low global warming potentials, it is certainly necessary to use natural refrigerants in a broader range of applications, with a view to obtaining energy efficiencies equal to or better than these obtained with fluorocarbons. The IIR thus organizes scientific and technical conferences on natural refrigerants (e.g. the Gustav Lorentzen Conferences: the next one will take place in Copenhagen in September 2008); specialized on ammonia (the next one will take place in Ohrid (Former Yugoslavian Republic of Macedonia) in 2009; on secondary refrigerants such as ice slurries; on properties and transfer processes of thermophysical refrigerants (the next one will take place in Boulder, USA, in June 2009), etc..

The IIR publishes books and guides on refrigerants, a Bibliography on CO₂ (2006), Ammonia as a Refrigerant (end of 2007), and articles in its journals (*International Journal of Refrigeration*, *e-Bulletin*).

- the IIR also encourages the development of innovative environmentally friendly refrigeration technologies. It holds conferences on magnetic refrigeration and will soon publish an Informatory Note on this promising technology, which is already available for low temperatures. Solar-powered units can also be an economical and practical solution in warm countries (including Italy!).

- reducing refrigerant emissions thanks to better containment, reinforcing the monitoring of tightness, developing systems using less fluids (refrigerant charge reduction).

An important issue is the recovery and recycling, regeneration or destruction of refrigerants during the disposal of refrigerating equipment, which should be systematically implemented. In this area, there is an ongoing need for training and certification of all practitioners handling refrigerants. The recent European F-gas regulation is a positive step in this direction but much still remains to be done, notably in developing countries.

- reducing the energy consumption of the refrigerating units, with a view to bringing the figures down by 30% at least before 2020.

Energy consumption is nevertheless a problem of whole systems: the energy consumption of a building, including both heating and air conditioning; the energy consumption of a car, including above all the performance of the engine We thus also have to promote overall solutions like heat pumps in buildings.

The IIR also holds conferences on energy efficiency, such as HVAC Energy Efficiency Best Practice Conference in Melbourne, Australia, in September 2008 or cosponsors conferences such as the conference of the IEA - Heat Pump Programme (the next one will be in Zurich, Switzerland, in May 2008)... And of course, energy efficiency is a key topic of each IIR conference.

The IIR also publishes Informatory Notes and Guides. It will publish a Guide on Energy Savings before the end of 2007.

Conclusion

Climate change needs technical changes in the refrigeration area. But climate change is an issue which cannot be simply divided into various problems with solutions for each problem.

We need an overall approach with several principles:

- global warming and reduction of the ozone layer are not independent issues;
- any solution must take into account both direct and indirect emissions;
- regulations with general targets like the F-gas regulation are better than rapid bans, because they allow more possibilities of innovation and overall solutions.
