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IIR Statement

Global warming: refrigeration-sector challenges

Refrigeration contributes to sustainable development

Refrigeration has applications embracing a huge range of fields we all encounter in our daily lives and therefore plays an essential role in sustainable development.

From social and economic viewpoints, the refrigeration sector's input can be illustrated by a few facts:

- the refrigeration sector employs approximately 2 million people [Ref 1] worldwide and the International Institute of Refrigeration (IIR) estimates annual sales of refrigeration equipment at around 200 billion USD [Ref 1];
- in the food sector, refrigeration contributes to reducing post-harvest losses and supplying safe, wholesome foods to consumers by enabling perishable foods to be preserved at all stages from production to consumption;
- the value of chilled and frozen foodstuffs totals at least 1200 billion USD [Ref 1];
- air conditioning contributes to social and economic development in hot and humid regions; it also provides comfort and efficiency, permits the use of large computers in offices, and maintains healthy conditions in hospitals
- natural gas, an environmentally friendly source of energy, can be transported economically in the form of liquefied natural gas (LNG) by employing refrigeration cryo-technology;
- many other fields require refrigeration technologies: industry (chemicals, agri-food...), heating (heat pumps), health (vaccine storage, cryosurgery, superconductivity used in scanners...), biodiversity (cryobiology).

However, there is a wide gap between industrialized and developing countries, particularly in terms of availability of knowledge, technologies and training tools. Bridging this gap is a priority action for the years to come.

From an environmental viewpoint

Industrialized and developing countries' co-operation via the Montreal Protocol enabled the refrigeration industry, over the past 17 years, to phase out CFCs almost completely and to limit the use of HCFCs. Global consumption⁽¹⁾ of CFCs was reduced practically 8-fold between 1986 (1070 ktonnes ODP⁽¹⁾) and 2000 (138 ktonnes ODP⁽¹⁾) [Ref 2] . The refrigeration sector has responsibly contributed to stabilization of the rising chlorine concentration in the stratosphere and to the lowering of this chlorine concentration, observed since late 2000, leading to predictions that the ozone layer will have recovered by 2050.

Given that these two types of refrigerants are also greenhouse gases, the refrigeration sector also contributed to limiting global warming.

HFCs (hydrofluorocarbons) were developed in order to replace CFCs and HCFCs and have been marketed since the early 1990s. They have no ozone-depleting potential; however, they do exert global-warming effects, albeit to a lesser extent than CFCs and HCFCs, and for this reason are included in the substances targeted by the Kyoto Protocol.

Reducing the climate impact of refrigerating plants: a top-priority challenge

The global-warming influence of refrigerating plants ("climate impact") requires in-depth analysis:

- about 20%, on the average, of this impact is due to direct emissions of fluorocarbons (CFCs, HCFCs and HFCs);
- about 80% of this impact results from indirect CO₂ emissions originating in the production of the energy which is used by these plants: generally electricity, but also direct use of fuel in mobile-air-conditioning and refrigerated-transport applications.

In developed countries, approximately 15% of all electricity use is for refrigeration and air conditioning.

Consequently, efforts implemented by refrigeration stakeholders in order to combat global warming need to focus on two facets:

- reduction of direct emissions of fluorocarbons in the atmosphere and use of alternative refrigerants with little or no climate impact;
- reduction of energy consumption; this is an essential facet since the related global warming impact is four times higher than that of direct emissions.

Reduction of emissions/use of alternative refrigerants

Actions implemented in order to reduce direct emissions of greenhouse gases have already begun to exert positive effects; according to the latest report published by IPCC/TEAP [Ref 3], emissions of CFCs, HCFCs and HFCs (expressed as CO₂ equivalents) were reduced 3-fold between 1990 and 2000.

A great deal remains to be achieved, and containment of refrigerants in refrigerating plants is in this respect vital, and needs to be applied to all phases in the life cycle of a refrigerating plant: this criterion is increasingly taken into account during the design, installation, servicing and disposal of refrigerating equipment. Refrigerant recovery and recycling, reclaiming or destruction are now being implemented; however, more incentives and control are needed, and widespread implementation needs to be achieved. In this area there is an ongoing need for training of all practitioners handling refrigerants.

The IIR highlights that the objective in this domain is to halve the impact of emissions by 2020, using the year 2000 as baseline.

Achieving this goal involves improving refrigerant containment but also using refrigerants with the lowest overall impact on global warming. This means:

- the development of alternative refrigerants with zero or low Global Warming Potential: the application fields of refrigerants such as ammonia, hydrocarbons and CO₂ are becoming broader; facilitating wider use of these refrigerants must be an ongoing policy. In the case of ammonia and hydrocarbons, this approach must go hand-in-hand with enhanced user safety.
- the pursuing of use of HFCs, these being safe, but selecting HFCs with the lowest GWPs and those making it possible to develop energy-efficient refrigeration plants. In this respect, refrigeration stakeholders should implement HFC traceability comprising responsible emissions accounting throughout the life cycle of these refrigerants.

Reduction of energy consumption

Reducing energy consumption has been one of the major concerns of designers and manufacturers of refrigerating plants for many years.

Reducing the unitary energy consumption of refrigerating plants by 30-50% — according to applications — by 2020, using the year 2000 as baseline, must be a goal to be achieved.

In order to reach this goal, optimization of traditional vapour-compression systems needs to be pursued, use of high-performance technology should be increased and improvement in the efficiency of components such as compressors and heat exchangers.

Equipment standardization and certification and energy labelling are valuable tools that, if promoted and widely applied, can further reduce energy consumption.

Improving refrigerant containment also reduces energy consumption; equipment operating with a partial lack of refrigerant is inefficient and uses more energy. Proper inspection and maintenance of systems is essential.

The application of the “high-temperature cooling and low-temperature heating” concept in buildings also enables energy consumption to be reduced.

Broader use of refrigerating technologies can save energy in many applications. For instance the use of heat pumps expands the benefits of the refrigeration cycle converting low-grade heat into useful heating energy. Wider use of renewable-energy technologies such as solar refrigeration or technology enabling reduced overall energy consumption, such as trigeneration and energy storage, will also be required.

Promotion of an overall approach to the climate impact

The achieving of these goals requires strong incentives or, if need be, regulations.

This approach would be more effective if it were to take into account indirect emissions of CO₂ as well as direct emissions of refrigerants. A reliable benchmark needs to be implemented in order to enable the overall climate impact to be quantitatively measured for each refrigeration plant.

LCCP (Life Cycle Climate Performance) could serve as the frame of reference in this context: it takes into account both these categories of emissions and also integrates emissions throughout the life cycle — from “cradle to grave” — originating in all components and the chemical constituents of the refrigerating plant. The optimal approach would thus be to favour, on an application-per-application basis, the technical option (system + refrigerant) that would have the least overall impact on global warming, calculated using this frame of reference.

For certain applications, the refrigerant option to adopt would be to give preference to natural refrigerants (ammonia, hydrocarbons, CO₂...) thanks to the negligible climatic direct impact of these refrigerants; in other cases, the HFC option will prove to be better because of the lower global warming impact thanks to limited indirect emissions achieved through higher energy efficiency.

Naturally, other criteria such as user safety, reliability, durability and cost effectiveness should also be taken into account.

The climate-change challenge is crucial because of its impact on future generations. In order to meet this challenge, the IIR considers that the following are top refrigeration-sector priorities:

- the need to analyse objectively and promote those initiatives that induce the least overall emissions of greenhouse gases — direct and indirect — throughout the life cycle (design, manufacture, operation, disposal) of the equipment by using the LCCP concept; within these processes, reducing energy consumption is of utmost importance;
- the need to take into account the influence of the refrigerant, and also the need to improve each system component and to attach great importance to the maintenance of plant components;
- therefore, to actively continue research on the design of refrigerating systems, and for all refrigeration applications, to ensure that technologies are reliable in terms of their impact — particularly on human health — and from an environmental viewpoint;
- enhancement of initial and ongoing training through certification of technicians: this is increasingly necessary, given the fast-paced trends in the refrigeration sector;
- accurate accounting and monitoring of greenhouse-gas emissions;
- the need to bridge the gap between industrialized and developing countries in terms of availability of knowledge, technologies and training tools.

Footnote

⁽¹⁾ Weighted consumption taking into account the Ozone Depleting Potential (ODP) of the CFCs concerned.

References

1. Refrigeration Sector Achievements and Challenges, IIR, 2002
2. Report of the Refrigeration, Air Conditioning and Heat Pumps Technical Options Committee, UNEP, 2002
3. IPCC/TEAP Report: Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons, Summary for Policymakers, 2005

The International Institute of Refrigeration (IIR) is an intergovernmental organization comprising 61 Member Countries representing over 80% of global population.

- The IIR's mission is to promote knowledge and disseminate information on refrigeration technology and all its applications in order to address today's major issues, including food safety, environmental protection and development in the least-developed countries.
- The IIR provides a wide range of services: organization of conferences, congresses, workshops and training courses, a database (Fridoc) containing 75 000 references, numerous publications (journals, manuals, technical books, conference proceedings, informatory notes), and a Web site providing a wide range of information: www.iifiir.org
- The IIR also prepares and publishes reference documents and position statements: these are valuable tools for decision-makers worldwide.

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