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

IIR listing refrigeration research priorities

The International Institute of Refrigeration (IIR) is an intergovernmental organization bringing together 61 countries on all continents, and is a forum for exchange and enhancing of knowledge on refrigeration technology and applications. The IIR's Science and Technology Council comprises 10 commissions spanning all refrigeration spheres:

A1 – Cryophysics, cryoengineering
A2 – Liquefaction and separation of gases
B1 – Thermodynamics and transfer processes
B2 – Refrigerating equipment
C1 – Cryobiology, cryomedicine
C2 – Food science and engineering
D1 – Refrigerated storage
D2 – Refrigerated transport
E1 – Air conditioning
E2 – Heat pumps, energy recovery

Almost 550 specialists in universities, research centres and companies belong to the IIR's worldwide commission network.

The refrigeration sector is today facing two great challenges: health and environment.

The quality of foods, in terms of safety, along with the quantity of foods available, is directly linked to the quality of the preservation process over time. Thus for many foods that are vital to human health, it is the quality of the cold chain that governs safety and availability. Too many foodborne diseases and deaths still occur through non-compliance with the preservation temperatures required.

Refrigeration is also vital to the preservation of products used in healthcare such as vaccines, organs awaiting transplant, etc. and is thus vital technology in medicine and surgery, playing both preventive and healing roles. A great deal of improvement can still be achieved in this field in order to protect human health.

Use of refrigeration is expanding worldwide, in order to address vital needs and to ensure optimal living and working conditions (air conditioning in vehicles, computer rooms…) and also in ultra-high-tech applications such as those used in the space industry, where refrigeration plays a key role. A striking example of expansion: the number of domestic refrigerators has almost doubled in 10 years.

Refrigeration technology consumes large amounts of energy; this consumption accounts for 15% of all electricity consumed worldwide. Refrigeration technology thus contributes indirectly to global warming. Moreover, refrigeration plants use refrigerants that in certain cases exert a very marked greenhouse effect where leakage into the atmosphere occurs. Certain other refrigerants, although used to a decreasing extent thanks to the Montreal Protocol, exert ozone-depleting effects where leakage into the atmosphere takes place.

Thus, refrigeration technology must be improved continually in order to meet the following objectives: greater control and safety, better efficiency and lower energy consumption.

The IIR therefore decided, within the framework of its Strategic Plan, to draw up a list of research priorities for the future. It hopes that these priorities will be a valuable guiding force for decision-makers in the public and private research sectors, and at governmental and corporate levels, in order to fund and promote technology needed to ensure the well-being of humanity and to provide protection for the future. Regrettably the IIR is not in a position to provide research funding itself.

Over a 1-year period, the IIR commissions worked on the definition, separately, then overall, of research priorities making it possible to achieve these objectives. The priorities were initially classified on a per-commission basis, then on a refrigeration-field basis, in order to reflect priorities in each sector.

Priorities were also grouped together in overarching themes, given that many research fields are common to several commissions and would benefit from interaction.

The research priorities are divided into 7 key themes:

1/ Understanding, improvement and optimization of present equipment and systems: although refrigeration technology is in many cases not new, the heat-transfer processes are complex and require better modelling, flow measurement and investigation of interactions. The design of various components used in refrigeration systems can be improved, thus enhancing energy efficiency and reliability.

2/ Performance of new energetic systems: refrigeration can be the source of and benefit from new technologies in the fields of superconductivity, liquefaction of gases, cryogenics, nanotechnologies, etc. Less widely used refrigeration systems such as adsorption-absorption systems are attracting interest in today's context of environmental issues to be addressed. Combined use of widely used and recent technologies can give rise to new approaches to optimisation and must be explored.

3/ Optimization of the whole chain, including connected installations: the cold chain, from harvest to the consumer's plate, forms a single entity. Improving one link in the cold chain is not enough: an overall approach taking into account overall energy consumption and compliance with the temperatures required in order to preserve foods, for instance, is required. A lot of work remains to be done on overall approaches involving control, measurements and monitoring.

4/ Behaviour of refrigerated and frozen live products: in both the medical and food fields, the use of refrigeration must not induce deterioration of the intrinsic quality of the product, even if refrigeration prevents contamination. Biological systems are fragile.
The manner in which cells are frozen must be perfectly mastered in the field of preservation of genetic resources or human and animal tissues. In the case of foods, safety, nutritional value and sensory quality must be maintained.

5/ Performance of refrigerants: beyond the value of previous work, targeted research on the properties of refrigerants with no ozone-depleting potential and little or no global warming potential (CO_2, hydrocarbons…) is now needed in order to encourage their use where the energy efficiency and running costs of the equipment used are competitive.

6/ Improvement of the environment: all of the above-mentioned research can contribute to improvement of the environment, to a small or greater extent. However, specific research focused on improvement of energy efficiency, process and refrigerants, safety, systems enabling waste cold and heat recovery, heat-pump systems, thermal storage, recycling of materials and noise abatement, etc. must be conducted in order to address overall environmental issues.

7/ Finally, new uses of refrigeration: just improving existing refrigerating systems is not enough. We need to take advantage of the extraordinary modifications refrigeration applications can induce in living and non-living material in order to develop new uses in space technology, medical (new surgical techniques…), preservation of genetic resources, in order to address new needs in terms of materials, health and preservation of biodiversity.

A lot remains to be done. The IIR intends to use all means at its disposal (conferences, manuals, courses, Informatory Notes and official statements…) in order to promote the expansion of this research and to publicise the technology derived from it to the greatest extent possible.