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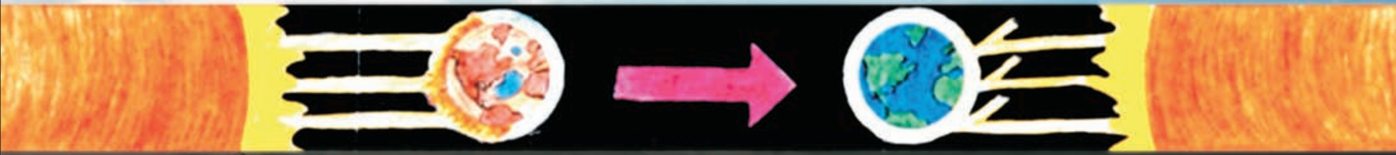
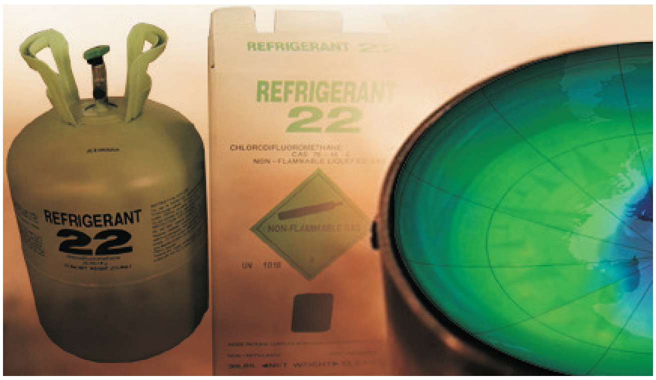
# INTERNATIONAL OZONE DAY, 2011



## HCFC phase-out: A unique opportunity

# Rising to the challenge of HCFC phase-out

*THE YEAR* 2010 observance of International Ozone Day marked yet another milestone for the Montreal Protocol and its Multilateral Fund (MLF), as the year marks the total phase out of three major ozone depleting substances (ODS): chlorofluorocarbons (CFCs), halons and carbon tetrachloride (CTC). By the end of December 2009, Article 5 countries had phased out 250,000 ozone depletion potential (ODP) tonnes of consumption and 196,000 ODP tonnes of production. This accomplishment has not only helped protect the ozone layer but has also provided significant climate benefits since ODS such as CFCs are also very potent greenhouse gases. By 2015, two of the three remaining ODS, namely methyl chloroform and methyl bromide, will have been phased out.




achievements, there remains the significant challenge of accelerated phase-out of hydrochlorofluorocarbons (HCFCs), as set out in decision XIX/6 of the Meeting of the Parties to the Montreal Protocol in September 2007. Article 5 countries must comply with the freeze in HCFC consumption and production in 2013 and the 10 per cent and 35 per cent reduction targets in 2015 and 2020.

Over the last three years, the Montreal Protocol and MLF have been working towards supporting the goal of accelerated HCFC phase-out. At its 60th Meeting in April 2010, the Executive Committee (ExCom) of MLF agreed the majority of policies to enable developing countries to initiate their HCFC phase-out activities and to reflect in full the spirit of decision XIX/6. In this context, ExCom also included consideration of more funding for introducing low global warming potential (GWP) alternatives to HCFCs. This marks a small but significant change from MLF's approach to select the lowest cost technology to achieve the required reduction in ODS.

ExCom is developing an approach to prioritize the technologies that will replace HCFCs so that the most cost effective and environmentally friendly technologies could be chosen.

ExCom is now fully engaged in helping Article 5 countries to phase-out HCFCs and this spirit will continue to guide the way ahead towards the goal of full compliance with the control measures of the Montreal Protocol, including those for HCFC.

***Pakistan contributing to save the ozone layer***

Pakistan is committed to contribute towards global efforts for the conservation and improvement of environment. Pakistan is in full compliance with regard to the import and consumption limits of first generation of Ozone Depleting Substances (ODS). Moreover, Import and consumption of these substances has been completely eliminated.

Government of Pakistan with the support of Multilateral Fund (MLF) of the Montreal Protocol has extended financial and technical assistance to the industry to switch over from ODS-based technology to Ozone Friendly Technology (OFT) through the implementing agencies, World Bank, UNIDO, UNDP and UNEP.

Pakistan has taken various initiatives for the preservation of environment over the past two decades and is a party to 14 International Conventions/Protocols and Multilateral Environmental Agreements (MEAs) including the Montreal Protocol on the Substances that Deplete the Ozone Layer.

The year 2010 has been indeed a landmark for the Montreal Protocol with the first phase of ODS have been phased out.

Chlorofluorocarbons (CFCs) phase out in Metered Dose Inhalers (MDIs) manufacturing was a challenge for Pakistan at a crucial juncture when Pakistan moved towards elimination of 100 per cent CFCs. Another issue is the accelerated phase out of Hydro-chlorofluorocarbons (HCFCs) in foam, refrigeration and air-conditioning sector through a gradual phase out schedule by 2030.

In line with the decision taken by 19th meeting of Parties (MoP-19) held at Montreal, Canada in 2007, the parties to the Montreal Protocol are committed to accelerate the elimination of HCFCs. In this connection, Pakistan has already submitted HCFC Phase out Management Plan for approval in the 62nd Executive Committee.

Illegal trans-boundary movement of ODS is another area of concern for almost all the countries. Pakistan is endeavoring to curb this menace with the collaborative efforts of national and international key players. Government of Pakistan is committed to protect the Ozone Layer and Environment and extending all possible support to the global community at all levels.

Pakistan is among 195 countries of the world, which are signatories to the Montreal Protocol which shows the consensus and commitment of global community for the preservation of fragile ozone layer.

*(Source: www.uneptie.org)*

# Ozone depletion and climate change

*SOME PEOPLE* confuse issues of climate change or "global warming" with the issue of depletion of the ozone layer. These are in fact two separate albeit related issues.

Ozone is a naturally occurring but rare gas; its molecules are made up of three atoms of oxygen. Ozone forms in the stratosphere between 10 and 50 kilometres above the earth as incoming ultraviolet radiation breaks molecular oxygen (two atoms) into atomic oxygen (a single atom). When a free oxygen atom encounters an oxygen molecule, they may bond to form a molecule of ozone (O3). Ninety per cent of ozone exists in the stratosphere, the upper atmosphere. Although it is rare, ozone is essential to life on earth. The ozone layer absorbs most of the harmful ultraviolet-B radiation from the sun and filters out lethal UV-C radiation.

The total amount of ozone above the surface of the earth varies with location on timescales that range from daily to seasonal. The variations are caused by stratospheric winds and the chemical production and destruction of ozone. Total ozone is generally lowest at the equator and highest near the poles because of the seasonal wind patterns in the stratosphere.

It should also be noted that ozone is a "secondary pollutant" resulting from the chemical reaction of primary pollutants (volatile organic compounds) in the presence of sunlight.

In 1985, scientists discovered a hole in the stratospheric ozone layer above the Antarctic. This discovery raised concerns amongst the international scientific community.

High stratospheric clouds are made up of tiny particles of frozen water, which contain chlorine held in inactive compounds such as hydrogen chloride, hydrochloric acid and chlorine nitrate (at temperatures lower than around –85° C.). These compounds do not react with ozone during the darker winter months, but when spring arrives, ultraviolet radiation from the sun acts as a catalyst and causes reactions on the surfaces of the water particles, converting the inactive compounds to reactive chlorine monoxide, which destroys ozone at a very rapid rate. Similar reactions occur with bromine, which destroys

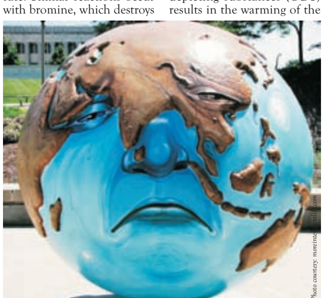


Photo courtesy: moreintelligentlife.com

**The ozone layer over the Antarctic has steadily weakened since measurements started in the 1980s, and in 2003, the size of the ozone hole peaked at around 28 million square kilometres, making it the second largest on record**

ozone at an even greater rate.

The human-produced chemicals which have provided most of the chlorine and bromine for ozone depletion are methyl bromide, methyl chloroform, carbon tetrachloride and families of chemicals known as halons, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).

The ozone layer over the Antarctic has steadily weakened since measurements started in the 1980s, and in 2003, the size of the ozone hole peaked at around 28 million square kilometres, making it the second largest on record.

Ozone depletion produces an indirect cooling effect, while an abundance of ozone-depleting substances (ODS) results in the warming of the atmosphere. These two climate-forcing mechanisms do not simply offset one another. The interaction between these two processes is more complicated. However, it is well established that the phase-out of CFCs, which have a high global warming potential, has resulted in a

# HCFC phase-out management plan

***HYDROCHLOROFLUOROCARBONS (HCFCS)*** have always been considered as an interim solution to Chlorofluorocarbons (CFC) Phase-out, because of their lower Ozone Depleting Potential (ODP) which is between 5-10% when compared to CFCs. While the Global Warming Potential (GWP) of HCFCs is high (600-2,200 CO2-equivalent), it is much lower than that of CFCs (6,000-10,600 CO2-equivalent).

Photo courtesy: NASA

**There are currently 34 controlled HCFCs, but only a few are commonly used. The most widely used have been HCFC-22 (usually a refrigerant), HCFC-141b (a solvent and foam-blowing agent), and HCFC-142b (a foam-blowing agent and component in refrigerant blends)**

The majority of HCFCs have a high GWP. Their phase-out through the introduction of lower GWP alternatives will therefore contribute significantly to climate change mitigation. Depending on the alternative selected, this contribution can be very significant or can be so deleterious and of such magnitude as to nullify the efforts a country is undertaking via other voluntary actions, such as efficient lighting or appliance replacement programmes to achieve energy savings.

In 2007, the Parties to the Montreal Protocol agreed to accelerate the phase-out of HCFCs (initially targeted for 2040) largely because of the substantive climate benefits this would bring about. Parties operating under the Montreal Protocol's Article 5(1) (mostly developing countries) may receive financial assistance from the Multilateral Fund for the implementation of the Montreal Protocol (MLF) to formulate their overarching strategy and prepare HCFC Phase-out Management Plans (HPMPs). The control steps under the adjusted Montreal Protocol for these parties are: i) "freeze" of HCFC production and consumption by 2013 (the baseline being the average of 2009 and 2010); ii) reduction of 10% by 1 January 2015; iii) 35% reduction by 2020; iv) 67.5% reduction in 2025; v) 97.5 reduction by 2030; and vi) 100% phase-out by 2040.

Hydrochlorofluorocarbons (HCFCs) are ozone-depleting substances and, under the terms of the Montreal Protocol, the production and consumption of HCFCs will be phased out in developed countries over the next 20 years. HCFCs are used extensively in the refrigeration and air conditioning industry, the most common being R-22.

The challenge for the refrigeration and air conditioning industry and equipment owners is to prepare for the orderly move from HCFC refrigerants to the many alternatives offered in the refrigeration marketplace. This is becoming more important when the typical life cycle of 10 to 30 years for HCFC equipment is taken into consideration. Based on these life cycle timeframes and the phase-out schedule for HCFCs, industry members and their customers need to be aware of the facts on the HCFC phase-out and the alternatives available when planning for future

# The Montreal Protocol and the Ozone Layer

*THE SCIENTIFIC* confirmation of the depletion of the ozone layer prompted the international community to establish a mechanism for cooperation to take action to protect the ozone layer. This was formalized by a treaty called the Vienna Convention for the Protection of the Ozone Layer, which was adopted and signed by 28 countries on 22 March 1985 in Vienna.

This led in September 1987 to the drafting of the Montreal Protocol on Ozone Depleting Layer (ODL) substances. The Protocol was signed by 24 countries and by the European Economic Community and entered into force on 1 January 1989.

The treaty states that the Parties to the Montreal Protocol recognize that worldwide emissions of ozone-depleting substances (ODSs) significantly deplete and otherwise modify the ozone layer in a manner that is likely to result in adverse effects on human health and the environment.

The provisions of the Protocol include the requirement that the Parties to the Protocol base their future decisions on the current scientific, environmental, technical and economic information assessed by panels drawn from the worldwide expert communities.

**The principal aim of the Montreal Protocol is to protect the ozone layer by taking measures to control total global production and consumption of substances that deplete it, with the ultimate objective of eliminating them, based on developments in scientific knowledge and technological information**

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The Montreal Protocol is structured around several groups of ozone-depleting substances. The groups of chemicals are classified according to chemical family and are listed in annexes to the Montreal Protocol text. Ozone-depleting substances are therefore sometimes referred to according to the annex in which they are listed in the Montreal Protocol.

The Montreal Protocol requires the control of nearly 100 chemicals, in several categories. For each group or annex of chemicals, the treaty sets out a timetable for the phaseout of production and consumption of those substances, with the aim of eventually eliminating them completely.

The timetable set by the Montreal Protocol applies to consumption of ozone-depleting substances. Consumption is defined as the quantities produced plus those imported, less those quantities exported in any given year. There is also a deduction for verified destruction.

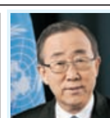
Percentage reductions relate to the designated "base year" for the substance. The Protocol does not forbid the use of existing or recycled controlled substances beyond the phase-out dates.

Attention was focused initially on chemicals with higher ozone-depleting potentials, including CFCs and halons. The phase-out schedule for HCFCs was more relaxed due to their lower ozone-depleting potentials and because they have also been used as transitional substitutes for CFCs.

The HCFC phase-out schedule was introduced in 1992 for both developed and developing countries, the latter with a freeze in 2015 and a final phase-out by 2030 in developed countries and by 2040 in developing countries. In 2007, the Parties to the Montreal Protocol decided to accelerate notably the HCFC phase-out schedule both for developed and for developing countries.

The Montreal Protocol embodies the international agreement on the overall scope and timescales for phase-out of ozone-depleting substances (ODS), and the Multilateral Fund, through its Secretariat and the implementing agencies, provides a financial and technical support mechanism. The financial assistance to developing countries covers the agreed incremental costs, which must be determined on the basis of the indicative list of categories of incremental costs adopted by the Parties to the Montreal Protocol.

However, the implementation of



*UN Secretary-General Ban Ki-moon*

**Message on the International Day for the Preservation of the Ozone Layer**
**16 September 2011**

***"HCFC phase-out: a unique opportunity"***

The international community adopted the Montreal Protocol on Substances that Deplete the Ozone Layer to protect the earth from harmful ultraviolet radiation. In more than 24 years of successful implementation, the Protocol has been gradually strengthened to cover the phase-out of nearly 100 ozone-depleting substances. The latest adjustments were adopted in 2007 to accelerate the phase-out of hydrochlorofluorocarbons, or HCFCs.

HCFCs are both ozone-depleting substances and powerful greenhouse gases: the most commonly used HCFC is nearly 2,000 times more potent than carbon dioxide in adding to global warming. By agreeing to speed up the phase-out of HCFCs, Parties to the Montreal Protocol increased their already-substantial contributions to protecting the global climate system.

The level of climate benefits that can be achieved depends on what chemicals and technologies are chosen to replace HCFCs. The phase-out thus presents countries and industries with a unique opportunity to acquire cutting-edge technologies that not only eliminate ozone-depleting compounds but do so in a way that lowers energy costs and maximizes climate benefits. To facilitate this transition in developing countries, the Montreal Protocol's Financial Mechanism is providing increased funding.

Parties to the Montreal Protocol are now considering further amendments, including proposals to bring hydrofluorocarbons, or HFCs, under the Protocol in a manner that would complement existing efforts under the UN Framework Convention on Climate Change and its Kyoto Protocol. HFCs do not deplete the ozone layer but are highly potent greenhouse gases, and their consumption has been increasing rapidly as they are being used to replace HCFCs.

I urge Parties and industries to seize the opportunity provided by the HCFC phase-out to leapfrog HFCs wherever possible. Only by limiting global climate change can we hope to achieve sustainable development for all.

# Foam industry to completely phase out use of HCFC

***FOAM BLOWING*** is one on the main uses of HCFCs globally. HCFC-141b, HCFC-142b and HCFC-22 are used in the manufacture of several types of polyurethane foams and extruded polystyrene and polyethylene foams.

Polyurethane and polystyrene foams have very good insulation properties and good strength-to-weight ratios and are used in a very wide range of applications. They are very commonly used as thermal insulation for refrigerators, freezers and cold boxes, and in the construction industry as thermal insulation for roofs, walls and storage containers. Flexible polyurethane foams are also used extensively for cushioning in furniture and some types of packaging, and to manufacture a wide range of components for the automotive industry.

Increasing oil prices and global efforts to reduce energy consumption and carbon dioxide emissions have led to new regulations and requirements for insulation levels in the construction of new buildings. This has resulted in increased demand for and production of polyurethane and polystyrene foam, as their use is a primary method of improving insulation and reducing energy losses.

Polyurethanes are forms of plastic. They were first developed in late 1930s by the German chemist, Otto Bayer, and since then they have come to be among the most versatile and widely used plastic polymers. They are used in building insulation, surface coatings, adhesives, solid plastics, and shoes, as well as flexible foams.

Polyurethanes belong to a larger class of compounds called polymers. They are synthetic (man-made) polymers produced by chemical reactions where single molecules known as monomers are joined together into chains of molecules; chemicals consisting of these chains of molecules are known as polymers.

Polyurethanes can be produced in four different forms, namely, flexible foams, rigid foams, elastomers and coatings.

Rigid foams can some times be referred to as crosslinked foams, as the cross linking of the polymer chains causes rigidity.

Flexible foams are the largest market for polyurethanes. These materials have a high impact strength and are used for making most furniture cushioning. They also provide the material for mattresses and seat cushions in furniture. Semi-flexible polyurethane foams are used to make car dashboard and door liners. Other uses include carpet underlay, packaging, sponges, squeegees and interior padding.

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Rigid, or cross-linked, polyurethane foams are used as insulation in refrigerators, freezers and cold boxes and to produce insulation in the form of boards or laminates. Laminates are used extensively in the commercial roofing industry, and buildings are often sprayed with polyurethane foam.

Elastomers are materials that can be stretched, but will eventually return to their original shape. They are useful in applications that require strength, flexibility, abrasion-resistance and shock-absorbing qualities. Thermoplastic polyurethane elastomers can be moulded and shaped into different parts. This makes them useful as base materials for automobile parts, ski boots, roller-skate wheels, cable jackets and other mechanical goods. When these elastomers are spun into fibres, they produce a flexible material called spandex. Spandex is used to make sock tops, bras, support hose, swimsuits, and other athletic apparel.

Polyurethane Coatings show a resistance to solvent degradation and have good impact resistance. These coatings are used on surfaces that require abrasion resistance, flexibility, fast curing, adhesion and chemical resistance, such as bowling alleys and dance floors. Water-based polyurethane coatings are used for painting aircraft, automobiles and other industrial equipment.

A blowing agent is any substance which alone or in combination with another substance produces the cellular structure which creates the foam. There are different ways to produce the gas bubbles that create the foaming effect in polyurethane.

Blowing agents are generally classified as physical or chemical. Chemical foaming agents are generally solids and undergo a chemical transformation when producing gas, while physical foaming agents undergo a generally reversible physical change of state, for example vaporization.

Other appliances include commercial refrigerators and freezers, display units, vending machines, cool boxes and other articles that require high insulation levels and strong lightweight structures, such as water heaters, where foam insulation leads to a significant saving in energy consumption, particularly in designs where the space for insulation is limited.

For the replacement of HCFC-141b, the blowing agents being considered are HFC-245fa and HFC-365mfc. The question of whether HFC-245fa can be supplied preblended into formulations will be an important factor in its widescale use in temperate and tropical climates, and this issue is being studied.

The various forms of pentane are also technically suitable, but the cost of appropriate safety measures and the difficulty in supplying pre-blended formulations may rule out widescale use, as many of the manufacturers in this sector are comparatively small enterprises.

HFCs are (or will be) available to meet transition requirements, although efforts will need to focus on optimization of formulation costs if these blowing agents are to see widespread use in polyurethane and extruded polystyrene board foams.

The "green building" agenda continues to militate against high-GWP blowing-agent solutions, although often without proper reference to comparative LCCP assessments. Nevertheless, where parity of performance can be achieved and demonstrated with lower-GWP solutions, uncertainties about future blowing-agent containment during the life cycle can be circumvented.

*Continued from Page I:* *HCFC phase-out management plan*

refrigeration and air conditioning equipment needs.

There are a wide variety of options available to replace both HCFC refrigerants and equipment or systems. The most widely-accepted replacement option for HCFCs is the use of hydrofluorocarbons (HFCs). Ammonia is also a replacement option in the large commercial air conditioning and refrigeration sectors. These refrigerants do not deplete the ozone layer and can replace both CFC and HCFC uses.

There are currently 34 controlled HCFCs, but only a few are commonly used. The most widely used have been HCFC-22 (usually a refrigerant), HCFC-141b (a solvent and foam-blowing agent), and HCFC-142b (a foam-blowing agent and component in refrigerant blends).

Almost 100 per cent of residential and commercial air conditioning equipment (excluding large air conditioning systems called chillers) has traditionally operated on HCFC-22 (R-22). The current refrigerant alternatives for residential and commercial air conditioning equipment are HFC blends. Some of these blends can be applied to existing equipment with modifications to the systems. Others can only be used with new equipment designed for the specific refrigerant blend.

As a Party to the Montreal Protocol, the Pakistan must incrementally decrease HCFC consumption and production, culminating in a complete HCFC phaseout in 2030. The major milestones that are upcoming for developed countries are a reduction in 2010 to at least 75 percent below baseline HCFC levels and a reduction in 2015 to at least 90 percent below baseline.

HCFC-22 is also referred to as R-22. It is a popular refrigerant that is commonly used in a variety of refrigeration and air-conditioning equipment, including:

***Residential Uses***

- Window air-conditioning units
- Dehumidifiers
- Central air-conditioners
- Air-to-air heat pumps
- Ground-source heat pumps
- Ductless air-conditioners
- Chest or upright freezers

***Commercial and Industrial Uses***

- Packaged air-conditioners and heat pumps
- Chillers
- Retail food refrigeration
- Cold storage warehouses
- Industrial process refrigeration
- Transport refrigeration

HCFC-22 is often used as a component in refrigerant blends.

# Significance of ozone day

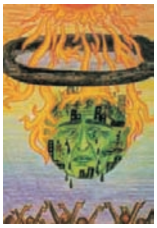
***SINCE 1995***, on 16 September each year, the International Day for the Preservation of the Ozone Layer is celebrated. This date has been designated by the United Nations General Assembly in its resolution 49/114, to commemorate the signing of the Montreal Protocol on Substances that Deplete the Ozone Layer.

This commemoration around the world offers an opportunity to focus attention and action at the global, regional and national levels on the protection of the ozone layer. All Member States are invited to devote this special day to promotion, at the national level, of concrete activities in accordance with the objectives and goals of the Montreal Protocol and its Amendment.

The International Day for the Preservation of the Ozone Layer also affords an opportunity to celebrate the significant benefits brought about by the Montreal Protocol. Specifically, by reducing the production and import of ozone-depleting substances by over 98 per cent, the parties have put the ozone layer firmly on the path to recovery and helped to ensure that present and future generations will reap the benefits of the parties' forward-looking and bold actions.

The theme for the year 2011 celebration is "HCFC phase-out: a unique opportunity". On the occasion of the twentieth anniversary of the Montreal Protocol, the Nineteenth Meeting of the Parties agreed to accelerate the phase-out of production and consumption of hydrochlorofluorocarbons (HCFCs).

HCFCs are ozone-depleting gases and also greenhouse gases that are over 2,000 times more potent than carbon dioxide. The level of climate benefits that can be achieved, however, is highly dependent on the global-warming potential of substitutes and the energy efficiency of alternative technologies that are used to replace HCFCs. In this context, the HCFC phase-out presents countries with a unique opportunity to select cutting-edge technologies that eliminate these ozone-depleting substances while reducing national energy costs and maximizing climate benefits. In so doing, the parties can increase their already substantial contributions to climate protection.



The Ozone Layer describes the protective layer of naturally occurring gas, comprised of three atoms of oxygen found about 10 – 50 km above the earth's surface that protects us from the harmful ultraviolet radiation or UV-B rays of sun. Scientist in the 1970's discovered that the layer was thinning as a result of the release of CFC's, consequently, the Ozone Hole developed. In 1985, nations around the world convened at Vienna in an attempt to develop a framework for co-operative activities to protect the Ozone layer. This signed agreement became known as the Vienna Convention for the Protection of the Ozone Layer.

The UNEP is monitoring compliance with the programmes of the international treaties aimed at eliminating the production and use of ozone-depleting substances, including chlorofluorocarbons (CFCs), and hydrochlorofluorocarbons (HCFCs) used as industrial refrigerants and in aerosols, and the pesticide methyl bromide.

Specifically, developing countries need to focus on eliminating the use of methyl bromide as an agricultural pesticide and they must halt illegal trade in CFCs and HCFCs.

# Environmental impact of ozone depletion

***THE ENVIRONMENTAL*** impact is related to the direct impact on ozone depletion and/or global warming of chemicals released into the atmosphere either naturally or as a result of human activities. For example, methane is released by animals, causing climate impact (natural), and refrigerants can be released during the servicing of equipment (human activity).

In refrigeration and air-conditioning systems, refrigerants can leak during normal operation if the system is not adequately sealed or during maintenance when systems are dismantled or when the system is disposed of at the end of its lifetime. Similarly, in the production of open-cell foams such as those used for cushioning furniture, the blowing agent is released into the atmosphere after the foam has been formed. Once it has been released, the impact caused on the environment is based on the mass of chemical released and its ozone-depletion and global-warming potentials.

However, any system or process that requires an input of energy derived from fossil fuels has an indirect impact on greenhouse gas emissions. This is because burning fuel to generate heat or electricity results in $CO_2$ emissions, and $CO_2$ is a major greenhouse gas.

The indirect impact is particularly important in relation to refrigeration and air conditioning systems, since these consume significant amounts of electrical power during their lifetimes, which may be more than 20 years. For insulating foams, the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contribution to energy-saving is an even more important factor, in view of the potential for even longer lifetimes.

The total environmental impact attributed to refrigeration or air-conditioning systems containing ODSs over their life cycles is therefore a factor of the direct emissions of greenhouse gases and ozone-depleting substances from the equipment and the global warming impact of electrical energy consumed in their lifetimes, as well as the impact of carbon emissions related to the manufacture, transportation and destruction of plant and chemicals.

The choice of an HCFC phase-out technology will have an impact on the environment in a number of ways. Clearly, there will be an environmental benefit related to ozone depletion from the phase-out of ozone-depleting substances, but the global warming impact could be negative, neutral or positive relative to the existing technology depending on a number of factors.

A number of the potential alternatives to HCFCs (HFCs and HFC blends) have higher global warming potentials than HCFCs and their use therefore entails a rise in the direct global warming impact of a system, assuming that leakage rates remain the same. However, direct emissions could be reduced if the amount of HFC used was reduced by reducing leakage.

The other factor to be taken into account is the indirect impact resulting from the energy consumption of the system. If a system is made more energy efficient by using more efficient substitutes, or by changing the operation mode, then fewer $CO_2$ emissions will occur in power generation. It is therefore possible that, over the lifetime of the system, the phase-out of HCFC will have a net positive global warming impact.

Of course, if a system is less energy efficient than the previous HCFC-based system, there will be a net negative global warming impact arising from the energy component of the comparison, although this may be offset by gains in the area of direct emissions.

The analysis of the overall environmental impact of HCFC phase-out decisions is therefore relatively complex, and this means that no universal solution can be right for all situations or operating conditions.

*Continued from Page I:* *The Montreal Protocol and the Ozone Layer*

phase-out activities and compliance with phase-out targets is ultimately the responsibility of the governments that are Parties to the Protocol.

One of the principal objectives of the Montreal Protocol and the Multilateral Fund is to facilitate a smooth and sustainable transition from ODS-based technologies to non-ODS technologies without creating local market distortions or increasing social costs resulting from phase-out costs being passed on to the consumer.

The Protocol requires each Party to annually report its production, import and export of each of the chemicals it has committed to phasing out (most countries use no more than four or five of these chemicals).

The Protocol includes a requirement for a regular assessment intended to enable the Parties to make informed decisions on the basis of the most up–to-date information available on science, environmental effects, technology and economics.

*Continued from Page I:* *Ozone depletion and climate change*

significant reduction of $CO_2$-equivalent emissions.

The amount of damage done to the ozone layer is different for different chemicals. The destructive capacity of a chemical depends (amongst other factors) on the number of chlorine or bromine atoms in a molecule and how long the chemical persists in the atmosphere before being broken down itself. The ozone-depleting potential (ODP) of a chemical is a simple measure of its relative ability to destroy stratospheric ozone. It depends on the percentage of chlorine or bromine atoms in the molecule and the lifetime of the compound in the atmosphere.

Many CFCs, HCFCs and HFCs being released into the atmosphere manifest themselves as effective greenhouse gases because they absorb infrared radiation going out from the earth's surface. Halocarbons can be much more efficient in absorbing radiant energy than $CO_2$. Global warming potential (GWP) is used to measure the warming impact of specific chemicals.

The majority of HCFCs have a high GWP. Their phase-out through the introduction of lower GWP alternatives will therefore contribute significantly to climate change mitigation. Depending on the alternative selected, this contribution can be very significant or can be so deleterious and of such magnitude as to nullify the efforts a country is undertaking via other voluntary actions, such as efficient lighting or appliance replacement programmes to achieve energy savings.

Agreements adopted at the United Nations Climate Change Conference in Cancun, Mexico (December 2010) encourage developing countries to formulate low-carbon development strategies or plans in the context of sustainable development. It is important that countries take into account the HCFC phase-out work when developing their low-carbon strategies and plans. This will allow countries not only control potent greenhouse gases but also utilize the HCFC phase-out as a step towards transformation to green economy.

As the HCFC phase-out will lead to the need to use alternative substances, the real impact on climate will be subject to the success or failure of the selection of alternatives and the pace of their introduction in the country. In addition, a successful strategy to promote the introduction of climate-friendly alternatives as well as control of high GWP technology introduction in the country is of essence.

In RAC servicing sectors, future consumption of HCFCs or alternatives will be subject to the refrigerant contained in the equipment being imported today and in the next five years. If a country does not carefully control the type of equipment being introduced into the market, it could inadvertently increase the future demand of high GWP substances to maintain this equipment in the future. This is particularly relevant considering that many of these appliances are im-