

Experiences on the implementation of the Montreal Protocol and Sustainable Cooling

A briefing on UNDP's work for partners



Empowered lives.
Resilient nations.

29 September 2022

I. Introduction

Since 1991, UNDP's Montreal Protocol programme has proudly partnered with around 120 countries supporting their obligations under the Montreal Protocol on Substances that Deplete the Ozone Layer. UNDP's cumulative portfolio of 2,708 projects since 1991 and sector programmes amounting to US \$904.4 million has already eliminated 71,617 Ozone Depleting Potential (ODP) tonnes per annum, generated cumulative climate benefits of almost 6.5 billion tonnes of CO₂-eq. emissions, and catalyzed innovative solutions for converting to environment-friendly alternatives. As of the end of 2021, UNDP has disbursed US\$ 826,815,710 and has active projects in 49 countries, of which 23 are low volume consuming countries (LVCs). The vast majority of ongoing projects are implemented using the National Implementation Modality, providing countries with larger country ownership.

While most of Ozone Depleting Substances (ODS) have been eliminated gradually, their main alternatives - Hydrofluorocarbons (HFCs) - a group of the powerful Greenhouse Gases, are growing rapidly. On January 1st 2019, the Kigali Amendment for phasing-down HFCs entered into force and made the Montreal Protocol very relevant for the global climate action.

The successful implementation of the Kigali Amendment could avoid up to 0.4°C of global warming by the end of the century¹. However, difficulties and challenges faced by developing countries in accessing and scaling-up sustainable and efficient cooling technologies are significant at present. Technical and financial support, as well as capacity development to reduce HFCs and improve cooling efficiency are needed in different stages for virtually all developing countries. At the same time, Developing countries must phase-out by 2030 the remaining HCFC consumption by 2030 as per the requirements of the adjusted schedule of the Montreal Protocol.

II. HCFC phase-out and HPMP implementation

UNDP has since 2008 been assisting 47 countries in phasing-out HCFCs (Hydrochlorofluorocarbons): UNDP is the lead agency in 29 countries and a cooperating agency in 18 countries for the implementation of HCFCs Phase-out Management Plan (HPMP) supported by the Multilateral Fund (MLF). UNDP is also supporting 5 countries in economic transition to phase-out HCFCs with financial assistance from the Global Environmental Facility (GEF). The Stage-I HCFC Phase-Out Management Plans (HPMPs) have a total grant of USD\$ 173 million from the MLF have already been completed with an outstanding result of meeting their reduction target of 2015 on time and in some cases with wide margins. The Stage-II HPMPs with total grant of USD\$ 257 million.

¹ Ozone Secretariat, 2016

UNDP activities address the needs of all HCFC consuming sectors in countries with varying industry sizes. Following table lists UNDP supported HPMPs per regions and countries in active projects.

UNDP’s assisted HPMPs per Region/Country (55)

<i>Region</i>	<i>Country</i>
<i>Africa (8)</i>	Angola, Congo, Ghana, Mali, Nigeria, South Sudan, Eswatini, Zimbabwe
<i>Arab States (3)</i>	Egypt, Lebanon, Jordan
<i>Asia and the Pacific (15)</i>	Bangladesh, Bhutan, Brunei, Cambodia, China, Fiji, India, Indonesia, Iran, Lao, Malaysia, Maldives, Nepal, Sri Lanka, Timor-Leste
<i>Europe and the CIS (9)</i>	Armenia, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Ukraine, Uzbekistan
<i>Latin America and the Caribbean (20)</i>	Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, El Salvador, Guyana, Haiti, Jamaica, Mexico, Panama, Paraguay, Peru, Saint Kitts and Nevis, Trinidad and Tobago, Uruguay

III. Demonstration projects on ozone and climate friendly alternative technologies to ODS

UNDP has been on the forefront of efforts for supporting partners in all regions to introduce and validate the new technologies. From 2008 to 2018, UNDP has pioneered approaches and has implemented 17 demonstration projects in 9 countries to demonstrate the applicability of low-global-warming-potential alternatives to HCFCs as well as of the environmentally sound management and disposal of ODS waste. Results and lessons learned from these demonstration projects have been applied for and replicated in the implementation of HPMPs and could be used for the HFC phase-down. The factsheets and final reports of these demonstration projects are available at the [portal](#) of the Secretariat of the Multilateral Fund. Please, refer to the Table 1 in the Annex for more information about the projects, countries, sectors and technologies.



² **Photos of Projects implemented with UNDP assistance:** (1) demonstration of ODS-free blowing Agent in Jamaica, (2) Market transformation of CO2 super-critical in supermarkets in Chile, (3) Recovery and Recycling of ODS in Brazil, (4) Training activities in Peru and (5) Guyana, (6) Industrial conversion to CO2-NH3 in MoonTech China, and (6) ODS destruction project in Colombia.

IV. Projects and Activities related to HFCs Management and Phase-down for the Kigali Amendment

Initial Data Survey

UNDP is well positioned to effectively support partners on the HFCs Management and Phase-down actions. In 2013-17 UNDP has supported Article 5 countries to undertake ODS Alternatives Surveys. With assistance from the Climate and Clean Air Coalition (CCAC), UNDP successfully supported Bangladesh, Chile, Colombia, Ghana, Indonesia, and Nigeria to undertake [initial inventories of HFC consumption](#) and implemented a HFC investment project in Chile.

Enabling Activity

Since 2017, UNDP has been supporting 19 countries to implement the Enabling Activities (EAs) for the Kigali Amendment. Apart from assisting the activities in the national level, UNDP is facilitating the experience exchange between Article 5 countries in the regional and global level during the implementation of EAs and other projects:

Pilot investment projects of HFC phase-down for the implementation of the Kigali Amendment

The Executive Committee of the Multilateral Fund is currently deliberating the cost guidelines of the HFC phase-down for the implementation of the Kigali Amendment. Ten (10) stand-alone projects have been approved by the Ex.Com in 2017 and 2018 to collect the cost information. UNDP assisted 5 countries in implementing investment projects. Four pilot projects in Bangladesh, China, Dominican Republic and Mexico implemented by UNDP had been completed successfully and timely with detailed technical and cost information, experiences and lessons learned in the completion reports. UNDP helped mobilize additional resources from K-CEP and bilateral donors for improving energy efficiency during the conversion for greater impact. Energy efficiency of new designed models in the pilot projects have been improved significantly up to 40%. Please, refer to the Table 2 in the Annex for further information about Enabling Activities and HFC phase-down stand-alone projects implemented by UNDP.

Preparation of the Kigali Implementation Plan (KIP)

As of mid-2022, UNDP has received approval from the Multilateral Fund to provide support to 28 countries to prepare their Kigali Implementation Plans as the lead or cooperating agency, including Angola, Bangladesh, Bhutan, Chile, Columbia, Costa Rica, Cuba, Dominican Republic, El Salvador, Fiji, Ghana, Granada, Cambodia, Kyrgyzstan, Laos, Lebanon, Maldives, Mexico, Mozambique, Nigeria, Panama, Paraguay, Peru, Sri Lanka, Eswatini, Trinidad & Tobago, Turkey, and Uruguay. Additional requests on the preparation of KIPs and investment projects will be submitted to the future meeting of the MLF when the country is eligible for funding for the Kigali Amendment. These KIPs will be submitted to the Ex.Com of the MLF earliest in 2023 after the cost guideline of the MLF on HFC phase-down is finalized.

V: Integrated approach for sustainable Cooling and energy efficiency

National Cooling Plan

Cooling is a significant contributor to greenhouse gas emissions. Air conditioners and electric fans currently consume 20% of the electricity used in buildings around the world and their use is expanding more rapidly than any other building appliance. According to projections by the International Energy Agency, global energy demand for cooling is expected to triple by 2050. While cooling is essential to human health, food security and economic productivity, inefficient cooling services worldwide can threaten the 2030 sustainable development agenda.

Recognizing the importance of sustainable cooling, UNDP, with the Clean Cooling Collaborative (CCC) (formerly known as the Kigali Cooling Efficiency Programme (K-CEP)), supported twelve countries in developing their National Cooling Plans (NCPs): Bangladesh, Chile, Costa Rica, Cuba, Ghana, Lebanon, Mexico, Nigeria, Panama, Philippines, Sri Lanka, and Trinidad and Tobago. A site event on the findings of the national cooling plans was organized by UNDP during the OEWG meeting of the Montreal Protocol in July 2022.

The NCPs are important instruments to promote sustainable and smart cooling practices in countries. They cover regulatory, technical and operational areas through which countries can contribute towards the targets of the Paris Agreement and the Kigali Amendment under the Montreal Protocol. The NCPs identify potential energy demand reduction and energy efficiency interventions, suggest pathways for synergies between efficiency improvements and the transition from high global warming potential (GWP) refrigerants and propose a framework for the implementation of these actions in an integrated national cooling plan. UNDP is developing a psummary on the key findings from 11 countries that have developed and published their NCPs with UNDP's support5.

Cool-Up Programme

The Cool UP programme is part of the International Climate Initiative (IKI) funded by The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) to address the challenges of sustainable cooling and to upscale the deployment of appropriate cooling technologies in markets of the MENA region (Lebanon, Jordan and Egypt) and Turkey. UNDP joined the Cool Up partnership and supports the coordination in the four countries, technical assistant, and demonstration projects. One of the focuses of the programme is to build partnerships and business models that can help finance the sustainable cooling solutions.

District Cooling

UNDP supports the introduction and upscaling of District Cooling in developing countries as an important strategy to mitigate CO2 emissions in the Cooling Sector. A well-functioning District will normally lead to at least a 50 % reduction in CO2 emissions and can be as high as 85-90 % reduction if the right conditions are in place (e.g. free cooling from Sea Water, access to waste heat, etc.). The mitigation potential is therefore huge and has been proven in several parts of the world, especially in Sweden and northern Europe, the Gulf States and is starting up in China and India. Latin America and the Caribbean has very low market penetration of District Cooling in high density areas.

UNDP is focusing on SIDS and smaller countries where changes are more likely to happen. Current focus is on Latin America and the Caribbean with the potential to expand to other regions. The work will consist of three phases: 1) Creating the Enabling Environment for District Cooling, 2) Development of Feasibility /

Business Case Studies, 3) Securing the finance for the construction of new Districts. UNDP will partner with a series of institutions and stakeholders to achieve the objectives.

Sustainable Cooling Offer

The global warming impact of cooling can be mitigated by enhancing clean energy access, transitioning to low global warming potential (GWP) refrigerants, increasing energy efficiency of cooling units and integrated cooling and heating solutions coupled with renewable energy. In response to the challenges and opportunities in the cooling sector, UNDP developed “Sustainable Colling Offer” as part of the services for achieving the goals in its strategic plan (2022-2025). The offer combines UNDP’s efforts in supporting countries on integrated and innovative cooling solutions through broad partnerships. This offer will contribute to the Moonshot target of UNDP in energy transition in its strategic plan.

VI. Institutional Strengthening and Differentiated Support to SIDS and LVCs

UNDP supports 22 countries (Argentina, Bangladesh, Chile, Brazil, Colombia, Costa Rica, China, Cuba, Georgia, Ghana, Indonesia, India, Iran, Lebanon, Malaysia, Nigeria, Pakistan, Panama, Sri Lanka, Trinidad and Tobago, Uruguay, Venezuela) to implement the activities aimed at institutional strengthening and capacity building to fulfill their obligations under the Montreal Protocol, particularly for the ODS annual data reporting to the Ozone Secretariat and the Multilateral Fund Secretariat.

UNDP is aware of the critical challenges faced by the Small Island Developing States (SIDS) and Low Volume Consuming Countries (LVCs) and has put together a network of partners and specialists ready to provide dedicated assistance to help increasing capacities to implement the Montreal Protocol. UNDP’s technical support team is de-centralized in Regional Hubs localized in Panama, Bangkok and Istanbul, along with country offices, providing wide coverage for all regions and sub-regions, being closer to the client countries and assuring a quick response to partner’s needs.

As part of these special efforts, UNDP has been organizing thematic workshops for SIDs and LVCs to discuss their specific circumstances, challenges and solutions, with a focus on the servicing sector, as well developing implementation strategies that can meet the compliance requirement and promote the transition.

VII. Partnership

UNDP is promoting broad partnerships to advance the implementation of the Montreal Protocol. UNDP is a partner of the CCAC and is participating in its new initiative of “Efficient Cooling” as one of the lead partners. UNDP is also member to in SE4ALL’s initiative “Cooling for all” and is assisting 12 countries develop their national cooling plans funded by Kigali Cooling Efficiency Programme (K-CEP) and some activities aiming to improve the energy efficiency through enhancing policy, standard, labeling, public procurement, as well as improving the product design using efficient components.

UNDP supports inter-agency cooperation and works together with UNEP, UNIDO, the World Bank, and bilateral agencies (Australia, Canada, France, Germany, Japan, Italy, New Zealand and USA) in various countries. UNDP is building public–private collaboration to implement the Montreal Protocol portfolio through extensive and growing engagement with the private sector and across civil society.

UNDP is working in over 170 countries and territories to help achieving the Sustainable Development Goals by 2030. Efficient, clean cooling for all underpins many SDGs and represents an opportunity to avoid substantial climate and air pollutant emissions. There is the need to mainstream and align the HFC management plan for the Kigali Amendment with broad efforts of SDGs and climate actions. UNDP positioned itself through its Global Policy Networks and Communities of Practice in the cross-cutting areas to help country achieving synergy and alignment among different programmes.

IV. Successful Experience and knowledge sharing

Case studies from the UNDP portfolio, and innovative approaches for cooling without warming, could be found in our recent publication “[Past Success And Future Opportunities](#)” which was presented in November 2017 for the 30th anniversary of the Montreal Protocol.

UNDP is proud of being the Agency that supported China, Chile and Eswatini for the development and implementation of three of five projects awarded as “[Exemplary Project](#)” on the 30th Anniversary of the Montreal Protocol in 2017. These successful stories demonstrated how the different parts of cold chain industries (food storage, super market and domestic refrigerator) could be equipped with highly efficient, economically viable and ozone-climate friendly technologies, and how UNDP, in partnership with private and public sectors, supported innovative and advanced technologies in pursuit of Sustainable Development Goals.

Recognizing the challenges on the supply chain faced by many A-5 countries in accessing the new technologies and key components of the products, UNDP organized the workshop of “[Green Supply Chain Workshop for Cooling Without Warming](#)” (8 to 10 October 2018 in Jakarta, Indonesia). The workshop brought together Ozone Units, Experts, Private Sector and Associations to narrow the Supply Chain gap of green [Cooling Solutions](#).

UNDP hosted the workshop “[Towards the effective implementation of the Kigali Amendment](#)”, on May 2018 in New York. The workshop brought together participants from twenty Article 5 countries and international experts to discuss challenges, opportunities and potential solutions, and to identify short-term priority activities and long-term strategy to effectively implement the Kigali Amendment and improve the energy efficiency.

UNDP developed a briefing document “UNDP: Experiences and Case Studies on Energy Efficiency in the Refrigeration and Air Conditioning Sector” <https://ozone.unep.org/system/files/documents/UNDP-case-studies.pdf> in the workshop on the energy efficiency while phasing down HFCs of the Montreal Protocol in 2018.

VIII. UNDP's Montreal Protocol Focal Points

At national level, UNDP Country Offices are the primary contact.

The Montreal Protocol and Chemicals Unit (MPU) is the focal point of UNDP on the Montreal Protocol:

Headquarters (New York):

Xiaofang Zhou (xiaofang.zhou@undp.org)

Loise Nganga (loise.nganga@undp.org)

Ajiniyaz Reimov (ajiniyaz.reimov@undp.org)

Monica Gaba Kapadia (monica.kapadia@undp.org)

Etienne Gonin(etienne.gonin@undp.org)

Asia and the Pacific Region (Bangkok Regional Hub):

Anderson Alves (anderson.alves@undp.org)

Manisha Vipul Sanghani (manisha.sanghani@undp.org)

Jie Pan (jie.pan@undp.org)

Xin He (xin.he@undp.org)

Africa, Arab States, Europe and Central Asia Regions (Istanbul Regional Hub):

Maksim Surkov (maksim.surkov@undp.org)

Charlotte De Bruyne (charlotte.de.bruyne@undp.org)

Selimcan Azizoglu (selimcan.azizoglu@undp.org)

Latin America and the Caribbean Regions (Panama Regional Hub):

Kasper Koefoed-Hansen (kasper.koefoed@undp.org)

Carlos Andres Hernandez (carlosandres.hernandez@undp.org)

Paloma Somohano (paloma.somohano@undp.org)

ANNEX

Table 1: Demonstration projects funded by MLF for HCFC phase-out and ODS destruction

Project Title	Country	Sector/Subsector/Applications
Pilot project to validate methylal as blowing agent in the manufacture of polyurethane foam	Brazil	PU Foam Non-insulation and insulation foam
Pilot project for validation of methyl formate as a blowing agent in the manufacture of polyurethane foam	Brazil	PU Foam/Flexible, integral skin, rigid insulation foam
Demonstration project for conversion from HCFC-22 technology to ammonia/CO2 technology in the manufacture of two-stage refrigeration systems for cold storage and freezing applications at Yantai Moon Group Co. Ltd.	China	Industrial and commercial refrigeration (ICR) /Cold storage and freezing applications
Demonstration project for conversion from HCFC-22 technology to HFC-32 technology in the manufacture of commercial air-source chillers/heat pumps at Tsinghua Tong Fang Artificial Environment Co. Ltd.	China	Industrial and commercial air-conditioning Unitary and multi-connected air-conditioning (AC) and heat pumps
Demonstration of the application of an ammonia/carbon dioxide refrigeration system in replacement of HCFC-22 for the medium-sized producer and retail store of Premezclas Industriales S.A.	Costa Rica	Industrial and commercial refrigeration
Assessment of the use in Colombia of the supercritical CO2 technology	Colombia	PU Foam/Spray foam
Demonstration project to validate the use of hydrofluoro-olefins for discontinuous panels in Article 5 parties through the development of cost-effective formulations	Colombia	Rigid Foam
Demonstration of low-cost options for the conversion to non-ODS technologies in polyurethane foams at very small users	Egypt	Rigid Foam
Conversion from HCFC-22/HCFC-142b technology to CO2 with methyl formate co-blowing technology in the manufacture of extruded polystyrene foam at Feininger	China	Extruded polystyrene (XPS) foam
Validation of use of HFO-1234ze as a blowing agent in the manufacture of extruded polystyrene foam board stock	Turkey	Extruded polystyrene (XPS) foam
Validation/Demonstration of low-cost options for the use of hydrocarbons as foaming agent in the manufacture of PU foam	Egypt	PU Foam Rigid and integral skin foam
Pilot project for validation of methyl formate in microcellular polyurethane applications (phase I)	Mexico	Integral skin foam
Demonstration project for conversion from HCFC-141b-based technology to isoparaffin and siloxane (KC-6) technology for cleaning in the manufacture of medical devices at Zhejiang Kindly Medical Devices Co. Ltd.	China	Solvents
Demonstration project for ammonia semi-hermetic frequency convertible screw refrigeration compression unit in the industrial and commercial refrigeration industry at Fujian Snowman Co. Ltd.	China	Industrial and Commercial Refrigeration Compressor
Demonstration project (R290) for HCFC phase-out in the manufacturing of commercial air conditioning equipment in industrials THERMOTAR LTDA.	Colombia	Commercial Air-Conditioning
Demonstration Project for Fisheries Sector in the Maldives	Maldives	Refrigeration in Fishery Sector
Punta Cana District Cooling Feasibility Study	Dominican Republic	Air conditioning sector/not-in-kind technology
4 Demonstration projects for ODS waste management and disposal		Brazil, Colombia, Ghana, Georgia

Table 2: List of Enabling Activities and HFC phase-down stand-alone projects funded by the MLF as of 83rd meeting of the Ex.Com and by other donors

Project Title	Country	Sector/Subsector/Applications
Conversion from HFC-134a to isobutane as refrigerant in manufacturing household refrigerator and of reciprocating compressor of HFC-134a to energy efficient compressor (isobutane) in Walton Hi-Tech Industries Limited	Bangladesh	Domestic Refrigeration/compressor
Conversion of a commercial refrigerator manufacturing line at Fábrica de Refrigeradores Comerciales, SRL (FARCO) from HFC-134a and R-404A to propane (R-290) as refrigerant	Dominican Republic	Commercial air conditioning
Conversion of domestic refrigeration manufacturing facility from HFC-134a to isobutane as a refrigerant and conversion of compressors manufacturing facility from HFC-134a-based to isobutane-based at Mabe Mexico	Mexico	Domestic refrigeration/compressor
Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Capri (SME Harare)	Zimbabwe	Domestic refrigeration
Conversion from C5+HFC 245fa to C5+HFOs in a domestic refrigerator manufacturer (Hisense Kelon)	China	Foam
Trans-critical CO2 refrigeration systems in the super market in Chile (assisted by CCAC)	Chile	Commercial refrigeration/ Supermarket
Maximization of Climate Benefits of HCFC Phase-Out through Demonstration of Alternative Technologies and conducting HFC Surveys	Bangladesh, Dominican Republic, Indonesia, Mexico, Moldova, Sri Lanka	Domestic refrigeration, air conditioning, foams