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PROTECTING THE OZONE LAYER AND REDUCING GLOBAL WARMING

Results, Case Studies and Lessons Learned from UNDP's Montreal Protocol Programme

Multilateral Fund
for the Implementation of the Montreal Protocol

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FOREWORD

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The Montreal Protocol has very rightly been termed the world's most successful environmental convention. Soon after the discovery of the Antarctic ozone hole, countries not only ratified the Montreal Protocol, but the Multilateral Fund (MLF) was established, and developing countries began receiving technical assistance and grants to help them eliminate ozone depleting substances. UNDP was selected in 1991 as one of the original MLF implementing agencies and has played a key role in the technology transfer process. While UNDP has worked with over a thousand private sector enterprises, given our main focus on sustainable development, UNDP pioneered the "umbrella" approach to dealing with small and medium enterprises (SMEs). This has included, for example, local manufacture of inexpensive, low maintenance equipment with low operational costs that SMEs could afford.
As a result, SMEs were able to successfully transition to new non-ozone depleting technologies and maintain market share and high employment numbers, thereby safeguarding livelihoods. As UNDP supports the HCFC phase-out currently underway, it will maintain its focus on the needs of SMEs and as such, there is no doubt that the Montreal Protocol will continue to be one of UNDP's flagship programmes.

INTRODUCTION

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The effort to protect the earth's ozone layer has been the first occasion where humanity has come together to tackle a serious global environmental threat. These actions have in the long run probably saved millions of lives, not only because of the reduction of harmful UV rays due to thinning of the ozone layer, but also due to the huge positive impact on climate change by phasing out high-GWP Ozone Depleting Substances. One can only hope that the success of the Montreal Protocol and its Multilateral Fund will be replicated in other conventions for the sake of future generations. An article in the September 2014 Economist mentioned that during the period 1989-2013, the Montreal Protocol had reduced CO_2 equivalent emissions as big as the 11 other global policy actions combined at a fraction of the cost. We are proud that UNDP has assisted 120 countries eliminate 67,870 tonnes of ODS while simultaneously reducing 5.08 billion tonnes of CO_2-equivalent greenhouse gas emissions. We have also started preparing partner countries for their 35% HCFC reduction targets to be achieved by 2020.

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WHY HAS THE MONTREAL PROTOCOL BEEN SO SUCCESSFUL?

The Montreal Protocol on the protection of the global ozone layer is a somewhat unique example of how the world can respond when faced with a serious environmental threat. The 1974 Rowland-Molina hypothesis was that CFCs in the stratosphere – when bombarded by UV radiation – could result in chlorine radicals that could destroy large numbers of ozone molecules and lead to ozone layer depletion. This in turn would lead to more UV radiation reaching the earth, contributing to increasing levels of skin cancer as well as slower plant growth and negative effects on marine phytoplankton.

This hypothesis was ignored until the discovery of the Antarctic "ozone hole" in 1985 that shocked the world, proving the Rowland-Molina hypothesis was correct. Action was immediate. In 1985 itself, the Vienna Convention was adopted and in 1987, the Montreal Protocol (MP) was agreed upon. This was the fastest response - ever - of the international community to a severe international environmental problem. And in 1991, the Montreal Protocol Multilateral Fund (MP-MLF) was established to assist developing countries transition away from ozone-depleting substances (ODS).

The question is often asked why the world moved so quickly in dealing with ozone layer depletion, yet has moved so slowly in addressing the equally critical problem of climate change. There are several reasons:[1]

- The MP was set up to eliminate ozone-depleting substances (ODS). It has focused on that main objective, and in recent years has also ensured that ODS replacements have low global warming potentials (GWPs) so as not to impact climate change.
- This was a brand new area of research and work, unlike the climate change/energy area which has a long history and many vested interests. So there was no treading on others "turf".
- Skeptics had long said that CFCs were irreplaceable. However, industrialized countries took the lead in technical innovation. Developing countries under the MP-MLF and its four implementing agencies (UNDP, UNEP, UNIDO, World Bank) - often with bilateral partners - followed rapidly with applied technical innovation almost every year – from 50% reduced CFCs during 1991-92 to even lower CFC alternatives during 1993-94 to the introduction of hydrocarbons in 1994 and the introduction during 1995-96 of HCFC-22 in refrigeration and other low-ODS in the foams, solvents and halons sectors. The speed of this technical innovation has not been matched by any other environmental convention/protocol.

[1] Frank Pinto, *Environment Initiatives by the United Nations Including RIO+20*, presentation to the visiting Vienna University student group to the United Nations, New York, 15 February 2012.

- The major ODS chemical producers worldwide – instead of fighting this development – decided to join it even though they would be giving up on a very lucrative business. They led the search for non-ODS alternatives and were able to develop new lines of business to replace those they had lost. So industry was supportive of the Montreal Protocol and never against it - very different from what happens in the climate change arena.

- The MP-MLF Executive Committee (ExCom) decided early in the process to give priority to and allocate funding for capacity building, training and institutional development in recipient developing countries to ensure long-term success. National Ozone Units were created and strengthened, and this paid immense dividends when national compliance mechanisms had to be formulated, and these National Ozone Units were able to take the lead in developing national legislation and supporting compliance mechanisms.

- The MP also adopted very clear prohibitions on ODS trade with non-Parties to the Protocol. This resulted in 197 Parties to the Protocol ratifying it in record time, so that recipient countries would have access to ODS during the transition process to new technologies. And these policies were strictly enforced, stopping the trade in illegal ODS and thus facilitating the conversion process. It demonstrates that difficult environmental issues can be tackled and resolved successfully in an equitable and sustainable manner. [2]

- During its first five years (1991-96), the MP-MLF ExCom focused on conversion of the larger ODS producing and consuming enterprises in recipient countries, given the need to show results and tackle the largest units first. It was, however, soon recognized that there were thousands of small and medium sized enterprises (SMEs) whose ODS consumption individually may have been small but which were labour-intensive, employing a large number of workers. With larger enterprises converting to non-ODS technologies, SMEs faced the prospect of being driven out of business with the loss of thousands of jobs. So the MP-MLF ExCom developed guidelines to facilitate the ODS transition process in SMEs, with UNDP taking the lead in developing new and innovative processes under umbrella projects which comprised local manufacture of inexpensive, low maintenance equipment which had low operational costs which the SMEs could afford. As a result, SMEs were able to successfully transition to the new non-ODS technologies and maintain their market shares as well as high employment numbers, thereby preventing job losses and safeguarding livelihoods. This approach proved to be invaluable when dealing with MP-MLF ExCom approved sector (e.g. aerosols, foam, halons, solvents, refrigeration) ODS phaseout programmes followed by national ODS phaseout programmes.

[2] Suely Carvalho, *Partnerships for Change: 25th Anniversary of the Montreal Protocol (1987-2012)*, UNDP, September 2012.

THE MONTREAL PROTOCOL AND CLIMATE CHANGE

The MP was established to eliminate ODS which often had high Global Warming Potentials (GWP). For instance CFC-11 has a GWP of 4,750 (compared to 1.0 for CO_2) and CFC-12 has a GWP of 10,900. As the MP continued eliminating ODS, it was also able to reduce their global warming potential significantly, since global ODS consumption was over one million tonnes/year.

A recent article in The Economist,[3] citing UNEP sources, showed that the Montreal Protocol had, during the period 1989-2013, reduced cumulative CO_2 eq. emissions by 135 billion tonnes – nearly as big as all the 11 other global policy actions including energy efficiency, hydropower, nuclear power, forest preservation, fuel efficiency standards, etc. Others have postulated that the first commitment period (2008-2012) of the Kyoto Protocol would only eliminate 5 billion tonnes of CO_2 eq. which was only 4% of the impact of the MP. So the MP has in effect eliminated 25 times more CO_2 emissions than the Kyoto Protocol as of end-2013 and at a fraction of the cost.

Some of the ODS-replacement chemicals also had significant GWPs. For example, HCFCs have GWPs in the 725-2,310 range and HFCs have GWPs in the 675-2,088 range. HCFCs are already in the process of being phased out. Proposals to include HFC phaseout under the MP (even though they do not affect the ozone layer) are being discussed since they relate to the same sectors as those addressed under the MP, due to the proven success of the MP, and since it can be done cheaper under the MP than under other options.

Given the huge quantities of HFCs already in use, it has been argued that if the Montreal Protocol was quickly amended to include them, it might be possible for the MP to eliminate the CO_2 equivalent of as much greenhouse gas emissions in the next 35 years as the MP did during 1990-2010.[4] However, political negotiations are still ongoing, and UNDP will be ready to assist developing countries when these negotiations are finalized.

[3] The Economist, *Curbing Climate Change: The Deepest Cuts: Our guide to the actions that have done the most to slow global warming*, pgs 21-23, 20 Sept. 2014 (print edition).

[4] Statement by Durwood Zaelke of the Institute for Governance and Sustainable Development, cited in The Economist article above.

UNDP'S WORK ON OZONE LAYER PROTECTION AND PROGRAMME IMPACT

UNDP established a dedicated Montreal Protocol Unit (MPU) in 1991 to spearhead and coordinate its efforts to support Article 5 developing countries as one of the implementing agencies of the MP-MLF. MPU is the focal point for UNDP's global MP programme, responsible for strategic planning, policy, programme and financial oversight, and reporting to the MP-MLF Secretariat and ExCom. MPU has a small team at UNDP/HQ in New York and technical teams based at UNDP Regional Centres in Bangkok (Asia-Pacific), Istanbul (Europe, Arab States, Africa), and Panama (Latin America & Caribbean).

MPU regional teams work with UNDP Country Offices in their regions to assist government counterparts develop projects and programmes to eliminate ODS to be funded under the MP-MLF. The MPU central unit at HQ coordinates these activities, produces periodic progress reports and the annual business plan for submission to the MP-MLF Secretariat and ExCom, and liaises with the Regional Bureaux at UNDP/HQ.

UNDP provides a variety of services to support developing countries in their efforts to comply with Montreal Protocol provisions. These services include technology transfer and technical assistance, formulation and implementation of country and sector strategies, capacity building, accessing funding from different sources, and facilitating public and private partnerships.

While a significant part of UNDP's effort during 1991-2000 was on assisting private and public sector enterprises in their ODS elimination efforts, since 2001 the focus has been more on sector and national ODS phaseout programmes especially covering SMEs.

MP-MLF programmes undergo intense scrutiny by the MP-MLF Secretariat and ExCom. The performance of each of the four implementing agencies of the Montreal Protocol[5] as well as bilateral programmes are monitored and assessed on a yearly basis through eight performance indicators inthree areas: approval, implementation, and administration.

ODS elimination programmes for non-Article 5 countries are funded under the GEF which uses approval criteria similar to those followed by the MP-MLF Secretariat and ExCom.

TOP ROW: CFC-12 RECOVERY-RECYCLING CYLINDERS IN BRAZIL. PHOTO BY ANDERSON ALVES, UNDP/MPU.

BOTTOM ROW: TESTING OF CFC RECYCLING BAGS. PHOTO BY BRAZIL NATIONAL OZONE OFFICE.

[5] UNDP, UNEP, UNIDO and the World Bank.

Programme Impact

By September 2014, UNDP had assisted partner countries access $690.6 million in funding from the MP-MLF (for Article 5 developing countries) and $42.5 million from the GEF (for non-Article 5 countries) to eliminate ozone depleting chemicals. UNDP support has assisted 120 countries eliminate 67,870 tonnes of ozone-depleting substances while simultaneously reducing 5.08 billion tonnes of CO_2-equivalent greenhouse gas emissions as Table 1 shows:

Table 1: UNDP's Montreal Protocol Programme Impact (1991-2014)

Funding Source	ODP Tonnes Eliminated	Projects	Countries	Total Grant Value ($ million)	Cumulative Climate Benefits (billion tonnes of CO_2-eq reduction)
MLF	65,975.9	2291	105	690.61	4.93
GEF	1,894.0	40	15	42.5	0.15
Total	**67,869.9**	**2,331.0**	**120**	**733.1**	**5.08**

In 2013, MPU mobilized approximately $35 million in funding from the MP-MLF. Of UNDP's 2,291 MP-MLF funded projects, 2,130 have been completed and 161 projects valued at $177 million are ongoing.

A detailed list of all Article 5 developing countries that UNDP's MP programme has been active in under the MP-MLF along with number of approved projects, grants received and ODP tonnes eliminated is shown in Table 2.

A detailed list of all non-Article 5 countries that UNDP's MP programme has been active in under the GEF along with number of approved projects, grants received and ODP tonnes eliminated is shown in Table 3.

FOAM PROCESS FOR CONSTRUCTION OF REFRIGERATED CABINETS. PHOTO BY WALTON HI-TECH INDUSTRIES AND BANGLADESH NATIONAL OZONE OFFICE.

Table 2: UNDP/MP Article 5 Developing Country Activities under the MP-MLF (1991-2014)

Country	Projects	MLF Grant ($ thousand)	ODP Tonnes Phaseout/Year
Global	46	5,282	–
Regional	18	2,882	45.7
Angola	4	222	–
Argentina	68	18,158	1,687.0
Armenia	5	690	2.2
Bahamas	2	166	12.6
Bahrain	8	1,042	96.2
Bangladesh	28	6,803	473.0
Barbados	6	287	13.1
Belize	7	395	12.1
Benin	2	158	27.3
Bhutan	6	222	0.1
Bolivia	15	1,205	37.6
Botswana	1	20	–
Brazil	213	75,859	11,651.1
Brunei Darussalam	3	468	52.3
Burkina Faso	2	149	30.9
Burundi	10	470	48.1
Central Africa Republic	3	143	–
Cambodia	9	1,368	69.7
Cape Verde	2	99	1.3
Chad	8	622	24.8
Chile	21	4,362	201.6
China	174	178,710	12,346.6
Colombia	61	27,297	1,768.1
Comoros	2	75	0.4
Congo	5	371	25.1
Congo Dr	18	2,367	324.6
Costa Rica	46	10,405	643.5
Cuba	33	12,213	572.5
Djibouti	5	335	10.4
Dominica	3	103	0.7
Dominican Republic	34	5,532	508.1
Ecuador	1	100	–
Egypt	46	20,249	2,485.2
El Salvador	16	2,409	365.3
Eritrea	1	20	–
Ethiopia	1	30	–
Fiji	7	390	15.7
Gabon	9	452	17.8
Gambia	6	311	14.6
Georgia	16	1,362	28.3
Ghana	31	4,074	414.0
Grenada	4	153	4.4

Country	Projects	MLF Grant ($ thousand)	ODP Tonnes Phaseout/Year
Guatemala	9	1,266	86.9
Guinea	2	70	7.9
Guinea-Buissau	2	308	14.3
Guyana	4	278	8.0
Haiti	5	430	102.7
Honduras	2	165	138.6
India	233	70,212	7,940.0
Indonesia	89	29,278	3,023.6
Iran	88	18,085	1,020.7
Jamaica	13	1,476	101.4
Jordan	2	41	–
Kenya	13	1,994	10.0
Kyrgyzstan	14	1,254	64.0
Laos	5	371	16.3
Lebanon	42	9,843	834.2
Lesotho	2	76	3.6
Liberia	3	144	8.4
Libya	14	1,584	307.0
Malawi	13	3,500	177.9
Malaysia	116	32,659	3,002.8
Maldives	5	635	2.9
Mali	7	662	57.5
Mauritania	6	368	11.0
Mauritius	5	674	29.7
Mexico	62	33,894	3,001.7
Moldova	10	984	87.8
Mongolia	2	134	3.9
Morocco	16	3,236	494.0
Mozambique	5	273	9.2
Myanmar	1	20	–
Nepal	10	362	18.1
Nicaragua	5	465	38.9
Niger	5	145	5.8
Nigeria	87	25,596	5,066.6
Pakistan	10	2,064	102.4
Panama	18	2,403	227.4
Paraguay	14	1,896	261.9
Peru	26	4,762	350.6
Philippines	32	7,066	755.0
Rwanda	6	319	17.5
Samoa	2	75	–
Sao Tome -Principe	2	125	1.8
Sierra Leone	8	365	52.1
Somalia	1	15	–
Sri Lanka	31	3,824	91.0
St Kitts And Nevis	3	145	–

Country	Projects	MLF Grant ($ thousand)	ODP Tonnes Phaseout/Year
St Vincent & Grenadines	2	128	2.1
Suriname	6	493	31.2
Swaziland	5	834	11.4
Syria	19	5,166	531.3
Tanzania	10	1,069	95.5
Thailand	56	12,301	2,220.7
Timor-Leste	2	106	–
Togo	7	459	30.2
Trinidad Tobago	22	2,246	113.5
Turkey	1	165	–
Uganda	3	74	3.6
Uruguay	35	4,378	349.7
Venezuela	36	7,966	485.7
Viet Nam	19	1,560	282.8
Yemen	2	1,488	220.0
Zambia	4	240	7.2
Zimbabwe	6	367	3.9
Grand Total	**2291**	**690,609**	**65,975.9**

Table 3: UNDP/MP non-Article 5 Country Activities under the GEF (1991-2014)

Country	Projects	MLF Grant ($ thousand)	ODP Tonnes Phaseout/Year
Armenia[6]	5	1,500	52
Azerbaijan	4	6,100	307
Estonia	2	500	42
Kazakhstan	5	3,900	618
Latvia	3	1,100	224
Lithuania	4	3,900	368
Regional	12	22,300	100
Tajikistan	2	500	25
Turkmenistan	1	100	31
Uzbekistan	2	2,600	127
Grand Total	**40**	**42,500**	**1,894**

[6] Armenia used to be funded under the GEF (non-Article 5) but was later reclassified as Article 5 and its HPMP activities appear under Table 2

UNDP/MPU SUPPORTS SUSTAINABLE DEVELOPMENT

The 2011 UNDP Human Development Report[7] cited the Montreal Protocol as an example of integration of environmental and equity concerns while promoting human development. The introduction of ozone-friendly alternative technologies reduced ozone layer damage and bought about additional benefits including helping thousands of SMEs maintain their competitiveness and ensure sustainable livelihoods for their families.

At the Rio+20[8] Conference in June 2012, world leaders - along with thousands of participants from the private sector, NGOs and other groups - came together to agree on how to reduce poverty, advance social equity and ensure environmental protection on an ever more crowded planet. Member States launched a process to develop a set of Sustainable Development Goals (SDGs), which will build upon the existing MDGs. Rio+20 also adopted ground-breaking guidelines on green economy policies.

Activities under the Montreal Protocol have contributed significantly to the Green Economy even before the term was coined. UNDP partners with governments and the private sector to provide targeted policy advice and specialized technical assistance, training and technology transfer to adopt ozone and climate friendly technologies and best practices. Our programme covers several sectors including manufacture (and servicing) of products in refrigeration and air-conditioning, foams, solvents, medical aerosols for asthma treatment, and agriculture.

The introduction of environment-friendly products and corresponding policy and technological advances have transformed markets. Developing countries have gained access to state-of-art technology, consumer energy bills have been lowered due to more energy-efficient appliances, innovation has been fostered, and a more equitable market for greener products has been created, allowing indigenous manufacturers to maintain their competitiveness.

UNDP/MPU plays a significant role in greening human development, through:

- The elimination of ODS reduces the higher incidence of UV radiation leading to decreased occurrence of skin cancer and eye-cataracts. According to the USEPA,[9] by year 2065, over 6.3 million skin cancer deaths and 22 million additional cataract cases will have been avoided in the U.S. alone, saving an estimated $4.2 trillion in U.S. health care costs during the period 1990-2065.

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[7] http://hdr.undp.org/sites/default/files/reports/271/hdr_2011_en_complete.pdf

[8] United Nations Conference on Sustainable Development which took place in Rio de Janeiro, Brazil in June 2012 – twenty years after the landmark 1992 Earth Summit in Rio.

[9] www.epa.gov/ozone/science/effects/AHEFApr2006.pdf and www.epa.gov/ozone/science/effects/AHEFCataractReport.pdf

- Reducing ODS helps reduce global warming due to the high global warming potential (GWP) of ODS, and also reduces biodiversity loss since lower UV radiation results in lower loss of plankton, resulting in less damage to ecosystems.

- UNDP/MPU's role in greening development derives from the assistance we provide to countries at the national level, which helps poor and vulnerable people maintain and enhance their livelihoods. For instance, we have assisted countries convert enterprises that manufacture CFC Metered Dose Inhalers (MDIs) to CFC-free alternatives, thus maintaining the availability of affordable medication for patients suffering from diseases such as asthma and chronic obstructive pulmonary disease (COPD). We have also assisted a large number of SMEs, primarily in the foam, refrigeration and air-conditioning manufacturing & servicing sectors, in cost-effective transitions to ozone friendly alternatives, helping them to remain competitive while transitioning to more environmentally friendly technologies.

- UNDP/MPU has also assisted thousands of farmers in 20 countries with technology transfer, assistance and training on alternatives to methyl bromide (an ODS) used in the fumigation of fruits and vegetables (e.g. melons, strawberries, tomatoes), tea, cut flowers, stored grains as well as in quarantine and pre-shipment (QPS) treatments.

In addition, UNDP/MPU's work fits into several of the sectors in the Rio+20 outcome document "The Future We Want"[10] as shown in the following table:

Poverty eradication, employment, decent work, social protection	MP assistance to SMEs and the private sector as a whole has saved jobs while converting to technologies that are more environment-friendly.
Food security & sustainable agriculture	MP phaseout of the fumigant methyl bromide has helped the agricultural sector move away from harmful pesticides while maintaining sector business and competitiveness.
Energy	MP technology transfer in refrigeration industries has – in addition to reduced ODS use - resulted in modern production lines able to produce more energy-efficient refrigerators, compressors and coolers.
Tourism	The tourism sector is heavily dependent on refrigeration and air-conditioning and benefits from the MP programme.
Transport	MP has contributed to more environment-friendly technologies in mobile air-conditioning in cars, trucks, trains, and refrigerated transport of food and other perishable commodities.
Health and population	Under the MP, CFC-based Metered Dose Inhalers (MDIs) mostly used by asthma patients were replaced by MDIs that are ozone-friendly. Cleaning applications for medical equipment such as syringes were also converted to ozone-friendly technologies.
Chemicals & waste	Ozone Depleting Substances are chemicals and the MP is a good example and model for other chemical conventions.
Climate change	The MP effect on the climate is estimated to have been many times larger than what the Kyoto Protocol could have achieved even if all its goals had been met because ozone depleting chemicals are also potent greenhouse gases.
Sustainable consumption and production	Giving developing countries access to environmentally friendly technologies at the manufacturing level and introducing better occupational practices contributes to sustainable consumption/production patterns.
Education	MP awareness efforts in all institutional strengthening projects and training programmes for refrigeration technicians and farmers (methyl bromide) helps farmers and SME owners better manage risks.
Sustainable Development Goals (SDGs)	The MP is directly contributing to the SDGs in various ways, including the examples mentioned above.

[10] http://sustainabledevelopment.un.org/futurewewant.html

UNDP/MPU AND EMERGING WORK UNDER THE CCAC

UNDP is a partner in the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), where UNDP focuses on reducing the negative impact of hydrofluorocarbons (HFCs) on climate and energy use. HFC usage is rapidly increasing in key sectors such as air-conditioning, refrigeration, solvents, foam blowing and aerosols – in these sectors HFCs are often used to replace the ODS controlled under the Montreal Protocol. While HFCs do not impact the ozone layer, they are unfortunately very potent greenhouse gases. By some estimates, HFC emissions could constitute up to 20 percent of global CO_2 emissions by 2050 in business-as-usual scenarios.[11]

With donor funding received through the CCAC, UNDP/MPU has assisted Bangladesh, Chile, Colombia, Ghana, Indonesia and Nigeria carry out HFC inventories to assess their current consumption of HFCs so as to help them develop viable options to replace HFC use.

UNDP is also assisting the Maldives study an innovative approach to climate-friendly city-wide cooling in the capital, Male. This approach would bypass the use of HFCs as cooling agents, while at the same time improving energy efficiency.

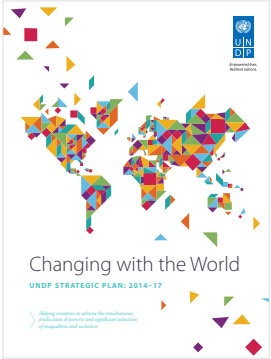
A project for Chile was approved by the CCAC in April 2014 and here UNDP will focus on replacing HFC-based refrigerants (used in supermarket cooling systems) by trans-critical CO_2 technology.

EXAMPLE OF SUPERMARKET FREEZERS WHERE HFCS WILL BE REPLACED BY TRANS-CRITICAL CO_2 TECHNOLOGY.

[11] www.pnas.org/content/106/27/10949.full.pdf

LINKAGES WITH THE UNDP STRATEGIC PLAN 2014-2017

UNDP/MPU's work on the ozone layer supports all seven outcomes under the UNDP Strategic Plan 2014-2017, with a special focus on Outcome 1 on inclusive and sustainable growth and development (Outputs 1.1 and 1.3) under the Area of Work 1 "Sustainable Development Pathways". We strive to achieve this outcome by assisting recipient countries establish regulatory schemes and enforceable national systems to manage imports and exports of ODS, and providing countries with technical and financial assistance to transform the productive base in key sectors such as foam products in construction, furniture, transportation, and buildings; medical products; electronic and firefighting industry; and the refrigeration/air conditioning sectors. The conversion of eligible production lines to alternative sustainable technologies allows these products to continue to be manufactured without ODS. It also assists industries – and especially SMEs - to remain competitive while complying with the Montreal Protocol provisions, thus saving jobs and sustaining livelihoods.



THE IMPORTANCE OF DEMONSTRATION PROJECTS

Implementation of demonstration projects and testing the use of innovative alternative ozone-friendly technologies that minimize negative environmental impacts, in particular impacts on climate, while meeting other health, safety and economic criteria, underpin successful technology transfer to developing countries under the Montreal Protocol. Developing countries demand that innovative alternative technologies be tested and fine-tuned to meet their environmental, legal and regulatory contexts before large-scale implementation. So the MP-MLF has been funding the development and implementation of these innovative demonstration projects, thanks to which various technology barriers - once thought to be insurmountable - have been removed.

UNDP has been at the forefront of developing and implementing demonstration projects to verify the effectiveness of ozone-friendly alternative technologies. Since 1992, with MP-MLF funding and approval, UNDP has supported 35 demonstration projects in 21 countries in all regions and various sectors. As a result, developing

countries are able to access a range of state-of-the-art and effective technologies that have been tested under local conditions in Brazil, China, Colombia, Egypt, Mexico and Turkey to name a few countries. UNDP, in collaboration with UNEP, has made strenuous efforts to widely disseminate the results of these demonstration projects, so that other countries will also be able to learn about and access these new state-of-the-art technologies.

For example, in Brazil and Mexico, demonstration projects assessed the performance of one alternative technology (methyl formate and methylal) to replace HCFC-141b based systems. As result, foam products supplied to the automotive industry, construction sector, and in the manufacture of shoe soles can be produced with this new tested alternative, which is ODS-free and has a low GWP. In Brazil, as a result of the successful demonstration project, the company which selected the tested technology is now producing "climate and ozone friendly" foam panels used in the construction of houses for low-income families.

For the Future

Decision 72/40 taken at the 72nd MP-MLF ExCom meeting in May 2014 called for proposals to demonstrate climate-friendly and energy-efficient alternative technologies to HCFCs with a funding envelope of $10 million. Bilateral and implementing agencies were invited to submit proposals for feasibility studies, including business cases for district cooling, no later than the 75th ExCom meeting in 2015. The resulting studies should assess possible projects, their climate impact, economic feasibility and options for financing such undertakings. The studies should enable stakeholders to understand the advantages and challenges as compared to business as usual.

Responding to this invitation, UNDP/MPU – at recipient government request – will be proposing the following demonstration projects for submission to the MP-MLF ExCom in 2015:

Country	Demonstration Project Sector/Subsector
China	Demonstrating low-GWP alternatives to HCFCs in commercial refrigeration in cold chain applications
Colombia	Demonstrating low-GWP alternatives to HCFCs through co-blowing with HFO and water in the foam sector addressing the needs of SMEs
Costa Rica	Demonstrating low-GWP alternatives to HCFCs through the use of NH3 (ammonia) in chillers for construction
Dominican Republic	District Cooling Feasibility Study
Egypt	Demonstrating low-GWP alternatives to HCFCs by finding cost-effective solutions for SMEs in foam sector pour-in-place applications
Egypt	District Cooling Feasibility Study
India	Demonstrating low-GWP alternatives to HCFCs by using hydrocarbon- based refrigerant to replace HCFC-22 in manufacturing water coolers
Kyrgyzstan	Demonstrating low-GWP alternatives to HCFCs through a CO_2 demo in cold storages in the agricultural sector/supermarket chain
Malaysia	Demonstrating low-GWP alternatives to HCFCs using of R-32 based commercial air-conditioning including service and maintenance practices for flammable refrigerants
Trinidad and Tobago	Demonstrating low-GWP alternatives to HCFCs through local production and supply of refrigerant-grade hydrocarbons
Uruguay	Demonstrating low-GWP alternatives to HCFCs through NH3 (ammonia) and HFO in commercial refrigeration

RECENT CASE STUDIES: RESULTS AND LESSONS LEARNED

CASE STUDY 1

Conversion from HCFC-141b to cyclopentane technology in manufacturing refrigeration equipment insulation foam at Walton Hi-Tech Industries Limited, Dhaka, Bangladesh

Walton Hi-Tech Industries is the only manufacturer of refrigeration equipment in Bangladesh, and used HCFC-141b in manufacturing insulation foam for domestic refrigeration equipment, amounting to 27% of total national ODP consumption. The company can produce over 2,000 units per day. Since the high expected future growth rate would require far more HCFC-141b, the company and Government requested UNDP assistance to convert HCFC-141b technology to a non-ODS one so that Bangladesh does its part under the Montreal Protocol.

NEW FOAM DISPENSING MACHINE USING CYCLOPENTANE AS BLOWING AGENT. PHOTO BY WALTON HI-TECH INDUSTRIES AND BANGLADESH NATIONAL OZONE OFFICE.

The company selected cyclopentane as the non-ODS alternative foam blowing agent following a detailed evaluation of available technology options, reviewing the technical and commercial feasibility of those options, and considering long-term sustainability. The MP-MLF ExCom approved this project at its 62nd Meeting in Nov. 2010. Project implementation during 2011-2013 covered installation and commissioning of cyclopentane storage and handling facilities, installing pre-mixing equipment and new foaming machines, as well as retrofitting existing equipment for use with cyclopentane.

The redesign of manufacturing lines included installation of safety systems. Cyclopentane is flammable, and given the importance of safety in new manufacturing operations, training on safety procedures and safe manufacturing operational techniques was conducted. A safety audit was also conducted prior to the start of new commercial operations. The project phased out an annual consumption of 183.7 metric tonnes of HCFC-141b. The GWP impact of using cyclopentane instead of HCFC-141b is an annual reduction of GHG emissions of over 130,000 tonnes of CO_2 equivalent.

CASE STUDY 2

Integrated implementation approach for polyurethane foam investment projects through South-South cooperation between Mexico, Jamaica and Trinidad & Tobago

Lessons learned:

- Technology-transfer investment projects must ensure minimum impact on industrial operations since they generate many jobs – directly and indirectly
- South-South technology transfer can often be done at high quality and lower cost
- Support from Governments is essential for projects to retain implementation flexibility and benefit from close monitoring

The newly agreed MP HCFC phaseout schedule calls for both prioritization of high-ODP substances during the first stage HPMPs and also adoption of low-carbon alternatives to mitigate climate change. In the LAC region, UNDP noted an "integration" of the polyurethane (PU) foam sector among countries since only five countries (Brazil, Mexico, Colombia, Panama, Chile) have PU system formulation industries (termed "System Houses") and enterprises in other countries depend on imports of these fully formulated systems (FFS) containing HCFC-141b from the system houses. This approach permits most of the conversion to HCFC alternatives to take place cost-effectively in a centralized location rather than at the various smaller clients of the system houses.

System Houses in Mexico provide HCFC-free systems to the Caribbean Region. Client enterprises in Jamaica and Trinidad & Tobago depend on Mexican system houses to supply them with FFS to be used in insulation applications for buildings (spray) and fisheries (boxes and storage units). UNDP first supported the adoption of low-carbon HCFC alternative technologies from Belgium, India, and the US by system houses in Mexico, which were then able to produce FFS using non-HCFC/low-GWP foam blowing agents. UNDP then promoted a series of technology and equipment transfer activities between Mexico, Jamaica and Trinidad & Tobago with minimum interruption to normal work processes.

PROJECT PHOTO SHOWING MULTIPLE DRUMS USED FOR BLENDING OF CUSTOM FORMULATIONS FOR SMES. PHOTO BY HORACIO HERNANDEZ.

CASE STUDY 3

Pilot demonstration project on ODS waste management and disposal in Georgia

This pilot demonstration project, approved at the 69th MP-MLF ExCom meeting in April 2013, will propose a feasible option for the environmentally sound disposal of two metric tonnes of ODS waste being stored in various facilities. It will examine synergies between management of ODS and Persistent Organic Pollutants (POPs), since chlorinated POPs waste is being addressed under a GEF/UNDP initiative with the Ministry of Environment and Natural Resource Protection and focuses on strengthening the existing national system for hazardous waste management in Georgia.

The GEF/UNDP POPs project provided legislative assistance, advisory support and capacity building on hazardous waste management, and in recovery from the central hazardous waste burial site with subsequent re-packaging and sound destruction through high-temperature incineration of 250 tonnes of POPs at hazardous waste disposal facilities in the European Union. UNDP ensured the MP-MLF and GEF initiatives cooperated closely and fostered an effective dialogue with key partners from the private sector and Government.

In early 2014, a reputed waste management firm was contracted to provide the required national and international level support for the disposal of the two streams of chlorinated wastes. As of August 2014, approximately 1.4 tonnes of available ODS waste was co-exported with the larger amount of recovered POPs pesticides and associated waste material to the Indaver hazardous waste facility in Belgium for final destruction, thus providing an excellent example of fruitful cooperation between the MP-MLF and the GEF.

ODS CYLINDERS CALIBRATION AT THE TBILISI RECYCLING CENTER. PHOTO BY VLADIMER VALISHVILI.

CASE STUDY 4

Landlocked LDC makes excellent progress – the Swaziland HCFC Phaseout Management Plan and Palfridge refrigeration manufacturing company

TRAINING OF TECHNICIANS IN THE SAFE USE OF CYCLOPENTANE IN FOAMING OPERATIONS AT PALFRIDGE. PHOTO BY PALFRIDGE.

Swaziland took the decision to make production of its refrigerators ODS-free and climate friendly, and thereby become an example of sustainability in Africa. This is what the Ozone Unit in Swaziland has embarked upon through its HCFC phaseout management plan.

The MP-MLF ExCom, at its 63rd meeting in April 2011, approved the rigid PU foam conversion process from HCFC-141b to cyclopentane as a blowing agent which has zero ODP and low-GWP at the Palfridge refrigeration manufacturing company. The process is underway and Palfridge exports to member countries of the Southern African Development Community (SADC) will also help those countries use non-ODS and low-GWP domestic and commercial refrigerators. Palfridge will - by end-2014 - completely eliminate its use of HCFC-141b, thus helping Swaziland meet its HCFC phaseout target.

This is a unique case for a low volume consuming (LVC) country in which a MLF-funded conversion in production positively impacts neighboring markets, including non-LVC countries, resulting in the availability of environmentally-friendly equipment solutions for end-users. Palfridge has also agreed to introduce this new technology including safety best practices to all its customers. This is an example of Green Economy principles bringing sustainability to products in several countries at the same time, thanks to regional trade agreements.

This has not been easy to implement. Palfridge has periods of peak production to meet high demand, during which time the conversion process was halted – it was restarted once the peak period passed. Another challenge was the added safety equipment and procedures due to the use of cyclopentane - additional gas sensors, emergency stop buttons, alarm boards, ventilation and fire detectors were installed, and the safety of the cyclopentane storage tank was confirmed by a safety audit following international standards.

Palfridge still faces competition from sub-standard imports. Marketing efforts will be stepped up to show that sustainable products are the long-lasting solution for Swaziland and SADC customers. In early 2015, an awareness event will be held by Palfridge to announce that all its production is now 100 percent ODS-free.

While UNDP assisted the conversion process, UNEP assisted on the HPMP training and policy support components, and Germany's GIZ provided funding to help the transition to non-HFC refrigerants. This is an example of the best that multilateral cooperation can achieve.

TOP ROW: FINISHING WORK ON FRIDGE DOOR PANELS FORMED USING CYCLOPENTANE AS BLOWING AGENT AT PALFRIDGE. PHOTO BY PALFRIDGE.

BOTTOM ROW: CYCLOPENTANE SAFETY ALARM BOARD AT PALFRIDGE. PHOTO BY PALFRIDGE.

CASE STUDY 5

Phaseout of CFCs in the manufacture of pharmaceutical Metered Dose Inhalers (MDI) in India

Eliminating consumption of CFCs used in Metered Dose Inhalers (MDI) manufacturing was one of the last challenges India faced in achieving 100% CFC phaseout by 1 January 2010. Even though CFC usage for MDIs was a small percentage of national CFC usage until 1999, it grew rapidly during 2000-2007 due to the increasing demand for inhalers by asthma and Chronic Obstructive Pulmonary Disease (COPD) patients.

India had a problem – how to eliminate this CFC use while at the same time ensuring continuous availability of cost-effective medication to asthma and COPD patients. At Government request, UNDP helped develop this 5-year project, approved by the MP-MLF ExCom at its 56th Meeting in Nov. 2008, with Italy providing bilateral assistance. UNEP was responsible for the awareness and capacity building components. Funding was provided to four beneficiary enterprises: Cadila Healthcare, CIPLA, Midas-Care Pharmaceuticals, and Sun Pharmaceutical Industries, to adopt CFC-free alternative formulations.

The implementation of this 5-year project started in 2009 and ended successfully in 2012, one year ahead of schedule. A performance- based payment implementation system was designed whereby the four enterprises received payments based on verification of specific performance milestones achieved. This innovative modality helped fast-track project implementation and increased buy-in and ownership of the conversion process by the beneficiary enterprises.

The project eliminated 703 ODP tons of CFCs and ensured a continuous and cost-effective supply of CFC-free medication not only to asthma patients in India but also to asthma patients in other countries served by Indian exports.

CASE STUDY 6

Adoption of a sustainable green technology approach in shoe sole production in Guanajuato, Mexico

USING METHYL FORMATE AND METHYAL TO REPLACE HCFC-141B IN SHOE SOLE PRODUCTION IN MEXICO. PHOTO BY HORACIO HERNANDEZ.

The manufacturing of shoes in an important industry in Mexico, and particularly in the Guanajuato region which produces around 244 million pairs of shoes each year in over 7,000 enterprises, employing 135,000 people directly (and some 270,000 indirectly).[12]

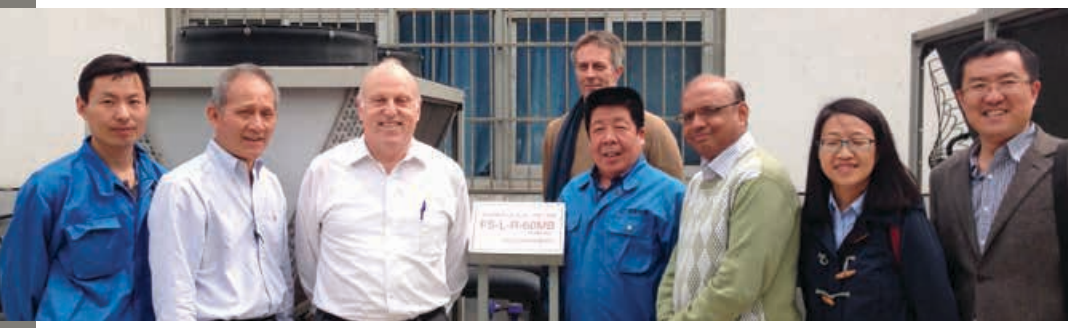
The newly agreed HCFC phaseout under the Montreal Protocol called for both prioritization of high-ODP substances during the first stage HPMPs and also the adoption of low-carbon alternatives to mitigate climate change. Normally technologies to replace HCFC-141b use in foams for shoe sole production are either water/CO_2, hydrocarbons or HFCs. Considering technical and financial limitations for the wide adoption of these technologies, the MP-MLF ExCom approved pilot projects to assess newer technologies. UNDP assisted the Government in testing the suitability of methyl formate and methylal as an alternative non-ODS and low-GWP blowing agent in the PU foam sector.

This pilot project, completed in 2011, demonstrated the viability of using methyl formate and methylal as a replacement for HCFC-141b in the production of shoe soles, and this new technology is currently being used in the ongoing Mexico HPMP. This is helping Mexico meet its MP ODS phaseout targets while simultaneously minimizing negative economic and social impacts of the industrial reconversion on local industries and local communities dependent on this industry. This new technology is also lower in cost and has easier applications – a truly green technology.

[12] Data from the Chamber of the Footwear Industry of the State of Guanajuato (Ciceg) (2013)

CASE STUDY 7

Demonstration project using HFC-32 technology in the manufacture of small-sized commercial air-source chillers and heat pumps at Tsinghua Tong Fang Artificial Environment Co., Ltd., Beijing, China



UNDP TEAM WITH CHINESE COUNTERPARTS AT THE TONG FANG DEMONSTRATION PROJECT. PHOTO BY UNDP.

HFC-32 is used as a refrigerant in air-conditioning applications and has zero ODP and a GWP of 650. This compares with a GWP of 1,810 for HCFC-22 and 2,088 for R-410A. However the GWP gains are more pronounced by unit since the charge needed for an HFC-32 system is 60-80 percent lower than the charge for the other two refrigerants. Currently, commercial a/c equipment widely used in China mainly uses R-410A or HCFC-22. HFC-32 is categorized as a refrigerant with relatively low flammability compared to hydrocarbons. The quantity of refrigerant charge in commercial a/c equipment can vary from 5-24 kgs/unit depending on the refrigeration capacity of the equipment. There was a need to demonstrate how the conversion of a manufacturing facility to produce such equipment could be done safely.

The MP-MLF ExCom approved this demonstration project at its 60th Meeting in April 2010. During 2010-2013, Tsinghua Tong Fang implemented the conversion project which involved overall system redesign of three models of commercial air-source chillers/heat pumps (13 kW, 30 kW, 60kW), redesign of key components (compressors, expansion valves, heat exchangers, unit structure, electrical and control systems) and redesign of the process, conversion of the production line, prototype trials, testing and production, and process and safety training. Training on safety aspects was provided to manufacturing, installation and maintenance staff. The conversion project was successfully completed in December 2013.

The project phased out 61.9 tonnes of HCFC consumption, and reduced greenhouse gas emissions by 170,000 tonnes of CO_2 eq. The project has shown how equipment using HFC-32 based technologies can be safely produced and used commercially.

CASE STUDY 8

South-South cooperation to promote low-carbon technologies in the refrigeration sector in Latin America

The newly agreed MP HCFC phaseout schedule calls for both prioritization of high-ODP substances during the first stage HPMPs and also the adoption of low-carbon alternatives to mitigate climate change. At the second stage of phaseout obligations, countries face the challenge of eliminating the use of HCFC-22 in the refrigeration & a/c (RAC) sectors, since the available alternatives at present have flammability or toxicity characteristics.

In September 2013, the Brazilian RAC Association, ABRAVA, sponsored the 18th Technical Congress and Exhibition on Heating, Ventilation, Air Conditioning and Refrigeration in São Paulo, which brought together technology developers and suppliers from all over the world. UNDP sponsored a booth and invited national ozone officers from Chile, Colombia, Costa Rica, Dominican Republic, Jamaica, Paraguay and Uruguay as well as Portuguese-speaking African countries (in partnership with UNEP) to attend the event and access the latest information on state-of-art technologies to replace HCFC-22.

UNDP TRAINING SEMINAR IN HCFC-FREE, LOW-CARBON TECHNOLOGIES IN REFRIGERATION FOR NATIONAL OZONE OFFICERS FROM LAC AND AFRICA AT THE CONGRESS. PHOTO BY MARINA RIBEIRO, UNDP/BRAZIL.

The invitees reveiwed field application of ODS-free and low carbon technologies such as CO_2, NH3 (ammonia) and hydrocarbons in several manufacturing and servicing sectors. UNDP organized back-to-back seminars with major technology providers and fostered bilateral discussions between suppliers and governments to discuss alternative technologies and policies for practical implementation of HPMPs. Field visits to local companies were organized to demonstrate the practical application of the alternative technologies.

The ideas discussed and contacts made during the Exhibition resulted in other pilot/demonstration activities currently being implemented. Among the lessons learned were:

- South-South cooperation requires information dissemination and technology transfer, so countries can assess technologies and situations similar to the ones that national ozone officers face in their countries;
- Costs may fall if experts and technologies come from southern partners.

EXHIBITION AREA FOR THE GOVERNMENT OF BRAZIL, UNDP/BRAZIL, AND GIZ (GERMANY) AT THE HCFC ELIMINATION PAVILION. PHOTO BY MARINA RIBEIRO, UNDP/BRAZIL.

CASE STUDY 9

Technology transfer and capacity building to accelerate HCFC phaseout in Countries with Economies in Transition (CEITs)

This GEF-funded programme approved in 2012 was launched in 2013. CEITs are not eligible for MP-MLF funding and GEF helps them with capacity building and investment activities to reduce ODS and particularly HCFCs. UNDP is assisting Belarus, Tajikistan, Ukraine and Uzbekistan and relevant stakeholders such as industry associations eliminate HCFC use through progressive reduction of HCFC import and consumption, thereby complying with MP requirements.

UNDP facilitated HCFC management best practice exchanges among these four countries and with others in the region that had already done so. National teams of technical and regulatory experts were established. In 2013, national consultations and initial national capacity building were conducted in all four countries, and their representatives participated in regional HCFC-related events.

In cooperation with UNEP and other agencies, UNDP helped organize a thematic meeting in Minsk, Belarus, during 18-22 March 2014 on the implications of joining the Customs Union between Belarus, Kazakhstan and the Russian Federation. Tajikistan was invited as a prospective future member. Following intensive discussions, a set of recommendations and action points on how to enforce MP provisions on mandatory reporting of imports, exports, production and destruction of ODS, mandatory national import/export licensing systems for any type of ODS and trade restrictions with non-Parties were developed.

One key initial activity was the review of their current HCFC legislation, with a thorough analysis, benchmarking and information-sharing between countries. It follows the regional networking principle that has worked so well throughout the history of the MP - a collaborative mechanism ensuring peer country support as a trigger for compliance with Protocol provisions.

TRAINING IN THE USE OF ODS RECYCLING EQUIPMENT IN TAJIKISTAN. PHOTO BY MIRZOHAYDAR ISOEV.

LOOKING FORWARD

The focus of UNDP/MPU work during the implementation of the UNDP Strategic Plan 2014-2017 will be to continue to assist developing countries comply with HCFC reduction targets controlled under the Montreal Protocol. Important future milestones are the 10% reduction of HCFC consumption in 2015 and the 35% reduction target in 2020.

As lead agency in 28 developing countries (including Brazil, China, and India), UNDP will support the implementation of Stage I of their HCFC Phaseout Management Plans (HPMPs) that have been developed over the last four years. Combined, these countries represent 77% of the global consumption of HCFCs. In addition, UNDP has also started preparing recipient partner countries for Stage II HPMPs which call for 35% HCFC reduction targets by 2020.

UNDP will continue its support to countries as they undertake sector-level technology needs assessments and situation analyses on HCFC import, export/re-export and distribution channels; forecasting HCFC production and consumption patterns; and helping countries develop comprehensive strategies and action plans for HCFC phaseout.

During HPMP implementation, UNDP will pay special attention to the needs of SMEs who tend to have limited operating capital, small-scale production and thus a lower potential to decrease production costs. Their conversion processes will have to ensure long-run sustainability and job protection so that they can maintain the livelihoods of their personnel and those who depend on them.

Maximization of climate benefits during HPMP implementation through energy efficiency improvements will remain an important aspect of our work, and we will work closely with our UNDP climate change colleagues in this area.

Finally, one of the key lessons learned under the MP-MLF has been the critical need and value of partnerships at all levels – international, regional, national and local – and UNDP/MPU will continue promoting partnerships at all these levels.

This is an independent publication by the UNDP Montreal Protocol/Chemicals Unit.

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