UNEP

# OzonAction

SPECIAL ISSUE 2011


## Tipping the Balance

## Towards Climate Protection through the HCFC Phase-Out

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# HCFC Phase-Out, Energy Efficiency and Climate Benefits

Prof. Dr. Balthasar Kambuaya, Minister of Environment, Indonesia

Energy Efficiency Concept

The Montreal Protocol is the only universally ratified[1] international treaty and provides an outstanding example of shared responsibility, transparent and equitable governance, an efficient financial mechanism, measurable results and market transformation through cooperative actions by governments and industry for protecting the environment. It also demonstrates exemplary collaboration between developed and developing countries and could well serve as a blueprint for a future climate treaty.

Due to the high global warming potential of ozone-depleting substances, their phase-out not only protects the ozone layer, but with prudent technology and policy interventions, can also result in significant reductions in direct and indirect $CO_2$ equivalent emissions, thereby protecting the climate system.

Indonesia has assumed voluntary reductions in $CO_2$ intensity of 26 per cent from business as usual to be achieved by 2020 with financing from its pure state budget. Recognizing the role and potential of the Montreal Protocol to protect the ozone layer and climate system simultaneously, Indonesia's recently approved HCFC Phase-out Management Plan (Stage-I) for meeting the 2013 and 2015 control targets was developed through a close collaboration between government and industry stakeholders, international organizations and bilateral partners.

Due to the expansion of the middle class and rising incomes, the demand for air conditioners in Indonesia has skyrocketed over the past decade. This has resulted in proliferation of the population of air conditioners with HCFC-22 technology and an increase in the demand for HCFC-22 in servicing. Air conditioners are also significantly energy intensive. Indonesia therefore prioritized actions to phase out use of HCFC-22 in air conditioners from 2015. While doing so, we had to ensure that the alternative technologies that would replace HCFC-22 would not only have a low global warming impact, but would also provide significant improvements in energy efficiency. Further, we needed to ensure that forward-looking, effective and enforceable regulations would be in place, which would encourage voluntary compliance without market distortion and sustain the phase-out actions.

We are pleased that in cooperation with our industry and with support from the international community, implementing agencies and our bilateral partners, we are taking this important step towards achieving significant climate benefits, while phasing out ozone-depleting substances.

We would also like to express our appreciation to the Executive Committee of the Multilateral Fund for the recent approval of Indonesia's HPMP (Stage-I) and for acknowledging it as an exemplary strategy.

Going forward, we are aware that the hard work begins now, with technology conversions to be carried out and important policy and regulatory interventions to be enacted in a relatively short time-frame. Indonesia however has full confidence in the solid foundations and strong partnerships which the HPMP (Stage-I) has been built upon.

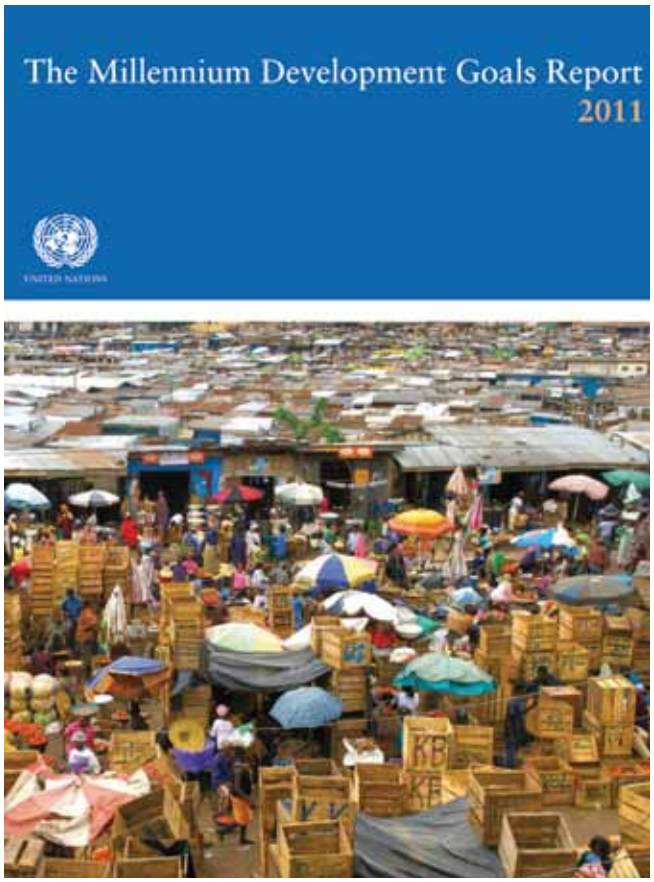
With the support of all our partners, we hope to achieve success and sustainability of actions to protect the ozone layer and the climate.

Finally, we also extend a warm welcome to the international community who will join us at the 9th Conference of the Parties to the Vienna Convention for the Protection of the Ozone Layer and the 23rd Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer that will be held in Bali, on 21-25 November 2011. We hope that the Bali conference and meeting will be a success and will continue to support efforts to accelerate the phase-out of HCFCs and thus provide a dual benefit to both ozone protection and climate change.

Rice terrace fields, Indonesia

[1] South Sudan newly recognized by the UN has not yet ratified the Montreal Protocol.

# Montreal Protocol's Contribution to Reaching Globally-Agreed MDGs Recognized

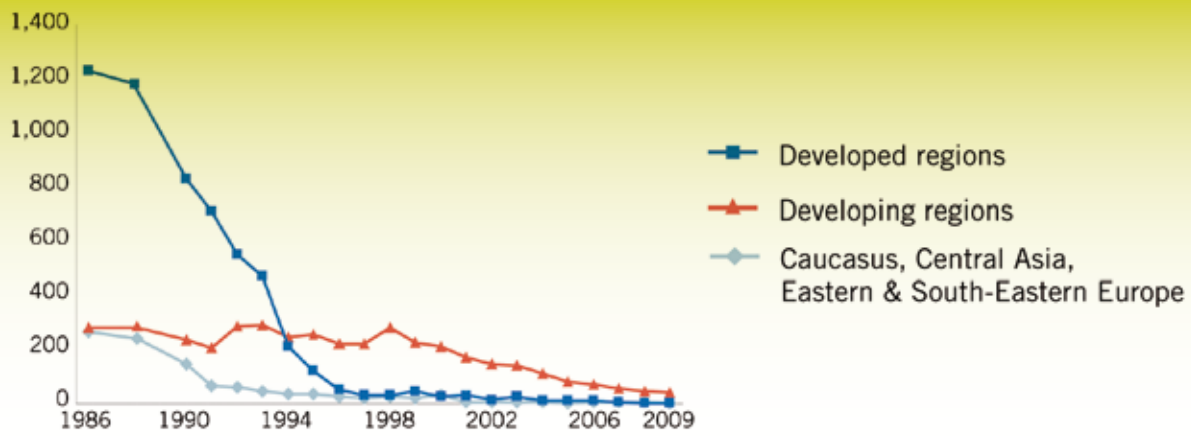



## THE MONTREAL PROTOCOL IS NOT ONLY HELPING TO RESTORE THE OZONE LAYER, BUT TO CURB CLIMATE CHANGE.

"Since they were first adopted, the Millennium Development Goals (MDGs) have raised awareness and shaped a broad vision that remains the overarching framework for the development activities of the United Nations." The following is a quote from 2011 MDGs report refering to The Montreal Protocol is an undisputed-but still unfinished-success story. Much more work remains to be done to ensure the protection of the ozone layer for this and future generations. Still, what the parties to the Protocol have managed to accomplish since 1987 is unprecedented, providing an example of what international cooperation at its best can achieve. As of end-2009, the consumption of 98 per cent of all ozone-depleting substances controlled under the Montreal Protocol had been phased out.

Global observations have verified that atmospheric concentrations of such substances are declining. With full implementation of the Protocol's provisions, the ozone layer is expected to return to its pre-1980 levels around the middle of this century. The Protocol has also delivered substantial climate benefits, since ozone-depleting substances are also global-warming gases. The reduction in such substances between 1990, when they reached peak levels, and 2000 has yielded a net reduction of about 25 billion tonnes equivalent of $CO_2$-weighted global warming gasses."

**Consumption of all ozone-depleting substances (ODSs), 1986-2009**
(Thousands of tonnes of ozone depleting potential)




(Excerpts from pages 3, 50)

**The full report can be downloaded from:**
**www.un.org/millenniumgoals/11_MDG%20Report_EN.pdf**

# Many Hurdles Ahead but China Determined to Meet HCFC Phase-out Challenges

**Jianxin Hu** Professor, Executive Director College of Environmental Sciences and Engineering Peking University


Shanghai, China

The production and consumption of HCFCs in developing countries will be frozen in 2013 at a baseline level, equivalent to the average of the 2009 and 2010 levels, and then reduced by 10 per cent of the baseline level in 2015. As one of the largest developing countries, China is faced with both an opportunity and an enormous challenge in finding effective alternatives to HCFCs.

China has become the largest producer and consumer of HCFCs in the world. The HCFC products made in China not only meet domestic demand, but are also exported to other developed and developing countries. These HCFC products include refrigeration and air conditioning equipment, foam and products which use solvents and process agents. If we regard the HCFC production as ODS, then to fulfill the frozen target and the reduction target of 10 per cent, more than 5,000 tonnes of ozone depletion potential (ODP) will be phased out every year, equivalent to the greenhouse gas (GHG) emissions of 200 million tonnes $CO_2$-eq (including the collaborative reduction of HFC-23). In other words, by phasing out HCFCs to the fullest extent and fulfilling the reduction target of 10 per cent in 2015, then it is possible for China to reduce GHG emissions by 200 million tonnes $CO_2$-eq every year if low-GWP alternatives are introduced. Besides, additional reductions in GHG emissions will be achieved by choosing energy-saving technologies.

However, it is a challenge for the enterprises in China to choose appropriate alternative technologies. Firstly, as a developing country, the research on alternatives to HCFCs in China is still far behind that of developed countries. Only about 2 per cent of national GDP is allocated for research and development by national bodies and enterprises, and the researchers and developers lack the required degree of training and experience. Secondly, standards for the environmental and safety performance of the substitutes are getting higher and higher. To fulfill the required criteria, alternative technologies must be energy efficient, cost-effective and safe. Besides, some limitations imposed by new international protocols also have an impact on the development of alternative technology. For example, if hexabromocyclododecane were restricted (a move which is being discussed in negotiations over amendments to the Stockholm Protocol Conventions for Persistent Organic Pollutants), the use of extruded polystyrene (XPS) foam products as an alternative to HCFCs would become more complicated. Moreover, the limitations on HFC technology also make it more difficult to develop HCFC alternatives. Thirdly, to fulfill the frozen target in 2013 and the reduction target of 10 per cent in 2015, there is insufficient time to complete the process of introducing alternative technologies, including development, demonstration and promotion.

In spite of all this, in order to protect the global environment, enterprises in China have chosen and are adopting climate-friendly and environment-friendly alternative technologies. For example, R290 (Propane) is chosen as the substitute for HCFC-22 in the room air conditioner sector; low-GWP alternatives, such as hydrocarbon (HC) and water blown, are chosen as alternatives to HCFC-141b in the Polyurethane (PU) foam sector; HC and $CO_2$ are chosen as alternatives to HCFC in the XPS foam sector. After low-GWP alternative technologies, such as HC, are adopted, safety becomes the greatest challenge.

It is important that enterprises should make improvements in many areas, including production facilities, security devices, levels of funding, employee quality and technical expertise. To meet these challenges, with the support and assistance of the international community, relevant Chinese government departments, related industry associations and enterprises have simultaneously addressed some important aspects, including co-location to enhance the security aspects of production, process establishment and implementation of safety procedures, amendments to technical standards of the product, and education and training for employees, in order to ensure the safe use and promotion of alternative technologies.

It is imperative to fulfill the reduction target of 10 per cent in 2015. To meet the target, environment-friendly alternatives must be adopted, especially low-GWP and even zero-GWP technologies, to achieve a maximum direct reduction of GHG emissions. Therefore, China's industry expects to work in collaboration with the global community to develop and adopt low-GWP, high-efficient, energy-saving and safe technologies.

# Keeping Cool and Environmentally Safe: A Hot Topic for the Gulf

**Walid Chakroun,** Professor, Mechanical Engineering Department, Kuwait University, Former ASHRAE Director and Regional Chair, Region At Large, ASHRAE
**Ayman Eltalouny,** Programme Officer, UNEP, Regional Office for West Asia, ROWA CAP

In 2007, an important adjustment to the Montreal Protocol triggered another round of technological development for the refrigeration and air conditioning industry. Although the adjustment did not add new controlled substances to the Montreal Protocol and only accelerated phase-out of the hydrochlorofluorocarbons (HCFCs), already known to the industry and international community as a non-viable long-term solution, it did however set new guidelines for choosing alternatives, taking into consideration the climate benefits and global warming-effects of other options.

Up to now, hydrofluorocarbons (HFCs) has failed to demonstrate that they are the most efficient alternatives for air conditioning applications, particularly in high-ambient temperatures. This situation is creating uncertainty with regard to the future of the air conditioning industry, especially in the Gulf Cooperation Council (GCC), and this is placing a burden on one of the most important sectors in the region.

The challenge for the HVAC&R industry and equipment owners is to prepare for an orderly move from HCFC refrigerants to the many alternatives offered in the refrigeration market-place. The future refrigerants should not only have substantial benefits for the environment but they should also provide efficient cooling. The challenges are more pronounced for places such as the Gulf countries which have high ambient temperatures.

The air conditioning sector is considered to be the core of the construction sector in the West Asia region, due to the harsh climatic conditions, where summer temperatures are well into the 40° range in many countries and exceed 50°C in others. The construction sector is the backbone of national development plans and is contributing significantly to the national economies of all West Asian states. In the GCC countries, the air conditioning sector corresponds to an average of 55-65 per cent of the national electrical demand and so is crucial in any strategic planning and development plans.

It is unfortunate that most of the currently commercially available alternatives to HCFC are not as energy efficient as HCFCs. In addition, there are higher cost considerations and other safety concerns associated with use of some flammable and/or toxic long-term alternatives like hydrocarbons and ammonia. HFCs, currently the most prominent alternatives, are also contributing significantly to global warming and also have an indirect global warming impact when operating at high ambient conditions in some applications.

Recent reports from the Technology and Economic Assessment Panel (TEAP), Montreal Protocol, have presented an assessment of the situation in the light of the internationally available alternatives. These reports have supported, to a large extent, the conclusion that there is currently no available long-term and low-GWP alternative that can easily replace R-22 in all air conditioning applications for high-ambient conditions.

As part of its role in supporting developing countries, UNEP has partnered with ASHRAE since 2007 to address key concerns in the refrigeration and air conditioning sectors about the future of alternatives for the air conditioning industry in high-ambient temperatures. UNEP and ASHRAE Kuwait Chapter organized – in cooperation with the Ministry of Electricity and Water (MEW), the Environmental Public Authority (EPA) of Kuwait and the AHRI – the first specialized event on Refrigerants Challenges & Prospects in High-Ambient Temperature Countries; and this was attended by key refrigerants and equipment manufacturers at both international and regional levels.

Countries affected by high ambient temperatures should adopt integrated strategies to ensure smooth transition to non-HCFC and compliance with the Montreal Protocol. However such strategies should include pioneering initiatives to promote research on feasible low or zero-GWP long-term alternatives through building partnerships between national and regional research centres and the air conditioning industry. It should also address staged-approach policies that reduce dependency on HCFC-based technologies wherever alternatives are commercially, technically and economically applicable.

Finally, the availability of standards for the safe design, use and handling of hazardous refrigerants is essential for facilitating the introduction of long-term alternatives, because the next generation of refrigerants is a group that has some flammability characteristics. These potentially hazardous substances include unsaturated HFCs also known as hydrofluoroolefins (HFOs) as well as the hydrocarbons (HCs) that are gaining ground day by day.

It seems likely that the future of the refrigeration and air conditioning industry will rely on reviving the first generation of refrigerants, introduced more than 100 years back.

Buildings and marinas in the Emirate Of Dubai

# Australia in Fast Lane for HCFC Phase-Out

**Patrick McInerney,** Director, Ozone and Synthetic Gas Team, Department of Sustainability, Environment, Water, Population and Communities
**Steve Anderson,** Executive Director, Refrigerants Australia


Map of Australia

Australia's accelerated HCFC phase-out programme will use only 40 per cent of the allowance provided under the Montreal Protocol and effectively cease consumption of HCFCs in Australia by 2016.

In 1994, the Australian Government and industry developed a joint HCFC phase-out strategy. This collaborative approach enabled Australia to set an ambitious timetable that set targets for significant HCFC reductions and at the same time provided industry with long-term certainty.

To achieve the 2016 target, Australia progressively adopted a combined approach including an import licensing and quota system, licenses for the businesses and technicians that used HCFCs, a ban on most HCFC equipment and on disposable cylinders.

Australia's quota system is designed to be simple and efficient and to provide certainty. The quota is established by law and reduces by 30 ozone-depleting potential (ODP) tonnes every two years between 1996 and 2015, with HCFC consumption essentially phased out by 2016, apart from a small servicing tail.

The quota is allocated to importers based on their share of imports in the previous quota period. This approach provides certainty to the industry and assists enforcement, as the quota is restricted to a small number of companies. The impact on competition has been minimal because the quota is readily tradeable, and considerable trading has taken place.

Australia's quota system allows HCFC quota holders to decide which species of HCFCs to import. The quantity of HCFCs that can be imported in each two-year quota period is set as a maximum level prescribed in ODP tonnes.

This has been based on availability of alternatives and the time it will take for industry sectors to move to alternatives. HCFC imports are now used almost exclusively for refrigeration and air conditioning applications, apart from a very small quantity for fire protection.

The import and use of disposable cylinders was banned to reduce the opportunity for illegal trade and to reduce emissions from disposed cylinders. The ban was implemented before disposable cylinders had a significant presence in the Australian market, and therefore market disruption was kept to a minimum.
The ban on disposable cylinders ensures that all imports arrive in isotanks. This approach assists compliance by minimising the effort to account for and verify import quantities. The ban also reduces emissions, as normally unrecoverable quantities of HCFCs in 'empty' cylinders are recovered when the cylinders are returned for refilling.

To assist the HCFC phase-out, Australia has banned the import and manufacture of air conditioning equipment containing HCFCs. The ban was introduced in 2010 when alternatives were well established for most applications, and is in step with similar controls in other developed economies. It is expected that the ban will be extended to refrigeration equipment in the future.

The Australian Government and industry have also developed a range of end-use controls to assist the HCFC phase-out and to reduce HCFC, CFC and HFC emissions.

A national permit scheme has been established; this will limit supply of HCFCs and HFCs in the refrigeration and air conditioning and fire protection industries to authorised businesses and restrict handling of HCFCs, HFCs and CFCs to properly trained and licensed technicians. There are some 80,000 businesses and technicians licensed under the scheme.

Refrigerant Reclaim Australia, an industry-funded product stewardship scheme was established in 1993 to recover and destroy refrigerants at end of life. To date it has destroyed some 4000 metric tonnes of waste refrigerant. Refrigerant recovery in Australia continues to increase, with 508 metric tonnes destroyed in the year to June 2011.

A collaborative government and industry approach to the HCFC phase-out has paid long-term dividends. By any measure Australia's programme has been very successful, with importers remaining within their quotas in all quota periods and a smooth transition to non-HCFC alternatives. Also, no HCFC shortages have occurred, which reflects industry's commitment to the phase-out and the wide availability and uptake of alternatives.

# The Uses and Benefits of Informal Prior Informed Consent (iPIC)

**Aléxandros Kiriazis,** Assistant Policy Officer, European Commission, Directorate General Climate Action

IPIC, launched in 2005, is a voluntary and informal mechanism to exchange information between importing and exporting countries to assist them in implementing licensing systems effectively. Participation in iPIC is open to all Parties to the Montreal Protocol. The initiative was originally developed and is managed by the OzonAction Compliance Assistance Programme.

At the end of every good fairytale the Prince marries his bride and they live happily ever after. However, every successful marriage requires some work to keep it alive and to overcome unwelcome obstacles. This truism also applies to the Parties to the Montreal Protocol that have endeavoured to protect the ozone layer and are now approaching the silver anniversary of their pledge. The illegal trade in ozone depleting substances is an unwelcome obstacle to the success of their endeavours but the informal Prior Informed Consent (iPIC) procedure can help to overcome the problem.

From a modest start in 2005, utilisation of iPIC has grown significantly and by 2010 more than a third of all Parties had participated. There must be some good reason for this success.

Certainly iPIC helps to prevent illegal trade. Dozens of unwanted trades have been detected or prevented since 2005. Looking only at European Union (EU) data between 2007 and today, 54 cases of unauthorised trades have been detected, representing 545 metric tonnes of ODS (equalling 144 ODP tonnes). In as many as 25 per cent of the requests, the trade turns out to be unauthorised or unwanted. These figures are impressive enough, but there is more.

## UNEXPECTED BENEFITS

The real success of iPIC lies beyond its originally intended task. It has turned out that it can also assist in domestic enforcement, for example by identifying gaps in the licensing systems or by pinpointing companies that are unintentionally unaware of the requirements.

Furthermore, iPIC has brought enhanced networking. Since it is applied globally, cooperation goes beyond existing regional networks. iPIC has brought National Ozone Units and licensing officers into contact and this has resulted in better relationships and cooperation between Parties. The informal dialogue that has developed on a working level between the European Union and China on their licensing systems and enforcement actions is just one example. Such exchanges provide useful feedback for policy development, both domestically and under the Montreal Protocol. As an example, one of the issues Parties will be discussing in the upcoming meetings is the monitoring of sales to sea-going vessels. iPIC requests have helped to shed light on a sector that was previously often overlooked.

Participation in iPIC can contribute to add ressing even higher objectives. For example, one of the guiding principles of environmental policy in the European Union is to minimise the impact of goods originating from the EU on the global environment. As one of the major sources of ozone-depleting substances, the EU's participation in iPIC assists in putting this overall approach into practice. At the same time, the domestic enforcement of measures that are more stringent than required under the Montreal Protocol is strengthened.

## EVEN MORE POTENTIAL

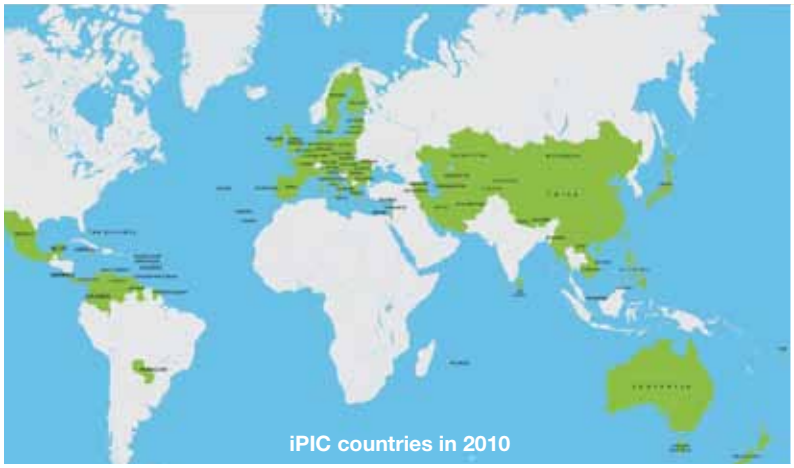
Many Parties are not yet exploiting iPIC to the maximum. While countries from most regions are already using iPIC successfully, there are still some regions which are under-represented. In particular, there is more potential in the upcoming phase-out of HCFC, methyl bromide and 1,1,1-trichloroethane. Communicating existing bans in the iPIC licensing sheet is an effective measure to prevent incoming trade. This facilitates the domestic enforcement of bans and National Ozone Units that have to cope with less sophisticated monitoring systems can benefit greatly.

Furthermore, under Decision XVII/16, the Ozone Secretariat compares annually the data that a Party reports as "exports to other parties" with the data reported as "imports by those parties". Every year, a large number of discrepancies are discovered and many of these could be prevented if more Parties were using iPIC.

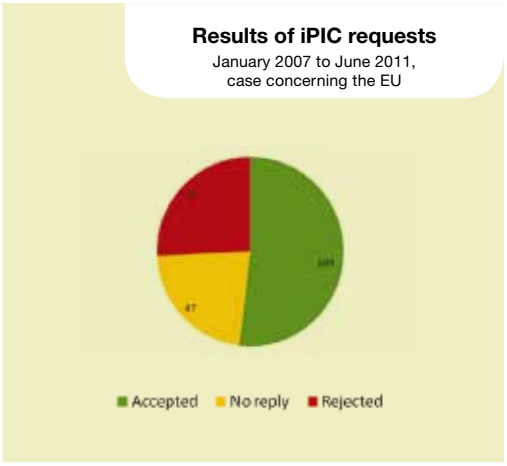
At the same time iPIC is a very simple process. Unlike other prior informed consent procedures such as those established under the Basel and the Rotterdam Conventions, iPIC is informal and voluntary. Most cases can be dealt with by simply consulting the licensing sheet of the source or destination country before issuing a license. The remaining cases can be solved by consulting informally with the licensing officer of the source or destination country.

## SIMPLE BUT SO USEFUL

In summary, iPIC is a very simple but valuable tool. It can help enforce licensing systems, reduce data discrepancies, enhance networking, contribute to higher policy objectives and good policy making, and – by the way – it can also prevent illegal trade!



iPIC countries in 2010



# Destruction of ODS and POPs Banks: Synergies Among Four Conventions in a Regional Bottom-Up Approach

Dr. Katharina Kummer Peiry[1], Executive Secretary, Secretariat of the Basel Convention

## AN ELUSIVE GLOBAL APPROACH TO A PRESSING PROBLEM

As the production and use of ODS are eliminated in accordance with the provisions of the Montreal Protocol, countries are faced with stocks of obsolete ODS (ODS banks). The environmentally sound disposal of these is becoming an urgent matter. Since ODS are also greenhouse gases, ODS banks left untreated over an extended period are a "time bomb" in terms of climate change.

ODS wastes are covered by the Basel Convention, and their transboundary movement and environmentally sound management are therefore governed by the Convention's provisions. Technologies for destruction of ODS wastes are available; they include co-processing in cement kilns and the use of mobile plasma plants. The same technologies are used for the destruction of Persistant Organic Pollutants (POPs), which are being phased out under the provisions of the Stockholm Convention. Many countries face not only the problem of ODS banks but also that of stockpiles of obsolete POPs. Destruction in a suitable facility often requires transfer across national borders, since facilities are not available everywhere, especially in developing countries. However, some countries that have the relevant facilities currently prohibit the import of all Basel wastes, including ODS and POPs waste, as is their prerogative under the Basel Convention.

It seems clear from this brief overview that there is great potential – indeed, one should say great necessity – for a coordinated approach between the Montreal Protocol, the Basel, Stockholm and Climate Conventions, and for OzonAction to address this issue. Clean-up projects have been carried out in different parts of the world by different actors, and discussions on how to address the problem of ODS wastes have taken place within and outside the framework of the Montreal Protocol. Regrettably, these have not thus far resulted in a consolidated strategy at the policy level.

The ultimate objective of the programme is to rid six Central American countries of ODS and POPs banks. The project runs a number of complementary activities in parallel, thus simultaneously producing initial concrete results on the ground and an analytical basis for proceeding on a wider scale. Its core elements are: pilot destructions to calibrate protocols, a legal assessment of the feasibility of trans-boundary movements of ODS and POPs to central destruction facilities in the region versus local destruction using mobile destruction equipment, an economic and technical feasibility assessment, and preparation for destruction of ODS and POPs banks, taking into account inventories prepared under National Implementation Plans of the Stockholm Convention and ODS inventories carried out under national ozone programmes.

Another unique feature of the programme is its approach of garnering hands-on contributions from actors as diverse as the US Department of Defence, the Netherlands Ministry of Defence and the US Environmental Protection Agency, which provide technical know-how and a mobile plasma plant (property of the US Army), and the Institute for Governance and Sustainable Development, which provides legal, capacity building and networking support. These actors work alongside donors as well as regional and national institutions. The project is supported by an Advisory Committee, comprising the Secretariats of all four Conventions concerned, UNEP/DTIE (OzonAction and Green Customs), as well as a wide range of international, regional and national public and private actors. A longer term objective may be a GEF or Multilateral Fund project.

**Meeting of the International Advisory Committee**

Geneva May 2011 (photo by Dadan Wardhana Hasanuddin, Secretariat of the Basel Convention)

## SPARKING OFF ACTION AT THE REGIONAL LEVEL

It would appear that inspiration is coming from Central America, a comparatively small region, where a highly innovative project focusing on coordinated action rather than policy agreement is being implemented. With the Basel Convention Regional Centre in the lead, seed funding from Norway and Switzerland, and in-kind support from the Basel Convention Secretariat, the project "Coordinated Destruction of ODS and POPs Banks in Central America" started off on a fairly modest scale. However, it is fast developing into an innovative, practice-oriented multi-stakeholder programme.

## A MODEL AND BUILDING BLOCK FOR A GLOBAL PROGRAMME?

The Central American programme is a positive example of a bottom-up approach – starting small both in terms of geography, scale, and funding, and growing progressively. It sets aside the politics that often hamper formal discussions on issues such as this. If successful, it has the potential to become a pilot programme for other parts of the world, and ultimately a building block for a global strategy on disposal of ODS and POPs banks.

[1] The author wishes to acknowledge with gratitude the contribution of Mr. Miguel Araujo, Director, Basel Convention Regional Centre for Training and Technology Transfer for Central America, on the Central American programme.

# The Challenge of Operating and Caring for Hydrocarbon Cooled Units

Rolf Hühren, GIZ Proklima

Most room air conditioning systems worldwide still contain hydrochlorofluorocarbons (HCFCs) as refrigerant gases, in particular in Article 5 Countries. As the air conditioning sector is a fast-growing sector, alternative environment-friendly technologies are urgently needed to reduce negative climate impacts and ozone depletion. Conversion to the use of non-ozone depleting and low-GWP substances, such as hydrocarbons (HCs), as refrigerants would not only cut greenhouse gas emissions but also achieve energy savings compared with conventional technology.

Therefore, the GIZ Proklima Programme has supported the introduction of ozone- and environment-friendly air conditioners running with hydrocarbons as refrigerants at the Chinese manufacturer Gree Electric, Inc. The demonstration project was funded by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety in the framework of the International Climate Initiative.

Good servicing practices by well-trained personnel are of utmost importance, especially while handling a flammable refrigerant. Refrigeration and Air Conditioning (RAC) systems operating with HCs, if not properly constructed, installed, operated or maintained, can be a danger to the health and safety of persons and detrimental to the environment. The project therefore also includes comprehensive training for production and service technicians; this covers the responsible and safe handling of flammable refrigerants as well as maintenance of the equipment. In cooperation with technical institutions, training material is being produced and distributed in Chinese and other languages. Workshops facilitate an exchange of experience on the conversion process, with other companies also being invited to participate.

PROSPECTS ARE AS FOLLOWS:

All personnel dealing with HC appliances and systems, from their conception to their destruction, need to develop knowledge and skills to apply best practices, including strategic risk assessment schemes for system installation, servicing, retrofitting and conversion to HC refrigerants. One specific goal is to review acquired habits and behaviours in applied RAC servicing technologies. The scope of training is related to the actual work responsibilities of employers, constructors, observers, manufacturing lines assemblers, sales staff, installation companies or workshop owners and practical service engineers and technicians. For example, a standard refrigeration training course with regard to HC would probably include the following topics:

- Review of basics in refrigeration and air- conditioning
- Thermodynamic properties, and significant differences in health and safety requirements – as compared with CFCs, HCFCs and HFCs – relating to the installation, servicing, maintaining and decommissioning of HC RAC systems
- Safety and risk assessment (SOI, PPE etc)
- Refrigerant circuit components
- Design of systems using HCs as refrigerant, standards and regulations
- Technologies to provide and maintain energy-efficient RAC system
- Sealed system provision, brazing and pressing technologies
- Electrical components and automatic control technique, design, selection and repair
- The use of oxygen free and dry nitrogen (OFDN)
- Planning and preparing of work activities
- HC system servicing technologies
- Preventive maintenance
- Specific tools and equipment
- Cylinder properties, storage and transport
- Safe refrigerant handling, including charging and recovery
- Leakage check, leakage test with OFDN and strength testing
- System/appliance decommissioning and disposal of components and fluids
- Provision of standard forms and labels for HC RAC system acceptance, repair- and-maintenance records

It is also important to ensure a safe working environment. This means: accident prevention, site safety, safety of equipment and tools, fire precaution and alarm procedures, basic fire fighting and, last but not least, “customer care”.

**Supporting training materials are available through GIZ Proklima’s website**
**www.gtz.de/proklima**

Best practices in refrigeration (GIZ PROKLIMA, 2010)

Guidelines on the safe use for HC refrigerants (GIZ PROKLIMA and TÜV Süd, 2010)

# Mexico's Drive for Energy Efficiency: A Win-Win Situation for the Country and for Consumers

**Agustín Sánchez Guevara,** Ozone Unit Coordinator - Mexico
**Ana María Contreras Vigil,** General Director of Air Quality Management

Reconversion of domestic RAC equipment in Mexico has been driven through an energy-saving programme. The main elements in this programme have been:

- Reduction of domestic energy consumption;
- Reduction in governmental expenses through reduction in subsidies;
- Promotion of the internal market in appliances;
- Reduction in expenses for lower income groups.

Reduction in energy consumption is a necessity in most, if not all, world economies. In Mexico, one of the largest energy users is the domestic sector, which consumes significant amounts of energy in appliances such as fridges and air conditioners, particularly in the north of the country.

Many developing economies, like Mexico, have been affected by a paradoxical situation that actually promotes inefficient use of energy. In most of these economies there are high levels of subsidies for the lower income sectors, which means that old equipment with high energy consumption is actually being subsidized.

To resolve this problem, the Mexican Government designed the RAC Equipment Retirement Program. Through the Energy Ministry and its Energy Savings Trust (FIDE in Spanish), this programme provides direct funding to lower income families to retire and scrap their old fridges and air conditioners and replace them with new energy-efficient models.

This measure makes it possible to reduce permanently the expenses on subsidies and pay for the programme in a relatively short period through the energy savings achieved. However, the scheme cannot succeed unless the standard of new equipment is properly regulated; thus the new RAC equipment must be certified as low energy consuming appliances.

To qualify for certification, the equipment must pass certain energy consumption tests and its compliance with required standards must be demonstrated to the public through an Energy Savings Label on the front of the appliance. Appliances approved under this system have an average level of energy reduction of 30 per cent. In the case of refrigerators, this means that energy expenses for low income consumers will be reduced by a similar amount, since the fridge is permanently connected to the power supply. In the case of air conditioning units, the percentage savings could be greater than 30 per cent.

With these results, we could conclude that the objectives stated at the start of the article have been satisfactorily completed, namely: reduction in energy consumption; reduced governmental expenses on subsidies; promotion of new energy-saving technologies and stimulation of the appliances industry, with concomitant employment and income increases; and, finally, benefits for the lower income families who will enjoy more efficient home equipment and energy savings.

However the task is not yet complete. Two important issues must still be tackled. One is the use of non-ozone depleting substances with low global warming potential (GWP) in the insulation of the new equipment and in the refrigerant gas used in cooling systems.

In Mexico, this has been dealt with through implementation of the Montreal Protocol. Where technology must move from HCFC-based equipment to non-ODS and low-GWP alternatives, new appliances must demonstrate significant energy savings, using environmentally friendly substances to meet the new required standards. This is the most important challenge for the industry in the next few years.

The other important factor is to ensure proper scrapping of the retired equipment and effective management of the different recovered compounds, mainly the refrigerant gas and the foams.

To address this issue in Mexico, we have installed around 100 scrapping centres through which the gas is recovered and collected. Most of the gas is not possible to reuse, so a destruction programme must be installed in order to avoid the environmental damage that release would cause.

In a few cases, the refrigerant gas can be recycled and reused, but it is not an appropriate option once the technology that uses that type of gas has become obsolete. A refrigerant destruction programme can become an incentive to promote new technologies because it reduces the availability of stock of the old gas.

In conclusion, since air conditioning equipment and domestic refrigerators are the main energy consumers at home, and the domestic energy consumption is a main part of the overall consumption, the promotion of new technologies with low energy consumption requires economic, logistical, technological, political and social efforts that governments, industries and consumers must all agree, in order to achieve environmentally sustainable economies.

# UNDP: Demonstration of HCFC Alternative Technologies Under Local Conditions in Developing Countries

**Suely Carvalho,** Principal Technical Adviser and Chief Montreal Protocol Unit, UNDP

After the Montreal Protocol was adjusted in 2007 to accelerate phase-out of HCFCs, Parties were encouraged to promote the development and availability of HCFC alternatives that minimised environmental impacts, particularly for specific applications where such alternatives are not presently available and applicable.

The Executive Committee of the Multilateral Fund (MLF) has agreed on the importance of approving a limited number of projects in Article 5 countries to demonstrate emerging technologies in various industrial processes under local conditions. Since 2007, the Executive Committee has approved such projects in different sectors, mainly foam, refrigeration and air conditioning.

UNDP has been at the forefront of demonstration projects since 1996 and is currently implementing such projects in all regions and all sectors. UNDP is in the process of assessing relatively new technological developments that have not or scarcely been used in developing countries. This task is conducted on behalf of and financed by the MLF.

For the foam and XPS sectors, assessments are being conducted for super-critical $CO_2$, methylal, optimized hydrocarbon technologies, $CO_2$ with methyl formate co-blowing and HFO-1234ze . The assessment report on the use of methyl formate has already been completed and was considered by the Executive Committee in November 2010. The others will be finalized by the latter half of 2011 and early 2012. For the RAC and solvents sectors, assessments are being conducted for ammonia/$CO_2$ in the manufacture of two-stage refrigeration systems for cold storage and freezing applications; HFC-32 in the manufacture of commercial air-source chillers/heat pumps; and iso-paraffin and siloxane (KC-6) for cleaning purposes in the manufacture of medical devices.

It is important to note that companies that participate in any MLF-funded programmes always have full freedom of choice in the technology that is selected.

UNDP welcomes additional demonstration projects in partnership with the MLF, bilateral donors and countries.

# HCFC Alternatives: Results of Demonstration Projects by Implementing Agencies

**Sidi Menad Si Ahmed,** Director, Multilateral Environmental Agreements Branch, UNIDO

UNIDO, as one of the implementing agencies, has been promoting zero-ODP and low-global warming potential (GWP) HCFC alternatives. A number of demonstration projects have been already carried out and show promising results. However, finding alternatives to convert HCFC production lines has proved to be challenging. Nevertheless, Article 5 countries have been willing to rise to the challenge and have accepted UNIDO's ideas for demonstration projects.

In the foam manufacturing sector there are several alternatives, such as HFC-245fa and -356mfc (moderate GWP), hydrocarbons and $CO_2$/methyl formate (low GWP). A number of demonstration projects showcasing use of the latter two substances have yielded positive results.

However, there are still a number of concerns. With regard to hydrocarbon technology for example, smaller companies are unable to afford the added expense of increased safety measures; and to help solve this problem, UNIDO is looking into innovative ways of mobilizing additional funds. The use of methyl formate on the other hand is cheaper but relatively new, which leaves room for a few uncertainties at this point in time.

The search for suitable refrigerant alternatives to HCFCs has also proved difficult in some circumstances. The results of demonstration projects have shown that the use of hydrocarbons, R410A or R407C in the majority of refrigeration applications is feasible and cost effective. However, there are still a few concerns; for example, in countries with high ambient temperatures, current available alternatives are not entirely suitable for air conditioning applications.

Together with our partners in these countries and some selected technology providers, we are looking into some new possibilities and hoping to 'see light at the end of the tunnel'.

Nevertheless, the phase-out of HCFCs has given rise to rapid progress in the development of new technologies. The willingness of individual countries to opt for ozone and climate friendly alternatives allows relatively new technologies to gain practical credentials. UNIDO will certainly have no hesitation in encouraging countries to adopt these tested and sustainable solutions.

Finally, in reviewing the last approvals of projects to phase out HCFCs, it is quite clear that the trend is for the adoption of technologies with a low GWP.

# Laying the Foundations for Ozone and Climate Smart HCFC Phase-out

**Karin Shepardson,** Program Manager, GEF and Montreal Protocol Operations, Environment Department, The World Bank

THE WORLD BANK

In 20 years as an implementing agency for the Multilateral Fund (MLF) of the Montreal Protocol (MP), the World Bank has managed, on behalf of client countries, cumulative grant approvals of over US $1 billion tied to implementation of more than 700 investment and technical and institutional assistance phase-out activities. This has resulted in elimination of more than 305,000 ODP tonnes of ODS and fulfillment of a number of the Protocol's obligations.

This year, 2011, marks the beginning of a transition period in which many countries must sustain previously implemented ODS phase-out activities, while addressing the first two targets – a freeze and 10 per cent reduction – of HCFC consumption. Beyond the challenge of tight timelines in the first HCFC phase-out stage is the urgent need to address links between ozone layer protection and climate mitigation. New project approvals reflect the convergence of these previously separate agendas in promoting investment strategies that benefit both, wherever feasible.

A limiting factor is the level of funds available to address the changing nature of Protocol business. Article 5 Country HCFC consumption has been defined by steep growth over a relatively short period, directly related to economic development in emerging economies. This trend threatens to impact the amount of MLF funding available for incremental costs. Consequently, there is a need to find ways to leverage additional support to MLF (Article 5) countries to meet future Protocol obligations, particularly recognizing the climate co-benefits in their HCFC phase-out programmes.

The World Bank sees the Montreal Protocol as more relevant than ever to global environment challenges and our mission. Integration of energy efficiency and climate mitigation finance with the Bank's MP operations can, in certain sectors, achieve significant benefits by reducing energy consumption, thus lowering demand for new investment in power generation capacity. This also aligns with the World Bank's strategic directions which include concerted efforts to promote green growth.
The Bank's MP programme has demonstrated examples of synergies between ODS elimination and climate mitigation through initiatives such as the Thai chiller replacement project, which eliminated the use of CFCs while generating significant energy savings. In this new phase, the Bank is focused on assisting clients to address their HCFC phase-out obligations while generating energy savings through more efficient technology. Conversion of energy savings into carbon assets is another mechanism we have tested to promote climate co-benefits in ozone investments. As the climate finance architecture continues to evolve, we hope to remain at the forefront in identifying opportunities to use multiple sources of finance to tackle shared ozone and climate challenges.

During 2011, the Bank began new HCFC phase-out work with clients in Asia, the Middle East, and Latin America, with recent Executive Committee HPMP first stage approvals for over US $78 million to commence work in China, Indonesia and Vietnam. Supported by the MLF, the Bank is also addressing ODS disposal challenges, and conducting a study to assess the viability of market mechanisms to raise funding for climate co-benefits, including upfront monetization of carbon credits. We are aligning our MP Programme more closely with other climate funding programmes of the Bank to give clients more options for bringing the agendas closer together. As a relative newcomer to the MP family, I am excited at the opportunities ahead, including the chance to help clients stay at the forefront of technological change and intensify our work together on critical investments and regulatory incentives to lead the next generation towards a more sustainable future!

# Choosing the Best AC and Refrigeration Equipment to Protect Ozone and Climate

**Stephen O. Andersen,** Director of Research at the Institute for Governance and Sustainable Development (IGSD), co-chair of TEAP

**Kristen N. Taddonio,** Director of Commercial Building Energy Alliances, U.S. Department of Energy, Former member of TEAP

The Montreal Protocol has the necessary technical expertise, stakeholder networks, and financing under the Multilateral Fund to implement the current accelerated phase-out of ozone depleting hydrochlorofluorocarbons (HCFCs) while leapfrogging high-GWP HFCs. The challenge is to choose the best technology for each application.

Making this selection is not as straightforward as choosing refrigerants by their chemical nomenclature or picking the option with the lowest GWP, because nomenclature and GWP are not reliable indicators of overall environmental performance. Neither takes into account toxicity, atmospheric fate, safety, or energy efficiency. And the GWP depends on the time period concerned (20, 100, or more years) and ignores the charge size and leak rates that vary substantially by application.

One solution is to use the comprehensive approach of Life-Cycle Climate Performance (LCCP), which takes everything into account: refrigerant greenhouse gas emissions (including those resulting from refrigerant production); the energy emissions from manufacturing, using, and recycling the product; the carbon content of electricity generation; and more.

## Consider the advantages of a practical five-step selection process:

❶ **Screen for safety:** Compare products configured to satisfy reasonable standards of health and fire safety, and then calculate the 'safety-screened energy efficiency'.

❷ **Compare LCCPs:** Calculate the LCCPs of the safety-screened systems, taking into account annual ambient temperature and humidity, electricity carbon intensity and owner preferences, in the location where the equipment will be used.

❸ **Select the technology with the lowest LCCP:** In some cases, one alternative may have a clear LCCP advantage, but in cases of comparable LCCP the choice can favour the lowest GWP.

❹ **Proceed with investment:** Unless an emerging technology under development is far superior and worth waiting for.

❺ **Manage atmospheric fate:** By engineering, economic incentives, and training, with the goal of reducing life-cycle emissions to acceptable levels.

## This approach has already identified the following climate-superior technology:

- **HC in small refrigerated units:** This category includes domestic refrigerators and small refrigerated food and beverage cases. HC has a very low GWP (<3 for 20- or 100-year time intervals), equals or exceeds the energy efficiency of the HFC alternatives, and is penetrating all markets including the United States.
- **$CO_2$ in commercial beverage coolers:** Coca Cola and other companies under the 'Refrigerants Naturally' partnership have engineered equipment to use ultra-low GWP $CO_2$ refrigerant (GWP~1 for 20- or 100-year time intervals), while equalling or exceeding the energy efficiency of systems that use high-GWP HFC alternatives.
- **HC in very small room air conditioners (AC):** Companies in Asia and elsewhere have developed very small room AC systems that use efficient HC refrigerant and meet all applicable safety standards; however, HC is not an acceptable alternative in larger systems where refrigerant leakage into a room could result in a flammable HC concentration.
- **HFC-32 for larger room ACs:** The Japan-Indonesia Partnership selected HFC-32 as the best alternative: (1) moderate GWP (20-year GWP = 2330; 100-year GWP = 675) compared to alternative HFC-410a (20-year GWP = 4340; 100-year GWP = 2088), (2) 30 per cent smaller charge size compared to HFC-410a, and (3) higher energy efficiency than lower-GWP alternatives.
- **HFC-1234yf for vehicle AC:** Global automakers used LCCP to identify HFC-1234yf as the next-generation refrigerant with very low GWP (~4 for 20- or 100-year time intervals) and high energy efficiency and cooling performance in a wide variety of climates, especially those that are hot and humid for long periods. Systems can be designed to be nearly leak-free to avoid issues of atmospheric fate.

The Technology and Economics Assessment Panel (TEAP) and its Technical Options Committees (TOCS) have documented a wide range of additional options to replace high-GWP HFCs in many applications and new ideas and technologies are rapidly emerging. Chinese companies are commercializing next-generation refrigeration and Heating, Ventilation, and Air Conditioning systems utilizing low-GWP alternatives; Japanese manufacturers are leaders in high-efficiency $CO_2$ heat-pump water heaters and the new Indonesia-Japan R-32 partnership (see box) is an important development. In addition, the United States Department of Energy is investing heavily in the development of a refrigerant roadmap so "US industry will be positioned to be a supplier rather than a purchaser of next-generation alternative technologies" *(www.anl.gov/renewables/research/building_emerging_tech_roadmap.html)*. Only time will tell who will be the winners of this race to save the world.

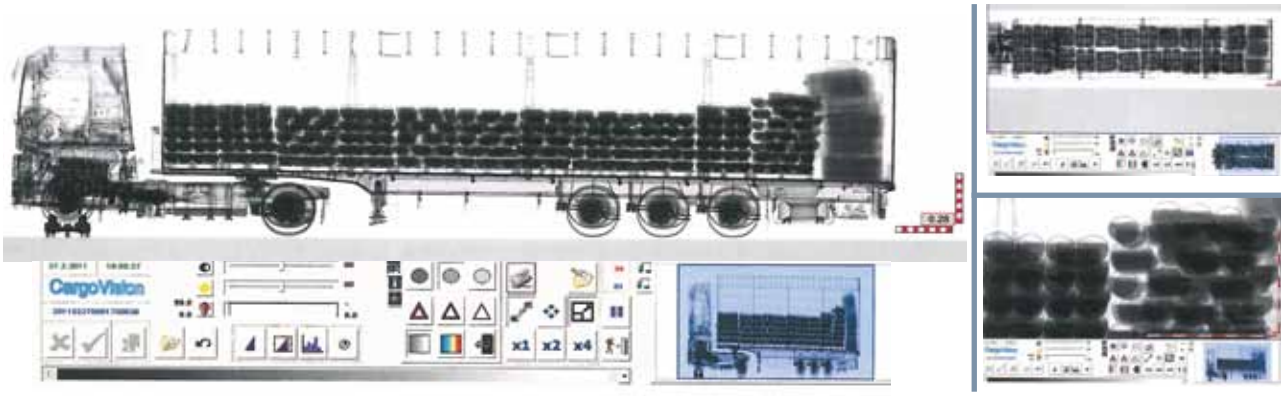
## INDONESIA-JAPAN HFC-32 PARTNERSHIP

*The Indonesia Ministry of Environment and Ministry of Industry and the Japan Ministry of Economy Trade and Industry (METI), plus Daikin, Panasonic, Fujitsu, Hitachi and Toshiba – with the support of the United Nations Development Programme (UNDP) and the Institute for Governance & Sustainable Development (IGSD) – will introduce high-efficiency HFC-32 (R-32) air conditioners that are safe for the ozone layer and will reduce life-cycle greenhouse gas emissions by more than 50 per cent under typical conditions in hot and humid climates. The first-stage strategy is for Indonesia and other developing countries to replace HCFC-22 (R-22) with R-32, leapfrogging the HFC-410A (R-410a) technology that most developed countries selected for their earlier transition away from ozone-depleting substances.*

**Contact:**
*sadatani-satoshi@meti.go.jp*

# Reducing the Risks of Illegal HCFC Trade

**Tapio Reinikainen,** , Finnish Environment Institute
**Heli Lampela,** Finnish National Board of Customs




The latest scientific assessment of ozone depletion, in 2010, showed us that concentrations of HCFCs in the troposphere are still rising steeply. This trend should level off and then experience a gradual downturn after implementation of measures to achieve the accelerated HCFC phase-down. This expected reduction of HCFC emissions, as well as the recovery of the stratospheric ozone-layer, are at risk if leakages from HCFC banks, increased leakages from equipment near the EOL (End of life of an equipment) and emissions from production and consumption of HCFCs made possible by illegal HCFC trading are allowed to continue.

Loopholes in legislation, insufficient inspections, potential profits through smuggling, and lack of severe sanctions create conducive conditions for illegal ODS trading. Loopholes may also be created where the legislation and systems in different countries are not uniform. For example, there may be different practices in the licensing of imports, exports and ODS transit, differences in licensing and reporting related to maritime operations, or different phase-out timetables. The latter is impossible to avoid as the different phase-out schedules are an inherent part of the Montreal Protocol's approach. Many of the aforementioned conditions encouraging illegal trading of HCFCs exist today, and there is again an increased risk of illegal ODS trading due to the ongoing HCFC phase-out.



## HOW CAN WE MINIMISE THIS RISK?

ODS present a great challenge to practical customs enforcement. Finding illegal shipments among the legal trade is difficult even if there are unambiguous inspection, detection and operating procedures, since smugglers use different methods to evade customs. Sufficient training, easy-to use guidelines and state-of-the-art tools such as X-ray scanning and laboratory testing equipment as well as detectors are very useful, but sometimes pure luck and the 'hunches' of experienced customs officers are crucial to the successful interception of ODS.

Training and other awareness-raising measures aimed at customs officers are essential, a point also emphasised in the Green Customs Initiative. The joint World Customs Organisation (WCO)-UNEP «Sky Hole Patching II» operation last year, play an important part in promoting these issues in the customs sector and among economic operators such as importers, exporters and forwarding agents. Of course, close cooperation between Customs and National Ozone Units (NOUs) organisations and personnel is essential since customs officers cannot, understandably, have in-depth knowledge of ozone-related issues.

Risk analysis is key in targeting controls. Information on patterns of demand related to illegal gases, consignment types, intelligence about the companies involved in illegal trading, and other such matters is essential – especially when this information is shared between countries or regions. The experiences gained through informal Prior Informed Consent (iPIC) show the value of having timely and detailed information flow between importing and exporting countries, an initiative that goes beyond the requirements for licensing systems under the Montreal Protocol.

The Nordic countries (Denmark, Finland, Iceland, Norway, Sweden, and autonomous regions therein) have a long tradition of customs cooperation – including with regard to ODS. This regional cooperation has also influenced international customs cooperation over ODS. Each Nordic country has distinctive characteristics and risk patterns related to ODS. Some support big fishing fleets that must be serviced, some belong to the EU, and some operate under their own national legislation exclusively.

Finland's distinguishing characteristic is our membership of the EU, which means we have a different HCFC phase-out timetable to our neighbour, Russia. This increases the risk of illegal trading of HCFCs and equipment using these gases, since a significant part of imports to Russia travel through Finland. In accordance with the EU's new ozone regulations, transit of HCFCs via the EU has also been forbidden since the beginning of 2010.

Some risk of illegal HCFC imports also exists, since HCFCs are still used in many buildings in Finland, yet only recovered and recycled HCFCs may be used in the RAC sector until the end of 2014. Importing, exporting and use of virgin gases are forbidden. Our approach to minimising the danger of illegal HCFC importing comprises risk assessment, training of customs officers (also through the Nordic customs' illegal ODS project), and an inter-agency task force. The latter comprises all the relevant agencies involved in inspection of ODS and F-gases.

Through coordinated efforts these agencies are encouraging real estate owners and companies to switch to legal and less harmful (low-GWP) refrigerants, including natural refrigerants. The replacement of old equipment with newer technology, capable of functioning on ODS and F-gas alternatives, needs to be carried out systematically, taking into account energy-efficiency aspects as well. This will not happen instantly, especially if all the actors overhaul their equipment at the last moment before the total ban on HCFC use comes into force at the beginning of 2015.

# New ODS Destruction Technologies - Promising Cleaner, Affordable Options

**Stephanie Hanford-Hass,** President, Connectivity Consulting
**Melanie Miller,** Director, Touchdown Consulting

A recent TEAP report recommends the addition of four new ODS destruction technologies to the Montreal Protocol's approved list, thereby increasing the range of options available and expanding the existing list[1] from 12 to 16 (see Table 1).

EFFICIENCY OF DESTRUCTION: TEAP evaluated key performance criteria for seven proposed new technologies. In each case, they examined the ability to destroy ODS, as a percentage of the amount fed into a typical facility. The study concluded that four new processes – ASADA, Midwest Refrigerants, SGL Carbon, and University of Newcastle technologies – can achieve the traditional threshold of at least 99.99 per cent ODS destruction (measured as Destruction and Removal Efficiency, DRE).

DIOXIN EMISSIONS: ODS contain chlorine or bromine, so their destruction tends to generate unintended by-products in the form of dioxins – persistent, highly toxic pollutants controlled under the Stockholm Convention.

Since 2002, TEAP has recommended destruction technologies that keep dioxin air emissions below 0.2 ng/Nm$^3$.[2] TEAP now recommends lowering the threshold to 0.1 ng/Nm$^3$, noting that this would be closer to the current industry norm. Thirteen of the 16 approved and recommended ODS destruction technologies will meet this lower threshold.

Dioxin emission levels vary greatly among the current approved destruction technologies, as seen in Table 1. Four of the 12 approved technologies can keep dioxin emissions below 0.01 ng/Nm$^3$. Two of the new recommended technologies also offer this degree of environmental and health protection: ASADA (< 0.000002 ng/Nm$^3$) and Midwest Refrigerants (0.0095 ng/Nm$^3$). This is at least 20 times less toxic output than the current TEAP threshold.

## CASE STUDY: MIDWEST REFRIGERANTS

The CTC Refri-GreenTM Process from Midwest Refrigerants is particularly interesting in terms of flexibility, cost and environmental performance. Midwest offers two types of units to meet different needs:

❶ Large-capacity chemical conversion units, available in two sizes. The smaller unit processes up to 300 tonnes ODS per year, while the larger one handles 3000 tonnes, or more, in a year. The chemical outputs are of high purity and suitable for sale to industry.

❷ Small neutralization units on a moveable frame (skids), which can eliminate either 75 or 150 tonnes per year. These can be disconnected after use, and moved anywhere in the world. Chemical outputs are neutralised, leaving only liquefied $CO_2$. This mobile unit would be useful when small volumes of ODS need to be destroyed in multiple countries.

Midwest's model deals with all types of ODS, HFCs and PFCs; it does not generate polluting 'stack gas' emissions and avoids the problem of dealing with hazardous waste.

The capital and operating costs of Midwest's process are favourable, and the company predicts their new technology will be more competitive, on both counts, than current options. It uses significantly less energy than traditional processes, resulting in lower operating costs, lower $CO_2$ emissions, and greater benefit for the climate.

Lew Steinberg, President of Midwest Refrigerants notes that, "The larger facilities can handle a throughput of at least 1000 kg ODS per hour, which is 10 times greater than the current commercial average of 100 kg per hour. In addition to meeting very high environmental and safety standards, this flexible technology supports the destruction of very small and very large volumes of ODS, making it suitable for diverse international needs."

## List of approved and recommended ODS destruction technologies

| Approved technologies | Applicable ODS destruction | | | Performance data [a] | |
|---|---|---|---|---|---|
| | CFC, HCFC, CTC, TCE | Halon | ODS in foam | Destruction efficiency[b] DRE % | Dioxin emissions[c] ng/Nm$^3$ |
| *Minimum DRE :* | 99.99% | 99.99% | 95% | | |
| Cement kilns | ✓ | | | > 99.99 | 0.04 |
| Liquid injection incineration | ✓ | ✓ | | > 99.99 | 0.52 |
| Gaseous/fume oxidation | ✓ | ✓ | | > 99.999 | 0.032 |
| Municipal solid waste incineration | | | ✓ | > 99.99 | < 0.5 [e] |
| Reactor cracking | ✓ | | | > 99.999 | < 0.01 |
| Rotary kiln incineration | ✓ | ✓ | ✓ | > 99.9999 | 0.03 - 0.15 |
| Argon plasma arc | ✓ | ✓ | | > 99.9998 | 0.006 |
| Inductively coupled radio frequency plasma | ✓ | ✓ | | > 99.99 | 0.012 |
| Microwave plasma | ✓ | | | > 99.99 | 0.0011 |
| Nitrogen plasma arc | ✓ | | | > 99.99 | 0.044 |
| Gas phase catalytic dehalogenation | ✓ | | | > 99.99 | < 0.01 |
| Superheated steam reactor | ✓ | | | > 99.99 | 0.041 |
| Technologies recommended for approval | | | | Performance data [d] | |
| ASADA (plasma destruction, small scale) | ✓ | | | > 99.99 | < 0.000002 |
| Midwest Refrigerants (thermal reaction) | ✓ | ✓ | | > 99.99999 | 0.0095 |
| SGL Carbon (porous reactor) | ✓ | | ✓ | > 99.99 [f] | < 0.1 |
| University of Newcastle (thermal conversion) | ✓ | ✓ | | > 99.99 | |

(a)Data reported in TEAP Report of the Task Force on ODS Destruction Technologies, April 2002, vol.3B, p.42-67.

(b)Destruction and removal efficiency.

(c)Measured as PCDD/PCDF ITEQ ng/Nm$^3$.

(d)TEAP Progress Report, May 2011, vol. 1, section 5, p.72-74; with additional DRE details.

(e)Only some municipal incinerators are able to meet the PCDD/PCDF threshold of 0.2 ng/Nm$^3$.

(f) > 95 for dilute sources (foam).

[1] Decision XV/9 adopted the current list in Annex II of MoP-15.
[2] Measured as total PCDD & PCDF ITEQ, international toxic equivalent units, in waste gas.

# The Green Airline

**Emirsyah Satar,** President and CEO of Garuda Indonesia

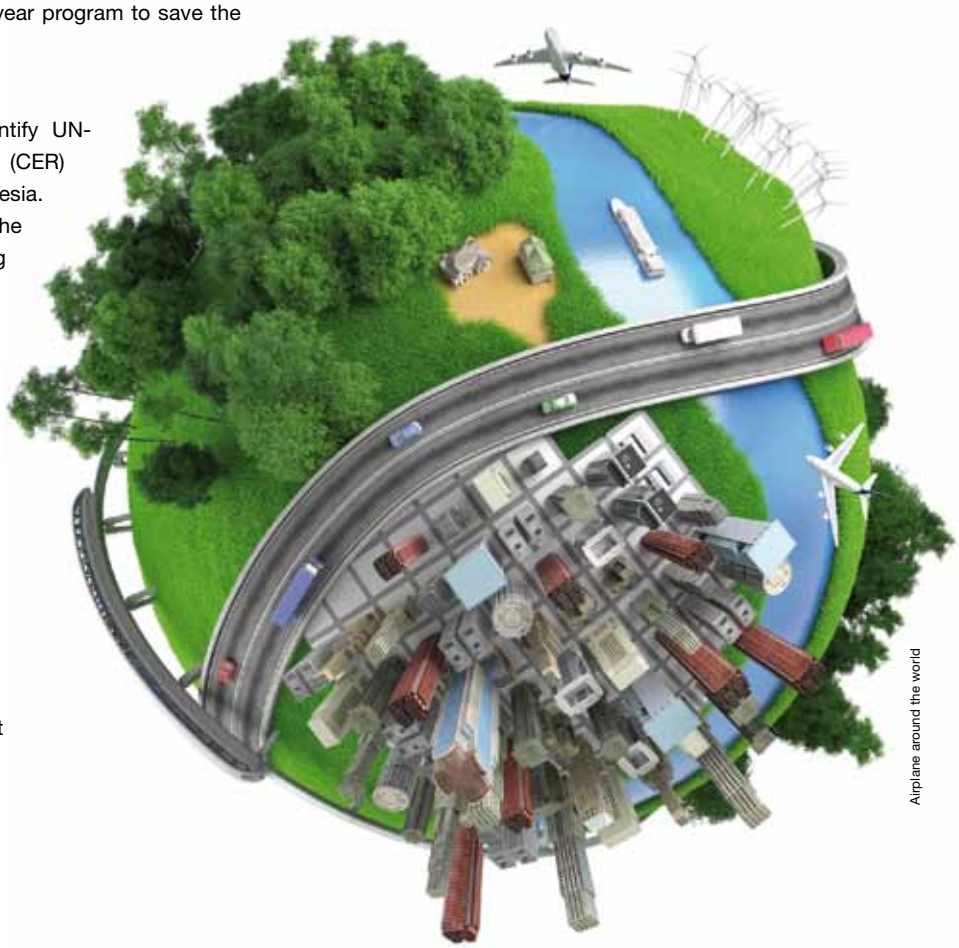
**GMF-AeroAsia is the leader in Halon Management in Asia and the Pacific region. In 2010 GMF-AeroAsia received the United States Environmental Protection Agency Montreal Protocol Awards for its Halon Bank Management Initiative**

We are delighted to be recognised by the United Nations Environment Program (UNEP) for the establishment by our subsidiary PT.GMF-AeroAsia, in conjunction with the Indonesian Government, of the first Indonesian Halon Bank. This is not just for aviation users in Indonesia but we envisage cooperation with other Halon Banks in South East Asia and DASCEM (the Commonwealth Department of Administrative Services Centre for Environmental Management) in Australia.

Garuda Indonesia has recognised the need to be an environmentally responsible airline for over 15 years, when we introduced aircraft Aqueous Cleaning Methods in 1995. But our commitment to being an environmentally conscious airline is on-going. In 2007 we introduced the "One Passenger, One tree" reforestation project in Sebangau National Park in Central Kalimantan which is a 5 year program to save the vital Orangutan habitat.

We are also working with IATA to identify UN-approved Certified Emissions Reduction (CER) projects or carbon offset projects in Indonesia. The question for Garuda Indonesia in the future, is not the additional costs of being a green or environmentally aware airline, but to consider the long term benefits to our passengers, partners, stakeholders, and the planet as a whole, of being a "green" airline.

GMF-AeroAsia has also provided technical assistance to the military establishments in Turkey and Pakistan on ODS management in defense forces. These are shining examples of GMF-AeroAsia's initiatives which help other developing countries in the region on technical operations to phase out ozone depleting substances.



Airplane around the world

# Building for the Planet: A Challenge for Developing Countries

**Lennox J Hernandez,** Senior Lecturer
Department of Architecture, Faculty of Technology, University of Guyana


The Beddington Zero Energy Development (BedZED), UK

Better energy efficiency in building design has been a global priority for many years now, especially after the energy crisis of the early 1970s. The building industry worldwide was slow to respond, but in recent times there has been a change in this attitude, at least in the developed world. According to British architect and researcher Susan Roaf, the year 2003 may have been the turning point as the public in developed countries became more aware of climate change[1]. Though the developing world may not be a great consumer of energy when compared to the developed world, appropriate environmental practices in architecture are still required to assist in the reduction of ozone depletion and climate change globally.

Historically, designers and builders followed the traditional architecture of a region as well as relying on their own experience for building design solutions. Today "… many people idealize the designs and innovations of vernacular architecture that can be found in ancient cultures all over the world"[2]. Acknowledged too, is the concept of "environmental syncretism" in British colonies during the Victorian era, where new building forms were created for a new cultural context in a new environment[3]. Unfortunately, such environmental awareness and concern for energy efficiency are not evident in the design of many, if not most, of our contemporary buildings. Generally, the developing world today, in an effort to appear "modern and advanced", imports building designs and relies less on designing with climate "in mind".

As architects, we must consider many different factors in designing a building. For example, to control heat flow through the building envelope, we have to consider the thermal properties of the wall itself, as well as the use of glass, the choice of colour, the requirement for shading and many other points. In the case of glass, this important material is seen as much more than a daylight-admitting element; it is also regarded as an architectural design feature to enhance the aesthetics of a building. Unfortunately, in hot countries, large areas of glass can greatly raise a building's heat load and increase energy consumption through use of air conditioning. Also, the shading of buildings to reduce the total solar heat gain is critical for both non air conditioned and air conditioned buildings; unfortunately, shading of buildings seems to be a thing of the past. Canopies, louvres, awnings, and external sunshading devices should be used to greater effect in contemporary tropical buildings. Building designers and owners in developing countries should also pay more attention to the design of open spaces and streets in settlements, for example by reducing the extent of paving and increasing the area under grass and trees.

Air conditioning is required in some buildings to achieve precisely controlled conditions indoors. However, attention to proper micro-climate of the settlement and to the eco-friendly design of the building can do much to reduce the task of the air conditioner and, in many cases, actually avoid the need for air conditioning.

Improving the energy efficiency of buildings is an important and effective way to protect the ozone layer and global climate. Whereas, in a humid climate, the movement of air into buildings is vital for indoor comfort when a building is not air conditioned, the air conditioned building must be properly sealed against the entry of hot air for energy efficiency. Building shape and form are also basic determinants of the energy required to cool a building: for example, a compact building shape reduces the area of a building's envelope through which solar heat may be gained. For air conditioned buildings, careful consideration of the relationships between external surface area, volume and floor area can result in greater energy efficiency.

With the need to reduce the amount of greenhouse gases being spewed into the atmosphere globally, and to make more efficient use of expensive fuels in developing countries, energy-efficient building design is essential. While architects and engineers in a developing country have a major role to play in the drive for energy-efficient buildings, the state has the duty to prepare and effect policies on energy efficiency in buildings, and building owners have to understand and appreciate the necessity for such measures. We have to look to our own environmental context for solutions to the problem of energy-efficient building design; appropriate local environmental practices will collectively reduce global warming and climate change.

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# Gaining Awareness of The Montreal Protocol Against a Ticking Clock: The role of Social Media

**Scott Kronick,** President, Ogilvy Public Relations Worldwide, North Asia
**Hannah Lane,** Senior Counsel, Ogilvy Earth

At the point of maturity, the delicate head of a dandelion sits ready for a gust of wind to disperse its cluster of identical tiny parachutes. Once launched, each tiny seed has the ability to travel vast distances before settling to grow and change another landscape.

Faced with the urgent global challenge of phasing out HCFCs, it is essential to take a dandelion approach in order to reach a mass audience to propel wide-scale change. The ever-adapting, fast-moving global digital platforms provide us the means to do this, making it possible to rapidly disseminate messages across country borders. The release of an 'online seed' in Indonesia can within a few minutes reach as far as Canada or the southernmost tip of Brazil.

The complex challenges of HCFC phase-out could be seen to lie, not with the public, but with the need to influence government policies and to work with retailers and producers across multiple sectors; however, the ability to drive change from the bottom up has great potential to accelerate on-the-ground adoption of ozone-layer-friendly technologies.

## CREATING A COMMON LANGUAGE

Most people are in daily contact with products containing HCFCs, but have no idea of their environmental impact. Ask any member of the public what the Montreal Protocol is and they will probably give you a blank look. People think the ozone layer problem is fixed.

As if it wasn't hard enough to create a general understanding of the effects of $CO_2$ on our planet, HCFCs and their alternatives now add another dimension to the already complex agenda of climate protection.

The first hurdle is to create a common, non-exclusive language accessible to everyone. We need to show the big picture by explaining the 'what', before describing the 'how' in easy-to-digest chunks in order to convert interest into action. Making the message both relevant and personal is essential.

## THE MASS DISSEMINATION OF INFORMATION

Can social media really help drive us towards phase-out? Potentially yes. In capitalizing on this ever-evolving way that people interact with and receive information, there is the opportunity to reach vast audiences.

A recent example of the power of social media can be seen in the COP15 Hopenhagen movement. This call for the sharing of global hopes and dreams around climate drew 6 million *netizens* within 90 days to create a mass voice; 70 per cent of these people had never been part of a climate movement before. The movement's momentum was maintained by the content created and shared in the form of videos and social media posts around a subject that affected everyone personally.

Where people feel part of a community, be it on or off line, they feel empowered to make a difference.

Brands in particular are starting to appreciate what social media can achieve, with masses of *netizens* 'following', 'liking' and contributing comments and points of view around certain products or services online, and sometimes driving innovation and shaping the company values.

## GAINING TRACTION ON THE GROUND

With the attention of a global audience, motivating the masses to move from sharing of information to taking positive action is the second biggest hurdle and, with the complexity and far-reaching impact of HCFCs in the products we use, it's important to maintain a narrative and enable change by providing relevant information and local action points.

With 64 per cent of the production, consumption and exports of HCFCs coming from China, this is a key example where localized action could really effect big change. Forty per cent of Chinese online users are content creators and the majority of these are young consumers and new homeowners buying products such as refrigerators and air conditioners for the very first time. They are a group searching for truth in a turbulent world of food scares and safety concerns.

With consumer pressure, we can create local competitive markets for HCFC-free products and this will spur development on, enabling the sharing of successes across the global network to 'change our own landscape'.

For HCFC phase-out there are many challenges to overcome but, as they say, 'a journey of a thousand miles begins with a single step'. In the same way that social media has the potential to reach a vast and diverse audience, it has the potential to inspire collaborative action and even accelerate innovation.

### THE POTENTIAL OF SOCIAL MEDIA:

- 72 per cent of all internet users globally are registered on a social networking portal
- Asia has the highest user growth in the world at 70,69 per cent
- More than 25 billion pieces of content are shared each month on Facebook alone
- In China there are 235 million social networkers, 87 per cent of these regularly 'friend' or 'follow' brands
- 81 per cent of Chinese youth check online comments before making a purchase decision

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*Languages: English*

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## RISK ASSESSMENT ON ILLEGAL TRADE IN HCFCs

***After CFC smuggling lessons are learnt.*** Despite significant progress in tackling illegal trade in ozone depleting substances over the past decade there is thought to be a significant threat in the near future of a dramatic increase in illegal trade in hydrochlorofluorocarbons (HCFCs). There is, in general, a lack of awareness raising on about the issue of illegal trade in HCFCs and the potential impact this may have on the HCFC phase-out.

This report provides a summary of recent cases of illegal trade and the policy measures in place to combat HCFC smuggling. By considering market conditions for HCFCs and drawing parallels with the context and methods used by smugglers which led to chlorofluorocarbon (CFC) smuggling, the report provides an analysis of the risks of HCFC smuggling becoming entrenched and makes recommendations on how this illegal trade can be prevented.

**www.unep.fr/ozonaction/information/mmcfiles/7507-e-risk_assessment.pdf**




VDO-12

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## THE ANTARCTIC OZONE HOLE – FROM DISCOVERY TO RECOVERY, A SCIENTIFIC JOURNEY

While the ozone hole has been considered by some as a solved problem, in fact its recovery is still many decades away and the effects and interactions of ozone depletion on climate change are just starting to be understood. Embark on an investigative journey through the history and science of the ozone layer, the actions taken to address this major environmental threat and the consequences both for the ozone layer and climate system. This short film seeks out explanations and answers from the scientists closest to the issue. The video is available in English, French and Russian.

**www.unep.org/ozonaction/Antarctic**

# Tribute to Rajendra Shende, Former Head of the OzonAction Programme


Retiring after 19 distinguished years as Head of the OzonAction Programme, Mr Rajendra Shende can look back with justified pride on a career of relentless dedication and extraordinary achievement in the global fight to save the ozone layer.

With a background in chemical engineering and corporate business, Mr Shende joined UNEP's Division of Technology, Industry and Economics (DTIE) in 1992 as head of the OzonAction Branch.

An expert on international technology transfer, he has been a valued advisor to developing countries and countries with economies in transition in implementing the Montreal Protocol. He helped build the OzonAction Programme from its early beginnings to its present global extent. Under his leadership, OzonAction was reorganized in 2002 into a unique regionalized Compliance Assistance Programme (CAP), comprising a strong team in UNEP's Regional Offices in Bahrain, Bangkok, Nairobi, Panama City and in Paris.

From the start of his tenure, Mr Shende appreciated the links between ozone layer protection and climate change mitigation and the potential for combining the two agendas. He was at the forefront in promoting important climate benefits while implementing the Montreal Protocol.

Mr Shende's vision has made him a determined advocate of technologies that simultaneously protect the ozone layer and climate, particularly those that use low-global warming potential refrigerants and improve energy efficiency in refrigeration and air conditioning appliances. Developing partnerships and leveraging inter-linkages between multilateral environmental agreements have been Shende's forte.

Under his guidance, OzonAction developed action-oriented partnerships with industries, international organizations, academia and non-governmental organizations. Notable examples included «Refrigerants, Naturally!» - a partnership to promote energy-efficient, HFC, CFC, and HCFC free technologies in «point of sale» refrigeration - and «SolarChill», an alliance of UN agencies, NGOs, research institutions, and bilaterals which developed an award-winning solar-powered vaccine cooler.

Delegates to the 64th meeting of the Executive Committee, in July this year, noted Mr. Shende's efforts for ozone layer protection. In his valedictory speech, Dr. Husamuddin Ahmadzai of the Nordic Environment Finance Corporation said, "Raj's more than twenty years of dedicated work and competency stand without doubt among the excellent examples of stewardships that facilitated compliance of developing countries to the Montreal Protocol and hence to the success of the world's most successful multilateral environmental agreement".

His colleagues and friends at UNEP's OzonAction Branch appreciate the guidance and inspiration he provided to his staff over the years and wish him the best for his new endeavours.

The **OzonAction Special Issue** is produced by the UNEP DTIE OzonAction Branch and financially supported by the Multilateral Fund for the Implementation of the Montreal Protocol.

The **OzonAction Special Issue** (OASI) is published once a year in Arabic, Chinese, English, French, Russian and Spanish.

**OASI is available online at** http://www.unep.org/ozonaction/News/OzonActionNewsletter/tabid/6238/Default.aspx

Special Issue team: Anne Fenner, Ezra Clark and James Curlin.

Publication Manager: Samira de Gobert
Editor: Catriona Child

Please send comments and material for publication to:

Mrs. Samira de Gobert,
OzonAction Branch
United Nations Environment Programme
Division of Technology, Industry and Economics (UNEP DTIE)
15, rue de Milan - 75441 Paris Cedex 09, France
Tel : +33 1 44 37 14 50
Fax : +33 1 44 37 14 74
ozonaction@unep.org
www.unep.org/ozonaction



Design and production by:
100 WATT, Annecy, France
Tel: +33 4 50 57 42 17
jacques@100watt.fr
www.100watt.fr