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ПРОГРАММА ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО ОКРУЖАЮЩЕЙ СРЕДЕ

Technology Innovations
Potential in Refrigeration and Air Conditioning Industry

By

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Two of the greatest environmental and developmental challenges in the 21st century have been the Protection of the Stratospheric Ozone layer and coping with Climate Change.

The world community set out to face these challenges more than a decade ago. The efforts towards meeting the first challenge, i.e. full recovery of the Ozone Layer, are still continuing. There are strong indications that these efforts have set the world on the successful path. Just prior to the Montreal Protocol no replacement was considered possible for the majority of applications for CFCs, particularly in the sector of refrigeration and air-conditioning. Today, the production and consumption of CFCs is down by 90%, from 1 million tons per annum to only about 80,000 MT annually. Developing countries have already cut their production and consumption by 50% - well before the target date stipulated in the Montreal Protocol.

There are many factors that have contributed to these dramatic results. One of them is surely international cooperation.

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Such cooperation has resulted in the setting-up of the first-ever funding mechanism to grant incremental costs to help developing countries in phasing-out the Ozone Depleting Substances.

This funding mechanism includes the Multilateral Fund that has been working without interruption and without decline for the last 12 years. Nearly US$ 2 billion have been disbursed to 140 developing countries to enable them to comply with the Montreal Protocol. Another US$ 200 million have been allotted by the Global Environmental Facility (GEF) to countries with economies in transition (CEITs) to achieve the targets of the Protocol.

Role of Refrigeration and Air Conditioning Industry:

One industry sector that has undergone an environmentally-friendly transition to implement the Montreal Protocol is Refrigeration and Air-Conditioning (RAC). It is also an industry sector that is fundamentally important for human development and the well-being of society. It is a sector that continuously and profoundly touches our daily life. Preservation of food, medicines, vaccines, comfortable and healthy working conditions and manufacture of many critical and sensitive goods rely on refrigeration. The contribution of this sector to societal development has been remarkable. For example, the near eradication of polio from the world could not have been conceivable without refrigeration to preserve vaccines. Comfort air-conditioning creates environments enabling work to be performed in hot and humid regions. It also maintains suitable conditions for reliable use of essential facilities such as hospital operating theatres and patient rooms. The quality of products manufactured in the sectors of information-technology and biotechnology is increasingly reliant on high-quality indoor environments

The increase in life expectancy around the globe and improvement in food availability would not have been possible without the refrigeration sector. The world produces 1.5 billion tons of perishable food annually. It is impossible to imagine how this food could be prepared, transported and sold to billions of people without refrigeration. Though there is enough food globally, it is not available at the right place and at the right time. In developing countries, only 20% of the perishable food is preserved through refrigeration.

Thus, the losses of perishable food following harvest, slaughter, fishing, milking, transportation and sale are still high. Indications, therefore, of the tremendous opportunities for the growth in RAC sector in next few decades are very obvious.

Refrigeration technology is used in many industrial processes (for instance, in the chemical and agri-food sectors) and in energy (production and distribution of industrial gases thanks to cryogenic processes, superconductivity) and heating (heat pumps) fields. The RAC sector has a large socio-economic dimension: it employs roughly 2 million people worldwide (much more if we take into account those engaged in the ancillary and auxiliary industry). Annual sales of refrigerating, air-conditioning and heat pump equipment are around US$ 200 billion and annual refrigerated foodstuff (chilled and frozen foods) sales total roughly US $ 1. 2 trillion.

The refrigeration industry is setting itself on the path of sustainable development by addressing:

- The social development dimension through increased employment, contributing to the health and well being of society through food, vaccine and medicine preservation, comfort as well as necessary air conditioning.
- The economic development dimension by making value addition to the ever expanding business of equipment and refrigerants supply, improving energy efficiency and reducing losses of refrigerant,
- The environmental dimension by selecting safe options which do not deplete the ozone layer and that do not contribute to climate change.

Experience in Technology Innovation in Refrigeration Industry :

While performing these societal tasks, the RAC industry has been subject to technological change since its inception. In fact we could say that the only element that is constant in the RAC industry is CHANGE! Technological changes that were demanded from the refrigeration sector over the last 20 years under the Montreal Protocol have been excellent examples of the potential of technological innovation in the private sector.

It is interesting that the refrigeration sector saw this "technology forcing" to implement the Montreal Protocol as an opportunity to innovate and as a 'technology-fostering' regime which would be of benefit to industry and society. . I would like to note the tremendous achievements made by the refrigeration industry which demonstrated rapid and frequent technology improvements that continually enhanced efficiencies.

Such technological innovations have even produced many spin-offs. Such was the intellectual and financial investment in R & D by the refrigeration industry that, it is believed that the number of research papers on the properties of refrigerants and their mixtures far exceeded the number of research papers on any other single sector during the peak period of last decade.

Before the Montreal Protocol entered into force, nearly 40% of 1 million tons of CFCs was used annually by the refrigeration industry in early 1980. Had that trend continued, today we would have faced a dilemma. While on one hand, CFC refrigeration would have saved many lives by reaching preserved food to people and helping to prevent malnutrition; on the other hand millions would have suffered due to skin cancer and other adverse impacts due to depletion of the ozone layer. The refrigeration industry should be congratulated that they resolved this dilemma very successfully.

More than any other industrial sector, the RAC industry's power of innovation has illustrated the potential for achieving energy efficiencies. This industrial sector continuously learns from the lessons of the Montreal Protocol and leaps forward. The enterprises involved in this sector have shown a remarkable ability to gainfully adapt to the needs of sustainable development.

The experience in technological innovation under the Montreal Protocol can now be leveraged to implement the Kyoto Protocol. Already, the elimination of CFCs has been considered as the Montreal Protocol's contribution to mitigating climate change. By phasing out CFCs, HCFCs and other ozone depleting substances under the Montreal Protocol, more than 5 billion tons equivalent of carbon dioxide have already been eliminated – representing more than 25% of greenhouse gases emissions of 1990.

Raising the bar for the technology innovations:

Further, elimination of the use of HFCs and HCFCs from refrigeration application - **where feasible** - and the improvement in energy efficiency itself has the potential of substantially reducing the emissions of CO_2. According to one estimate, the refrigeration industry engaged in food processing is estimated to globally consume 15% of the total electricity generated by power. If we consider 50% improvement in energy efficiency by refrigeration – which is achievable - we could sketch a potentially realistic scenario of significantly reducing CO_2 emissions through actions by the refrigeration industry.

Consider some of the recent developments reported by the private sector and research institutes:

- Most of the 80 million domestic refrigerators that get produced annually today in the world use an alternative refrigerant, i.e. HFC 134 a or isobutane. They consume up to 50% less energy than the refrigerators that were produced before 1987.

- Use of waste heat from exhaust and its use in absorption chillers , providing the chilling in two temperature ranges, i.e. one for frozen products and one for chilled food, could increase energy efficiency by more than 50%.

- In Japan, due to the use of vacuum insulators, control of compressor speed, and use of isobutene have resulted into reducing energy consumption by 80% as compared to what it was 10 years back. For 400 liters refrigerators in Japan, the power consumption could be just about 150 kWh/year.

- Sainsbury's UK has cut the energy bill for its more than 450 stores by US$ 7 million annually by improving the energy efficiency of the refrigeration system. Case studies in the UK have shown that supermarkets and food processing plants could cut the energy use by over 30% and emissions of the GHGs by up to 50%.

The advantage in a country like the UK is obvious where the use of energy in supermarkets and food outlets is 5% of the total energy consumption and food processing plants consume 10% of total energy.

In the Commercial Refrigeration sector the energy use subsequent to the replacement of CFCs by HFCs, Ammonia, Hydrocarbons or CO2, has either been stabilized or increased up to 20%. There are opportunities to develop energy efficient commercial refrigeration. The same is true for transport refrigeration. Such opportunities need to be exploited by research and development in the area of improved insulation, compressor frequency control, water cooled condensers, and preventive maintenance to keep the heat exchangers in good conditions.

Surely, the potential of the RAC sector in technology innovation is not yet fully utilized. The RAC industry has done a lot, but more can be done. The use of HFCs and HCFCs is discouraged where other, more environmentally-friendly, safe, and technically and economically feasible alternatives and technologies are available. However in some applications no alternatives have yet been found for the use of HFCs. In such cases, UNEP promotes the responsible use of HFCs and HCFCs - including containment, use of lower charge and effective recovery and recycling procedures to minimize their emissions - to encourage responsible chemical stewardship. UNEP, USEPA and the Alliance for Responsible Atmospheric Policy have created an international initiative for the responsible use of HFCs.

HCFC 22 challenge:

One of the ODS used as a refrigerant, i.e. HCFC 22, has been useful in implementing the Montreal Protocol so far. Elimination of HCFC 22 is one of the remaining challenges under the Montreal Protocol. Let us not forget that HCFC 22 is also a powerful GHG. But the immediate challenge is the increasing consumption of HCFC 22 in developing countries. Ammonia is a leading candidate for the replacement of HCFC 22 in industrial refrigeration. It has great appeal for its thermodynamic efficiency. The ammonia refrigeration industry has a potential role to play in developing reliable ammonia systems in the situation in developing countries based on the success in water cooled chillers increasingly used in developed countries.

Interrelation between Ozone Layer and Climate Change:

189 countries that are Parties to the Montreal Protocol and an equal number of countries that are Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have recently taken the historic decision to work together to explore the inter-relation between climate change and ozone layer protection problems. They have recognized that a solution to one environmental problem should not pose a threat to another. HFCs that have replaced CFCs as part of the implementation of the Montreal Protocol have very high global warming potential. HFCs are one of the six Global Warming Gases whose emissions are to be controlled and reduced as per the targets of the Kyoto Protocol. The experts, agencies, industries and Governments have been requested to develop and share information on policies, technologies and good practices that protect the ozone layer and at the same time mitigate climate change. The Intergovernmental Panel on Climate Change (IPCC) and the Technical and Economic Assessment Panel (TEAP) are working together on a special report on such interlinked issues. The Summary for the Policy Makers of this report was released in April 2005. The full report will be released soon.

Partnership Fosters Innovations:

I would like to emphasize the efforts of industries as well as governments to promote natural refrigerants. In this context I would like to highlight an initiative of three multinationals –Unilever, Coca Cola and McDonalds – promoted by UNEP and Greenpeace. These food and brewery industries earlier approached UNEP with a classical perfect business proposition:

"**Can we just have one solution to the two most critical global environmental challenges facing this world? Can we contribute to the implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer and at the same time contribute to climate change mitigations under the Kyoto Protocol?"**

UNEP considered this as the perfect sustainable development proposition**.**

Over the last couple of years these corporations have developed solutions that use natural refrigerants and are embarking on the corporate decision to convert all their operations away from CFCs and HFCs. This partnership initiative called 'Refrigerants, Naturally', is now enlarging to include other multinationals. It illustrates the far-reaching changes being implemented through sustainable refrigeration practices. It is about energy efficient, HFC-free refrigeration. **"Energy efficient and HFC-free"** means finding one solution to two global environmental problems, i.e. ozone layer depletion and climate change. But it is not only refrigerant and energy efficiency that needs to be looked into. Better maintenance and operation can contribute to a 30% reduction in power use just by simple good practices of door seals, loading the cooler items in the refrigerator and by maintenance. Just to illustrate where it could go, by improving energy efficiency of refrigeration systems by 30% - and it is actionable - the world would save the equivalent of 400 millions of barrels per year.

The refrigerants that would solve two environmental issues in one go are ammonia, carbon dioxide or hydrocarbons. Their use has been growing. However, some of these refrigerants pose user-safety problems, while for others energy-efficiency advantages may vary. The energy efficiency improvement is the clear incentive for business to rapidly adopt the alternatives. However, the choice between HFC, HCFCs and non-HFC refrigerants should be based on the life-cycle analysis of their environmental impact. In a refrigeration plant, about 20% of the global warming impact is due to direct emissions of fluorocarbons and about 80% is derived from carbon dioxide emissions originating in the production of energy used by the plant. Hence it is important that the Life Cycle Climate performance is analyzed to make appropriate decisions.

UNEP would like to encourage a partnership with industries and NGOs to undertake projects and good practices that demonstrate integrated solutions to more than one multilateral environmental agreement. Ammonia, hydrocarbons, carbon dioxide, air and even water are the natural refrigerants that would ensure elimination of GHG emissions. UNEP will continue to encourage, through such partnerships, the use of Life Cycle Climate Performance (LCCP) and Life Cycle Analysis (LCA) as decision-making tools for integrated environmental solutions.

Adapting to natural refrigerants is like going back to the future. It is like exploring the world and then coming back to the starting point to rediscover it with renewed awards. Ammonia refrigeration, if used safely, and with higher energy efficiency, not only helps in eliminating the direct emission of GHGs, but also indirect emissions of CO2 due to reduced energy consumption. The ammonia-refrigeration industry needs further work to make the systems more reliable and efficient as a matter of priority. The health benefits due to improving energy efficiency are also significant. The burning of fossil fuel in power generation and transport industry causes air pollution. According to the World Health Organization, **three million** people die each year from the effects of air pollution: that is to say, 5% of the 55 million annual deaths in the world. Every improvement in energy efficiency would result in health benefits that will go beyond estimation**.**

UNEP's Division of Technology, Industry and Economics in Paris has been operating the first ever programme for capacity building and technical cooperation to assist developing countries to meet their compliance of the Montreal Protocol. At the same time it has also been working to assist countries in mitigating climate change. I would like to appeal to the Italian Associazione and Centro Studi Galileo to join hands with UNEP DTIE's OzonAction programme in this endeavour.