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OzonAction

SPECIAL ISSUE 2010

Out of the Maze

Montreal Protocol, Climate Benefits and the Green Economy

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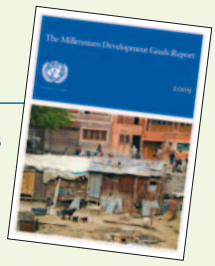

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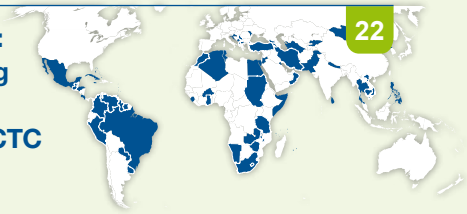

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The Ozone Dream…and the Climate Wake-up Call

Rajendra Shende, *Head OzonAction Branch*

The more I reflect on the 23 impressive years of the Montreal Protocol, the more I realize what far-reaching lessons it holds for the global environment agreements of today. The crises facing us at the end of the first decade of the 21st century require action on an even greater scale than the world's commendable response to the ozone-depletion emergency. The Montreal Protocol transformed a potential catastrophe into a golden economic opportunity. Having listened to the sound and fury of the international climate talks, the ozone messages are worth noting.

The intense reverberations: The Montreal Protocol is not simply a multilateral global accord designed to get rid of ozone-depleting substances (ODS). To define it like that would be to describe the telescope simply as a tube with a lens on each end. As Nobel Laureate, Mario Molina has said, "The Montreal Protocol is widely considered the most successful environmental treaty, phasing out almost 100 ozone-depleting chemicals by 97 per cent and placing the ozone layer on the path to recovery by mid-century. It also is the most successful climate treaty to date, because chlorofluorocarbons (CFCs) and most other ozone depleting substances (ODS) that it has phased out are powerful GHGs."[1]

The high octane notes: In addition to reducing global consumption of ODS by 97 per cent, the Montreal Protocol lowered greenhouse gas emissions by the equivalent of 135 gigatonnes of CO_2 during the period 1990-2010. This can be translated to 11 gigatonnes a year, four to five times the reductions targeted in the first commitment period of the Kyoto Protocol. This unprecedented achievement is even more remarkable given that global GHG emissions have increased by more than 35 per cent since 1990.[2]

The new resonating tunes: In phasing out the vast majority of ODS, the Protocol has created new employment opportunities in fields such as recycling, retrofitting, containment and best practices, as well as the implementation of energy standards and labelling. A wave of technological innovation has benefited developing-country enterprises, which have been able to upgrade their production lines and deploy the latest energy and resource efficient technologies. Countries like China have been able to phase out not only ODS but also their inefficient enterprises, enabling industrial rationalization and the achievement of an economy of scale.

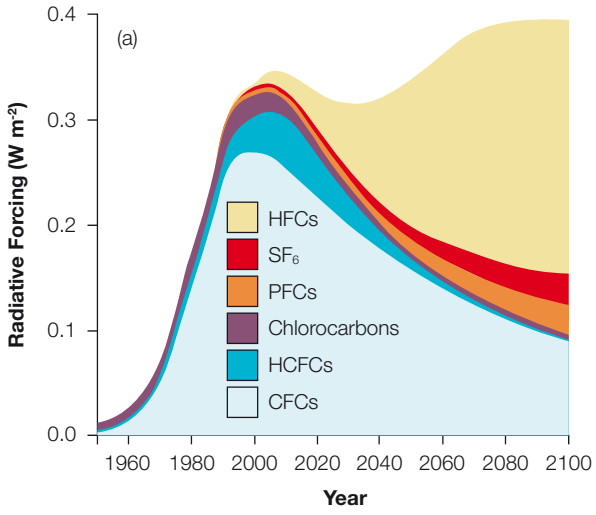
The ricocheting waves: Now the ozone layer is well on the path to recovery, phytoplankton, the bedrock of many marine ecosystems, are now much better protected from harmful UV radiation. Elimination of methyl bromide has not only safeguarded the bacteria that are essential for soil productivity but has also protected farmers from exposure to a carcinogenic substance. The foundations on which biodiversity flourishes are now better secured.

Distant thunders: While the Montreal Protocol has achieved much of what it set out to do, it still has some weighty challenges ahead.

The 2005 IPCC/TEAP Special Report on Ozone and Climate, of which I was a coordinating lead author, exposed some alarming trends:

- *Destruction of ODS banks:* The 21 Gt CO_2 Eq contained in old equipment will inevitably seep into the atmosphere in the absence of any significant destruction effort. The international community has shown how to bail out financial banks, it now needs to focus on ODS banks.
- *Absence of low-GWP alternatives across certain subsectors:* The pace of development of low-GWP alternatives is not keeping up with the accelerated HCFC phase-out schedule for developing countries. Many countries may have no choice but to transition to high-GWP HFCs to meet their HCFC commitments in the near term. This is particularly true in the refrigeration and air-conditioning sector.
- *Growth of HFCs:* The projected growth of HFCs in a business-as-usual scenarios is alarming. Forecasts indicate that the share of HFCs in the global fluorocarbon market will jump from 35 per cent in 2008 to 58 per cent in 2018[3]. The 900,000 tonnes that will make up annual global HFC demand in 2018 is equivalent to over 2 Gt CO_2-eq.[4]

The graph below from the 2005 IPCC/TEAP report makes clear that if high-GWP HFCs become the primary replacements to HCFCs, then by 2050 the Montreal Protocol will become a net and significant *contributor* to climate change:



The wake-up call: Today, that distant thunder is a storm at our doorstep. The reputation of the Montreal Protocol is at stake. Without immediate action to address these challenges and strengthen the treaty, the Protocol is in danger of becoming a liability to the global commons. Stasis could result in the Montreal Protocol being responsible for the emission of 130-190 Gt CO_2-eq. (Velders *et al.* 2009 estimates of HFC emissions + ODS Banks). If we consider the reduced energy efficiency in refrigeration and air-conditioning equipment and appliances, this figure would be much higher.

While we are justified in celebrating the success of the Montreal Protocol so far, this is certainly no time to snooze.

1 Molina *et al.* 2009, PNAS.
2 *According to the Netherlands Environmental Assessment Agency, total CO_2 emissions related to the use of global fossil fuel and cement production increased by about 34% during the period 1990-2007.*
3 Freedonia "Industry Study 2528 – WORLD FLUOROCHEMICALS" (2009).
4 Average HFC GWP based on consumption in developing countries taken from Velders *et al.* (2009) *PNAS*.

Millennium Development Goals (MDG) Report 2010: The Unparalleled Success of the Montreal Protocol Shows that Action on Climate Change is Within Our Grasp

The recently published 2010 edition of the United Nations MDG report highlights the ozone protection success to date of the Montreal Protocol and emphasizes its potential to achieve significant additional climate benefits:

"By 16 September 2009, 196 parties had signed the Montreal Protocol, making it the first treaty of any kind to achieve universal ratification. All the world's governments are now legally obligated to phase out ozone depleting substances (ODS) under the schedules defined by the Protocol. This year – 2010 – marks the beginning of a world virtually free of the most widely used ODS, including chlorofluorocarbons and halons.

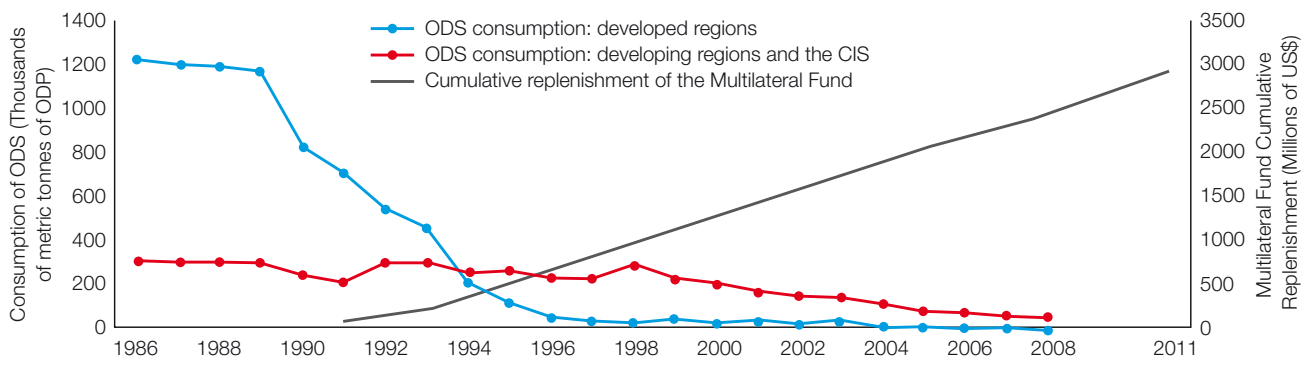
Throughout the process, developing countries have demonstrated that, with the right kind of assistance, they are willing, ready and able to become full partners in global efforts to protect the environment. In fact, many developing countries have exceeded the reduction targets for phasing out ODS, with the support of the Montreal Protocol Multilateral Fund.

Between 1986 and 2008, global consumption of ODS was reduced by 98 per cent. Furthermore, from 1990 to 2010, the Montreal Protocol's control measures on production and consumption of such substances will have reduced greenhouse gas emissions by the equivalent of 135 gigatonnes of CO_2. This is equivalent to 11 gigatonnes a year, four to five times the reductions targeted in the first commitment period of the Kyoto Protocol, the agreement linked to the UN Framework Convention on Climate Change. Parties to the Montreal Protocol are now examining ways to use the treaty's vigorous implementation regime to promote even greater climate change benefits.

Without the action prompted by the Montreal Protocol and its Vienna Convention, atmospheric levels of ozone-depleting substances would grow 10-fold by 2050. The resulting exposure to the sun's ultraviolet radiation would likely have led to up to 20 million additional cases of skin cancer and 130 million more cases of eye cataracts; it would also have caused damage to human immune systems, wildlife and agriculture. For much of the world, the time it takes to get sunburned would have been dramatically reduced, due to a 500-per cent increase in DNA-damaging ultraviolet radiation." (Page 54)

As preparations enter into high gear for the September summit on the MDGs during the General Assembly's 65th session, a series of report launches, official events and press briefings are taking place at the UN in New York building momentum for this year's big push to accelerate progress – just five years from the 2015 deadline for achieving the Goals. This 2010 MDG report will be one of the key reference documents used to assess where UN members stand in meeting their MDG commitments. The full report can be downloaded from: **http://www.un.org/millenniumgoals/** ■

Consumption of all ozone-depleting substances (ODS), 1986-2008 (Thousands of metric tonnes of ozone-depleting potential) and Montreal Protocol's Multilateral Fund replenishment, 1991-2011 (Millions of US Dollars)



Maldives Takes the Lead on HCFC Phase-Out

H.E. Mohamed Nasheed, *President of the Republic of Maldives*

Resort island in the Maldives

The Maldives plans to phase out the use of HCFCs by 2020; 20 years ahead of the country's international obligations under the Montreal Protocol.

The decision reflects Maldives' concerns over the greenhouse gas emissions that cause climate change. Scientists have warned about the effects of global warming for decades. For a country such as the Maldives, which sits just 1.5 metres above the sea, these warnings come with added bite.

The Maldives hopes that by leading the way and discontinuing the use of HCFCs early, we can demonstrate that an early phase-out is possible and practical, leading the way for other countries to follow suit. The government's decision is in line with the Maldives' ambitions to become carbon neutral, by pioneering low carbon development and ecologically sound tourism.

We believe that going green isn't just ecologically sound but also economically beneficial. The Maldives is famed for its luxury resorts, and their refrigeration systems are the source of most of the country's HCFC emissions. Moving early to phase out the use of HCFCs not only helps protect the beautiful tropical environment tourists come to see but also positions Maldives as a strong eco-destination.

A similar economic logic applies to the Maldives' plans to shift from oil to renewable energy production. Imported diesel is not just dirty, it is also extremely expensive. For us, it makes financial sense to shift from using foreign oil to using energy resources we have in abundance: namely, the sun, the sea and the wind.

We believe that the countries that move first and move fast to green their economies will be the winners in the 21st century. As the effects of climate change continue to worsen, world leaders will be forced, sooner or later, to impose some form of price on greenhouse gas emissions. Once this price signal is in place, hundreds of billions of dollars of investments will flow from increasingly expensive dirty technologies and fuels to ever cheaper green and renewable products. Those countries that invest in and develop green industries today will be well placed to profit in the new economy of tomorrow.

For the Maldives, HCFC phase-out is an important part of a wider shift towards green growth and development, where the environment is viewed not as something to be plundered but as a precious economic asset to be protected. ■

Desert Island atoll and lagoon in the Maldives

Saving the Ozone Layer: The Science of Success

Lisa P. Jackson, *Administrator, USEPA*

This year marks 40 years since the founding of the U.S. Environmental Protection Agency and passage of the Clean Air Act. In those four decades, we've worked with our international partners on a number of necessary environmental safeguards to protect our individual nations, and our entire planet. One of our strongest collaborations has been the Montreal Protocol, the groundbreaking international treaty to protect the stratospheric ozone layer.

The Montreal Protocol has been called the most successful international environmental treaty ever – and with good cause. In the two decades since its inception, developed and developing countries have discontinued consumption and production of 97 per cent of all ozone-depleting substances (ODS). Today, developing countries are meeting their goals and making great strides in ozone-layer protection, while developed countries are building on the commitments they have made for rapid action.

Part of the treaty's success stems from the fact that it is a living document. Over the years, new studies and scientific advances have pointed us toward faster action, additional controls, and sharper reductions in ODS production. By moving from an initial 50 per cent cut to today's agreed-upon future phase-out of virtually all potent ODS, the treaty has adapted effectively as science has documented ever more urgent danger to the ozone layer.

Science continues to lead the way today. In 2007, scientists showed that the Montreal Protocol had not only put the world on track to close the ozone hole, but had also delayed the advance of climate change effects by a decade[1]. In response to new science, the wider availability of affordable alternatives and concern about the climate forcing potential of those alternatives, the world community came together in 2007 to further accelerate reductions in the ODS that act as greenhouse gases. The result was an understanding that, even with conservative expectations, better alternatives could reduce greenhouse gases significantly – the equivalent of taking one of every two U.S. cars off the road each year for the next three decades.

To build on this progress and address the climate forcing potential of some ODS substitutes, the U.S., Canada and Mexico came together in partnership to submit the North American Proposal to amend the Montreal Protocol. Our proposal seeks to bring the treaty's powerful tools to the fight against climate change, including adding hydrofluorocarbons to the treaty's control scheme. That change would apply the successful framework of the Montreal Protocol to finding significant, near-term reductions in emissions that are many times more potent climate forcers than carbon dioxide.

Because the Montreal Protocol was undertaken to save the ozone layer, some will argue that we should not use the treaty in any other way. But protecting the ozone layer was the means to a greater end: protecting the atmosphere, and the planet, we all depend on. Our proposed changes would serve the same goals. As we undertake the greatest environmental challenge the world has yet faced, we should not ignore a tool that has been proven to work and is ready to hand.

When it comes to climate change, the Montreal Protocol contains the seeds of future success. In our work to protect the ozone layer, we have tested an international process that, year after year, brings 196 countries together to serve a common purpose.

In the same way, fighting changing climate will be the result of action taken in communities around the world, driven by sound science. The process has already begun. In the U.S., cities and states are joining the effort to track and reduce their emissions of greenhouse gases.

Responding to growing consumer demand for healthier, more sustainable products, U.S. companies are turning to energy efficiency and innovative clean energy technologies. The U.S. EPA is fully engaged in addressing the danger posed by greenhouse gases.

This, however, must be a global effort. Steps must be taken at many levels and by many countries. As we undertake this process, the Montreal Protocol can provide the foundation to build stronger partnerships and work together as a community of nations. The Treaty's 20 years of success will be instrumental for the urgent work ahead, work that is essential to leaving our planet a healthier, safer place for our children and grandchildren. ■

1 Guus J. M. Velders, Stephen O. Andersen, John S. Daniel, David W. Fahey, and Mack McFarland. **The Importance of the Montreal Protocol in Protecting Climate**. *PNAS 2007* 104: 4814-4819. www.pnas.org/content/104/12/4814.full.pdf+html.

The Wider Benefits of the Montreal Protocol: An EU Perspective

Connie Hedegaard, *European Commissioner for Climate Action*

The European Union is strongly committed to stepping up efforts both domestically and globally to fight climate change. The creation of a new Directorate-General for Climate Action in the European Commission in February this year underlines this commitment. The new department also covers activities related to protection of the ozone layer, a remit which highlights the actual and potential synergies that exist between the phasing out of ozone-depleting substances (ODS) and combating climate change.

Benefits of the Montreal Protocol for the ozone layer and climate

The Montreal Protocol is indeed contributing substantially to mitigating climate change. It is estimated that compliance with the phase-out of ODS has reduced global greenhouse gas emissions by the equivalent of around 8 billion tonnes of CO_2 per year between 1990 and 2010. By comparison, the Kyoto Protocol's first commitment period, from 2008 to 2012, is expected to yield annual emission cuts estimated at around 1 billion tonnes of CO_2-equivalents. In addition, the accelerated hydrochlorofluorocarbon (HCFC) phase-out agreed by Montreal Protocol parties in 2007 could lead to further reductions equivalent to up to 18 billion tonnes of CO_2 between 2010 and 2040, depending on the ability of Parties to implement alternatives with low global warming potential (GWP).

In the EU, the main instrument for implementing the Montreal Protocol is our Regulation on substances that deplete the ozone layer. To date, it has enabled the EU to reduce production of controlled ODS by more than 99 per cent. The Regulation has recently been revised to take into account changes to the Montreal Protocol, including the accelerated HCFC phase-out, and to lock in progress made at the EU level. It strengthens the measures on the use of ODS in the EU, and introduces new measures to prevent illegal trade and the dumping of ODS – and of obsolete equipment relying on these substances – in developing countries. With the revised legislation the EU will further contribute to securing the recovery of the ozone layer and also to combating climate change.

Refrigerated containers in the port of Antwerp

Supporting the phase-out of ODS in developing countries is also important for the EU. The European Commission is currently funding a project implemented by UNEP, aiming to raise awareness and facilitate information-sharing in developing countries on available non-ozone- depleting and low-GWP solutions, as well as best practices and more energy-efficient technologies. Part of the project seeks more specifically to help developing countries comply with their HCFC phase-out obligations and adopt ozone-friendly alternatives. Regional workshops aimed at capacity building and information-sharing on the availability of HCFC alternatives in refrigeration, air-conditioning and foam blowing have recently taken place in Colombia and South Korea.

Other side benefits in the EU: health and a greener economy

Contributing significantly to the fight against climate change is not the Montreal Protocol's only co-benefit. For example, the EU has been concerned about the health impacts of methyl bromide. Whereas the Montreal Protocol phases out the production and consumption of methyl bromide, except for uses deemed "critical" in the agriculture sector, there is also a general exemption for uses to prevent the introduction and spread of plant pests through international trade (also known as the "quarantine and pre-shipment" applications). Cases of accidental poisoning of port workers related to these uses have raised concerns among policy makers in several countries, including in the EU.

The revised EU legislation on substances that deplete the ozone layer bans all uses of methyl bromide from 18 March 2010, including quarantine and pre-shipment applications. This measure, which goes far beyond the requirements under the Montreal Protocol, was inspired by earlier decisions under EU biocide and pesticide legislation which banned substances due to health and safety concerns. The final phase-out of methyl bromide

Grafting tomatoes – an alternative to methyl bromide

is the culmination of a series of legislative measures and other initiatives that considerably reduced its use over the past decade. Since 2001, the EU legislation on ozone-depleting substances imposed a cap on the consumption of methyl bromide, including quarantine and pre-shipment uses, and introduced monitoring and reporting obligations. The European Commission also supported initiatives to disseminate information about alternatives and encouraged industry to replace methyl bromide on a voluntary basis. This process has contributed to more sustainable agricultural and commercial practices. The EU will continue to seek support for some control measures to reduce methyl bromide quarantine and pre-shipment uses at international level, not only to secure the recovery of the ozone layer but also for the safety of consumers and port workers in the EU and worldwide.

In addition, the current EU legislative framework on ozone depleting substances continues to drive innovation in refrigeration, foam blowing (for building insulation), fire protection and medical aerosols. These eco-innovations are contributing to the realization of the vision of a more resource-efficient, more competitive, lower-carbon economy that is set out in *Europe 2020*, the Commission's strategy for the EU's development over the next decade and beyond.

Further potential EU and global climate benefits

Coming back to the climate co-benefits of the Montreal Protocol, I believe that further synergies can be achieved.

Products and equipment containing ODS, such as refrigeration and air-conditioning units, or insulation foam in buildings, are clearly a matter for concern. Global emissions from these ODS "banks" could amount to 20 billion tonnes of CO_2-equivalents, or four times the EU's annual greenhouse gas emissions. The fact that these emissions are controlled by neither the Montreal nor the Kyoto Protocol, combined with the estimated significant costs of managing and destroying these banks, calls for innovative solutions.

As well as short-term options to deal with the most urgent banks, there is a need for stable long-term funding solutions. In the EU, the implementation of a producer responsibility scheme is resulting in effective recovery from refrigeration and air-conditioning small appliances. The European Commission is currently reviewing options for promoting recovery from other types of ODS banks. Globally, extended responsibility schemes, as already implemented in some other Parties, could also be a good step forward and would bring further benefits in terms of waste management. The European Union is looking forward to discussing this and other options for the management and destruction of ODS banks with other Parties in the forthcoming Montreal Protocol meetings.

I am also very conscious of the risk that use of high-GWP alternatives to ODS, such as the potent greenhouse gases hydrofluorocarbons (HFCs), might cancel out the potential climate benefits of the HCFC phase-out. Despite the availability of low-GWP alternatives in the relevant sectors, HFC use and emissions have been increasing substantially since the 1990s in both industrialized and developing countries, and will continue to do so.

The EU has already moved to address this by putting in place a legislative framework. Our Regulation on certain fluorinated greenhouse gases (the F-gas Regulation) focuses on specific measures for individual end-uses and on emission containment. It is driving innovations in key sectors such as refrigeration and air conditioning, and is now gaining momentum as part of the EU's climate change policy framework. The Commission is currently looking at options to improve the legislation further based on experience to date.

We remain keen to see international action to control HFCs. Action under the Montreal Protocol would be appropriate to counter the growth of HFCs because the Protocol has the relevant expertise and infrastructure. We should be mindful, however, that HFCs are controlled under the United Nations Framework Convention on Climate Change and the Kyoto Protocol. I believe it is possible to take action under the Montreal Protocol that would complement rather than undermine the existing and future climate framework.

The Montreal Protocol has already achieved great progress not only for the protection of the ozone layer but also generally for more sustainable development, including the mitigation of climate change. The EU is keen to exploit the potential synergies that remain, and we will continue to work towards this goal in future Montreal Protocol meetings. ■

The Montreal Protocol and UNFCCC: Working Together to Enhance the Environmental Governance

Yvo de Boer, *Special Global Advisor, Climate Change and Sustainability*

As Parties focus on the challenges of finding a way forward after Copenhagen, it is clear that the need for ambitious global resolve to reduce emissions and implement immediate action on climate change is as pressing as ever.

Now is the time to make significant advances on our way to Cancún, where governments can reach agreement on the architecture required to deliver enhanced global action on climate change. Immediate action on climate change can be readily effected by strengthening cooperation between the various environmental initiatives that have an impact on climate change. In most respects, objectives of the climate change and ozone regimes are complementary: ozone-depleting substances (ODS) controlled through the ozone regime, notably CFCs, HCFCs and halons, are also greenhouse gases (GHGs). Combating ozone depletion through the successful phasing out of the use of these ODS under the Montreal Protocol has thus contributed to climate change mitigation.

The United Nations Framework Convention on Climate Change (UNFCCC) recognizes the interconnections between climate change and ozone depletion and establishes a division of labour between the climate change and ozone regimes, determining that the scope of the UNFCCC shall be limited to "GHGs not controlled by the Montreal Protocol". The same division of labour is reflected in the Kyoto Protocol.

Both regimes have worked well together in tackling these issues, but new challenges are looming as we move forward. Under the UNFCCC, several Parties have expressed interest in expanding collaboration to address a possible increased demand in HFCs, which are not ozone-depleting substances, but are greenhouse gases. This is due to the accelerated phase-out schedule for HCFCs adopted by the Montreal Protocol in 2007.

A comprehensive assessment of the magnitude of this problem was first provided in 2005 by a Special Report prepared by the Technology and Economic Assessment Panel (TEAP) of the Montreal Protocol and the Intergovernmental Panel on Climate Change (IPCC). The report stated that emissions of HFCs were expected to increase from 0.4 to 1.2 $GtCO_2$-eq yr^{-1} from 2002 to 2015, before the new phase-out schedule for HCFCs was adopted. A report published by TEAP in 2009 shows that the mitigation potential in switching to low-GWP alternatives when phasing out HCFCs ranges from 500 to 600 $MtCO_2$-eq in 2020.

This issue is currently being considered by the Ad Hoc Working Group on Long-term Cooperative Action (AWG-LCA)[1]. A draft decision on various approaches to enhance the cost-effectiveness of, and to promote, mitigation actions was discussed in Copenhagen. This included text urging Parties to pursue, under the Montreal Protocol, the adoption of appropriate measures to progressively reduce the production and consumption of HFCs[2]. The UNFCCC and its Parties were informed of the work undertaken by the Montreal Protocol in this area, including the Meeting of the Parties' (MOP) Decision XXI/9 on "Hydrochlorofluorocarbons and Environmentally Sound Alternatives".

The Subsidiary Body for Scientific and Technological Advice (SBSTA) will resume its work on scientific, technical and socio-economical aspects of climate change in its June session. Parties might discuss future work on different near-term mitigation options, and they may take this as an opportunity for discussing mitigation options for HFCs and other non-CO_2 gases.

HFCs represent a real threat for the climate, due to their production and use as an HCFC replacement, and also to their unintended emissions in industrial processes. This two-fold challenge requires the coordinated application of a number of tools available under the Montreal Protocol, the UNFCCC and the Kyoto Protocol. Significant benefits could be obtained from the Montreal Protocol's successful experience in applying strategies for phasing-out ODS and from the special funding facility provided under the Montreal Protocol. Further benefits could result from using the Kyoto Protocol Clean Development Mechanism and the emission reporting procedures under the UNFCCC. ■

1 The AWG-LCA was established to conduct a comprehensive process to enable the full, effective and sustained implementation of the United Nations Framework Convention on Climate Change through long-term cooperative action, now, up to and beyond 2012, guided by the Bali Action Plan.

2 This draft decision has no formal standing and its purpose is to be available to Parties in the continued efforts of the AWG-LCA to reach agreement on the outstanding issues.

Ozone Layer Protection and Biodiversity: the Struggle to Save Life on Earth

Ahmed Djoghlaf, *Executive Secretary of the Convention on Biological Diversity*

There is a direct relationship between ozone depletion and biodiversity loss, making the protection of the ozone layer a prerequisite for the conservation and sustainable use of biodiversity. Thinning in the ozone layer leads to increased ultraviolet radiation at the Earth's surface, disrupting the ecological balance by harming the metabolism of cells as well as damaging genetic material. With the depletion of the ozone layer, ultraviolet rays are also increasingly penetrating below the ocean surface, which can negatively affect plankton and have cascading effects throughout the marine food chain.

That is why the Convention on Biological Diversity (CBD) is an active supporter of the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol. Indeed, since 2005 the CBD Secretariat has worked with the Ozone Secretariat as co-members of the Green Customs Initiative, which was established in 2001 to strengthen the capacities of customs services to detect and act on illegal trade in environmentally-sensitive commodities such as ozone-depleting substances, toxic chemicals, hazardous wastes, endangered species and living modified organisms.

The Convention also supports the implementation of the Montreal Protocol because, in reducing the use of ozone-depleting substances, the Protocol also reduces greenhouse gas emissions, thereby contributing to the mitigation of climate change. This has substantial benefits for life on Earth, since climate change is projected to be one of the most significant drivers of biodiversity loss in years to come. At the Copenhagen Climate Conference last December, the CBD's Ad Hoc Technical Expert Group on Climate Change and Biodiversity released a major report which showed that observed changes in climate have already adversely affected biodiversity at the species and ecosystem level, with further changes in biodiversity being inevitable with further changes in climate.

Bumble bee pollinating plant

Indeed, observed changes in the climate have recently produced alterations in species distribution and population size, timing of reproduction or migration events, and an increased frequency of pest and disease outbreaks. Climate change has also been implicated in widespread coral bleaching, wetland salinization and salt-water intrusion, the expansion of arid and semi-arid lands at the expense of grasslands and acacia, poleward and upward shifts in habitats, replacement of tropical forests with savannah, and the shifting of desert dunes. Overall, approximately 10 per cent of species assessed so far have an increasingly high risk of extinction for every 1°C rise in global mean surface temperature, a trend that is expected to hold true up to at least a 5°C increase, which would result in about 50 per cent of species facing increased risks of extinction. These trends are confirmed by the fourth set of national reports the CBD has thus far received from its Parties, 89 per cent of which indicate that climate change is either already contributing to biodiversity loss or will do so in the relatively near future.

Hence, implementing the Montreal Protocol is an important way to help preserve the richness of life on this planet. This is important because we humans are one of the prime beneficiaries of a diverse and stable biosphere. We depend on biodiversity for everything from food, fuel and medicines, to air and water purification and the pollination of wild plants and crops. It is no exaggeration to say that biodiversity loss poses a severe threat to our long-term health, wellbeing, and economic prosperity.

This is particularly true when it comes to the poor, who often depend directly on biodiversity for their day-to-day livelihoods. Three hundred million people worldwide, the majority of whom are poor, are estimated to depend substantially on forest biodiversity, including non-wood forest products, for their survival and livelihood. And yet about 13 million hectares of the world's forests are lost

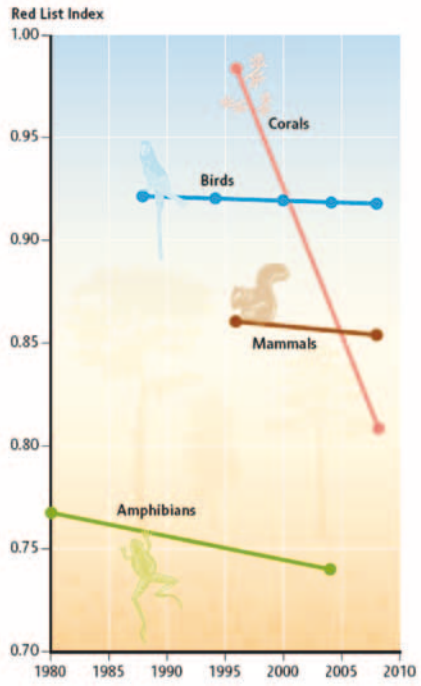


Figure 1

The Red List Index tracks the percentage of fully-assessed species groups expected to survive into the future: in other words, whether the risk of extinction is increasing or decreasing over time. In all four of the groups assessed: warm-water corals, birds, mammals and amphibians, the downward slope of the line indicates that the risk of extinction is increasing. The status of coral species has declined most sharply, and amphibians are the group facing the highest extinction risk.

A Red List Index value of 1.0 indicates that all species in a group would be considered as being of Least Concern, that is not expected to become extinct in the near future. At the other extreme, a value of 0 indicates that all species in a group have gone extinct. Note that a flat line on this graph would indicate that the risk of extinction was constant – if the rate of biodiversity loss were reducing, the lines should be moving upwards, indicating a reduced risk of extinction.

Source: IUCN

to deforestation each year. One billion people depend on fish as their sole or main source of animal protein, while fish provide more than 2.6 billion people with at least 20 per cent of their average per capita animal protein intake. And yet about half of marine stocks worldwide were fully exploited in 2005, while another one-quarter were over-exploited, depleted or recovering from depletion. Coral reefs provide food and livelihood for most of the estimated 30 million small-scale fishers in the developing world. And yet 60 per cent of coral reefs could be lost by 2030 through fishing damage, pollution, disease, invasive alien species and coral bleaching.

Overall, it is estimated that natural capital constitutes 26 per cent of the total wealth of low-income countries. That is why at the Johannesburg World Summit on Sustainable Development in 2002, world leaders agreed to achieve the Biodiversity Target of significantly slowing rates of biodiversity loss worldwide by 2010 as a contribution to poverty alleviation and to the benefit of all life on Earth. That is why the 2010 target was incorporated as a new target under the Millennium Development Goals and endorsed by the UN General Assembly. And that is why 2010 was declared the UN International Year of Biodiversity.

To quote Gro Harlem Brundtland on this topic: "You cannot tackle hunger, disease, and poverty unless you can also provide people with a healthy ecosystem in which their economies can grow".

Unfortunately, the recently released third edition of the CBD's *Global Biodiversity Outlook* concludes that the 2010 target has not been met. Reviewing all available evidence, including the national reports of over 100 Parties to the CBD and the scientific literature, the report shows that biodiversity continues to disappear at an unprecedented rate (see Figure 1) – up to 1,000 times the natural background rate of extinction. It also warns that irreparable degradation may take place if ecosystems are pushed beyond certain tipping points, leading to the widespread and irreversible loss of ecosystem services on which we are heavily dependent.

In order to prevent this from happening, in September 2010 the 65th session of UN General Assembly will for first time discuss the importance of biodiversity, its role in sustainable development, its role in the fight against climate change, and action for the future. And in October, at the 10th meeting of the Conference of the Parties to the CBD in Nagoya, Japan, our 193 Parties will finalize a 2020 biodiversity target and a 2050 biodiversity vision as a part of a comprehensive post-2010 strategic plan for stopping biodiversity loss in the future. This will be done with the participation of a broad range of stakeholders, including youth, local and indigenous authorities, parliamentarians, cooperative agencies and the private sector.

At CBD, we will be looking to the tremendous success of the Montreal Protocol for inspiration as we continue our struggle to save life on Earth. Mario Molina, who received the Nobel Prize in 1995 for his work in helping to reveal the threat posed to the Earth's ozone layer by chlorofluorocarbon gases, stated in his Nobel lecture that the problem of ozone depletion "has shown us that different sectors of society can work together – the scientific community, industry, environmental organizations, government representatives and policy makers – to reach international agreements". As we approach the Nagoya Biodiversity Summit, our great hope is that this will once again happen in 2010 – that society as a whole will come together to preserve the great richness of life on the planet. The stakes could not be higher. As the slogan of the International Year reminds us: "Biodiversity is life…Biodiversity is our life". ■

How California is Addressing Climate Change and Benefitting

Linda S. Adams, *Secretary, California Environmental Protection Agency, Chair, Climate Action Reserve*

Long before there was a federal Clean Water Act or federal Clean Air Act, California was blazing trails in environmental protection.

As the eighth largest economy in the world, California is home to 38 million people. We are the top agricultural state in the United States, growing half of the country's food. We produce 300,000 tons of grapes every year, and world-class California wine. We offer an abundance of sunshine and tourist attractions that bring millions of people to California every year.

California is also home to the oldest, largest and tallest living things. The bristlecone pines of the eastern Sierras are 4,600 years old, the General Sherman giant sequoia in Sequoia National Park is the largest tree in the world and the California coastal redwoods are the tallest.

The state's unique geography – from the Central Valley to the Sierra Nevadas and Southern California beaches – makes it extremely vulnerable to the threats of global warming.

California has a particular interest in climate change and with good reason.

- 1,100 miles of coastline are threatened by rising sea levels
- A US$ 36 billion agriculture industry is threatened by pests and water shortages
- Critical natural water supplies are threatened by diminishing snowpack in the Sierra Nevada mountains
- Both new and older communities in forestlands are threatened by increasing wildfires and a new year-round fire season
- Heat-related deaths have increased due to more frequent extreme heat events

Because of these threats, California has a compelling interest in protecting public health and the environment, which the state sees as crucial to its economy.

California's climate policies

Governor Schwarzenegger recognized the implications of climate change for Californians when he signed AB 32 in 2006 establishing California's landmark Global Warming Solutions Act, also known as AB 32. This important measure set us on a path to reduce our greenhouse gas emissions to 1990 levels by 2020 and drive a clean energy economy.

Solar panels powering the machinery of a California vineyard

We have moved swiftly in adopting and implementing such policies as the Low Carbon Fuel Standard, which will reduce the carbon intensity of our fuels by 10 per cent; the Renewable Portfolio Standard, which requires that 33 per cent of our energy comes from clean, renewable sources; our clean car regulations, which have been adopted at the national level; and SB 375 which requires better land-use planning to reduce vehicle miles travelled. We've also worked hard to clean our air by greening our trade corridors and ports, and have introduced regulations for refrigerants and high global warming pollutants.

We have protected the ozone layer with voluntary measures to avoid CFCs in hairspray and deodorant spray, then with local and national control measures, and finally with the Montreal Protocol. Our policies are creating a cleaner, greener California and also spurring our economy. To do this, we've worked with partners from around the world to learn best practices, and inspire innovation and the development of alternatives.

Working through the Climate Action Reserve

I am chair of the Climate Action Reserve (CAR), a non-profit organization representing international interests in addressing climate change and bringing together participants from the government, environment, academic and business sectors. It works to ensure environmental benefit, integrity and transparency in greenhouse gas

(GHG) emission reduction projects by establishing high quality standards for quantifying and verifying GHG emissions reduction projects, overseeing independent third-party verification bodies, issuing carbon offset credits (CRTs) and tracking the transaction of credits in a transparent, publicly-accessible system.

CAR adopted the Article 5 ODS Project Protocol in February 2010 with the collaboration of the California Air Resources Board, The World Bank, EOS Climate, Coolgas Inc, Verisae Inc, DuPont Refrigerants, Pew Center on Global Climate Change, United States Environmental Protection Agency, NSF-ISR, Environmental Credit Corp, 3M and ICF International.

By July 2010, the reserve already had three Article 5 ODS projects. The Reserve's project protocols, such as the Article 5 ODS Project Protocol, provide regulatory-quality guidelines for the development of offset projects and the quantification of carbon offset credits.

Adherence to the Reserve's protocols, which are widely regarded as among the highest quality standards for GHG emissions reduction projects, ensures emissions reductions associated with projects are real, additional, verifiable, enforceable and permanent. Real reductions are quantified emissions reductions that have actually occurred. Additional, verifiable, enforceable and permanent reductions are above 'business as usual' practices, readily monitored and verified, subject to penalties for non-compliance and result in long-term benefits to the environment.

The Reserve only registers projects that have been independently verified as adhering to its project protocols. The Reserve also assigns unique serial numbers to all generated carbon credits, preventing the possibility of double counting and assuring offset buyers that when a CRT has been retired, it cannot be re-sold or transferred again. Transparency is a fundamental and distinguishing characteristic of the Reserve, and all project information is made publicly available online.

The California Aqueduct flows over the Altamont Pass in Northern California. The location is one of the world's largest wind farms

Industry reports indicate the market price for CRTs has always ranked in the top tier among carbon credits. Also, industry experts and participants widely regard the Reserve's projects and CRTs as most likely to be accepted into compliance programs.

Success of the Montreal Protocol

The Montreal Protocol is credited with removing ozone-depleting substances from our air. This is crucial because the same substances that destroy our ozone layer are also potent greenhouse gases that contribute to global warming and can devastate our natural resources. Today, the Montreal Protocol has virtually eliminated nearly 100 damaging chemicals and put the ozone layer on the path to recovery by mid-century.

California's emerging green economy

While state, regional and international efforts are curbing greenhouse gas emissions and removing ozone-depleting substances, California has found that its progressive environmental policies are creating a new shift in the economy away from one dependent on dirty fossil fuels and towards a cleaner, greener economy.

In fact, we are already realizing the economic benefits of a green economy and are seeing our green job sector grow 10 times that of any other sector in the state. California captured more than 56 percent of the country's total venture capital investment.

Furthermore, venture capital investment in California reached almost US$ 4 billion during the second quarter of 2010, which is a 51 percent gain from the same period last year. The number of companies also being funded by venture capital investment has also increased.

Opportunities for the future

California's progressive environmental policies and programmes have an impact far beyond our own borders. We're working with the Western Region, national governments and international leaders to advance climate policies that protect our environment and drive the creation of green economies.

As early movers in the environment and the clean technology space, we will continue to reap public health and economic benefits even as competition grows in the green marketplace. With our culture of entrepreneurship, innovation and strong government policy, California is well placed to continue its leadership role.

But for all that California is doing, we realize that we can't solve environmental challenges like climate change alone. We rely on our partners to join efforts and affect change on a national and international level because we all have vital resources to protect and share.

Join me in advancing climate policies across the globe so no one has to suffer from impacts of environmental degradation. ■

Ozone and Climate Protection: Opportunities for Greening the Economy

Pavan Sukhdev, *Study Leader – The Economics of Ecosystems and Biodiversity (TEEB) & Project Leader – Green Economy*

The debate about climate change is essentially a debate about ethics and about economics. But the traditional line of thought in climate talks – focusing on who will bear the cost of climate change action – tends to ignore the substantial benefits of action: opportunities for economic growth and jobs, as well as reduced environmental risks.

Moreover, a government, business or individual that sees clear economic benefits from climate change action will quickly become its greatest advocate and an agent of change.

How does action on climate change create economic opportunities? The answer lies in investment, both public and private, in economic sectors with the most potential for 'greening', such as energy, transportation, agriculture, forestry. A number of countries have recognized the potential for green economic growth and are moving in this direction. Let us consider some examples from the energy sector.

In 2005, China passed a Renewable Energy Law, which contains a number of measures to create incentives for the development and use of renewable energy technologies. The national fund, for instance, finances the development of these technologies, and lending at discounted rates and tax advantages are available for renewable energy projects.

These financial incentives, and other related policy measures, have enabled investors and research institutions to leverage green economic opportunities in the renewable energy sector. China's renewable energy sector as a whole now generates output worth 17 billion USD and created an estimated 300,000 jobs in 2009 alone.

In Tunisia, primary energy consumption from renewable energy sources and savings from energy efficiency are expected to reach 20 per cent of total energy consumption in 2011. The national Solar Energy Plan covers the use of solar photovoltaic systems, solar water heating systems and solar concentrated power units for electricity generation. Of the estimated total of 2.5 billion USD required to fund the plan, private sector funding accounts for 1,660 million USD, highlighting the importance of private actors in stimulating the transition to clean energy solutions.

Furthermore, just one solar energy programme in Tunisia, PROSOL, has generated significant economic activity and created new jobs: as of 2008, 42 renewable energy technology suppliers were registered, and at least 1,000 companies were in the business of installing solar water heating systems.

Solar collectors on the rooftop of a company headquarters, China

Wind turbines in the Eifel, Zuelpich, Germany

An effective way to stimulate these types of investments further is through international agreements, such as agreements on climate change. The Montreal Protocol provides a worthy model. It represents one of the most successful multilateral environmental agreements to date and may offer the international community guidance on harnessing the economic potential from collective action on the environment.

While it is fair to say that Montreal Protocol benefited from significant industry backing and the fact that it dealt with a relatively limited set of substances, the Montreal Protocol experience can nevertheless offer valuable lessons in converting multilateral action into economic opportunities.

A fundamental factor in the success of the Montreal Protocol has been the Multilateral Fund, which helps developing countries meet incremental costs in the shift from ozone-depleting substances to alternative technologies. The Multilateral Fund was instrumental in getting governments to sign up to the Montreal Protocol and has played a key role in ensuring compliance with Protocol commitments. The mechanism, widely hailed for its approach, not only provides North-to-South financial and technical assistance, but also works towards strengthening institutional and human capacity in developing countries.

A financial mechanism comparable to the Multilateral Fund could catalyze innovation and investment in the type of green technologies that could mitigate climate change or assist adaptation to climate change.

Such a financial mechanism could also help ensure that the benefits of climate change action are available to all countries. The international community needs to define a climate change strategy that focuses on generating opportunities for a transition to a green economy, and the chosen strategy should provide for a multilateral financial mechanism that can act as one of the enablers in making the green economy happen.

It is crucial that we do not miss this opportunity to maximize the economic opportunities that climate change action can create. Countries that have taken ambitious measures to develop a renewable energy industry in response to climate change can today benefit from new dynamic sectors that generate significant economic gains and employment opportunities.

In Germany, it is estimated that by 2020, renewable energies will generate more jobs than the country's automobile industry. And, as illustrated above, the green economy also presents opportunities for countries such as China and Tunisia.

Going forward, the international community must focus, and act, on the benefits of climate change action. We also need to ensure that these benefits are available to all. The Multilateral Fund of the Montreal Protocol illustrates the powerful role that a multilateral financial mechanism can play in generating economic opportunities, facilitating technology transfer and addressing climate change. This is an example worth following. ■

Resurgence of Trade in Ozone-Depleting Substances – HCFCs this Time

Allan Thornton, *President, Environmental Investigation Agency*

The Montreal Protocol has worked hard to restore the ozone layer by mandating the phase-out of nearly 100 ozone-depleting substances (ODS). First on the list were the chlorofluorocarbons (CFCs) and other powerful ODS. These were replaced with hydrochlorofluorocarbons (HCFCs), which have a lower ozone-depleting capacity.

During this phase-out in the 1990s, a black market developed in CFCs and other ODS. In response, the Montreal Protocol was amended to implement ODS licensing systems. It was estimated that up to 20,000 tonnes of CFCs and ODS were smuggled annually with a value of 150-300 million USD. Enforcement actions and regulations brought the illegal trade under control in developed countries. However, in 1999, the use of ODS was frozen in developing countries, with the result that illegal trade began to appear in these parts of the world also.

HCFCs themselves are now being phased out and replaced with alternatives which pose no risk to the ozone layer. Under this programme, developed countries have phased out 75 per cent of the production and consumption of HCFCs. The European Union has banned the use of virgin HCFCs when servicing equipment. The United States has banned the use of virgin HCFCs in equipment manufactured after 1 January, 2010. The use of HCFCs in developing countries is set to freeze in 2013.

Unfortunately, the stage is set for a repeat of the smuggling of ODS that occurred in the 1990s, and evidence of a growing illicit trade in HCFCs is mounting as the examples below show:

- Charleston, South Carolina, 2008, 12,000 canisters of HCFCs worth over 1 million USD seized;
- Miami, Florida, 2010, company fined for importation of 29,107 cylinders of HCFCs between 2007 and 2009 with a market value of 3.9 million USD;
- India/Bangladesh border, July 2006, 160 cylinders of mostly HCFC-22 seized.

The illegal trade presents both a risk of serious harm to the ozone layer and to the global climate because these ODS are 'super' greenhouse gases with global warming potentials hundreds and thousands of times that of carbon dioxide.

Immediate action to tighten controls to prevent this illegal trade is essential. It will be necessary to:

- Actively monitor illegal exports of HCFC to developed countries, especially the United States and the EU;
- Engage with industry as a useful source of information;
- Improve enforcement capabilities, including training for customs agencies.

Additionally, the current licensing regime needs to be improved in the following ways:

- HCFC imports and exports must be licensed;
- The country of import must verify licenses with the country of export;
- There needs to be full use of inter-regional cooperation to share information on illegal trade in ODS with regional UNEP offices (iPIC);
- Uses that are not regulated by the Montreal Protocol, such as feedstock, should be brought into the licensing system.

The important lessons learned from combating illegal trade in CFCs need to be applied to ensure that the growing illicit trade in HCFCs is stopped. Additionally, developing countries need to start preparing now for the consequences of the 2013 freeze in the production and consumption of HCFCs. ■

Seized illegal canisters on the black market

© Environmental Investigation Agency

Refrigerants, Naturally! – Giving HFCs the Cold Shoulder

Refrigerants, Naturally! *Partners The Coca-Cola Company, Unilever, McDonald's, Carlsberg, and PepsiCo. Supported by UNEP and Greenpeace*

Can we have one solution to the two most burning global problems that humanity will face in the coming millennium? Can two Protocols –Montreal and Kyoto – work toward one goal? Does industry have the potential and the motivation to help solve these kinds of problems? How can interactive dialogue with diverse stakeholders help us move toward the goal of sustainability? That's what Rajendra Shende, Head of the Energy and OzonAction Branch of UNEP, asked himself in the autumn of 2000, after he attended a meeting organized by The Coca-Cola Company and McDonald's.

At this historic meeting, companies in the food and drinks sector, environmental organisations and representatives of over 30 major refrigeration suppliers came together to discuss alternatives to the use of hydrofluorocarbons (HFCs) in refrigeration. In the coming years, Rajendra Shende was to discover, to his delight, that many of his questions had positive answers.

The meeting not only resulted in subsequent individual actions by the companies, it was also the beginning of a unique business partnership: Refrigerants, Naturally! In June 2004, three food and drinks sector giants – The Coca-Cola Company, Unilever and McDonald's – joined forces to commit to an HFC-free future. The United Nations Environment Programme (UNEP) and Greenpeace became official supporters and took an active role in the management of this alliance.

Single efforts are not enough!

The members soon realised that single efforts would not be enough. In Carlsberg and PepsiCo they found like-minded companies. The key goal of Refrigerants, Naturally! is to promote a shift in the refrigeration sector towards sustainable natural refrigerant-based technologies. The members of Refrigerants, Naturally! are reducing their impact on climate change and ozone depletion by replacing hydrochlorofluorocarbons (HCFCs) and HFCs with natural refrigerants, by using HCFC-free and HFC-free insulation material, and by reducing the energy consumption of new refrigeration equipment.

It's time to act!

Refrigerants, Naturally! partners have been taking action to address the problem of HFCs. These are the most commonly used replacements for ozone-depleting HCFCs in refrigeration units. However, HFCs have a very high Global Warming Potential (GWP) and are controlled under the Kyoto Protocol. If HFCs continue to replace ozone-depleting gases, their impact on global warming may lead to irreversible environmental consequences. Therefore, international negotiations have been initiated to address the phase-down of HFCs. Refrigerants, Naturally! supports such an international reduction agreement. It is now time to act and implement climate-friendly natural refrigerants. Natural refrigerants, such as hydrocarbons (HCs), for example propane and iso-butane, carbon dioxide (CO_2), and ammonia (NH_3) have no or significantly less GWP compared to HFCs and a zero Ozone Depleting Potential (ODP). Furthermore, they are cheap, reliable and energy-efficient and can be used as cooling and foam-blowing agents in refrigeration and air-conditioning equipment.

Half a million HFC-free-units

Members of Refrigerants, Naturally! are committed to making a substantial effort and investment to progressively replace fluorocarbons with natural refrigerants in point-of-sale cooling and freezing applications. This includes research and development, testing, financial investment, staff time or public engagement. Research and development is done in close collaboration with suppliers and research institutes. The introduction of natural refrigerants into refrigeration appliances is a part of the overall greenhouse gas reduction effort and environmental policy of the initiative's members. Until the end of 2009, almost half a million units of cooling and freezing equipment, operating either with CO_2 or hydrocarbon refrigerants, have been installed worldwide. "The members of Refrigerants, Naturally! have come a long way in the past 10 years", says Wolfgang Lohbeck from Greenpeace. However he goes on to say: "We challenge them to go the rest of the way now and continue their efforts to become 100 percent HFC-free in their equipment worldwide". In advancing its journey toward climate-friendly cooling, The Coca-Cola Company just recently announced that 100 percent of its new vending machines and coolers will be HFC-free by 2015 (50 percent by 2012).

Challenges and opportunities

Field tests carried out over the recent years have shown very encouraging results and in many cases have led to the wider use of HFC-free refrigeration equipment. But there are still factors limiting the use of natural refrigerants on a wide scale. These include the following:

Table 1: Pros and cons of natural refrigerants in refrigerated point-of-sales equipment

Refrigerant	Pro	Con
CO_2	• Application in all regions • ODP = 0, GWP = 1 • Non-flammable/low toxicity • No certain limits on charge size • Higher energy efficiency than R134a under most conditions • High volumetric refrigeration capacity • Smaller compressor	• Lower energy-efficiency under high ambient temperature conditions • High pressure • Limited availability • Limited service infrastructure
HC	• High energy efficiency • ODP = O, GWP = 3 • Availability in Europe and Asia • Less charge than R134a/R404A	• Regulatory restraints in the US • Some safety precautions required • Max. charge restrictions in several international standards • Limited service infrastructure

Availability

Regarding CO_2 technology, the members of Refrigerants, Naturally! have experienced difficulties in sourcing high pressure components. These special components are produced in small numbers, a factor which limits availability and raises costs. In certain regions it is also difficult to obtain HC and CO_2 gases in the quantities and quality required.

Service and maintenance

An additional challenge when attempting a major shift to natural refrigerant-based equipment is the lack of service and maintenance infrastructure. In this area the members of Refrigerants, Naturally! cooperate to provide training for technicians to ensure that the overall quality of service and maintenance is kept at a high level.

Legal restrictions

Currently, the use of HCs is restricted in the U.S. and Unilever has applied for clearance to use hydrocarbon-based ice cream cabinets. This process involved submitting an EPA (Environmental Protection Agency) application under the Significant New Alternatives Policy (SNAP) for testing new refrigerants and meeting Underwriters' Laboratories (UL 471) standards for commercial refrigeration equipment. It also included development of a training package for service technicians and making this training available throughout the U.S. Following the approval, field trials of ice cream cabinets using HC refrigerant in the U.S. have now commenced and the Unilever initiative has already encouraged other end-user companies and equipment manufacturers to consider requesting trial approvals and making SNAP applications for their appliances. PepsiCo for instance has started field trials with CO_2 vending machines in Washington. The company has also recently started a field test in Miami with 35 innovative energy-efficient coolers which not only contain HC as natural refrigerant but at the same time use less energy than a 100-watt incandescent light bulb. These coolers are the first HC coolers that have been approved by UL and EPA.

National legal requirements are sometimes linked to international (industry) standards. Several international (ISO, IEC) and European (EN) standards currently place restrictions on the amount of HC that can be used in refrigerated cabinets. Devices with hermetically sealed refrigeration circuits containing less than 150 grams may be placed in any location or size of room. Larger devices using higher charge levels require specific design criteria and some restrictions on placement. Unilever is investigating the most economical way to introduce natural refrigerants to their larger cabinets, which require charge levels of higher than 150 grams. In line with this, Refrigerants, Naturally! investigates the backgrounds of these restrictions, and considers options to revise these standards on the basis of recent scientific insights.

Pros and cons

Based on the current experience and insights of Refrigerants, Naturally! members, Table 1 summarises the pros and cons of natural refrigerants in refrigeration equipment.

As in many businesses, availability and cost of equipment are closely related. Safety is largely design related and is addressed by building systems to designs that mitigate operational safety risks. To reduce servicing risks to a minimum level, technicians must be fully and appropriately trained.

Yes, it can be done

The member companies of Refrigerants, Naturally! have already demonstrated that climate-friendly alternatives are, or can become, commercially available in the near future in most point-of-sale applications. The widespread introduction of natural refrigerants in refrigerated point-of-sales equipment in the US and in other regions is the major goal for the years to come.

The members of Refrigerants, Naturally! share a commitment to eliminate HFCs in point-of-sale cooling and freezing applications and a conviction that alternative technologies work efficiently and reliably whilst offering environmental benefits and commercial viability.

http://www.refrigerantsnaturally.com/ ■

Domestic Refrigeration – Prospects for Hydrocarbon Based Air Conditioners

Dr. Fabio de Longhi, *Vice Chairman and Chief Executive Officer, De'Longhi*

Energy and environmental protection feature prominently on the political agenda of all world governments and all industrial sectors have been requested to make considerable efforts to reduce energy consumption and environmental impact.

The air-conditioning sector plays an important role in terms of both energy consumption and greenhouse gas emissions and as a result has undergone a major technological revolution over the last 10 years.

In Europe, HCFCs (usually R22) were phased out in domestic air-conditioning systems in December 2003 because of their contribution to ozone-layer depletion. The replacements were HFC refrigerants: R407C (mainly in the first stage) and R410A (very common today). The ODP (ozone-depletion potential) value of these HFC refrigerants is zero.

But even HFCs have a drawback: they are powerful greenhouse gases and the air-conditioning sector is now under pressure from all sides to produce systems with a lower contribution to global warming.

Air conditioners contribute to global warming in two ways:

- A direct contribution from refrigerant emissions into the atmosphere (leaks during installation, use, end of life). This contribution is related mainly to the tightness of the system, to the quantity of refrigerant used and to its GWP (global warming potential) value.
- An indirect contribution from carbon dioxide emissions from the energy required to operate the system. This contribution is related mainly to the size and to the efficiency of the system.

The use of propane (R290) can reduce contributions from both the above sources, as it is an environmentally friendly, non-toxic, non-ozone-depleting refrigerant, with low global warming potential. Household air conditioners charged with propane are available in Europe and Australia, and elsewhere.

The table below summarizes the main characteristics of the above mentioned refrigerants.

Refrigerant	ODP	GWP (100a)	Relative Indicative Efficiency
R22	0.05	1700	100
R407C	0	1653	85-90
R410A	0	1975	90-95
R290	0	3	105-110

The main problem in the use of propane is its flammability, and for this reason some adaptations to the system are required. The most important adaptations are:

- No ignition sources shall be present within the appliance where leaked refrigerant could accumulate.
- The refrigerant mass shall be limited to the lowest possible value.
- The severity of the factory leak tests shall be increased.
- Servicing requiring opening of the refrigerating circuit shall be performed only by trained people and in a specialized workshop.

However, there are also major advantages in the use of propane:

- The compressor lubricant can be mineral oil instead of the synthetic oil required for HFC refrigerants. Mineral oil is cheaper and less sensitive to humidity.
- The efficiency of appliances using propane is about 10 per cent higher than the efficiency of the same appliance using HFC refrigerants.
- The GWP value of propane is 3: it is 1653 for R407C and 1975 for R410A.
- The typical refrigerant quantity is about 50 per cent of the HFC quantity required for the same system.
- In conclusion, both direct and indirect global-warming impacts are lower for appliances using propane compared to those using traditional fluorinated gases. ■

Some Reflections on 23 Years of the Montreal Protocol

Dr. Joseph Farman, *The British Antarctic Survey (Retired)*

Ozone depleting CFCs

It was announced on 16 September 1987 in Montreal that a United Nations Environment Programme (UNEP) Working Group had reached agreement on a plan to protect the ozone layer. Readers of Lewis Carroll may recall the words of a song that came into Alice's head in 'Through the Looking Glass'. "Tweedledum and Tweedledee agreed... to have a battle".

What was agreed in Montreal? Signatures were to be invited to ratify a Protocol for the Control of Substances that deplete the Ozone Layer that would, provided that there was sufficient support, come into force on 1 January 1989, but require no action until 1 July 1989. CFC consumption was to be frozen at 1986 levels from July 1989, and reduced in steps to 50 per cent of 1986 levels by 1999. Halon consumption would be frozen at 1986 levels in 1992. Under such measures the accumulation of chlorine and bromine in the atmosphere would not be stopped, but merely slowed down. The most important Article in the Protocol committed the Parties to a Review of Measures every four years, with the first of these in 1990. Without this Article the outlook would have been very bleak!

This seemed a very poor return for negotiations that had begun in 1977. Richard Benedick, the chief US negotiator, has said that the Montreal Protocol was an application of the precautionary principle. A simpler interpretation would be that the working group had been overtaken by events. The ozone depletion in early spring over Antarctica, reported in *Nature* in May 1985, was much more severe than any prediction, and was confirmed by NASA in October 1985. In reporting the NASA results, the *Washington Post* gave the world the expressive term 'ozone hole'. Du Pont, reminded of a promise made in 1975, wrote to its CFC customers in September 1986, declaring that it now accepted the need for some controls. Also in 1986, the US National Ozone Expedition (NOZE) to McMurdo Station in Antarctica had produced much evidence to support the view that the depletion was driven by chlorine chemistry. In September 1987, attention was again focused on Antarctica, with press releases expected from NOZE II, and from the US Airborne Antarctic Ozone Experiment (AAOE), whose planes had flown from Punta Arenas in Chile into and under the ozone hole. The timing of the announcement of the Protocol, and the weakness of the measures, make sense only as a pre-emptive move astutely designed to preserve some credibility for the negotiators, and to give industry time for orderly reorganisation.

Success, compromise, muddle, failure – all these terms have been used to describe the 1987 Protocol. There can be no doubt that it was a psychological breakthrough. However, the terms were tempered by what was thought

Antarctica

practicable, and the ultimate objective was not clearly defined. The Protocol was ratified and came into force on 1 January 1989 in line with the timetable. Meanwhile sales of CFCs and halons had reached record levels! The review procedure was set in motion at once. By then a consensus had been reached on the main scientific issues, NGOs had fought vigorous campaigns for public awareness, and industry was responding to the problem much faster than had initially seemed possible. The London Amendments in 1990, although substantially stronger than the original Protocol, were nevertheless disappointing by comparison with statements made by most of the Parties in preparatory meetings. Subsequent adjustments and amendments were needed at Copenhagen 1992, Vienna 1995, Montreal 1997 and Beijing 1999. There were two noteworthy events in the preparations for the Beijing meeting. The Multilateral Fund for the Implementation of the Montreal Protocol (MFMP) approved 150 million USD for China and 82 million USD for India, to fund the complete closure of CFC production in those countries within 10 years.

The main concern in all these negotiations was to replace CFCs quickly with new chemicals; hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) being the options preferred by industry. Some 75 per cent of the global production of CFCs was in the hands of 13 groups of companies, who were quite content to close down old CFC plant if the Protocol would allow reasonable time for the industry to profit from investment in HCFC and HFC production. The negotiators readily accepted this; these transitional substances were made subject to guidelines rather than controls, and their future was originally left open-ended, as consensus could not be reached on a phase-out date.

In my view this approach was deeply flawed. Technical surveys had already shown that large quantities of CFCs and halons had been released unnecessarily by poor working practices. The quantities of replacements needed were much less than current consumption. More emphasis should have been placed on prudent long-term goals, with active encouragement of the development of halocarbon-free and energy-efficient technologies, to protect the ozone layer, to slow down the forcing of climate change and to reduce the cost of improvements to living standards in developing countries.

There is still some unfinished business. The amount of halon 1301 (used in large stationary fire protection systems, for large computers, and for important art collections, for example) in the atmosphere is still rising, and is likely to continue to do so for at least 10 years, despite the fact that production in developed countries ceased in 1994. There is some production in developing countries, due to cease in 2010. There was for a few years a black market in halons from clandestine producers, but this appears to have been greatly reduced by more effective control of the shipment of chemicals. The main sources now are leaks from existing installations and losses during recycling. It is surely time to consider collecting the existing stockpile, and destroying it.

Looking to the future

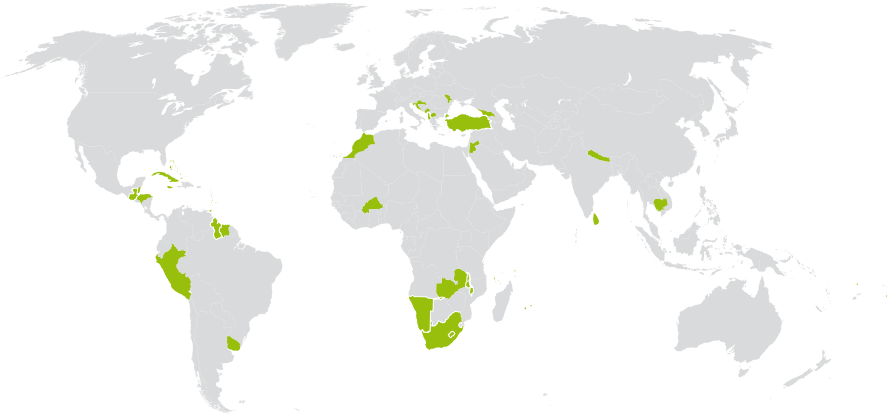
As things stood until 2007, the Montreal Protocol did not control the consumption of HCFC22 (used mainly for air-conditioning equipment) in developing countries until 2016, and allowed these countries to maintain 2015 consumption levels until complete phase-out by 2040. (In developed countries HCFC consumption should effectively cease by 2020.) A by-product of the manufacture of HCFC22 is HFC23, a greenhouse gas with a global warming potential 11700 times greater than that of carbon dioxide. In developing countries this used to be allowed to escape into the atmosphere. Now, any which is trapped and burnt can be counted as a credit for carbon trading under the Clean Development Mechanism (CDM) of the Kyoto Protocol. In 2005, the destruction of HFC23 accounted for 64 per cent of the value of all CDM projects, and 51 per cent in 2006. It is reported that an Indian chemicals firm (SRF) has so far sold credits worth 96 million USD in the 2006-07 financial year, its second largest revenue stream. This example acts as a reminder that international protocols are seen by some as one more set of rules from which to gain advantage. There is currently much debate on whether carbon trading based so heavily on burning HFC23 constitutes sustainable development.

Proposals to accelerate the phase-out of HCFCs were agreed in principle in 2007, but have yet to be implemented. If and when implementation takes place, it will be perhaps be time to declare the Protocol fit for purpose. We may applaud what has been achieved, but deplore the time that it has taken to reach this position. Nevertheless, in comparison with the wrangling and confusion of the 2009 Copenhagen Climate Change Summit, the Montreal Protocol has been a Good Thing! ■

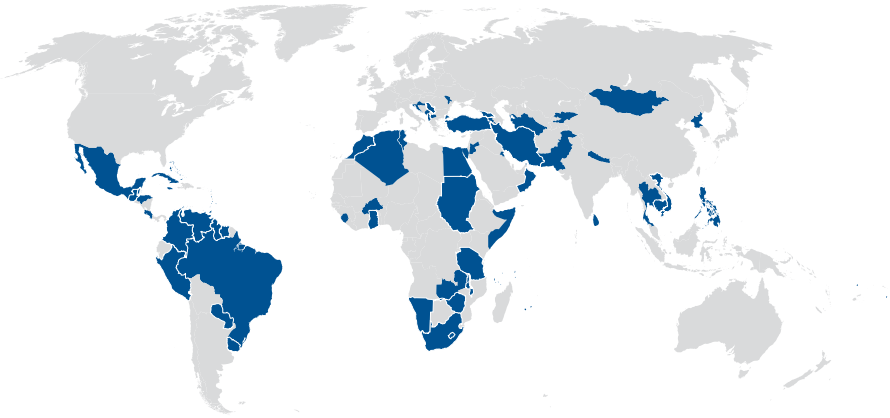
Ahead of the Curve: Article 5 Countries Reporting Early Phase-out of CFCs, Halons and CTC

A number of countries have reported data for 2009 which shows they have achieved early phase-out of the consumption of one or more of the major groups of ozone depleting substances: CFCs, Halons and CTC, ahead of the Montreal Protocol schedule. The maps below highlight those countries.

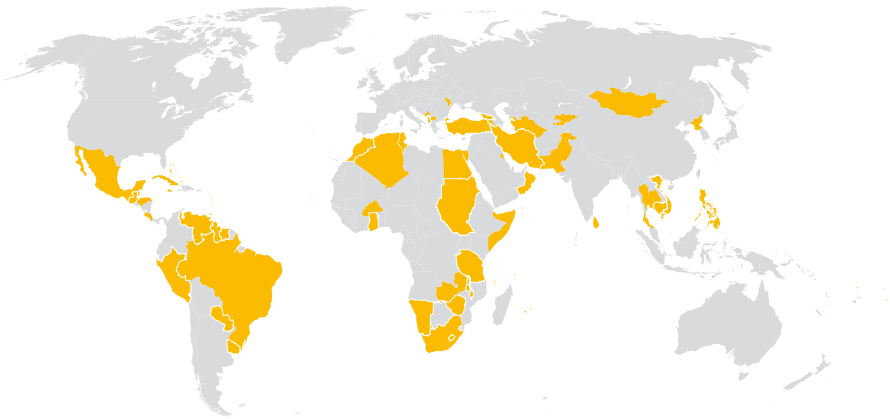
Countries reporting zero consumption of CFCs in 2009



Countries reporting zero consumption of Halons in 2009



Countries reporting zero consumption of CTC in 2009



*Source: Ozone Secretariat, data as of 25 August 2010

	CFCs	Halons	CTC
Albania	■	■	■
Algeria		■	■
Antigua and Barbuda	■	■	■
Armenia		■	■
Bahamas	■	■	■
Barbados	■	■	■
Belize	■	■	■
Brazil		■	■
Burkina Faso	■	■	■
Cambodia	■	■	■
Colombia		■	
Costa Rica		■	■
Croatia	■	■	
Cuba	■	■	■
Democratic People's Republic of Korea		■	■
Dominica	■	■	■
Egypt		■	■
Georgia	■	■	■
Ghana		■	■
Grenada	■	■	■
Guatemala	■	■	■
Guyana	■	■	■
Honduras	■	■	■
Iran (Islamic Republic of)		■	■
Jamaica	■	■	■
Jordan	■	■	
Kuwait		■	■
Kyrgyzstan		■	■
Lesotho	■	■	■
Malawi	■	■	■
Mauritius	■	■	■
Mexico		■	■
Mongolia		■	■
Montenegro	■	■	■
Morocco	■	■	■
Namibia	■	■	■
Nepal	■	■	
Niue	■	■	■
Oman		■	■
Pakistan		■	■
Paraguay		■	■
Peru	■	■	■
Philippines		■	■
Republic of Moldova	■	■	■
Saint Lucia	■	■	■
Saint Vincent and the Grenadines	■	■	■
Serbia		■	
Seychelles	■	■	■
Sierra Leone		■	
Somalia		■	■
South Africa	■	■	■
Sri Lanka	■	■	■
Sudan		■	■
Suriname	■	■	■
Thailand		■	■
The Former Yugoslav Republic of Macedonia	■	■	■
Trinidad and Tobago	■	■	■
Tunisia		■	■
Turkey	■	■	■
Turkmenistan		■	■
Tuvalu	■	■	■
United Republic of Tanzania		■	■
Uruguay	■	■	■
Venezuela (Bolivarian Republic of)		■	■
Vietnam	■	■	■
Zambia	■	■	■
Zimbabwe		■	■

Article 5 countries reporting zero consumption for CFCs, Halons and CTC in 2009

For a detailed graphical representation of the ODS consumption trends of these and other countries, please visit http://www.unep.fr/ozonaction/information/trends/index.htm

The Montreal Protocol Can Deliver Fast Action on Climate

Stephen O. Andersen, *Co-Chair Montreal Protocol's TEAP;* **K. Madhava Sarma**, *former Executive Secretary of Ozone Secretariat;* **Durwood Zaelke**, *President of IGSD and Director of INECE*

Humans are rapidly driving Earth towards atmospheric and ecosystem tipping points and putting us at risk from climate change. Many international initiatives aimed at achieving agreement on bold measures to mitigate climate change are stalled. In this situation, the only way forward is to use our best-performing institution – the Montreal Protocol – to take fast action to reduce threats to the climate and buy time for a strong multilateral agreement focused on carbon dioxide (CO_2).

The Montreal Protocol is recognized as the most successful multilateral environmental agreement to date for the following reasons:

- Near complete phase-out of almost 100 targeted ozone-depleting substances in the past 20 years with extraordinary climate co-benefits because the ozone-depleting substances (ODS) are also potent greenhouse gases;
- Every country a member of the treaty, with near perfect compliance over two decades;
- Approximately US$3 billion of investment fuelling global market transformation with little impact on product price, and no unwanted change in lifestyle; and
- Lean and effective institutions and supporting networks respected by all governments and industry stakeholders.

The Protocol has obligations for both developed and developing countries, financing for the incremental costs of developing countries, compliance assistance backed up with necessary trade controls, and UN institutions that execute their responsibilities in a pragmatic manner in close cooperation with national authorities.

The Montreal Protocol community of diplomatic, technical, and financial experts, who have a long history of working together for the benefit of the atmosphere, can take action to mitigate climate faster and more effectively than any other global network. They have already achieved much but they can do still more, including the following:

At the Montreal Protocol: Phase down production and use of high-global warming potential hydrofluorocarbons (high-GWP HFCs) employed as substitutes during the early days of ODS phase-out. This requires leapfrogging over high-GWP HFCs during the ongoing hydrochlorofluorocarbon (HCFC) phase-out, while also taking out the high-GWP HFCs that replaced CFCs. It is also important to collect and destroy ODS and HFCs in the 'banks' of discarded products and equipment and to shift feedstock and process agent uses not achieving minimal ODS and GHG emissions from global exemption to essential use exemption.

At the Multilateral Fund (MLF): Increase replenishment to enable countries to move faster than mere compliance with mandated controls on ODS.

At UNEP OzonAction Programme, Regional Networks, and National Ozone Offices: Build more capacity for information sharing and technology partnerships.

At UNDP, UNIDO, World Bank, and other implementing agencies of the MLF: Organize carbon funding to bridge the gap between ozone and climate investments to leapfrog high-GWP HFCs while pushing energy efficiency for sustainable development.

In national capitals: Reward climate protection undertaken by business and citizens. Label, tax, or ban non-essential products and services that have high climate footprints. Start with changing government procurement rules. Have 'Top Runner' programmes as pioneered in Japan to require that all products achieve the same or higher energy efficiency as the best product sold three years previously. Shift taxes or charges to force petroleum and coal companies to price their non-renewable and high-risk energy at the real cost to society, including the risk of economic and ecological catastrophe, which after the BP oil spill in the Gulf of Mexico is more than obvious. Promote low-GWP HFCs and natural refrigerants, while progressively prohibiting the high-GWP HFCs.

In environmental NGOs: Be a bigger part of the solution by advocating technological development that goes beyond (but includes) natural refrigerants and by embracing life-cycle, start-and-strengthen, and fast action as guiding principles.

In companies: Be vocal in support for MLF replenishment to leap-frog high GWP HFCs, to finance energy efficiency gains during the transition, and to collect and destroy banks of ODS and HFCs in discarded products and equipment. Demand fast phase-out of high GWP HFCs – in the same way that companies previously promoted phase-out of CFCs – and share technology among both developing and developed countries, on a fair and equitable basis worldwide.

The Montreal Protocol and its global community are ready and able to do more for future generations. ■

Publications

2010 Communication Strategy for Global Compliance with the Montreal Protocol: Presents plans for the OzonAction Clearinghouse plus strategic approaches for ICE delivery to Article 5 countries.

Vital Ozone & Climate Graphics: Important updates on HCFC phase-out and the use of alternatives, plus an examination of links between ozone depletion and climate change. Available in A, C, E, F, R, S, P.

Manual for Refrigeration Servicing Technicians: A handbook for those involved in training and organisation of service and maintenance of refrigeration and air-conditioning (RAC) systems. Available as an e-publication which is downloadable and printable.

Foam Technology Source Book: A comprehensive guide to selection of appropriate alternatives to HCFCs in the Flexible and Rigid foam sector, with particular emphasis on minimizing climate impact.

HCFC Policy and Legislative Options: Outlines short and medium-term measures that will enable developing countries to meet the new HCFC phase-out schedule and remain in compliance with the Montreal Protocol.

Case studies on HCFC Replacement in the RAC Sector: A global information resource to help developing countries make decisions about HCFC-free alternatives in the Refrigeration & Air conditioning sector.

Ozzy & Zoe Go Around the World: An Implementation Manual for Ozzy Ozone Campaign: This useful training guide will help National Ozone Units implement the Ozzy Ozone campaign successfully at the regional and national levels.

All publications above are available from UNEP DTIE OzonAction website at:
http://www.unep.fr/ozonaction/information/mmc/main.asp

JumpStart HCFC *Phase-Out for Ozone and Climate Benefit:* A project to encourage developing countries to expedite their compliance with the HCFC phase-out obligations and adopt environmentally friendly alternatives to HCFCs.
http://www.unep.fr/ozonaction/topics/hcfc_jumpstart.htm

OzonAction and Social Media: Social media and web 2.0 tools to empower and engage the global ozone community and help developing countries meet Montreal Protocol compliance objectives.
www.youtube.com/ozonaction | www.facebook.com/ozonaction | www.twitter.com/ozonaction | www.slideshare.com/ozonaction |

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