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EXECUTIVE COMMITTEE OF  
 THE MULTILATERAL FUND FOR THE  
 IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eighty-first Meeting

Montreal, 18-22 June 2018

status reports and REPORTS ON PROJECTS   
WITH SPECIFIC REPORTING REQUIREMENTS

# This document serves as a follow-up to the issues raised in the last annual progress and financial reports submitted to the 79th meeting,[[1]](#footnote-1) and with respect to projects and activities for which specific reports were requested in previous meetings.

# These reports are arranged in the following parts:

Part I: Projects with implementation delays and for which special status reports were requested

Part II: Reports related to HCFC phase-out management plans (HPMPs)

Part III: Demonstration projects for low-global-warming potential (GWP) alternatives to HCFCs and feasibility studies for district cooling (decision 72/40)

Part IV: Phase-out in consumption and production of CTC in India

Part V: ODS waste disposal projects

Part VI: Ongoing chiller projects

# Each part contains a brief description on progress, and the Secretariat’s comments and recommendations.

PART I: PROJECTS WITH IMPLEMENTATION DELAYS AND FOR WHICH SPECIAL STATUS REPORTS WERE REQUESTED

Project implementation progress in 2017

# The Secretariat held discussions with relevant bilateral and implementing agencies on projects for which status reports were requested at the 80th meeting. Further to the discussions, several issues were satisfactorily addressed.

# The projects classified with implementation delays and for which an additional status report is required are listed in Annex I, and the projects with outstanding issues are listed in Annex II to the present document.

Recommendation

# The Executive Committee may wish:

## To note:

### The status and implementation delays reports of the bilateral and implementing agencies submitted to the 81st meeting and contained in document UNEP/OzL.Pro/ExCom/81/10;

### That bilateral and implementing agencies would report to the 82nd meeting on three projects with implementation delays and on seven projects recommended for additional status reports, as indicated in Annexes I and II, respectively, to the present document; and

## To approve the recommendations on ongoing projects with specific issues listed in the last column of Annex II to the present document.

**PART II: REPORTS RELATED TO HPMPs**

# Relevant bilateral and implementing agencies submitted, on behalf of the Governments of Brazil, Cuba, Indonesia, Islamic Republic of Iran, Kenya, Kuwait and Viet Nam, reports on the implementation of projects under stage I or stage II of HPMPs with specific reporting requirements.

# The report of the HPMP of Kuwait submitted by UNEP as the lead implementing agency, related to the implementation of the second tranche, and included a request for adjusting the implementation period for stage I due to unforeseeable delays with the conversion of the foam manufacturing enterprises. Subsequently, UNEP, on behalf of the Government, requested that the submission be withdrawn, allowing for advancing the delayed conversion of the foam enterprises and indicated that the request for the third tranche would be submitted to the 82nd meeting.

Stage I of the HPMP for Brazil (temporary use of high-GWP-HFC polyol systems) (UNDP and the Government of Germany)

**Background**

# At the 80th meeting, UNDP, as lead implementing agency, submitted the annual progress report on the implementation of the work programme associated with the fifth tranche of the HCFC phase-out management plan (HPMP).[[2]](#footnote-2) [[3]](#footnote-3)

# UNDP explained that two systems houses (Shimtek and U-Tech) had requested the temporary use of HFC polyol systems with high global-warming potential (GWP), as HFOs were not yet available on a commercial scale in the country. Both systems houses had signed a commitment to stop the temporary use of HFC blends once HFOs were commercially available and the systems had been developed and optimized at no additional cost to the Multilateral Fund.

# Further to a discussion, the Executive Committee requested UNDP to continue assisting Shimtek and U-Tech in securing the supply of the alternative technologies selected, on the understanding that any incremental operating costs would not be paid until the alternative technology originally selected or another technology with a low-GWP had been fully introduced. UNDP was also requested to report on the status of use of the interim technology selected by the systems houses at each meeting until the technology originally selected or another technology with a low-GWP had been fully introduced (decision 80/12(e)).

# In line with decision 80/12(e), UNDP has reported that both systems houses are currently developing polyols based on HFOs.

# **Comments**

# The Secretariat notes the efforts by UNDP to assist the two systems houses in securing the supply of low-GWP foam blowing agents. In response to a request by the Secretariat, UNDP confirmed that the specific blowing agent is HFO-1233zd and that although its availability in Brazil is better than in previous years, it is still a challenge to procure larger quantities. UNDP will continue reporting on any additional progress by Shimtek and U-Tech.

# **Recommendation**

# The Executive Committee may wish:

## To note, with appreciation, the report provided by UNDP and the efforts made to facilitate the supply of technology with low global-warming potential (GWP) to the systems houses Shimtek and U-Tech in Brazil; and

## To request UNDP to continue assisting the Government of Brazil in securing the supply of low‑GWP alternative technology and to provide a report on the status of the conversion of the two systems houses, to each meeting, until the technology originally selected or another technology with a low-GWP has been fully introduced.

# Temporary use of a high-GWP technology by enterprises that had been converted to a low-GWP technology in Cuba (UNDP)

# **Background**

# At the 77th meeting, the Government of Cuba submitted a request for approval of the third tranche of stage I of its HPMP,[[4]](#footnote-4) indicating that, although two polyurethane (PU) foam enterprises (namely Friarc and IDA) had received assistance to convert to water-blown technology (a low-GWP technology), they were currently using, on a temporary basis, a blend of HFC-365mfc and HFC‑227ea (a high‑GWP technology), because the technology initially selected was not available, nor did it provide the required insulation performance. In approving the tranche, the Executive Committee *inter alia* requested UNDP to continue assisting the Government in securing the supply of low‑GWP technology and to report on the status of the use of the interim technology at each meeting until the technology originally selected or another technology with a low‑GWP had been fully introduced and the enterprises converted (decision 77/50(b)).

# In line with decision 77/50(b), UNDP has reported that Friarc has been discussing administrative arrangements for the purchase of a foam injection machine operating with hydrocarbon (HC), and has approached a regional systems house regarding the supply of HFO-based PU systems. UNDP has also reported that IDA and the National Ozone Unit have approached the same regional systems house, which has now sent samples of HFO-based PU systems to the two enterprises for trials.

# **Comments**

# The Secretariat notes the efforts by UNDP to assist the two enterprises in securing the supply of low-GWP technologies.

# Further to a request for clarification, UNDP has indicated that Friarc has: identified a supplier for the foam machine capable of handling HC-based systems; conducted a technical and financial feasibility study for the purchase of the equipment; and requested funds for the acquisition of the new equipment from the management of the industrial group. As it could take time to obtain the additional funding, in line with the commitment of the Government to adopt a non-ODP, low-GWP alternative, the enterprise is currently testing HFO-based systems. In the case of IDA, while the enterprise has not made a final decision on the technology, it is considering using HFO-based systems.

# UNDP has also indicated that it will report to the Secretariat on the final technology selection. In the event that HFO is the technology selected, the two enterprises will assume the higher cost of the systems. Given the limited level of funding approved for the conversion of the foam sector, UNDP expects flexibility with regard to the selection of the low-GWP technology and use of the available funding. Only once the selection of technology has been decided, and UNDP has reported the cost of introducing it, will the Secretariat be able to assess its incremental cost. Despite the fact that the final technology has yet to be introduced, the Government has already banned the use of HCFC‑141b in line with its commitment.

# **Recommendation**

# The Executive Committee may wish:

## To note, with appreciation, the report provided by UNDP and the efforts made to facilitate the supply of technology with low global-warming potential (GWP) to the enterprises Friarc and IDA in Cuba; and

## To request UNDP to continue assisting the Government of Cuba in securing the supply of low‑GWP alternative technology and to provide, to the 82nd meeting, a report on the status of the conversion of the two enterprises in the foam sector, including, in the event of use of a technology other than that selected when the project was approved, a detailed analysis of the incremental capital and operating costs.

Indonesia: HCFC phase-out management plan – stage I: Update on enterprise conversion of technology (UNDP, UNIDO, World Bank, and the Government of Australia)

# **Background**

# On behalf of the Government of Indonesia, UNDP, as the lead implementing agency, submitted a report on the status of enterprises temporarily manufacturing high global warming potential (GWP)-based refrigeration and air‑conditioning equipment at enterprises that received funding to convert to low-GWP alternatives in line with decision 77/35.

# Stage I of the HPMP included conversion of 48 enterprises in the refrigeration and air-conditioning (RAC) manufacturing sector to low-GWP technologies. However, during implementation, 28 enterprises (16 in the air-conditioning sector and 12 in the commercial refrigeration sector) decided to convert to high‑GWP technology with their own resources and returned US $3,134,216 plus agency support costs to the Multilateral Fund.

# Of the remaining 20 enterprises, only one (Panasonic) is currently manufacturing air-conditioners based on HFC-32 technology. Eight large- and medium-sized enterprises have manufactured HFC‑32‑based prototype equipment, while eight small-sized enterprises are assemblers that work based on custom‑made orders; to date, no orders for HFC-32-based equipment have been received. Three additional enterprises were still waiting for the market for HFC-32-based equipment to improve before undertaking their conversion.

# The reasons for the delay in the conversion of and manufacturing RAC equipment with the agreed technology by 19 enterprises are: the limited commercial availability of HFC-32-based compressors and components at affordable prices; the lack of demand in the local market for HFC-32-based equipment; and the higher cost of HFC-32-based equipment compared to other equipment available in the country (e.g., those based on R-410A refrigerant).

# To enable these manufacturing enterprises to start manufacturing using the technology for which the funding had been approved, the national ozone unit (NOU) with UNDP conducted awareness activities and a study tour to China in October 2017. From the study tour enterprises learnt that compressor manufacturers in China were waiting for a safety standard (anticipated for June 2018) to initiate mass production of HFC-32-based commercial compressors; some manufacturers indicated that while they were ready to export, it would not be economically viable to do so due to small market demand. Some of the Indonesian enterprises have shown interest in starting discussions with compressor manufactures from China about detailed design, trials, analysis of performance and pricing.

# UNDP also indicated that a review meeting with the RAC manufacturing enterprises to estimate timelines for production of equipment based on the low-GWP technology selected, will be held in July 2018. Subsequent to the meeting, UNDP would be able to provide an update of the situation.

**Comments**

# The Secretariat sought further information on steps being undertaken to facilitate the conversion of the enterprises to the selected low-GWP technology. UNDP indicated that the Government of Indonesia and UNDP were continuing activities to promote the introduction of the HFC-32 technology, and confirmed that incremental operating costs will not be paid until it has been verified that the enterprises are manufacturing equipment using the approved technology in line with decision 77/35.

# With regard to the limited supply of HFC-32 compressors to Indonesia, UNDP explained that the China National Standardization Administration Committee released a national safety standard in refrigerating systems and heat pumps (GB/T9237-2017), that specifies the threshold for the use of flammable refrigerants to be implemented as of 1 July 2018. While the safety standard does not impede the export of HFC-32 compressors, mass production at Chinese compressor manufacturers is only likely to start once the standard is in place. Such mass production would likely be required for HFC‑32-based compressors to be available at competitive prices for export to the Indonesian market. In addition, UNDP emphasized that the ability of enterprises in Indonesia to start large-scale manufacturing with HFC-32 not only depends on the availability of HFC-32-based compressors, but also on broader factors affecting market acceptance, including that the equipment is perceived as being safe, energy efficient and reliable.

# The Secretariat noted that enterprises in Viet Nam believe they will have no issues sourcing HFC‑32 compressors. While noting that enterprises in Indonesia have relationships with their existing component suppliers, UNDP also indicated that, in preparation for the July 2018 meeting with RAC manufacturing enterprises, it will investigate other potential suppliers of HFC‑32 compressors, including one compressor manufacturer in Thailand that is ready to manufacture compressors of similar capacity as used by the enterprises in Indonesia.

# The Secretariat noted that, in line with decision 77/35(a)(vi), any IOCs that had been approved for the manufacturing enterprises are not to be paid until it had been verified that the enterprises were manufacturing equipment using the approved technology, and that in line with decision 76/47(d), the project completion report for stage I of the HPMP would be submitted to the first meeting of 2019. Therefore, and pending the outcome of the review to be held in July 2018 with the enterprises, it may be necessary to consider a limited extension for the completion of the RAC sector activities in stage I and of the submission of the project completion report. It was agreed to discuss this possibility after the July 2018 review with the enterprises and during the review of the stage I progress report that would be submitted to the 82ndmeeting.

**Recommendation**

# The Executive Committee may wish:

## To note the update on enterprise conversion of technology in stage I of the HCFC phase‑out management plan (HPMP) for Indonesia, submitted by UNDP;

## To note with appreciation the efforts by the Government of Indonesia and UNDP to facilitate the introduction of the low-global warming potential technology selected by the refrigeration and air‑conditioning (RAC) manufacturing enterprises funded under stage I of the HPMP; and

## To request UNDP to continue providing a report on the status of the conversion of the RAC technology enterprises to each meeting until they were manufacturing equipment based on the agreed alternative technology.

Stage I of the HPMP for the Islamic Republic of Iran (annual progress report) (UNDP)

# **Background**

# On behalf of the Government of the Islamic Republic of Iran, UNDP, as lead implementing agency, has submitted the annual progress report on implementation of the work programme associated with the fourth tranche of stage I of the HPMP,[[5]](#footnote-5) for the country, in line with decision 74/43(b).

HCFC consumption

# In 2017, in its country programme implementation report, the Islamic Republic of Iran reported consumption of 3,144.67 mt (229.28 ODP tonnes) of HCFCs. This consumption was 39.7 per cent below the HCFC consumption baseline and 33 per cent below the annual consumption target for 2017 (342.45 ODP tonnes) stipulated in the Agreement between the Government and the Executive Committee. The licensing and quota system for HCFC imports and exports continues to operate effectively.

Progress report on the implementation of the fourth tranche of the HPMP

*Activities in the manufacturing sectors*

# Activities implemented include:

## Conversion of eight polyurethane (PU) foam enterprises in the continuous panel sector (Government of Germany) (30.7 ODP tonnes):Seven enterprises have completed their conversion to HC technology, phasing out 27.8 ODP tonnes of HCFC-141b. One additional enterprise stopped, on its own, using 2.9 ODP tonnes HCFC-141b, and the associated funding will be returned to the Multilateral Fund by deducting it from the second tranche of stage II of the HPMP, in line with decision 80/21;

## Conversion of 11 rigid PU foam enterprises (UNIDO) (88.7 ODP tonnes): Ten enterprises have completed their conversion to HC technology, resulting in the phase-out of 54.6 ODP tonnes of HCFC‑141b. Conversion of the one remaining enterprise (accounting for 34.1 ODP tonnes) will be fully completed in September 2018 but the enterprise is already manufacturing cyclopentane-based foam; and

## Activities in the air-conditioning manufacturing sector (UNDP): The project was completed in 2015 phasing out 29.3 ODP tonnes of HCFC‑22. The technology introduced was R‑410A.

*Activities in the RAC servicing sector (Government of Germany and UNEP)*

# Activities in the RAC servicing sector have been completed, and in the past few years have included:additional training workshops on good servicing practices in several provinces; awareness workshops on energy efficiency and good practices in RAC; distribution of technical publications to stakeholders; and monitoring of the results of installing sealed-system modifications in the refrigeration systems of two supermarket chains.

*Level of fund disbursement*

# As at March 2018, of the US $9,994,338 approved, US $9,205,837 had been disbursed, as shown in Table 1.

**Table 1. Financial report of stage I of the HPMP for the Islamic Republic of Iran**

| **Agency** | **Approved (US $)** | **Disbursed (US $)** | **Disbursement rate (%)** |
| --- | --- | --- | --- |
| UNDP | 4,340,246 | 4,340,246 | 100 |
| UNIDO | 2,506,277 | 2,009,372 | 80 |
| Government of Germany | 2,885,815 | 2,885,815 | 100 |
| UNEP | 262,000 | 262,000 | 100 |
| **Total** | **9,994,338** | **9,497,433** | **95** |

**Comments**

# The Secretariat notes: the submission of a comprehensive report; that the licensing and quota system has been enforced and strengthened through the online system; and that additional stage I activities have been completed. The last investment project in the foam sector will be completed in September 2018 and the remaining balance of US $496,905 will be disbursed prior to the end of 2018. UNDP has confirmed that the date of operational completion of stage I is 31 December 2018 as established in the Agreement. Accordingly, the final progress report and project completion report will be submitted to the 83rdmeeting.

**Recommendation**

# The Executive Committee may wish to take note of the 2017 progress report on the implementation of stage I of the HCFC phase‑out management plan for the Islamic Republic of Iran, submitted by UNDP.

Stage I of the HCFC phase-out management plan for Kenya (expenditure report on project management unit) (Government of France)

**Background**

# At the 80th meeting, the Executive Committee approved the fifth and final tranche of stage I of the HPMP for Kenya,[[6]](#footnote-6) and *inter alia* requested the Government of France to submit a report to the 81st meeting providing detailed reporting on the activities that had been and continued to be undertaken by the project management unit (PMU) for stage I of the HPMP (decision 80/68 (d)).

# The Government of France submitted a report on the activities that have been undertaken by the PMU during implementation of stage I of the HPMP up to March 2018. As explained by the Government of France, the PMU plays an important role in project coordination and monitoring activities relating to coordination with other Government institutions especially with the National Environmental Management Authority (NEMA) and the Kenya Revenue Authority (KRA) on import-export monitoring of ODS; training of customs officers and refrigeration technicians; stakeholder awareness activities including participating in workshops and consultations on HPMP-related matters; coordinating processes on consumption verification, preparing progress report on implementation of the HPMP; and supporting the NOU on project related procurement and accounting procedures.

# As of March 2018, of the total adjusted funding of US $196,610 for the PMU, US $187,610 has been disbursed. The balance of US $9,000 will be disbursed by October 2018.

**Comments**

# The Secretariat noted with appreciation the efforts taken by the Government of Kenya in reducing PMU costs, which included reduction in rent costs, cost-sharing arrangement for PMU staff, and reduction in other operating expenses for PMU. The Government of France indicated that they would continue their efforts in reducing PMU costs, where feasible, during implementation of both stage I and stage II of the HPMP.

# The Secretariat also noted that the Director of the Multilateral Environmental Agreements of the Government of Kenya submitted an official letter to the Secretariat in December 2017 confirming the Government’s commitment to accelerate and completely phase-out of HCFCs by 1 January 2030 in line with decision 80/58(g).

# The Government of France also clarified that stage I of the HPMP would conclude by October 2018, and that a report on actual expenditures of the PMU associated with stage I would be submitted upon submission of the funding request for the second tranche of stage II of the HPMP.

# **Recommendation**

# The Executive Committee may wish:

## To note with appreciation the report on the project management unit (PMU) activities and expenditure of stage I of the HCFC phase-out management plan for Kenya; and

## To request the Government of France to submit a report on expenditure of PMU activities of the HPMP of Kenya (stage I) while submitting the request for the second tranche of stage II of the HPMP of Kenya.

Viet Nam: HCFC-phase out management plan (stage II) - Change in technology at Midea Consumer Electric (Viet Nam) Co. Ltd.) (World Bank and the Government of Japan)

**Background**

# At the 76th meeting, the Executive Committee approved in principle, stage II of the HCFC phase‑out management plan (HPMP) for Viet Nam[[7]](#footnote-7) for the period 2016 to 2022 to reduce HCFC consumption by 35 per cent of its baseline, in the amount of US $15,683,990 (US $14,411,204, plus agency support costs of US $1,008,784 for the World Bank, and US $233,630, plus agency support costs of US $30,372 for the Government of Japan).

# Stage II of the HPMP includes the conversion of four air-conditioning (AC) manufacturing enterprises. Three of the enterprises (i.e., Hoa Phat, Nagakawa and REE) decided to convert to HFC‑32, while the fourth, Midea Consumer Electric (Viet Nam) Co. Ltd. (Midea Viet Nam), decided to convert two manufacturing lines to R‑290 based on the experience of the conversion of the Midea enterprise in China that received funding from the Multilateral Fund to convert to the same technology. Funding provided to Midea Viet Nam for conversion to R-290 technology amounted to US $837,017.

# In preparation to implement the project, Midea Viet Nam sent an official request to the Government of Viet Nam requesting to change the alternative technology to HFC-32 for the following reasons: concerns regarding market acceptance of R-290-based room AC units; lack of a regulation or standard that would facilitate the sales of R-290-based equipment in the country; challenges to provide sufficient training to the servicing sector for safe handling of R-290 beyond the warranty period and under service contracts, as opposed to HFC-32 where several enterprises began training service workshops in safe handling of this refrigerant since 2014; and better parity with the other local AC manufacturers and importers in terms of the market and in addressing safety concerns and potential regulatory issues. Midea Viet Nam also referred to the current circumstances in the Southeast Asia market where other larger manufacturers (e.g., Daikin, Hitachi, LG and Panasonic) were marketing HFC-32-based AC units. Finally, the enterprise noted that Midea headquarters (in China) has a sustainable ongoing production of HFC-32-based equipment. Midea Viet Nam believes it can directly benefit from that experience.

# In accordance with paragraph 7(a)(v), of the Agreement between the Government of Viet Nam and the Executive Committee, the Government through the World Bank has submitted a request to change the technology for Midea Viet Nam from R-290 to HFC-32.

# Incremental capital and operating costs have been revised as shown in Table 2. Costs items related to prototypes for testing and certification, official testing for rating and labelling, and technical assistance were not provided for the conversion to R-290 as Midea China had previously received funding from the Multilateral Fund for the conversion to that technology. Funding is now being requested for the HFC-32 technology. Avoided emissions to the atmosphere decreases by 40,801 mt CO2-eq. due to the higher global warming potential value of HFC-32.

**Table 2. Revised incremental cost of the conversion of Midea Viet Nam to HFC-32 technology (US $)**

| **Cost components** | **R-290** | **HFC-32** | **Difference** |
| --- | --- | --- | --- |
| Model redesign, research, development, in-house testing | 50,000 | 66,000 | 16,000 |
| Prototypes for testing and certification |  | 10,800 | 10,800 |
| Official testing for rating and labeling |  | 5,000 | 5,000 |
| Technical assistance |  | 25,000 | 25,000 |
| Training | 5,000 | 5,000 | - |
| Charging equipment | 104,000 | 120,000 | 16,000 |
| Vacuum pumps |  | 33,600 | 33,600 |
| Leak detectors | 4,000 | 4,000 | - |
| Safety measures, ventilation, electrical installations | 70,000 | 50,000 | (20,000) |
| Storage of refrigerant, transfer pump and piping | 50,000 | 20,000 | (30,000) |
| Contingency (10 per cent) | 28,300 | 33,940 | 5,640 |
| Installation and servicing | 55,000 | 55,000 | - |
| Total incremental capital costs | 366,300 | 428,340 | 62,040 |
| Total incremental operating costs | 470,717 | 341,419 | (129,298) |
| Total cost | 837,017 | 769,759 | (67,258) |

**Comments**

# The Secretariat noted that the agreement between the Government of Viet Nam and the World Bank has not been signed yet, and therefore the request for the second tranche of stage II of the HPMP could not be submitted to the 81stmeeting. The World Bank clarified that the signing of the agreement had been further delayed by another six months due to new internal clearance procedures with the Government.

# Notwithstanding the lack of a signed agreement, the Secretariat noted that preparation for implementation of stage II had started, and Midea Viet Nam would like to start conversion of its manufacturing lines to HFC-32 technology immediately upon the signature of the agreement between the Government of Viet Nam and the World Bank. The Secretariat considers that in light of the circumstances, and to avoid further delay in the implementation of stage II, it would be beneficial that the request to change technology be considered at the 81st meeting instead of the 83rdmeeting when the request for the second tranche is expected to be submitted.

# The Secretariat recalled the demonstration project for the conversion from HCFC-22 to R-290 at Midea (China) approved at the 61stmeeting, and that an additional two lines were converted to R-290 under stage I of the HPMP in China. The Secretariat further noted that the R-290 split AC units manufactured by Midea recently obtained the Blue Angel ecolabel. The Secretariat understands that while Midea remains committed to converting to R-290 in the room AC sector in China, it is pursuing a multi-refrigerant strategy, depending on the model, type and market.

# The Secretariat recalled that in addition to the experience of Midea’s parent enterprise with R-290, the rationale for selecting R-290 was also influenced by the distribution of equipment manufactured by the enterprise. Approximately 60 per cent of the AC units manufactured by Midea Viet Nam have a capacity of 0.75 tonnes of refrigeration (TR), and a further approximately 25 per cent are 1 TR, meaning that approximately 85 per cent of the equipment manufactured by the enterprise is 1 TR or less. Such smaller systems, which have a correspondingly smaller charge size, have more often been the target for R-290 conversion projects than larger capacity equipment. In contrast, REE only manufactured units larger than 4 TR; while Hoa Phat and Nagakawa’s production also included a significant proportion of equipment at 1 TR or less, they also manufactured more equipment of 2 TR or more. Notwithstanding the equipment manufactured by Midea Viet Nam, the enterprise prefers to convert to HFC-32.

# The Secretariat queried on the availability of HFC-32 composition in Viet Nam noting that refrigeration AC enterprises in Indonesia had converted to HFC-32 but were not yet manufacturing equipment due to difficulties in sourcing HFC-32 compressors. The World Bank indicated that there were no issues with sourcing HFC-32-based compressors in Viet Nam, and that the conversion plans for the three enterprises that originally planned to convert to HFC-32 remain the same.

# Regarding the incremental costs for the conversion to HFC-32 technology at Midea Viet Nam, the World Bank clarified that the reduction in incremental operating costs was due to the lower cost of HFC‑32 compressors relative to R-290 compressors. It was agreed to adjust training to US $4,000, consistent with the funding that was provided to the other three enterprises that will convert to HFC-32. Other incremental costs in the revised World Bank proposal are consistent with the costs agreed at the 76thmeeting for the other three enterprises that decided to convert to HFC-32. On that basis, the total cost of the conversion was agreed at US $768,659, resulting in the return of US $68,358, plus agency supports costs of US $4,785 for the World Bank, to the Multilateral Fund. The Agreement between the Government of Viet Nam and the Executive Committee would be amended to reflect this return when the second tranche of stage II of the HPMP would be submitted.

# Finally, the Secretariat noted that should the Executive Committee approve the requested change of technology, future eligibility of the enterprise under an HFC phase-down would be in accordance with paragraph 18 decision XXVIII/2, noting that an approval would take place after the adoption of the Kigali Amendment.

**Recommendation**

# The Executive Committee may wish:

## To note the request submitted by the World Bank on behalf of the Government of Viet Nam for the change of technology in Midea Consumer Electric (Viet Nam) Co. Ltd., from R‑290 to HFC-32 in the context of stage II of the HCFC phase-out management plan (HPMP);

## To approve the change of technology for Midea Consumer Electric (Viet Nam) Co. Ltd., from R-290 to HFC-32, at the amount of US $768,659, plus agency support costs of US $53,806 for the World Bank, resulting in the return to the 81stmeeting of US $68,358, plus agency supports costs of US $4,785 by the World Bank to the Multilateral Fund; and

## To note that the Agreement between the Government of Viet Nam and the Executive Committee for the stage II of the HPMP would be amended to reflect the funding return indicated in sub‑paragraph (b) when the second tranche of stage II of the HPMP was submitted.

**PART III: DEMONSTRATION PROJECTS FOR LOW-GWP ALTERNATIVES TO HCFCs AND FEASIBILITY STUDIES FOR DISTRICT COOLING (DECISION 72/40)**

**Background**

# At the 74th, 75th and 76th meetings, the Executive Committee approved three feasibility studies for district cooling (the Dominican Republic, Egypt, and Kuwait) and 17 projects to demonstrate low‑GWP technologies pursuant to decision XXV/5 and decision 72/40 including: seven projects in the refrigeration and air-conditioning and assembly sub‑sector (China, Colombia, Costa Rica, Kuwait, Saudi Arabia (two), a global (Argentina and Tunisia) and a regional (West Asia[[8]](#footnote-8)) project; six in the foam sector projects (Colombia, Egypt, Morocco, Saudi Arabia, South Africa, and Thailand); and three in the refrigeration servicing sector (Maldives, Europe and Central Asia region), and a global project (Eastern Africa and Caribbean regions)).

# At the 80th meeting, the Executive Committee considered updated information on the status of implementation of the demonstration projects for low-GWP alternatives which had not been finalised. Subsequent to a discussion, the Executive Committee agreed to changes the completion dates for each one of the on-going demonstration projects and three feasibility studies for district cooling, and *inter alia* requested implementing agencies to submit an update on the progress in implementation of all the on-going demonstration and three feasibility studies for district cooling as those with specific reporting requirements at the 81st meeting; and reiterated that implementing agencies should comply with the decisions of the Executive Committee on reporting requirements and submit reports as requested by the Secretariat (decision 80/26).

# In line with decision 80/26, final reports of the demonstration projects for Colombia (two projects), Costa Rica, Maldives, and South Africa; and detailed progress reports of approved projects for Egypt (district cooling), Kuwait (district cooling), Morocco and Regional project in West Asia (PRAHA-II), have been submitted to the 81st meeting. In addition, the very succinct progress reports of demonstration projects for China, Egypt, Saudi Arabia (three projects), Thailand and the Dominican Republic (district cooling), submitted to the 81st meeting are contained in Table 3.

**Table 3. Reports on feasibility studies on district cooling and low-GWP demonstration projects not submitted to the 81st meeting**

| **Country (agency)** | **Project title** | **Comple-tion date** | **Progress reported to the 81st meeting** |
| --- | --- | --- | --- |
| China (UNDP) | Demonstration project for ammonia semi-hermetic frequency-convertible screw refrigeration compression units in the industrial and commercial refrigeration industry at Fujian Snowman Co., Ltd. | Jun-18 | The project has been progressing well and a commissioning meeting took place. In line with decision 80/26(a), a final report will be submitted to the 82nd meeting. |
| Egypt (UNDP) | Demonstration of low-cost options for the conversion to non-ODS technologies in polyurethane foams at very small users | Dec-18 | The project was cleared by the Government; budgets have been allocated with specific procurement plans moving forward to optimize target equipment models.  In line with decision 80/26(e), a final report will be submitted no later than the 83rd meeting. |
| Saudi Arabia (UNIDO) | Demonstration project on promoting HFO-based low-global-warming-potential (GWP) refrigerants for the air-conditioning sector in high ambient temperatures | Dec-18 | The contract with the supplier has been signed. The development of prototypes is ongoing. Components (e.g., compressors) have been delivered for testing. Visit of engineers from the equipment supplier, and the delivery of production equipment and production of first HC-290 units are still pending. In line with decision 80/26(g), the final report will be submitted no later than the 83rd meeting. |
| Saudi Arabia (World Bank) | Demonstration project at air-conditioning manufacturers to develop window and packaged air-conditioners using lower-GWP refrigerants | Sep-18 | Administrative process to start implementation completed in February 2018. The prototype design is expected in June 2018 with prototype production done by August 2018. The final report will be submitted to the 82nd meeting. |
| Saudi Arabia (UNIDO) | Demonstration project for the phase-out of HCFCs by using HFO as a foam blowing agent in the spray foam applications in high ambient temperatures, | Dec-18 | On-site mission was organized in February 2018. Testing of the new HFO-1233zd foam system has been conducted; the testing demonstrated the cost‑effectiveness and similar physical properties of the new system as compared to HCFC-141b-based systems. In line with decision 80/26(i), the final report will be submitted no later than the 83rd meeting. |
| Thailand (World Bank) | Demonstration project at foam system houses to formulate pre‑blended polyol for spray polyurethane foam applications using low-global warming potential blowing agent | Sep-18 | Agreements were signed with both systems houses in November 2017. Both systems houses have initiated procurement of equipment, and are awaiting for equipment delivery. In line with decision 80/26(k), the final report will submitted no later than the 83rd meeting. |
| Dominican Republic (UNDP) | Technical assistance for a feasibility study for district cooling | Dec-17 | UNDP has reported this project as completed as of 79th meeting. However, a final report has not yet been submitted as required under decision 80/26(m). |

\* This value does not include project preparation fund and agency support cost.

\*\* Project to be completed by May 2018 but project document for implementation not yet signed, no activities yet implemented.

**Recommendation**

# The Executive Committee may wish:

## To note the reports on the progress of implementation of the demonstration projects submitted by the implementing agencies as contained in Table 3 of this document;

## To urge UNDP to submit the final report on technical assistance for a feasibility study for district cooling in the Dominican Republic no later than the 82nd meeting; and

## To urge the implementing agencies to submit an update on the demonstration projects for China, Egypt, Saudi Arabia and Thailand to the 82nd meeting and the final reports in line with decision 80/26.

Colombia: Final report on the demonstrative project for HCFC-22 phase-out in the manufacturing of commercial air‑conditioning equipment at Industrias Thermotar Ltda. (UNDP)

**Background**

# At the 75th meeting, the Executive Committee approved the demonstration project for the use of R‑290 (propane) as an alternative refrigerant in commercial air‑conditioning (AC) manufacturing at Industrias Thermotar Ltda., in Colombia,[[9]](#footnote-9) in the amount of US $500,000, plus agency support costs of US $35,000 for UNDP (decision 75/40).

# The project was approved to demonstrate the safe use of R-290 as a low‑global warming potential (GWP) refrigerant in the commercial AC manufacturing sector with ranges between 3.5 kW (one tonne of refrigeration (TR)) and 17.5 kW (five TR); facilitate the possibility of manufacturing hydrocarbon (HC)‑based AC equipment with good performance and minimum incremental operating cost; and demonstrate the safe handling and proper risk management for the introduction of flammable refrigerants in the commercial AC sector in Colombia, to encourage possible adoption in other Article 5 countries.

# On behalf of the Government of Colombia, UNDP has submitted the final report of the demonstration project (the final report is attached in Annex III to the present document). The project was implemented at Industrias Thermotar Ltda., an enterprise manufacturing HCFC-22 ducted split condensing units and package-type equipment, with an average production of 4,100 units per year, and consuming approximately 60 per cent of the total HCFC-22 consumption in the commercial AC sector. Conversion to R‑290 technology has been completed, resulting in the phase-out of 13.27 mt (0.73 ODP tonnes) of HCFC‑22.

# Colombia faced two barriers to manufacture commercial AC equipment with R-290: a lack of information on technical aspects in the design, engineering and manufacturing of R-290-based equipment, and the limited technical knowledge of the personnel that install and service this type of equipment.

# The following conclusions can be pointed out:

## Reduction of the heat exchanger tube diameter (condenser): Two models were defined for both types of AC equipment, namely, aluminium micro-channel heat exchangers and 8 mm copper tube heat exchangers. The designs and tests performed were applied to the largest model (five TR), because it is replicable to the rest of the models;

## Reduction of R-290 refrigerant charge: The estimated charge was 1.00 kg for ducted split condensing unit (five TR) with a 5-meter pipe; the charge for the packaged‑type condenser unit was 0.95 kg. In some cases, charge reductions were more than 50 per cent as compared to HCFC-22 models;

## Modification of the metal structure (cabinet) of condensing units: The metal structure for both types of equipment were modified, and the electrical boxes were individualized or insulated;

## Modification of the handling unit metal structure: The metal structure of the handling unit (part of the split condensing unit) was modified to insulate the electrical box and the entire frame, mainly the air-intake area, to prevent accumulation of R-290 inside an enclosure in case of leaks;

## Pump down cycle installation: The split condensing unit and the package-type unit have a "pump down" cycle, which collects the largest amount of refrigerant in the condensing unit (outside of the equipment). This occurs once pressure variations are detected through two pressure switches located in the AC unit;

## Ultrasonic sensor: The handling unit has an ultrasonic sensor for leak detection, as an additional safety feature that prevents high levels of R-290 inside an enclosure in case of leaks; and

## Power consumption: The enterprise conducted comparative tests related to energy consumption between R-410A and R-290-based equipment (five TR). R-290-based equipment consumes 15 per cent less energy than the HCFC-22-based equipment and 13 per cent less than the R-410A-based equipment.

# The safety measures required for the new manufacture line and for the entire enterprise were defined through the safety assessment carried out by an independent insurance company, who certified that Industrias Thermotar Ltda. implemented all the recommendations from the risk analysis study for the new R-290 production line.

# Training activities were carried out under the supervision of the international consultant, and will continue at the national level. Technical documents for updating national standards (NTC 6828) based on ISO 5149[[10]](#footnote-10) were developed, and a support plan was prepared focusing on the end-users and the servicing sector. The results and conclusions of the demonstration project were presented in local and international events.

**Comments**

# The Secretariat noted that stage II of the HCFC phase-out management plan for Colombia includes a number of activities in the servicing sector that would complement this conversion by allowing for the use and servicing of R-290-based equipment, including the establishment of a natural refrigerant training centre; development and establishment of regulations and standards for flammable refrigerants; and online log book in the AC servicing sector. In addition the project to promote change in end-users consumption habits of refrigeration and commercial AC systems, including the adoption of a value-added tax exemption for end-users of cooling systems that apply energy efficiency and low environmental impact criteria, should encourage the market uptake, as should the inclusion in business association strategies to use low-GWP and energy efficient equipment.

# The enterprise offers a basic maintenance plan that is free for the first six months and a preventative contract, which includes a minimum of three visits per year. In addition, all equipment manufactured by the enterprise has a one-year warranty. Servicing and maintenance is carried out by the enterprise’s own technical service department or by service providers that are trained by Thermotar and the Servicio Nacional de Aprendizaje (SENA). All equipment will be installed by the enterprise’s own technical service or related distributors that will be trained by the enterprise.

# The Secretariat noted that the enterprise has not yet been able to sell any R-290-based equipment. UNDP indicated that there are no commercial obstacles, and that the company is waiting for the first stock of R-290-based compressors and to finish the training of service technicians. Regarding the possibility that the enterprise would offset the idle R-290 manufacturing line by increasing the manufacturing of high‑GWP based equipment, UNDP indicated that the enterprise had a slight increase in the manufacturing level of high-GWP-based equipment, but that increase was due to market trends and not to the conversion of the manufacturing line.

**Recommendation**

# The Executive Committee may wish:

## To take note with appreciation of the final report of the project for the demonstration of R‑290 (propane) as an alternative refrigerant in commercial air-conditioning (AC) manufacturing at Industrias Thermotar Ltda., in Colombia submitted by UNDP; and

## To invite bilateral and implementing agencies to take into account the final report of the demonstration project mentioned in sub‑paragraph (a) above, when assisting Article 5 countries in preparing projects in AC sectors.

Colombia: Final report on the demonstration project to validate the use of hydrofluoro-olefins for discontinuous panels in Article 5 Parties through the development of cost-effective formulations (UNDP)

**Background**

# At the 76th meeting, the Executive Committee approved the demonstration project to validate the use of hydrofluoro-olefins (HFO) for discontinuous panels in Article 5 parties through the development of cost-effective formulations, in Colombia,[[11]](#footnote-11) in the amount of US $248,380, plus agency support costs of US $22,354 for UNDP (decision 76/29).

# The project was approved to validate polyurethane (PU) formulations for discontinuous panels with reduced HFO (namely HFO-1233zd(E) and HFO 1336mzz(z)); to optimise the cost/performance balance to achieve a similar thermal performance to HCFC-141b-based formulations; and to make a cost analysis of the different HFO/water formulations versus HCFC-141b-based systems. In particular, the project was designed to evaluate two HFOs as co-blowing agent in association with CO2 derived from the water‑isocyanate reaction: HFO-1336mzz(Z) and HFO‑1233zd(E). The foam processing and physical properties obtained with these substances along with their respective formulating costs were compared to those of HCFC-141b-based systems. Espumlatex, the largest Colombian 100 per cent-owned PU system house equipped with 18 blending tanks and with a certified quality control laboratory, served as local technical host to coordinate the demonstration, foam application and testing activities.

# On behalf of the Government of Colombia, UNDP has submitted the final report of the demonstration project (the final report is attached in Annex IV to the present document). The conclusions of the demonstration project are the following:

## HFO-based formulations were developed with blowing agent reductions of 61 to 64 per cent by weight (equivalent to an HFO reduction in the gas cells of 60 per cent). These formulations do not present any additional environmental, safety and/or industrial hygiene issues;

## Compared to HCFC-141b-based formulations, the HFO-reduced formulations showed better foam flow (i.e., lower flow ratio between the free rise density and the minimum fill density); an initial foam *k*-factor[[12]](#footnote-12) 7 per cent higher in the laboratory (Brett injections; it was also reproduced at industrial plant level), and similar *k*-factor values measured one month after injected; and similar laboratory and production plant values of compressive strength, dimensional stability and adhesion to metal;

## Handling and processability at the production plant of the HFO reduced formulation was similar to HCFC-141b;

## No difference was observed (statistically) between the performance of foam based on the two types of HFOs, (HFO-1233zd(E) and HFO-1336mzz(Z));

## Under hot climatic conditions, the HFO-1233zd(E)-based systems could require a storage conditioned to cool the formulated polyol storage and the formulated polyol day-tank to 20 to 25 Celsius degrees;

## For discontinuous panels and other rigid foam applications, the moulds should be equipped with temperature controls to ensure good performance;

## Currently, the price of HFO-reduced systems is 16.4 to 33.2 per cent more expensive; however, this could be lower in the future; and

## Initial work was undertaken to investigate 80 per cent reduced HFO foam formulations. The results were promising but further trials are suggested.

**Secretariat’s comments**

# The Secretariat noted with appreciation the report, which comprehensively assessed the performance and costs of reduced HFO systems, used design of experiments to provide statistically significant results, and demonstrated the technology at a foam manufacturer (Ingeniería de Refrigeración Industrial Rojas Hermanos S.A). The results are consistent with reports in the literature and previous technical reports.

# UNDP emphasized that substantial work was undertaken at the systems house to develop the formulations and the level of complexity has not been described in the report, partially because of confidentiality constraints. UNDP also emphasized the importance of heated molds; that some chemicals were provided at favorable costs for the demonstration project; and that the results of the report should be seen a starting point for further development of HFO systems in Article 5 countries.

# The report provides the total costs in US $/kg of PU system. The Secretariat converted those costs to incremental operating costs (IOCs) as shown in Table 4. IOCs for HFO‑1233zd(E) vary between US $9.17/kg of HCFC-141b and US $3.48/kg of HCFC-141b, while the IOCs for HFO-1336mzz(Z) vary between US $21.60/kg of HCFC-141b and US $8.14/kg of HCFC-141b.

**Table 4. Costs of PU systems based on HFO-1233zd(E) and HFO-1336mzz(Z)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **HCFC‑141b** | **0% reduced** | **20% reduced** | **40% reduced** | **60% reduced** |
| Cost of PU systems based on HFO-1233zd(E) | | | | | |
| Total system cost (US $/kg of system) | 2.73 | 3.91 | 3.59 | 3.32 | 3.18 |
| IOC (US $/kg of HCFC-141b) | n/a | 9.17 | 6.66 | 4.53 | 3.48 |
| Cost of PU systems based on HFO-1336mzz(Z) | | | | | |
| Total system cost (US $/kg of system) | 2.73 | 5.52 | 4.75 | 4.32 | 3.78 |
| IOC (US $/kg of HCFC-141b) | n/a | 21.60 | 15.68 | 12.33 | 8.14 |

# The IOCs shown in Table 4 are based on the costs of HCFC-141b and HFOs as provided in the report.[[13]](#footnote-13) Recent trends suggest the price of HCFC-141b has increased, and reduced production of the substance is likely to result in further increases. Data included in recent submissions of HCFC phase-out management plans suggests that higher costs of HCFC-141b are common. Similarly, the reported price of HFOs vary substantially, with costs above those used in the report common. According to some reports, commercial production of HFOs in one large Article 5 producing country is expected in mid-2019, with an expected corresponding reduction in costs, though the timing of this reduction is uncertain.

# In order to provide information relevant to the market penetration of the technology, the Secretariat assessed the variation in IOCs with increasing price of HCFC-141b and reduced prices for HFOs based on the formulations provided. Tables 5 and 6 show the IOCs for the 60 per cent reduced formulation as a function of price of HCFC-141b and of HFO. For reference, when the cost of HFOs is US $10/kg, IOCs are zero when the cost HCFC-141b reaches US $5.65/kg for the case of HFO-1233zd(E) and US $7.85/kg for the case of HFO-1336mzz(Z). UNDP emphasized that the costs of chemicals in other Article 5 countries could differ from those in the report, which would affect the IOCs.

**Table 5. IOC (US $/kg) for 60 per cent reduced formulation as a function of price of HCFC-141b and of HFO-1233zd(E)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Price of HCFC-141b (US $/kg)** | **Price HFO-1233zd(E)** | | |
| **US $14/kg** | **US $12/kg** | **US $10/kg** |
| US $2.97/kg | 4.18 | 3.43 | 3.08 |
| US $3.5/kg | 3.65 | 2.9 | 2.15 |
| US $4.5/kg | 2.65 | 1.90 | 1.15 |
| US $5/kg | 2.15 | 1.40 | 0.65 |

**Table 6. IOC (US $/kg) for 60 per cent reduced formulation as a function of price of HCFC-141b and of HFO-1336mzz(Z)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Price of HCFC-141b (US $/kg)** | **Price HFO-1336mzz(Z) (US $/kg)** | | |
| **US $20/kg** | **US $15/kg** | **US $10/kg** |
| US $2.97/kg | 8.14 | 5.62 | 3.1 |
| US $3.5/kg | 7.61 | 5.09 | 2.57 |
| US $4.5/kg | 6.61 | 4.09 | 1.57 |
| US $5/kg | 6.11 | 3.59 | 1.07 |

**Secretariat’s recommendation**

# The Executive Committee may wish:

## To take note with appreciation of the final report of the project for the demonstration project to validate the use of hydrofluoro-olefins (HFOs) for discontinuous panels in Article 5 parties through the development of cost-effective formulations, implemented in Colombia and submitted by UNDP; and

## To invite bilateral and implementing agencies to take into account the final report of the demonstration project mentioned in sub‑paragraph (a) above, when assisting Article 5 countries in preparing projects with HFO-blown foam.

Costa Rica: Demonstration of the application of an ammonia/carbon dioxide refrigeration system in place of HCFC-22 for the medium-sized producer and retail store at Premezclas Industriales, S.A. (UNDP)

## **Background**

# At the 76th meeting, the Executive Committee approved the project to demonstrate the application of an ammonia/carbon dioxide refrigeration system in place of HCFC-22 for the medium-sized producer and retail store at Premezclas Industriales, S.A., in Costa Rica,[[14]](#footnote-14) in the amount of US $524,000, plus agency support costs of US $36,680 for UNDP (decision 76/23).

# The project was approved to demonstrate the use of an ammonia (NH3)/carbon dioxide (CO2) two‑stage refrigeration system[[15]](#footnote-15) in retail stores as a viable replacement of an HCFC-22 system, at the enterprise, Premezclas Industriales de Panadería S.A. (Premezclas), operating a 50-tonne refrigeration capacity (TR) cold storage system. The proposed system will reduce the working pressure and cost of the secondary circuit as well as the amount of NH3 charge reducing safety and health risks.

# On behalf of the Government of Costa Rica, UNDP has submitted the final report of the demonstration project (the final report is attached in Annex V to the present document).

# The conversion to the the new cascade refrigeration system started in June 2017 and was concluded in January 2018. It represents the first and only refrigeration system adopted in the food manufacturing industry currently in operation in the Central American region. The results of the demonstration project are the following:

## The use of NH3/CO2 in cascade (with recirculated CO2 type brine), is an innovative and viable solution to be implemented in medium manufacturing enterprises. This system can be adopted by other national and/or regional enterprises, which need to find a definitive solution for the replacement of HCFC or HFC refrigerants;

## The new cooling system of the finished product chamber based on the cascade technology, results in electricity savings (i.e., during two months of operation of the new system, the electricity costs reflect a reduction of 10 per cent). According to the estimation made, the new system could achieve up to 20 per cent reduction in electricity costs;

## The new system provides lower production costs due to the reduction in electricity consumption, less maintenance interventions, no purchase of HCFC-22 for topping-up the systems due to leaks during operation, and the use of lower-cost natural refrigerants;

## The new technology adopted and implemented, demonstrates that it is possible to break the barriers to apply natural gases with levels of toxicity, flammability and working at high pressures. Furthermore, it will contribute to the business commitment of the carbon neutrality target of 2021 established by the Government of Costa Rica;

## Additional training of technical personnel should be provided the medium term, in accordance with the increased experience in the operation, service and maintenance of the new cascade system; service procedures should also be developed based on the experience gain with the operation of the new system;

## The new technology should be demonstrated to refrigeration technicians, students and engineering as well as to business decision-makers to promoting change in similar industries;

## Periodic monitoring and evaluation of the operation of the new system is necessary including keeping records related to energy consumption and operational data.

**Comments**

# The Secretariat noted the successful implementation of the project, which demonstrated the potential for energy savings in the operation of the new NH3/CO2 cascade refrigeration system (10 per cent of savings in electricity bills so far), an increased range of temperatures that can be achieved (as low as ‑18 degrees Celsius), a lower operation cost due to less maintenance required and lower cost of the refrigerants, and the phase-out of 900 kg of HCFC-22 installed in the replaced refrigeration system.

# The application of this technology could potentially be replicated in a number of applications in the food industry including, bakery, milk, meat, fish and frozen products. An additional analysis of the economic feasibility of the technology would be required to better understand its replicability. While savings up to 20 per cent in electricity bills are expected and the operational cost will be reduced, the capital cost of the installation was US $943,000.

# An additional matter subject to further analysis is the health and safety related aspects of the installation, operation, maintenance and disposal of systems based on this technology. Both, CO2 and NH3 require more advanced skills and know-how for installers and technicians than HCFC-22 based system. A wider use of this technology in smaller systems would require a review of the local technicians’ capacity to handle CO2 and NH3 and the type of regulations, standards and codes of practice that would be applicable.

**Recommendation**

# The Executive Committee may wish:

## To take note with appreciation of the final report of the project to demonstrate the application of an ammonia/carbon dioxide refrigeration system in place of HCFC-22 for the medium-sized producer and retail store at Premezclas Industriales, S.A., in Costa Rica and submitted by UNDP; and

## To invite bilateral and implementing agencies to share the final report of the demonstration project mentioned in sub‑paragraph (a) above, when assisting Article 5 countries in preparing projects for replacing HCFC-22 used in commercial refrigeration systems in medium-sized producer and retail store.

Maldives: Demonstration project for HCFC‑free low‑GWP alternatives in refrigeration in the fisheries sector(UNDP)

## **Background**

# At the 76th meeting, the Executive Committee approved the demonstration project on HCFC free low-GWP alternatives in refrigeration in the fisheries sector in Maldives,[[16]](#footnote-16) in the amount of US $141,000, plus agency support costs of US $12,690 (decision 76/34).

# The project was approved to identify low-GWP alternative technologies to HCFCs for use in refrigeration equipment with a charge of 150 kg to 200 kg of refrigerant in the fisheries sector. It included conversion of the HCFC-22-based refrigeration equipment in three fishing vessels to low-GWP technologies, by assessing alternative technology performance, and evaluating the suitability of the selected technology based on the cost of retrofitting and maintaining best possible performance of the equipment. Based on the evaluation, suitable technologies will be disseminated to the fishing industry.

# On behalf of the Government of Maldives, UNDP has submitted the final report of the demonstration project (the final report is attached in Annex VI to the present document). During project implementation, the criteria for the selection of the alternative refrigerant was developed, as summarized below:

## Flammability, a crucial safety criterion that need to be reviewed prior to selecting a suitable refrigerant. Both R-444B[[17]](#footnote-17) and L40/D8[[18]](#footnote-18) are mildly flammable while R-448A[[19]](#footnote-19) is non‑flammable;

## Cost of retrofitting the refrigeration systems used in fishing vessels, which are old (approximately 20 years old and fragile due to years of operation), and any required modifications would be expensive. Due to years of operation, it is not possible to ensure that the refrigeration systems (i.e., equipment and pipes) are leak-proof. Furthermore, refrigeration systems are confined in very limited space within the vessels. Thus, retrofitting using R-444B and/or L40/D8 refrigerants remains risky as both are mildly flammable, and conversion would involve significant costs; and

## Performance of the refrigeration systems, where it appears that R-448A is the best refrigerant that can be used without significantly impacting the performance of the equipment.

# Based on the above criteria, and supported by a desk study undertaken, it was found that R-448A remains as the best drop-in refrigerant for replacing HCFC-22 used in the selected refrigeration systems used in fishing vessels in Maldives. Refrigerant performance seemed suitable to retrofit the systems without affecting their performance and with limited system modification and technical support available for the retrofitting from the refrigerant manufacture is adequate. It was also noted that the personnel involved with the repair and daily operation of the refrigeration systems in fishing vessels are semi-skilled, making difficult to undertake complex retrofitting of the equipment.

# During project implementation, UNDP liaised with the Nordic Council of Ministers (as it was previously suggested), to enquire on the report on Alternatives to HCFCs and high GWP HFCs in marine vessels; the report is yet to be finalised. It was noted that in the Norwegian Environmental Agency publication on “Study on environmental and health effects of HFO refrigerants” (December 2017)[[20]](#footnote-20) states that HFO blends, R-448A, R-449A, R-450A and R-452A are commercially available with R-448A and R‑449A being the most widely used.

**Comments**

# The Secretariat requested additional information on evaluation of performance of R-448A. UNDP clarified that based on technical review, R-448A is found suitable as a refrigerant with limited negative impact on equipment performance and on changes in refrigerant systems in vessels. Based on the technical assessment, the current availability of R-448A and knowledge and know-how of service technicians that would allow safe and effective retrofit of the equipment in the country, R-448A is the most feasible alternative.

# Upon request for clarification on the status of technical assessment of R-448B (A2L refrigerant), UNDP mentioned while the assessment was undertaken, the fisheries sector was reluctant to adopt the substance as it is a mildly-flammable refrigerant and there are potential risks of using that refrigerant in fishing vessels.

**Recommendation**

# The Executive Committee may wish:

## To take note with appreciation of the final report of the demonstration project for HCFC‑free low GWP alternatives in refrigeration in the fisheries sector in Maldives and submitted by UNDP;

## To request the Government of Maldives and UNDP to include in the progress report on the implementation of stage I of the HCFC management plan, a detailed report on the activities undertaken when retrofitting the three HCFC-22-based refrigeration systems in fishing vessels with the alternative refrigerant selected, and on the status of the conversion of the HCFC-22 based refrigeration systems in fishing vessels in Maldives;

## To request UNDP to continue exploring other low-GWP alternatives for the fisheries sector in the Maldives, in line with decision 80/26(p); and

## To invite bilateral and implementing agencies to share the final report of the demonstration project mentioned in sub‑paragraph (a) above, when assisting Article 5 countries in preparing projects for conversion of HCFC-22 based refrigeration systems in fishing vessels.

# Morocco: Demonstration of the use of low cost pentane foaming technology for the conversion to non-ODS technologies in polyurethane foams at small and medium-sized enterprises (UNIDO)

## **Background**

# At the 75th meeting, the Executive Committee approved the demonstration project on the use of low cost pentane foaming technology for the conversion to non-ODS technologies in polyurethane foams at small and medium-sized enterprises (SMEs), in Morocco,[[21]](#footnote-21) in the amount of US $280,500, plus agency support costs of US $19,635 for UNIDO (decision 75/41).

# The project was approved to explore the possibility of reducing the initial capital cost by designing a simple, standardized and easy-to-handle compact foaming machine capable of operating with pentane, equipment and movable ventilation systems serving several products. The technology could be considered as a solution for enterprises that do not have a high production rate, and have a non-regular need for foaming.

# At the 80th meeting, the Executive Committee noted the update provided by UNIDO on the progress in implementation of the demonstration project and extended the project completion date to 31 December 2018, on the understanding that no further extension of project implementation would be requested, and to request UNIDO to submit the final report no later than the 83rd meeting (decision 80/26(f)).

# On behalf of the Government of Morocco, UNIDO has submitted a progress report of the demonstration project. The systems house Pumex, Mexico was visited in September 2017, as a potential supplier of cyclopentane pre-blended polyols for SMEs. Several manufacturers of foam production equipment were visited in October 2017 and technical and safety aspects relating to use of pentane-based equipment by SMEs was discussed. Detailed terms of reference were prepared for the supply of a foaming line, including safety equipment and control systems; for safety system and technical assistance; and for training of technicians, operators and maintenance personnel. The equipment is expected to be installed in the third quarter of 2018; a workshop will be organized in the fourth quarter; and a detailed project report will be submitted by early 2019.

**Comments**

# The Secretariat requested details of how cost savings, as envisaged during the project submission, is proposed to be achieved during implementation of project. UNIDO informed that a major cost reduction is through use of polyol pre-blended with cyclopentane in place of preblending cyclopentane at the enterprises; design of compact foaming machine suitable for SMEs would also result in cost reduction. Commissioning and testing of the plant/equipment would lead to recommendations on how to further optimize the cost.

# Upon request for clarification on when the final project report would be submitted noting that the project would be completed by December 2018, UNIDO clarified that the final project report would be submitted by early 2019.

**Recommendation**

# The Executive Committee may wish to take note of the progress report of the demonstration of the use of low cost pentane foaming technology for the conversion to non-ODS technologies in polyurethane foams at small and medium-sized enterprises, implemented in Morocco and submitted by UNIDO.

South Africa: Demonstration project on the technical and economic advantages of the vacuum assisted injection in discontinuous panels plant retrofitted from HCFC-141b to pentane (UNIDO)

## **Background**

# At the 76th meeting, the Executive Committee approved the demonstration project on the technical and economic advantages of the vacuum assisted injection (VAI) in discontinuous panels plant retrofitted from HCFC-141b to pentane in South Africa,[[22]](#footnote-22) in the amount of US $222,200, plus agency support costs of US $19,998 for UNIDO (decision 76/32).

# The project was approved to evaluate the advantages of the VAI in the discontinuous panel production process when using cyclopentane as a foam blowing agent and demonstrate improved safety of foaming operations in an enterprise manufacturing commercial refrigeration equipment.

# At the 80thmeeting, the Executive Committee noted the update provided by UNIDO on the progress in implementation of the demonstration project and extended the project completion date to 31 December 2017, on the understanding that no further extension of project implementation would be requested, and to request UNIDO to submit the final report no later than the 81stmeeting (decision 80/26(j)).

# On behalf of the Government of South Africa, UNIDO has submitted the final report of the demonstration project (the final report is contained in Annex VII to the present document). As informed by UNIDO during the 80th meeting, there was a change in beneficiary. The project was originally intended to be implemented at Dalucon Refrigeration Products; instead, Panel World installed the VAI technology; prior to the foaming operation, a controlled degree of vacuum is applied between the press plates where the pre-assembled panel is positioned. The reduced pressure applied during the injection and the expansion of the foam facilitates the filling of the panel, providing benefits.

# Several tests were performed on operating production lines where the maximum loss of cyclopentane by evaporation was 5 per cent of the cyclopentane content; the loss also occurs during the foam expansion phase in the first 90 seconds after the pouring. The foam density can be reduced up to the 5 per cent saving polyurethane (PU) consumption. The foam, in all the tested panels, did not display any irregular change-pattern in compressive strength along the panel length. It showed good chemical flow during the chemical reaction, assisted by the vacuum, without any sign of foam stretch or cell elongation as well as reasonably balanced foam compressive strength. The foam in all the panels passed the stability test. The thermal conductivity was good and similar in all the panels. The panels were filled at relatively low applied density. With vacuum the density distribution is excellent, a significant improvement from without vacuum. The adhesion was improved; superior dimensional stability and better appearance quality was perceived.

# The ventilation of the press has the added advantage of removing the cyclopentane vapors and volatile organic compounds in the work area, which is the case of production without the VAI. The direct suction by vacuum inside the panel of the PU expansion results in total extraction of the cyclopentane and isocyanate vapor, making the production safe and healthy for the operators. The technology because of the increased reactivity-viscosity of the foam reduces the foam leakage at the venting points of the panel keeping the working area cleaner.

# The demolding time has been reduced by 40 per cent; considering the total production cycle (i.e., loading/unloading and preparation), it was estimated that the press can produce the same number of panels with a reduced time of 25 per cent, saving energy consumption at the enterprise.

**Comments**

# The Secretariat noted that the cyclopentane-blown foams with VAI technology show excellent dimensional stability; allows for a reduction in foam density of up to 5 per cent, which could result in considerable savings in terms of PU consumption; removes cyclopentane and isocyanate vapors from the work area, thereby improving worker health and safety; and achieving similar *k*-values (between 20.12 and 20.54 mW/mK) of HCFC‑141b-blown foams (20.4 mW/mK). In addition, savings could be found from reduced energy consumption and reduced demolding time.

# While noting the promising results, the Secretariat observed that the report included no information on the costs of the technology, on the project disbursements, nor on lessons learned and whether the technology could be replicated in other Article 5 countries. In response, UNIDO informed that the capital costs of the VAI vacuum kit and necessary modifications to the existing equipment was US $425,000, and that two sets of side profiles cost US $30,000; the cost of the profiles will depend on the size and number of sets, depending on customer needs (see the addendum to the final report contained in Annex VII to the present document). The funding provided by the Multilateral Fund, together with counter-part funding, sufficed to meet the objectives of the demonstration project. UNIDO considered the technology to be globally applicable for new installations, retrofits, and upgrades, and suggested that future commercial costs of VAI technology may be reduced with increasing uptake of the technology. Table 7 shows the project costs of the demonstration project.

**Table 7. Project costs (US S)**

| Item | Approved costs | Actual funding | | Actual costs |
| --- | --- | --- | --- | --- |
|  |  | Grant funds | Counterpart funds |  |
| Modification of press for VAI, vacuum kit | 80,000 | 181,200 | 244,000 | 425,200 |
| Set of side profiles | 20,000 | 30,000 |  | 30,000 |
| Safety audit | 2,000 | Included above |  |  |
| Technology transfer, services, consultancy and training | 25,000 | Included above |  | 0 |
| Installation, commissioning, start up, and trials and testing of technology and end products | 75,000 | 11,000 and 64,000 included above |  | 11,000 |
| Total | 222,200\* | 222,200 | 244,000 | 466,200 |

\* Includes contingency of US $20,200.

# The Secretariat notes that the savings identified above, including the reduced foam density and demolding time, combined with the reduced labor costs and improved worker health and safety, are likely to provide savings that could help offset the initial capital costs of the technology. Assuming comparable costs and formulations as provided in the final report on the demonstration project to validate the use of hydrofluoro-olefins for discontinuous panels in Article 5 countries through the development of cost‑effective formulations in Colombia,[[23]](#footnote-23) the 5 per cent reduction in foam density translates to approximately US $21,200 per year in savings for an enterprise consuming 20 mt of blowing agent. The 40 per cent reduction in demolding time and associated 25 per cent increase in panel throughput can be estimated to yield additional savings of approximately US $50,000 per year in reduced labor costs, assuming approximately ten operators with annual salary of US $20,000, including overhead. Other benefits, for example improved worker health and safety, would be additional and further contribute to offsetting the initial capital investment needed for the VAI technology.

**Recommendation**

# The Executive Committee may wish:

## To take note of the final report of the demonstration project on the technical and economic advantages of the vacuum assisted injection in discontinuous panels plant retrofitted from HCFC-141b to pentane, implemented in South Africa and submitted by UNIDO; and

## To invite bilateral and implementing agencies to take into account the final report of the demonstration project mentioned in sub‑paragraph (a) above, when assisting Article 5 countries in preparing projects for cyclopentane-blown foam.

Egypt: Feasibility study for district cooling in New Cairo (UNEP and UNIDO)

# At the 75th meeting, the Executive Committee approved the request for funding the feasibility study for district cooling in New Cairo, Egypt, which would include a business model,[[24]](#footnote-24) the corresponding UNEP component, in the amount of US $27,223, plus agency support costs of US $3,539 (decision 75/33), and the corresponding UNIDO component in the amount of US $63,521 plus agency support costs of US $5,717 (decision 75/35).

# The feasibility study will link the possibility of using district cooling in the New Cairo Capital currently being designed; will focus on one district of the new capital, the selection of which will be done prior to the study, and will include around 21 residential and non‑residential districts; and will simulate the dynamic cooling loads profile through the chosen district. Design, simulation and optimization of multiple energy inputs powered by natural gas, a solar thermal energy source and a fresh water heat sink, will be considered.

# The expected outputs of the feasibility study are determination of the most suitable district cooling technology (hybrid natural gas or solar assisted heat driven chiller); identification of renewable energy sources, energy saving mechanisms, environmental benefits, and legal barriers to implementation; development of a financial structure and financial scheme for both the Government, co‑financing mechanisms; and completion of a full proposal for a district cooling system in the New Cairo Capital, highlighting implementation strategy, financial incentives and assessments.

# At the 80th meeting, the Executive Committee noted the update provided by UNEP and UNIDO on the progress in implementation of the feasibility study for district cooling in New Cairo, in Egypt, and agreed to extend the project completion date to 30 June 2018, on the understanding that no further extension of project implementation would be requested, and to request the implementing agencies to submit the final report no later than the 82nd meeting (decision 80/26(n)).

# On behalf of the Government of Egypt, UNEP and UNIDO have submitted a progress report on the feasibility study. All activities are completed and final report is currently under final review by local the local committee of the project as well as UNEP and UNIDO. Below is summary of activities completed:

## Establishment of a National Committee under the Housing and Building National Research Centre (HBRC) of the Ministry of Housing and New Settlements of Egypt, to manage the project;

## Two study locations have been selected, New El Alamein city and Capital One city. Based on technical information on different cooling technologies, deep sea cooling system was chosen for New El Alamein city; and district cooling plant using not in-kind cooling systems (producing 60 per cent of the cooling load capacity) assisted by in-kind cooling using absorption chillers operated with natural gas, was chosen at Capital One city;

## The financial analysis for both locations, including capital cost and operating costs comparisons with conventional technologies, has been completed;

## A national institutional and regulatory framework for district cooling in Egypt is under development, taking into consideration experiences from countries with district cooling applications; and

## An international conference on district cooling and urban development[[25]](#footnote-25) has been conducted with participation of experts from more than 20 countries. A side session on outcomes of the project is planned at the Open-ended Working Group Meeting in July 2018,[[26]](#footnote-26) and a final outreach workshop is planned for August 2018.

**Comments**

# The Secretariat noted that the project has been completed and the final report was still under review. However, it has not been received as of date.

**Recommendation**

# The Executive Committee may wish to take note of the progress report of the feasibility study for district cooling in New Cairo, Egypt, submitted by UNEP and UNIDO.

Kuwait: Feasibility study comparing three not-in-kind technologies for use in central air‑conditioning (UNEP and UNIDO)

# At the 75th meeting, the Executive Committee approved the request for funding the feasibility study comparing three not-in-kind technologies for use in central air‑conditioning in Kuwait, which would include a business model,[[27]](#footnote-27) the corresponding UNEP component in the amount of US $27,223, plus agency support costs of US $3,539 (decision 75/34), and the corresponding UNIDO component in the amount of US $63,521 plus agency support costs of US $5,717 (decision 75/36).

# The feasibility study will present a full comparative analysis of three not‑in‑kind technologies: deep sea water free cooling, waste heat absorption and solar assisted chilled water absorption systems, to determine which may be the most promising option for central air‑conditioning systems. The following activities will be implemented a literature review on the current status of the three not‑in‑kind technologies; an analysis of renewable energy sources, legal barriers, energy saving mechanisms, environmental benefits; and development of a financial structure and financial scheme for both the Government, co‑financing mechanisms, and private energy providers.

# At the 80th meeting, the Executive Committee noted the update provided by UNEP and UNIDO on the progress in implementation of the feasibility study comparing three not-in-kind technologies for use in central air‑conditioning, in Kuwait, to agree to extend the project completion date to 30 June 2018, on the understanding that no further extension of project implementation would be requested, and to request the implementing agencies to submit the final report no later than the 82nd meeting (decision 80/26(o)).

# On behalf of the Government of Egypt, UNEP and UNIDO have submitted a progress report on the feasibility study. The first draft of “The technical study comparative study to analyses the three most promising for air-conditioning for Kuwait” was submitted to UNIDO in February 2018; the criteria of the selection site have been finalized. The Government has chosen three sites (i.e., a school, a mosque, and a hospital), and consultant has been hired to complete the technical and financial assessments.

# Conceptual designs will be prepared for two sites. Each conceptual design will be governed by the principle of energy conservation, adopting, possibly with conventional cooling technologies, not-in-kind cooling technologies. A final workshop will be held during the third quarter of 2018 to explain the comparative studies of the three technologies as well as criteria for site selection.

**Comments**

# The Secretariat noted that the progress achieved in this project including the confirmation from UNIDO that all project activities will be completed by June 2018 and the final report will be presented to the 82nd meeting.

**Recommendation**

# The Executive Committee may wish to take note of the progress report of the feasibility study Feasibility study comparing three not-in-kind technologies for use in central air conditioning in Kuwait, submitted by UNEP and UNIDO.

Promoting low-global-warming-potential (GWP) refrigerants for the air-conditioning sectors in high‑ambient-temperature countries in West Asia(UNEP and UNIDO)

# At the 69th meeting, the Executive Committee the project on promoting low-GWP refrigerants for the air-conditioning sectors in high-ambient-temperature countries in West Asia, and allocated US $155,000, plus agency support costs of US $20,150 for UNEP, and of US $365,000, plus agency support costs of US $25,550 for UNIDO. The project aimed to facilitate the transfer of technology and the exchange of experiences relating to low-GWP alternatives for the air-conditioning sector in high‑ambient‑temperature countries for better decision making to assist them with HCFC phase-out.

# UNEP and UNIDO has submitted to the 81st meeting a progress report on the status of implementation of the project. Several activities have been implemented including capacity building of the local research and development facilities in HAT countries from the experience of the most advanced industry. For the HFC-32 technology, activities were conducted in cooperation with the Japan Refrigeration and Air Conditioning Industry Association (JRAIA) and Japanese industry; for the R-290 technology, activities were conducted in cooperation with the China Household Electrical Appliances Association (CHEAA) and the Chinese industry; and for the HFO technology, activities were conducted with the Air‑Conditioning, Heating, and Refrigeration Institute (AHRI) and the technology providers of refrigerant and compressor manufacturers. Risk assessment activities were conducted for designing, developing and examining a risk assessment model suitable for use pattern and operating conditions for high ambient conditions; these activities including model development suiting local needs of high-ambient temperature countries will be completed by October 2018. Activities related to testing and optimization using prototypes that were previous developed under the project PRAHA-I, had not started yet due to change of contractor. These activities will be completed by November 2018.

# **Comments**

# The Secretariat reviewed the progress report and noted that project activities would be largely completed by October/November 2018.

**Recommendation**

# The Executive Committee may wish to take note of the progress report progress in implementation of the project in West Asia promoting refrigerant alternatives for high-ambient-temperature countries (PRAHA-II).

**PART IV: PHASE-OUT IN CONSUMPTION AND PRODUCTION OF CTC IN INDIA**

**Background**

# At the 75th meeting, the Executive Committee considered a report on the accelerated CFC production phase-out project in India and phase-out in consumption and production of CTC in India,[[28]](#footnote-28) where it was mentioned that the Agreement between the Government of India and the World Bank (as the implementing agency selected by the Government for both projects) had ended, with the remaining funds yet to be disbursed to CFC producers who had phased out their production in 2008 and with technical assistance activities remaining in the World Bank and Japanese bilateral CTC production and consumption phase-out project.

# With regard to the CTC proposal, it was noted that some funding had been allocated for strengthening the monitoring system for CTC production for feedstock uses and other activities relating to adoption of CTC alternatives in 2016. Further to a discussion, the Executive Committee *inter alia* approved the action plan for the remaining activities associated with the phase‑out in consumption and production of CTC, with a revised completion date of the end of 2016, noting that any remaining funds would be returned to the Multilateral Fund at the first meeting of the Executive Committee in 2017. The Committee also requested UNDP to undertake a study on the country’s use of CTC for feedstock applications and to make the results of the study available to the Executive Committee by the end of 2016 (decision 75/19(b)).

# At the 77th meeting, the Executive Committee considered the Consolidated progress report as at 31 December 2015,[[29]](#footnote-29) which included a report on the status of the phase-out in consumption and production of CTC in India. On this project, the Executive Committee noted that one component of the CTC phase-out plan approved at the 75th meeting would be completed in December 2016 and any remaining balances would be returned by December 2017 (decision 77/8(b)(i), and extended the completion date of two technical assistance components approved at the 45th meeting to November 2017 (decision 77/8(c)(i)).

**Comments**

# The Secretariat noted with concern that neither the study on the country’s use of CTC for feedstock applications, expected to be submitted to the Executive Committee by the end of 2016 (decision 75/19(b)(iv)), nor the project completion report, expected to be submitted to the 81st meeting (decision 75/19(b)(iv) and decision 77/8(c)(i)), were submitted.

**Recommendation**

# The Executive Committee may wish:

## To request UNDP to submit to the Secretariat the study on the country’s use of CTC for feedstock applications as soon as possible, and not later than the 82nd meeting; and

## To request the World Bank, together with the Governments of France, Germany and Japan, and UNDP and UNIDO as cooperating implementing agencies, to submit the project completion report on the phase-out of CTC consumption and production to the 82nd meeting of the Executive Committee.

**PART V: ODS WASTE DISPOSAL PROJECTS**

**Background**

# At the 79th meeting, the Executive Committee requested, *inter alia,* bilateral and implementing agencies to submit final reports on outstanding ODS disposal pilot projects[[30]](#footnote-30) other than those for Brazil and Colombia, and to return to the 82nd meeting the remaining balances for projects for which reports had not been submitted to the 80th or 81st meeting (decision 79/18(d)).

# Relevant bilateral and implementing agencies submitted, on behalf of the Governments of China, Colombia, Nigeria and Turkey reports on the implementation of ODS waste disposal projects. These reports are summarized below. Full reports are attached in Annex VIII to the present document.

# In line with decision 79/18(e), a synthesis report on the pilot ODS disposal projects completed thus far, collating lessons learned, and including issues related to project design, synergy with other projects, opportunities for resource mobilization, and the cost-effectiveness of the projects, will be submitted to the 82nd meeting.

China: Final report on the pilot demonstration project on ODS waste management and disposal (Government of Japan and UNIDO)

# The objective of the pilot demonstration project is to explore treatment to the collected ODS wastes, set up a sustainable model for ODS wastes destruction, and the disposal of 192.0 metric tonnes (mt) of ODS wastes, particularly CFCs banks.

# The Regulation on ODS Management, which became effective in June 2010, is the basis for ODS recycling. It stipulates *inter alia* that enterprises specialized in the servicing and scrapping of refrigeration equipment, refrigeration and fire-extinguishing systems that contain ODS, shall be recorded under the local Environmental Protection Bureau (EPBs) and shall collect, recycle the ODS or transfer them to enterprises specialized in their collection, recycling and destruction to give proper treatment to ODS.

# The total amount of CFCs destroyed amounted to 194.793 mt, consisting of 11.788 mt of CFC refrigerants, 172.005 mt CFCs in foam wastes and 11 mt of CFC-11 used as a blowing agent. All the collected wastes were incinerated using rotary kilns. The disposal cost for ODS-related foam wastes and refrigerants comprised direct and indirect costs. Direct costs included those related to energy including electricity and gas, water and other materials for flue gas treatment and testing. Indirect costs included shared investment of fixed asset, overheads, management and others (e.g., taxes). Although the costs vary among provinces, the average cost of destruction ranged from US $8.00/kg to US $12.50/kg.

# The demonstration project has validated that the rotary kiln technology is efficient for the destruction of CFC-12, CFC-11 and CFC-11-based foams although the cost of operation is relatively high. Optimization of the destruction process is recommended in order to improve efficiency and reduce cost. While there are hazardous wastes disposal facilities available in some provinces, these are operating at full capacity dealing with other solid wastes. Considering the potential ODS waste coming from HCFCs and HFC-based products in the coming years, additional disposal facilities may need to be established in future.

Colombia: Final report on the demonstration project on end of life ODS management and destruction (UNDP)

# The objective of the pilot project is to demonstrate a sustainable approach for ODS waste management from collection to destruction, by strengthening destruction capabilities of domestic facilities integrating them into broader hazardous waste, and energy efficiency initiatives. It proposed to address the disposal of 114 mt of ODS wastes for destruction; put in place measures to support the sustainability of the project taking into account ODS wastes that will be collected through the refrigeration servicing sector, and supported by policy initiatives now being implemented.

# The ODS waste disposal project was implemented within a broader national policy framework of an integrated approach to hazardous waste management, energy efficiency, management of greenhouse gas emissions and the commitment to meeting the obligations under the Montreal Protocol. This included a priority attached to the environmentally sound management of end-of-life ODS as a result of national policy initiatives in the areas of refrigeration and air-conditioning. It was also supported by a sustainable Extended Producer Responsibility Programme that started in 2013, which progressed from a voluntary pilot phase to a mandatory system.

# The demonstration test burn work showed that a domestic capability is qualified in principle, for the destruction of ODS, specifically CFC-11 and HCFC-141b-based foam and CFC-11 and CFC-12 chemicals up to established limits of chlorine feed content. While the destruction facility met the destruction efficiency requirements, there were limitations related to air emissions, particularly acid gases (hydrochloric acid (HCl) and hydrogen fluoride (HF)) that limit chlorine and fluorine content of the feed, impacting the productivity and cost-effectiveness of the destruction tests. The cost-effectiveness for destruction of CFC-11 and CFC-12 chemicals was estimated at half the cost-effectiveness specified by the Multilateral Fund (i.e., US $13.20/kg). However, for the destruction of foam, the cost-effectiveness was estimated at approximately four times the threshold and, therefore, not affordable. Based on this, the current option is either the use of an electric arc furnace steelmaking plant processing intact refrigerator cabinet and doors, or a commercial cement kiln to destroy foam and potentially ODS refrigerant. Depending on the option selected, overall cost estimates range from US $6.40 to US $12.30 per refrigerator.

Nigeria: Draft final report on the pilot demonstration project for disposal of unwanted ODS (UNIDO)

# The objective of the pilot project is to demonstrate a sustainable business model for ODS waste management from collection to disposal using Multilateral Fund assistance as seed money to destroy current stock of unwanted ODS and generate carbon credits. These credits would be used to establish an Appliance Replacement Programme (for the replacement of existing domestic refrigerators and air-conditioners with more energy efficient ones), to sustain the current recovery and collection system for ODS, with the view to incorporate other refrigerants in the future. The project intended to destroy future ODS wastes through local incineration facilities whose capacity would be developed through the revenues generated from these carbon credits. The expected output from this project was the destruction of 84.0 mt of CFC-12 which had been reported as already collected during the project preparation from industrial sources, particularly from oil refineries.

# An inception workshop took place in November 2013, with participation from Government agencies, servicing companies, waste management companies and end-users. A local contractor was hired to aggregate ODS wastes in the country; a training workshop was provided to technicians on safe collection, transportation and storage of ODS wastes including testing, correct labelling and documentation procedures; and a capacity building workshop for ODS collection and aggregation was held in June 2014. Companies and end-users that were identified during the preparatory phase were contacted to enquire about their stocks of ODS. However, stocks of ODS reported in most cases were not found. The total ODS collected amounted to only 1.5 mt of CFC-12. The collection activities were halted as no new stocks of CFC-12 were found and new inquiries repeatedly turned out to be halons (which are stored in Government agencies).

# The revised ODS Regulations (2016) makes provisions for mandatory destruction of wastes, guidelines for destruction facilities including emission limits, and extends responsibility of end-of-life waste equipment to producers/suppliers. Extended Producer Responsibility regulations are now in place for the electronic/electrical sectors; thus, for new refrigerators, future recovery of refrigerants at their end‑of‑life should be the responsibility of the private sector. Training sessions on e-waste collection and management were carried out.

# Officials from the Ministry of Environment and UNIDO inspected four disposal facilities and invited two of them to bid for the disposal of CFCs. The company selected has a proven track record of hazardous waste management for multinational companies and experience of managing CFC wastes specifically from collection to recycling. The collected stocks of CFC waste were tested for purity at the storage facility before loading, and transported to the destruction facility in Port Harcourt, Nigeria. The destruction process employed by the contracted facility is a rotary kiln incineration. As of the writing of this report, UNIDO had reported that the disposal process is ongoing. Wastes are being disposed of on a batch basis and the draft report will be updated as soon as disposal is concluded.

# Of the total funds approved of US $911,724, only US $219,288 has been disbursed. Based on these disbursement, the actual cost of destruction for this project was US $146/kg of ODS waste. The financial report will be updated once destruction is complete and all outstanding payments are made. The balance of funds will be returned to the 82nd meeting.

Turkey: Final report on the demonstration project for disposal of unwanted ODS (UNIDO)

# The objective of the project was to establish a sustainable and integrated business model for an efficient waste management system of ODSs, through institutional measures that will organize the existing recovery and collection systems in the country into an integrated and efficient collection validation and valuation system.

# Turkey had already collected some ODS wastes through Government-authorized recovery and reclamation centers established in three cities, Ankara (TUHAB), Istanbul (ISISO) and Izmir (ESSIAD); the expected amount of ODS wastes to be destroyed was 103.72 mt of CFC-12. However, during implementation, it was found that the ODS wastes available were in many cases mixtures of all types of refrigerants and the actual amount available for destruction was 9.162 mt of CFC-12.

# The project had envisaged exporting the ODS waste to the United States of America for destruction; however, the absence of expected revenue from carbon markets, and the very small amounts of ODS wastes to be destroyed led to a redesign of the disposal strategy. It was decided to destroy the collected waste in Europe through an international bidding process.

# In order to be more cost-effective, the ODS wastes from Turkey was combined with that of ODS waste from Montenegro; the latter was part of the regional demonstration project for ODS waste disposal pilot project for the Europe and Central Asia (ECA) region also funded by the Multilateral Fund. Other activities such as sharing of lessons learned, awareness raising were also done in close cooperation with the ECA region.

# The project resulted in the destruction of 9.162 mt of CFC-12, reported an expenditure of US $598,345 out of the approved US $1,076,250, plus agency support costs, resulting in a cost‑effectiveness of US $65/kg of ODS wastes destroyed. The financial report will be updated once destruction is complete and all outstanding payments are made. The balance of funds will be returned to the 82nd meeting.

**Comments**

# The Secretariat noted that the following aspects of decision 58/19 were included in the final reports for China, Colombia, Nigeria and Turkey:

## The estimated amount of ODS that was eventually destroyed by the project;

## Descriptions of collection systems, especially where the Multilateral Fund projects were in synergy with other projects;

## Detailed steps of the overall process; and

## The main challenges encountered and how they were addressed and lessons learned so far in undertaking the pilot projects.

# The Secretariat had a number of observations from the final reports, including the low amounts of ODS wastes reported as destroyed in some projects compared to what had been committed during the approval, challenges in aggregating waste materials through collection facilities or other methods, among others.

# In line with decision 79/18(e), the Secretariat will submit a synthesis report on the pilot ODS disposal projects completed thus far, collating lessons learned, and including issues related to project design, synergy with other projects, opportunities for resource mobilization, and the cost-effectiveness of the projects to the 82nd meeting. Balances of all ODS waste disposal projects will be returned to the 82nd meeting.

# **Recommendation**

# The Executive Committee may wish:

## To note, with appreciation, the final reports on the pilot ODS waste management and disposal projects for China, submitted by UNIDO and the Government of Japan, for Colombia, submitted by UNDP, for Nigeria and Turkey, submitted by UNIDO;

## To invite bilateral and implementing agencies to take into account, when appropriate, the lessons learned from the pilot ODS disposal demonstration projects mentioned in sub‑paragraph (a) above, in the design and implementation of similar projects in future;

## To note that the final report of the outstanding ODS disposal pilot project for Lebanon was not submitted to the 81st meeting, and to request UNIDO to return unspent balances for this project to the 82nd meeting in line with decision 79/18(d); and

## To further note that in line with decision 79/18(e), a synthesis report on the pilot ODS disposal projects, collating lessons learned, and including issues related to project design, synergy with other projects, opportunities for resource mobilization, and the cost‑effectiveness of the projects will be submitted to the 82nd meeting and, balances of all ODS waste disposal projects will be returned to the 82nd meeting.

**PART VI: ONGOING CHILLER PROJECTS**

**Background**

# An update on status reports for the four ongoing chillers projects is summarised in Table 8.

**Table 8. Status report on ongoing chiller projects**

| **Country** | **Project title** | **Agency** | **Meeting** | **Funds approved**  **(US $)** | **Planned date of completion** | **Status of progress** |
| --- | --- | --- | --- | --- | --- | --- |
| Brazil | Demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers. | UNDP | 47 | 1,000,000 | January 2017 | UNDP submitted the project completion report (PCR). The information will be included in the report on all chiller projects to be submitted to the 82nd meeting. |
| African  region | Strategic demonstration project for accelerated conversion of CFC chillers in five African countries (Cameroon, Egypt, Namibia, Nigeria and Sudan) | France | 48 | 360,000 | December 2017 | The project completion report is expected to be submitted by October 2018. The final report would be submitted to the 82nd meeting. |
| Japan | 48 | 700,000 | December 2017 |
| Global | Global chiller replacement project | World Bank | 47 | 6,884,612 | December 2017 | The project included Argentina, China, India, Indonesia, Jordan, Malaysia, the Philippines and Tunisia. No project activities were initiated for China, Malaysia and Tunisia.  As per decision 79/19(b)(i), the project completion report would be submitted no later than December 2018, and fund balances would be returned no later than June 2019. |

# **Comments**

# The Secretariat reviewed the PCR submitted for the chiller demonstration project in Brazil. Relevant information from PCR will be included in the detailed report on all chiller projects to be submitted to the 82nd meeting.

**Recommendation**

# The Executive Committee may wish to take note of the progress report on the ongoing chiller projects implemented by the Governments of France and Japan, UNDP and the World Bank.

**Annex I**

**PROJECTS THAT ARE CLASSIFIED AS “SOME PROGRESS” AND ARE RECOMMENDED**

# **FOR CONTINUED MONITORING**

|  |  |  |
| --- | --- | --- |
| **Country** | **Agency** | **Project title/code** |
| China | UNIDO | Sector plan for phase-out of CFCs consumption in MDI sector (CPR/ARS/56/INV/473) |
| Egypt | UNIDO | Phase-out of CFC consumption in the manufacture of aerosol metered dose inhalers (MDIs) (EGY/ARS/50/INV/92) |
| Syrian Arab Republic | UNIDO | Phase-out of HCFC-22 and HCFC-141b from the manufacture of unitary air‑conditioning equipment and rigid polyurethane insulation panels at Al Hafez Group (SYR/REF/62/INV/103) |

**Annex II**

**PROJECTS FOR WHICH ADDITIONAL STATUS REPORTS TO THE 81ST MEETING ARE REQUESTED**

|  |  |  |  |
| --- | --- | --- | --- |
| **Country** | **Agency** | **Project title/code** | **Recommendations** |
| Central African Republic (the) | UNEP | HCFC phase-out management plan (stage I, first tranche) (CAF/PHA/64/TAS/22) | To request a status report to the 82nd meeting to monitor the resumption of activities in the country. |
| Central African Republic (the) | UNIDO | HCFC phase-out management plan (stage I, first tranche) (CAF/PHA/64/INV/21) | To request a status report to the 82nd meeting to monitor the resumption of activities in the country. |
| Guyana | UNEP | HCFC phase-out management plan (stage I, second tranche) (GUY/PHA/74/TAS/24) | To request a status report to the 82nd meeting to monitor low disbursement rate of approved funds and signing of agreement, noting that the first disbursement has not been released yet. |
| Iraq | UNIDO | HCFC phase-out management plan (stage I, second tranche) (refrigeration servicing sector) (IRQ/PHA/74/INV/23) | To request a status report to the 82nd meeting to monitor implementation progress due to security situation. |
| Libya | UNIDO | HCFC phase-out management plan (stage I, first tranche) (foam sector) (LIB/PHA/75/INV/36) | To monitor implementation progress and disbursement rate of approved funds due to security situation. |
| Mozambique | UNEP | HCFC phase-out management plan (stage I, second tranche) (MOZ/PHA/73/TAS/25) | To request a status report to the 82nd meeting to monitor the signing of the agreement due to structural and administrative changes in the country. |
| Saint Kitts and Nevis | UNDP | HCFC phase-out management plan (stage I, first tranche) (STK/PHA/64/TAS/16) | To request a status report to the 82nd meeting to monitor low disbursement rate of approved funds. |

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1. UNEP/OzL.Pro/ExCom/79/8-13. [↑](#footnote-ref-1)
2. The fifth and final tranche of stage I of the HPMP was approved at the 75th meeting at a total cost of US $2,035,094, consisting of US $1,470,700, plus agency support costs of US $110,313 for UNDP, and US $409,091, plus agency support cost of US $45,000 for Germany. [↑](#footnote-ref-2)
3. UNEP/OzL.Pro/ExCom/80/34. [↑](#footnote-ref-3)
4. UNEP/OzL.Pro/ExCom/77/39. [↑](#footnote-ref-4)
5. The fourth and final tranche of stage I of the HPMP was approved at the 74th meeting at a total cost of US $885,977, consisting of US $250,430, plus agency support costs of US $18,872 for UNDP, US $274,827, plus agency support costs of US $20,612 for UNIDO and US $288,582, plus agency support costs of US $32,744 for the Government of Germany. [↑](#footnote-ref-5)
6. UNEP/OzL.Pro/ExCom/80/41. [↑](#footnote-ref-6)
7. UNEP/OzL.Pro/ExCom/76/55. [↑](#footnote-ref-7)
8. The demonstration project in West Asia on promoting refrigerant alternatives for high-ambient-temperature countries referred to as PRAHA-II. [↑](#footnote-ref-8)
9. UNEP/OzL.Pro/ExCom/75/42 and Add.1. [↑](#footnote-ref-9)
10. ISO 5149-1:2014 specifies the requirements for the safety of persons and property, provides guidance for the protection of the environment, and establishes procedures for the operation, maintenance, and repair of refrigerating systems and the recovery of refrigerants. [↑](#footnote-ref-10)
11. UNEP/OzL.Pro/ExCom/76/26. [↑](#footnote-ref-11)
12. Thermal conductivity, *k*-factor, is the measure of a material's ability to transfer heat. Materials that transfer heat readily have high *k*-factors; the lower the *k*-value, the better the insulation property of the material. [↑](#footnote-ref-12)
13. The unitary costs contained in the report are: HCFC-141b: US $2.97/kg, HFO-1233zd(E): US $12.00/kg, HFO‑1336mzz(Z): US $20.00, polyol blend: US $2.16‑2.42/kg, additives (catalysts, surfactant, additives): US $1.47‑1.61/kg. [↑](#footnote-ref-13)
14. UNEP/OzL.Pro/ExCom/76/28. [↑](#footnote-ref-14)
15. NH3 is in the high temperature system and CO2 is in the low temperature circuit driven by pumps, where CO2 is used as a heat transfer fluid (brine). [↑](#footnote-ref-15)
16. UNEP/OzL.Pro/ExCom/76/40. [↑](#footnote-ref-16)
17. R-444B: 41.5 per cent of HFC-32, 10 per cent of HFC-152a, and 48.5 per cent of HFO-1234ze(E), with a GWP value of 295. [↑](#footnote-ref-17)
18. L40/D8: 40 per cent of HFC-32, 10 per cent of HFC-152a, 20 per cent of HFO-1234yf and 30 per cent of HFO‑1234ze(E), with a GWP value below 300. [↑](#footnote-ref-18)
19. R-448A: 26 per cent of HFC-32, 26 per cent of HFC-125, 21 per cent of HFC-134a, 7 per cent of R-1234ze and 20 per cent of HFO-1234yf, with a GWP values of 1,273. [↑](#footnote-ref-19)
20. http://www.miljodirektoratet.no/Documents/publikasjoner/M917/M917.pdf. [↑](#footnote-ref-20)
21. UNEP/OzL.Pro/ExCom/75/58. [↑](#footnote-ref-21)
22. UNEP/OzL.Pro/ExCom/76/48. [↑](#footnote-ref-22)
23. Paragraphs 74 to 82 and Annex IV to the present document. [↑](#footnote-ref-23)
24. UNEP/OzL.Pro/ExCom/75/30 and ExCom/75/31. [↑](#footnote-ref-24)
25. Conference documents can be found at http://www.ozonactionmeetings.org/international-conference-district-energy-urban-development-sharm-el-sheikh-egypt-21-22-september-4. [↑](#footnote-ref-25)
26. Vienna, Austria, 8 to 14 July 2018. [↑](#footnote-ref-26)
27. UNEP/OzL.Pro/ExCom/75/30 and ExCom/75/31. [↑](#footnote-ref-27)
28. UNEP/OzL.Pro/ExCom/75/20 and Add.1. [↑](#footnote-ref-28)
29. UNEP/OzL.Pro/ExCom/77/11. [↑](#footnote-ref-29)
30. Final reports of the pilot projects for Georgia, Ghana and Nepal were submitted to the 79th meeting and for Mexico and the Europe and Central Asia (ECA) region were submitted to the 80th meeting. [↑](#footnote-ref-30)