Montreal Protocol: Ozone Treaty? No, climate treaty!

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This topic will be discussed in the next 15th EU Conference

Rajendra Shende, who retired from UNEP as Head of OzonAction of DTIE at the level of Director, is better known as ' man in hurry with action-agenda '. After 20 years of experience in the private sector he brought the corporate culture of management-by-results and the target-oriented-goals to build the OzonAction Programme of United Nations from scratch. He was awarded with Climate Protection Award of USEPA in 2009 for his achievement in Climate Mitigation through OzonAction. His programme also became first ever Programme of United Nations to get USA award for the Ozone Layer Protection. Here he talks to Marco Buoni Vice President of AREA and Technical Director of CSG:

INTERVIEW

It was 5 years back that the world community decided under the Montreal Protocol to accelerate the phase out of HCFCs. That time you were leading the United Nations programme to assist the developing countries to enable them to implement that decision. As some one who is not in UN system now, and one who has opportunity to observe the phase out scenario from 'outside' the system, do you think that historic decision of accelerated HCFC phase out is getting implemented effectively?

I completed my assignment in United Nations Environment Programme in 2011. As a chief of the OzonAction Programme I had assisted 146 developing countries to enable them to implement the Montreal Protocol. Having assisted the countries in phase out of CFCs and other Ozone Depleting Substances, before leaving UNEP I assisted more than 100 countries between year 2007 and 2011 to prepare the HCFC Phase out Management Plan (HPMP). Other implementing agencies i.e. World Bank, UNDP and UNIDO have assisted other developing countries. Positioning the phase out strategies for HCFC phase out in such HPMPs, itself has been remarkable achievement for the developing countries. HPMP is the first small but critical step towards long march of the developing countries to phase out the production and consumption of HCFCs.

National Ozone Units (NOUs) have demonstrated extraordinary commitment and creativity in developing their HPMPs. NOUs understood very well that HCFCs is the last ODS under the Montreal Protocol and that accelerating the HCFC phase-out would guarantee a faster recovery of the ozone layer. As Head of OzonAction it was not easy task for me to convey and convince NOUs that HCFC phase out would also significantly reduce greenhouse gas (GHG) emissions and help delay further climate change. UNEP team deployed various strategies to convey this message. Each and every HPMP now has mainstreamed the concept of 'getting maximum Climate-benefit' under the Montreal Protocol. The implementation so far has been very effective.

Considering that the Montreal Protocol is aiming to get 'Ozone Benefits', can you explain how the developing countries can effectively get 'climate benefit' from HCFC phase out?

The Technology and Economic Assessment Panel (TEAP) estimates that HCFC production without any controls could exceed 700,000-800,000 tonnes by 2015 – roughly five times more than its 1998 projection of just 163,000 tonnes by 2015. The future is difficult to predict, of course, and the HCFCs growth predictions could be higher still. The actual HCFC production in year 2010 (the last year for which full figures are reported to UNEP) was about 38500 ODP tonnes i.e. about the same as what was projected by TEAP for 2015. The growth rate of HCFC-22 was considerably higher than what was predicted. For the last decade the growth rates particularly in the developing countries varied between 15-20 percent. As per UNEP Scientific Assessment Panel, an accelerated HCFC phase-out would contribute to a faster recovery of the ozone layer to pre-1980 levels, possibly advancing recovery to as early as 2035.

These are the 'Ozone Benefits'.

Given that many substances like CFCs and HCFCs that deplete the ozone layer are also potent greenhouse gases, the Montreal Protocol by phasing out CFCs has "provided substantial co-benefits by reducing climate change." Already, the phase-out of CFCs and other ODSs reduced GHG emissions by 11 $GtCO_2$-eq. yr^{-1} [or ~ 110 $GtCO_2$-eq. in aggregate, between 1990 and 2010, and delayed climate forcing by up to 12 years. Thus annual GHG emission reductions were five times larger than those targeted by the first commitment period (2008-2012) of the Kyoto Protocol, the greenhouse emissions reduction treaty.

HCFC who's Global Warming Potential (GWP) is nearly 1600-2000 times that of CO_2, phasing them out will provide 'climate benefit'. To be specific, accelerating the HCFC phase-out could reduce GHG emissions by an estimated 20-30 gigatons of carbon dioxide-equivalence (22 $GtCO_2$-eq.) between 2010 and 2050, according to calculations by TEAP

Additional emissions reductions of an estimated 3.5 $GtCO_2$-eq. would occur from 2010 to 2040, according to TEAP, from the elimination of the HFC-23 by-product emissions, which otherwise would result from HCFC-22 production. Further emissions reductions, which in reality would be significant as compared to the direct emissions of HCFCs, will also result from improvements in energy efficiency expected to accompany the transition out of HCFCs. As a result, maximizing the climate benefits of an accelerated HCFC phase-out could reduce GHG emissions up to 40 $GtCO_2$-eq. between 2010 and 2050, assuming the substitution pathway is managed carefully to avoid substitutes with high Global Warming Potentials (GWPs) and to promote the use of low GWP substitutes and alternatives as well as more energy efficient equipment and products. Maximizing the climate benefits of the HCFC phase-out to reduce more than 30 $GtCO_2$-eq. between 2010 and 2050, will further delay climate change.

It seems that there are many 'ifs and buts' to get these climate benefits. Do you think that these benefits would finally remain in the sort of ' cloud'?

The progress of HCFC phase out in the developed countries where more than 80% of the phase out has occurred, does give dismal picture of the reality about the 'climate benefit'. More than 60% of the HCFC phased out in the developed countries has taken place with HFCs, another powerful GHGs. For example, the GWP of HFC 134a, which is major replacement of HCFCs in the refrigeration and AC application, is 1300 and that of HFC 410A, which has replaced most of HCFCs in the Air conditioning and heating sector in the developed countries, is 1800. It is also not at all clear if the replacement of HCFCs in the developed countries has resulted in the better energy efficiency and how much better or worse.

Replacing HCFCs with HFCs of high GWP is certainly not a way to avail the opportunity of climate benefits. Developing countries who have just embarked on the HCFC phase out have lot to learn from the adverse lessons from HCFC phase out in the developed countries so far. There is no doubt that the technology development for replacing HCFCs has been identified by the industry and research and development institutes as one of the major potential area for action within the overall climate change challenge.

An international group of modelers working with UNEP have concluded that current commitments and pledges linked with the Copenhagen Accord are unlikely to keep a global temperature rise to under 2 °C by 2050. The gap between scientific reality and ambition is estimated to average around 4.7 Gigatonnes of CO_2 equivalent per year—a gap that needs to be urgently bridged over the next decade or so if the 2 °C target is to be met. HCFC phase out with low GWP or zero GWP gases, therefore, provide hopes to bridge this gap. The industry is definitely moving towards such alternatives. Hence I am optimist that climate benefit would not remain in the 'cloud' but will precipitate into action.

The high projected HCFC growth is driven by economic development in A5 Parties and the "perverse incentive" under the Kyoto Protocol's Clean Development Mechanism (CDM), which awards carbon credits for the capture and destruction of HFC-23 emissions produced as a by-product from HCFC-22 production. HFC-23 is a super greenhouse gas with a global warming potential (GWP) of 11,700, meaning it is 11,700 times more powerful at warming the planet than carbon dioxide. HCFC-22 producers can earn a multiplier of the profits by capturing and destroying HFC-23 for CDM credits as they can from selling HCFC-22 itself.

Is there evidence for your optimism?

Yes. My organization TERRE Policy Centre is engaged in the regular Review of Refrigerants development in Dubai, where every six months number of technological development to replace HCFCs is announced. It is done in partnership with CPI-Industry of Dubai. We decided to hold the review every two months due to accelerated development of the technologies. Such review takes place with direct interaction with the technology developers.

Several new substitute chemicals have been identified for use in automobile air conditioning systems (to replace HFCs) that have low GWPs and have

The last visit of Mr. Rajendra Shende (in the middle of the picture) in Centro Studi Galileo's headquaters in Palazzo Anna D'Alençon in Casale Monferrato, Italy.

the potential to be adapted to other applications to replace HCFCs, including in room air conditioning and commercial applications. The replacement of HCFCs by near- zero GWP alternatives in insulating foams has been commercial reality now.

Many of developing countries have prioritized their phase out in the foam sector, because low GWP alternatives are proven. Natural replacements like Cyclopentane and other hydrocarbons are being deployed to replace HCFCs in the foam sector. Vacuum insulation is also being employed to get more energy and climate advantage.

Refrigeration and AC is challenging sector as far as low GWP and energy efficient replacement is concerned. However the technology development is progressing faster than one could imagine. The assessment criteria like toxicity, safety as well as LCCP (Life Cycle Climate Performance) are being increasingly used for the decision making.

International Institute of Refrigeration (IIR) has been advocating environmentally friendly, safe, energy-efficient and cost-effective design, operation and end-of-life management of refrigeration and air-conditioning systems. As part of these efforts, the IIR formed a Working Party (WP) to assess the merits of different methods of LCCP for evaluating the environmental impact of direct emissions refrigerants and indirect emissions of GHGs. In Dubai in September 2012, IIR provided the work plan with target dates for the Working Party to produce implementation protocols for these methods. IIR also presented the results of LCCP analysis by more than one methods carried out by experts for Mobile Air Conditioning (MAC) technologies . It showed that Hydrocarbon HC 290 has the lowest LCCP among the alternatives including HFCs. Hydrocarbons as refrigerants in smaller room ACs are already commercialized. I am the proud owner of Hydrocarbon based room ACs –first of its kind in India. Multilateral Fund of the Montreal Protocol has financially supported the conversion of HCFCs to Hydrocarbons in China . My optimism is based on such initiatives .

Can you give specific examples that demonstrate the Industry's stewardship in latest technology development?

During the Refrigerants Review in September 2012 in Dubai, DuPont announced that it continues to explore the compound class of Hydro-Fluoro-Olefins (HFOs) as working fluids with no ODP and very low GWP for cooling, heating and power generation. DuPont presented two new HFO-based developmental refrigerants, DR-2 and DR-12 the blends based on HFOs. DR-12 was presented publically for the first time.

What is interesting is that technology development is crossing the traditional technical barriers. Earlier HFO-based fluids have been subject to an apparently inescapable trade-off between GWP and flammability. In contrast, DR-2 and DR-12 offer both very low GWPs of 9 and 32, respectively, and non-flammability (according to ASHRAE Standard 34). Moreover, DR-2 and DR-12 remain chemically stable up to 250 dig C, the highest temperature tested thus far (according to ASHRAE-ANSI Standard 97). Clearly, the remarkable thermal stability of DR-2 and DR-12 solidifies the paradigm shift away from the conventional wisdom that unsaturated fluorocarbons would necessarily be inadequately stable as working fluids. DR-2 and DR-12 could enable energy efficient chillers, high temperature heat pumps and Organic Rankin Cycles and contribute to meeting sustainability objectives (e.g. reducing non-renewable energy consumption and greenhouse gas emissions) with attractive economics.

Similarly, Daikin of Japan, the only manufacturer involved in all phases from refrigerant development to development of air conditioning equipment, has announced in Dubai's September Refrigerant Review that it will adopt in its air conditioners the refrigerant HFC32, a refrigerant having only one-third*2 of the global warming potential (GWP) of the conventional refrigerant R410A. In addition to having a lower global warming impact than that of R410A, HFC32 can help curtail greenhouse gas emissions originating from energy sources when equipment is in use by its better energy efficiency compared to R410A.

Daikin also gave free access to its "Basic Patent Essential to Manufacture and Sale of Air Conditioners Using HFC32 for most developing countries in order to prepare an environment in which each country could begin to easily promote the widespread use of HFC32 air conditioners. Carrier, the leading Refrigeration and AC equipment manufacturers anno-unced that apart from its initiatives off use of CO_2 in the Supermarket and transport refrigeration, it also has achieved the emission reductions in its own manufacturing facilities across the world. Its Mexico Factory building was the first in the World to be LEED Gold certified.

Do you see the challenges in HCFC phase out in short and long term amidst the hopes and optimism you express?

Replacing HCFCs with low or zero GWP substitutes and alternatives and

About the top picture on the cover the image of Monte Rosa mountains. The picture with Rajendra Shende and Marco Buoni above shows Mont Blanc montains and illustrates:
*– **Ozone protection** the blue sky our Earth's ozone shield*
*– **Climate Change** the Global Glacier reteat is a global threat due to global warming*
*– **Renewable Energy** the water is a primary font of energy for our hydroelectric plants*

In the middle Rajendra Shende (white dress) chairman of the EEC-CSG-UNEP Conference in Heriot Watt University in Edinburgh. On the podium Paolo Buoni director of EEC.

Improving energy efficiency of equipment that use such refrigerants is obviously the key challenge.

The 2007 G8 Summit Declaration that affirms: "We will also endeavor under the Montreal Protocol to ensure the recovery of the ozone layer by accelerating the phase-out of HCFCs in a way that supports energy efficiency and climate change objectives." The statement further adds, "Improving energy efficiency worldwide is the fastest, the most sustainable and the cheapest way to reduce greenhouse gas emissions and enhance energy security.

Improvements in energy efficiency are expected to accompany a transition out of HCFCs, as HCFC-based equipment is replaced with superior designs. The accelerated HCFC phase-out could spur improvements in energy efficiency of about 20% within a decade, which is double the business-as-usual" rate of improvement. The global potential for saving energy is huge. According to the International Energy Agency, successfully implemented energy efficiency policies could contribute to 80% of avoided greenhouse gases while substantially increasing security of supply. The TEAP has found that when energy efficiency is improved, the reduction in GHG emissions from decreased energy use can far outweigh the direct emissions over the life of the product or equipment. However, such energy efficiency improvement would need system wide technology development going beyond the simple refrigerant replacement. This would be challenge for any industry.

The high ambient temperatures that generally exist in the developing countries further complicate the improvement in energy efficiency. Higher the ambient temperature, lower is the energy efficiency of the system for the given refrigerants. There is critical need to develop a refrigerant as well as the RAC system to face the challenge.

Yet another challenge will be to deal with the ODS Banks. Banks are defined as ODSs contained in existing equipment (air conditioners and refrigerators), products (e.g. foam insulation), and stockpiles (e.g. the military stockpiles various chemicals for specialized uses). These exist in both developed and developing countries. Since developed countries phased-out of CFCs well ahead of developing countries, most of the CFC banks in the present and the future will be in developing countries. Approximately 7.4 $GtCO_2$-eq. of CFCs currently contained in banks of existing equipment and products are expected to be released into the atmosphere between 2002 and 2015. There will be additional significant emissions beyond 2015 from as more CFC and HCFC-based equipment reaches end-of-life. A portion of these emissions can be avoided as part of the accelerated HCFC phase-out. Destroying ODS banks ensures a "bonus" for ozone and sets an important precedent for future efforts to address the growing problem of banks. However the destruction of ODS is huge challenge considering the logistics and facilities needed for such operation.

Unlike CFCs, HCFCs are used as feedstock to manufacture high engineering polymers. The production and consumption of HCFCs for such feedstock purposes is not covered under the Montreal Protocol. In other words, significant quantities of production and consumption HCFCs will never be phased out. This is multi dimensional challenge. Firstly, HFC 23, super GHG with GWP of more than 10,000 and by product of manufacture of HCFC 22 will continue. The emitted HFC 23 needs to be destroyed. Second, the continued production of HCFCs may give rise to illegal trade of HCFCs for the use in RAC applications. Capacity building to understand the extent of these challenges and to resolve them would be herculean task.

What is the scenario in your own country – India? Is there any unique feature of phase out of HCFCs in India?

Like many developing countries India faces all the challenges that are described above. It appears that the market and the unique feature would lead India would be 'democratic choices of technology' keeping the energy efficiency and HCFC phase out targets as priority. Company like Godrej is leading the Hydrocarbon based energy efficient room AC manufacture where as Daikin will start mass production of HFC 32 based room AC products in 2012, having produced sample models already and having kept in view superior energy efficiency as compared to HFC 410A. India does not have very large base for the manufacture of RAC equipment as in case of China However the energy efficiency would be the driving criteria for the HCFC phase out in India. It will keep close watch on Chinese technology development and its own energy star rating for the room AC would lead the transformation.

What will be the priority of TERRE in the context of HCFC phase out?

TERRE considers that HCFC phase out is mainly the climate issue and less of Ozone protection issue. The recent massive electricity power grid failure in north India has part of its roots in the growing energy consumption for AC in residential and commercial buildings. Hence raising awareness on the opportunity of energy efficiency during the transition away from HCFCs will be the priority of TERRE. Not in kind technologies like vapor absorption systems that avoid the use of refrigerants and use of renewable and waste energy for such system would be promoted by TERRE. As a partner with Centro Studi Galileo, it will engage itself in the training and capacity building of the technicians and work with industry to continue reviewing the technology development.

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