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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Eightieth Meeting
Montreal, 13-17 November 2017

STATUS REPORTS AND REPORTS ON PROJECTS WITH SPECIFIC REPORTING REQUIREMENTS

1. 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], 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: Financial audit reports for the CFC production, halon, polyurethane (PU) foam, process agent II, refrigeration servicing and solvent sectors in China

Part V: ODS waste disposal projects

Part VI: Ongoing chiller projects

Part VII: Sector plan for the phase-out of methyl bromide production in China

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

[1] UNEP/OzL.Pro/ExCom/79/8-13.

Pre-session documents of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol are without prejudice to any decision that the Executive Committee might take following issuance of the document.

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

Project implementation progress in 2016

3. The Secretariat held discussions with relevant bilateral and implementing agencies on projects for which status reports were requested at the 79th meeting. Further to the discussions, several issues were satisfactorily addressed. Particularly in the case of UNEP, zero disbursement rates have been reported for several projects; however, additional information provided show that funds had been released to the country. In fact, the financial and progress reports have to be submitted by the countries to UNEP before the disbursements can be recorded in UMOJA. Progress was noted for the majority of projects for which a special status report has been requested.

4. 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.

5. Concerning the projects for ODS waste disposal, the issues have been addressed in Part V of this document. For ODS alternative surveys, a detailed report is being presented in the document on Overall analysis of the results of the surveys of ODS alternatives (decision 79/42(c)).[2]

Recommendation

6. The Executive Committee may wish:

(a) To note:

(i) The status and implementation delays reports of the bilateral and implementing agencies submitted to the 80th meeting and contained in document UNEP/OzL.Pro/ExCom/80/12;

(ii) That bilateral and implementing agencies would report to the 81st meeting on four projects with implementation delays and on 22 projects recommended for additional status reports, as indicated in Annexes I and II, respectively, to the present document; and

(b) 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

Proposed change to the Agreement for stage I of the HPMP for Bahrain (UNEP and UNIDO)

Background

7. At the 68th meeting, the Executive Committee approved, in principle, stage I of the HPMP for Bahrain to reduce HCFC consumption by 39 per cent of the baseline by 2020, at the amount of US $3,033,814, plus agency support costs for UNEP and UNIDO. The main activities of stage I included a feasibility study (prototyping, testing and certification) for the conversion of a central air-conditioning (AC) line, the conversion of a manufacturing line for split ACs to a low-GWP technology after testing, policy

[2] UNEP/OzL.Pro/ExCom/80/54.

development, activities in the servicing sector and project management and monitoring. The Executive Committee also decided to allow the submission of the conversion of a central AC line once the feasibility study was successfully completed during the implementation of stage I.

8. UNEP, on behalf of the Government of Bahrain, submitted a request for adjusting stage I of the HPMP, deferring the third tranche from 2016 to 2019 and extending the implementation period to 2023. All the activities planned for stage I will remain.

Progress report

9. HCFC consumption in Bahrain has been decreasing due to the enforcement of the licensing and quota system and the shift of the HCFC-22-based AC manufacturing sector to other alternatives, as shown in Table 1.

Table 1. HCFC consumption in Bahrain (Article 7 data)

HCFC	2012	2013	2014	2015	2016	Baseline
Metric tonnes						
HCFC-22	1,358.80	891.4	876.13	829.04	824.23	935.8
HCFC-123	0	2.7	2.724	-	2.54	0
HCFC-124	2	0	1.63	-	-	0
HCFC-141b	7.3	4.7	7.82	3.48	3.55	4
Sub-total (mt)	**1,368.10**	**898.8**	**888.3**	**832.53**	**830.32**	**939.7**
HCFC-141b in imported pre-blended polyols*	82.3	123.1	90.1	174.05	172.93	91.87**
Total (metric tonnes)	**1,450.40**	**1,022.00**	**978.4**	**1,006.57**	**1,003.25**	**939.70**
ODP tonnes						
HCFC-22	74.73	49	48.19	45.60	45.33	51.5
HCFC-123	0	0.1	0.05	0	0.05	0
HCFC-124	0.05	0	0.04	0	0	0
HCFC-141b	0.81	0.5	0.86	0.38	0.39	0.4
Sub-total (ODP tonnes)	**75.59**	**49.6**	**49.14**	**45.98**	**45.77**	**51.9**
HCFC-141b in imported pre-blended polyols*	9.1	13.5	9.9	19.15	19.02	10.11**
Total (ODP tonnes)	**84.6**	**63.1**	**59.05**	**65.13**	**64.80**	**62.01**

* Country programme implementation data.
** Average of 2007 to 2009.

10. The second tranche was approved at the 75th meeting and the following results have been achieved in the refrigeration servicing sector:

(a) Law 54/2014 for the Gulf Cooperation Council (GCC) Unified ODS Regulation was enacted; the national quota system was updated and the e-licensing program for registering, licensing and clearing imports of HCFCs and HCFC-based equipment was developed; and 100 customs officers were trained;

(b) A framework for training and certification of refrigeration and air-conditioning (RAC) technicians was established in cooperation with the Ministry of Education, Bahrain Society of Engineers and training institutes;

(c) Equipment was procured and a refrigerant reclamation center was established and is expected to be operational by December 2017; a special bylaw is being developed to support mandatory refrigerant recovery and recycling practices; and

(d) A trial production line has been established and commissioned in the first quarter of 2017. Two contracts have been signed to conduct trials and testing on low-GWP technologies including R-290 and R-32 for the conversion of a central AC and a split line.

11. The conversion of the split AC line at Awal has been delayed. Over the last three years, the AC industry in the Gulf countries has introduced minimum energy efficiency standards (MEPS) for AC units at high ambient temperature conditions. Accordingly, the market shifted to R-410A technology, which has readily available inverter technology that can meet the MEPS requirements. Local original equipment manufacturers (OEM) and importers started to manufacture or import R-410A-based units to compete for market share in the region (i.e., Saudi Arabia and United Arab Emirates). Under such circumstances, Awal increased its manufacturing of R-410A-based units using equipment that already existed in its manufacturing line, and correspondingly decreased its production of HCFC-22-based units.

12. Bahrain was the first country in the region to include conversion of the AC industry in its HPMP. The main challenge for Awal is the lack of mature, low-GWP alternatives for conversion, in particular, the limited commercial availability of compressors that are suitable for high ambient temperature conditions. The trials and testing undertaken to identify suitable technologies for high ambient temperature conditions, under the project Promoting low-GWP refrigerants for air-conditioning sectors in high-ambient temperature countries, PRAHA-II, are still on-going. Additional optimization and tests are being conducted but the Government estimated that this would take a few more years.

13. Due to the above challenges, the Government does not consider possible, from a technical and economic perspective, at this point in time and in the current regional market conditions, to convert the production lines for split units in Awal to a low-GWP technology as originally planned.

Proposed change of Agreement

14. The Government of Bahrain revisited all the options available in light of the commitment under its Agreement of stage I. After consulting with the industry, UNEP and UNIDO considered the preferred and soundest option for meeting compliance targets without harming the local industry would be to defer the conversion project for two years to allow finalization of the trials under PRAHA-II and at Awal, and to find suitable components for conversion to low-GWP technologies. This would allow the country to maintain the momentum in stage I implementation, and in the meantime develop relevant standards and undertake training and certification of technicians to ensure that the technical and institutional framework are well established when the local industry starts converting to low-GWP technologies. The proposed change will maintain the same reduction target of 39 per cent by 2020 and the same funding level, but defer the remaining tranches for two years, as shown in Table 2 below.

Table 2. Proposed adjustment to Appendix 2-A of the Agreement for stage I of the HPMP*

As approved at the 68th meeting										
Row	Particulars	2012	2013	2014	2015	2016	2017	2018	2019	2020
1.1	Montreal Protocol reduction schedule of Annex C, Group I substances (ODP tonnes)	n/a	51.90	51.90	46.71	46.71	46.71	46.71	46.71	33.74
1.2	Maximum allowable total consumption of Annex C, Group I substances (ODP tonnes)	n/a	51.77	51.77	46.58	46.45	45.39	43.54	37.27	31.66
2.1	Lead IA (UNEP)	120,000		145,000		125,000		55,000		25,000
2.3	Cooperating IA (UNIDO)	549,455				936,646		720,384		132,500

As approved at the 68th meeting										
Row	Particulars	2012	2013	2014	2015	2016	2017	2018	2019	2020
3.1	Total agreed funding (US $)	669,455		145,000		1,061,646		775,384		157,500

Proposed adjustment to the 80th meeting												
Row	Particulars	2012	2014**	2015	2016	2017	2018	2019	2020	**2021**	**2022**	**2023**
1.1	Montreal Protocol reduction schedule of Annex C, Group I substances (ODP tonnes)	n/a	51.90	46.71	46.71	46.71	46.71	46.71	33.74	**33.74**	**33.74**	**33.74**
1.2	Maximum allowable total consumption of Annex C, Group I substances (ODP tonnes)	n/a	51.77	46.58	46.45	45.39	43.54	37.27	31.66	**31.66**	**31.66**	**31.66**
2.1	Lead IA (UNEP) agreed funding (US $)	120,000	145,000	0	**0**	0	**0**	**125,000**	**0**	**55,000**	0	**25,000**
2.3	Cooperating IA (UNIDO) agreed funding (US $)	549,455	405,000	0	**0**	0	**0**	**936,646**	**0**	**720,384**	0	**132,500**
3.1	Total agreed funding (US $)	669,455	550,000	0	**0**	0	**0**	**1,061,646**	**0**	**775,384**	0	**157,500**

* Other part of Appendix 2-A remains unchanged.
** The second tranche originally planned for 2014 was only approved in 2016.

15. The demand for HCFCs is expected to decrease, which would help the Government meet the compliance targets before the conversion of Awal in 2019, as shown in Table 3.

Table 3. HCFC consumption and future projection in Bahrain*

Sector	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Montreal Protocol control targets (ODP tonnes)	n/a	51.90	51.90	46.71	46.71	46.71	46.71	46.71	33.74
Reported HCFC consumption and projection of future demand									
HCFC-22 in RAC manufacturing sector (mt)	812	504	490	470	495	405	375	350	300
HCFC-22 in RAC servicing sector (mt)	219	377	323	296	233	275	275	275	275
Other HCFCs in servicing sector (mt)	6	10	12	3	6	2	1	0	0
Total (ODP tonnes)	57.32	49.04	45.64	42.46	40.42	37.62	35.86	34.38	31.63

* Country programme data from 2012 to 2016, projected data from 2017 to 2020.

Comments

Technical issues

16. The Secretariat noted that HCFC-22 consumption in the manufacturing sector has decreased from 812 mt in 2012 to 495 mt in 2016 (30 per cent decrease) and that AC technology is shifting from HCFC-22 to R-410A, and enquired whether some manufacturing capacity using HCFC-22 in Awal has been converted to HFCs. UNEP explained that Awal had the capacity to produce both HCFC-22 and R-410A/R-407C-based AC units since the project was submitted. When the HPMP was submitted, the majority of production was for HCFC-22-based equipment, as HFC-based units were only produced based

on special orders and in limited quantities. In recent years, the production of HFC-based units has increased to match that of the market. No conversion in the production lines has taken place; the company has two sets of equipment and was able to use the same lines to produce either HCFC-22 or R-410A/R-407C-based ACs. Awal produces for other OEM as well as for its own brand. The manufacturing line for split units is still producing with HCFC-22 but with reduced capacity, as foreseen in the original plan.

17. The Secretariat further enquired about the progress made in testing low-GWP technologies. UNEP reported that the testing at Awal for the central and split units was just starting. As for the testing undertaken in PRAHA-II, there was a delay in optimizing prototypes due to contracting issues. The optimization work was only planned to begin in late 2017, ending mid of 2018. Feedback on trials and optimization of designs would be available around the second half of 2018. This timeline was part of the reason why the Government proposed to submit the third tranche and start conversion in 2019. The time between completing the trials and submitting the third tranche would be used to secure the components in commercial quantities to facilitate the conversion.

18. UNEP explained that with the current funding resources available, activities in the servicing sector will continue until the 2019 tranche was submitted, without an impact on implementation (of the total US $265,000 approved so far for UNEP, US $137,000 has been disbursed and US $128,000 is still available; for UNIDO, funds approved were for establishing a reclamation centre and a trial line and testing only).

19. The Secretariat noted that the limited availability of component, in particular compressors that can be supplied in commercial quantity, and the enforcement of MEPS, are the reason for the delay in the conversion to a low-GWP technology. However, the Secretariat noted that R-290-based inverter compressors are already being sold to produce AC units in other countries. Moreover, it would appear that strict energy efficiency requirements at high ambient temperatures would be more easily met by R-290-based equipment rather than R-410A-based equipment.

20. UNEP further indicated that the enterprise Awal is also concerned about the market adaptability and the economic competitiveness of low-GWP technology as compared with R-410A technology. Given the other manufacturers in the region are producing with either R-410A or HCFC-22, Awal fears it would lose its market share if converting to a low-GWP technology due to the high cost of the new product and the lack of market acceptance. The Secretariat noted the challenge in introducing low-GWP technology in the market at this time, and further noted that the funds for conversion project have not yet been approved, and considers there may be a benefit in delaying the conversion to allow the results of PRAHA-II to become available and thereby provide greater market clarity, particularly in the region.

21. The Secretariat further noted that deferring the conversion of the AC manufacturing lines would result in a negative environmental impact, as more HFC-based equipment would be manufactured and installed. However, deferring rather than cancelling the project would allow the conversion of manufacturing capacity at Awal to a low-GWP technology, giving the time for market acceptance, ultimately resulting in a greater environmental benefit. The Secretariat also noted that Awal has 12 categories of products using HCFC-22. The conversion project in stage I only covers four types of split AC units, accounting for 27 per cent of the total consumption (2012 data). If implemented, the conversion of these four categories would validate the low-GWP technology, establish a technology direction for phasing out HCFCs in the enterprise and influence the market in the region.

Compliance with the Montreal Protocol control target

22. Based on the projected HCFC consumption by the Government, the shifting of HCFC-22 consumption to R-410A, the ongoing activities under the HPMP (licensing and quota), the Secretariat considers that a delay in implementation would not put the country’s compliance at risk with the Montreal

Protocol and its Agreement with the Executive Committee. In addition, despite the deferral of the funding tranche, the Government has maintained its commitment to stay in compliance with the Montreal Protocol.

Changes to the Agreement

23. The Secretariat will update the Appendix 2-A of the Agreement to reflect the revised funding schedule and the extended implementation period of stage I of the HPMP. A new paragraph 16 has been added to indicate that the updated Agreement will supersede the Agreement between the Government of Bahrain and the Executive Committee that was reached at the 68th meeting, as shown in Annex III to the present document. The full revised Agreement will be appended to the final report of the 80th meeting.

Recommendation

24. The Executive Committee may wish:

(a) To note the request to revise the Agreement for stage I of the HCFC phase-out management plan for Bahrain submitted by UNEP on behalf of the Government of Bahrain; and

(b) To approve the revised Agreement as contained in Annex III to the present document.

Stage I of the HPMP for Chile (verification of 2016 HCFC consumption) (UNDP)

Background

25. In line with decision 79/15(b), UNDP on behalf of the Government of Chile, submitted the 2016 HCFC consumption verification report for consideration of the 80th meeting.

HCFC consumption and verification report

26. The Government of Chile reported HCFC consumption of 63.33 ODP tonnes in 2016 under Article 7 of the Montreal Protocol, which is 20 per cent below the target of 78.75 ODP tonnes established in its Agreement with the Executive Committee, and 27.5 per cent below the established baseline of 87.5 ODP tonnes. The Government also submitted sector consumption data under the 2016 country programme (CP) implementation report which is consistent with the data reported under Article 7.

27. The 2016 verification report confirmed HCFC consumption reported by the Government under Article 7, and in the CP implementation report. The report further highlighted the robust import/export licensing system in place, and that the quota system will allow Chile to meet the targets of its HCFC phase-out.

Recommendation

28. The Executive Committee may wish to take note of the 2016 verification of HCFC consumption, as part of the HCFC phase-out management plan (stage I) for Chile, submitted by UNDP.

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

Background

29. At the 77th meeting, the Government of Cuba submitted a request for the approval of the third tranche of stage I of its HPMP[3] indicating that although two PU foam enterprises received assistance to convert to a low-GWP technology (water-blown technology), they were currently using on a temporary basis a high-GWP technology (a blend of HFC-365mfc and HFC-227ea) as the selected technology was not available nor it provided 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 original technology selected or another technology with a low-GWP was fully introduced and the enterprises converted.[4]

30. In line with decision 77/50(b), UNDP reported that one foam enterprise (Friarc) have found a supplier of hydrocarbon (HC)-based systems and associated equipment; as the cost of conversion will be larger than that of converting to water-based technology, the enterprise will provide the co-financing required. Currently the equipment procurement process is taking place. With regard to the second enterprise (IDA), UNDP continues searching for a supplier of low-GWP alternatives (water-blown technology or HFO).

Comments

31. The Secretariat noted the effort from UNDP to assist the two enterprises to secure the supply of low-GWP technology. In the case of Friarc, UNDP confirmed that the equipment and polyol systems will be procured in China and that UNDP will continue reporting status during the process of conversion to pre-blended HCs. UNDP estimated that the conversion will be completed during the second half of 2018. In the case of IDA, UNDP indicated that consultation with system houses in Brazil and Panama were conducted, but so far no supplier has shown interest due to the size of the enterprise. UNDP will continue contacting potential suppliers and reporting to the Executive Committee on the status of the conversions, as requested.

Recommendation

32. The Executive Committee may wish:

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

(b) To request UNDP to continue assisting the Government of Cuba in securing the supply of low-GWP alternative technology and to provide a report on the status of the conversion of the two enterprises in the foam sector in line with decision 77/50(b).

[3] UNEP/OzL.Pro/ExCom/77/39.
[4] Decision 77/50(b).

Stage I of the HPMP for India (annual progress report) (UNDP, UNEP, and the Government of Germany)

Background

33. On behalf of the Government of India, UNDP as the lead implementing agency, has submitted the annual progress report on the implementation of the work programme associated with the third and final tranche of the stage I HPMP[5] in line with decision 75/29(a).

HCFC consumption

34. The Government reported HCFC consumption of 1,014.48 ODP tonnes in 2016, which is 30 per cent below the HPMP target of 1,447.38 ODP tonnes for 2016, and 37 per cent lower than the established baseline of 1,608.20 ODP tonnes. The Government submitted sector consumption data under the 2016 CP implementation report consistent with the data reported under Article 7 of the Montreal Protocol.

Progress report on the implementation of the third and final tranche of the HPMP

PU foam manufacturing sector

35. All 15 foam enterprises funded under stage I converted to cyclopentane (eight manufacturing insulation foam for domestic refrigeration equipment, two continuous and five discontinuous sandwich panels), and completed the phase-out of 269.61 ODP tonnes[6] of HCFC-141b by 1 January 2015. Five of the enterprises are waiting for their final disbursement pending the technical review and endorsement by the Government of the verification for project completion undertaken by an independent consultant.

36. In addition, technical assistance was provided to 15 system houses that have developed HCFC-free formulations based on HFO-1233zd(E), FEA-1100, methyl formate and pre-blended cyclopentane, which can be supplied to downstream PU foam enterprises subject to appropriate commercial conditions.

Enabling activities

37. In collaboration with the National Academy of Customs Excise and Narcotics (NACEN), training materials were developed, including the Country Handbook on the National Regulations for Monitoring and Controlling Production and Use of Ozone Depleting Substances in India, which was published in December 2016; two train-the trainers workshops for customs officers with 48 participants were organized; and a workshop on zero- and low-global warming potential alternatives for the building sector was organized.

Remaining activities

38. The following activities have been initiated and are expected to be completed by the end of 2017:

(a) *PU foam sector:* disbursement to the remaining five enterprises (US $1,548,490), and further technical assistance to the systems houses (i.e., submission of invoices for equipment and demonstration of HCFC-free polyols to downstream users in few cases, US $880,594);

[5] The third and final of stage I of the HPMP was approved at the 75th meeting at a total cost of US $1,858,200, consisting of US $1,438,490, plus agency support costs of US $100,694 for UNDP, US $86,160, plus agency support costs of US $10,478 for UNEP, and US $199,440, plus agency support costs of US $22,938 for the Government of Germany.

[6] In addition, one non-eligible enterprise phased out 8.36 ODP tonnes of HCFC-141b.

(b) *Refrigeration servicing sector:* continue monitoring of the technicians training programmes (US $21,400), workshop to promote recovery, recycling and reclamation (US $21,400), additional training for staff from Defence Services and Indian Railways (US $12,000), one or two additional train-the-trainers workshops at a Government Industry Training Institute (US $23,000), one workshop for capacity- building for training partners (US $10,000); and

(c) *Enabling activities:* policy and enforcement capacity building (US $92,500); development of amendments for building codes to integrate HCFC-free design and the template for amending curriculum of architectural colleges to include ODS issues (US $21,000); and awareness activities (US $147,240).

Level of fund disbursement

39. As of August 2017, of the US $21,294,490 approved, US $18,010,812 (85 per cent) had been disbursed (US $15,877,310 for UNDP, US $281,542 for UNEP, and US $1,851,960 for the Government of Germany) as shown in Table 4.

Table 4. Financial report of stage I of the HPMP for India

Agency	Approved (US $)	Disbursed (US $)	Disbursement rate (%)
UNDP	18,438,490	15,877,310	86
UNEP	861,600	281,542*	33
Government of Germany	1,994,400	1,851,960**	93
Total	**21,294,490**	**18,010,812**	**85**

* The disbursement for UNEP decreased relative to the 77th meeting (US $530,800) as that reporting previously received reflected obligations rather than disbursements. Current disbursement figure is correct.

** There was an inadvertent error in the disbursement reported to the 77th meeting by the Government of Germany. Current disbursement figure is correct.

Comments

40. The Secretariat noted that while India's 2016 consumption (1,014.48 ODP tonnes) remained well below its Montreal Protocol target (1,447.38 ODP tonnes), there was a 20 per cent increase in consumption of HCFC-141b relative to 2015 notwithstanding the phase-out activities undertaken in the foam sector. UNDP clarified that import of HCFC-141b is against a license that is valid for 18 months issued by the Government of India on the recommendations of the national ozone unit, which are made keeping in view the phase-out targets and the compliance obligations under the Montreal Protocol. UNDP also emphasized that the conversion projects in stage I related to 15 foam manufacturing enterprises only, and that there are still many enterprises that will be addressed in stage II. Noting that licenses for controlled substances are valid for 18 months, and that therefore a license could be granted in one year but the consumption may take place in the subsequent year, the Secretariat suggested that the Government consider using a licensing system that uses the same timeframe as the quota system it is intended to enable, i.e., a single calendar year.

41. In accordance with decision 75/29(a), the project completion report was to be submitted to the 80th meeting. As a number of activities are being finalized, the Government of India has requested that the completion of stage I be extended to 31 December 2017 and the project completion report submitted to the 81st meeting. In light of the progress made, the Secretariat supports this request.

Recommendation

42. The Executive Committee may wish:

(a) To note the 2016 progress report on the implementation of stage I of the HCFC phase-out management plan (HPMP) for India, submitted by UNDP; and

(b) To approve extension of the duration of stage I of the HPMP for India until 31 December 2017; on the understanding that no further extension of project implementation will be requested; and that the project completion report would be submitted to the 81st meeting.

Stage I of the HPMP for Indonesia (annual progress report) (UNDP, UNIDO, World Bank, and the Government of Australia)

Background

43. On behalf of the Government of Indonesia, UNDP as the lead implementing agency, has submitted to the 80th meeting the annual progress report on the implementation of the work programme associated with the third and final tranche of the HPMP[7] in line with decision 76/47(d).

HCFC consumption

44. The Government of Indonesia reported HCFC consumption of 244.66 ODP tonnes in 2016, which is 33 per cent below the HPMP target of 363.51 ODP tonnes for 2016, and 39 per cent lower than the established baseline of 403.9 ODP tonnes. The Government submitted sector consumption data under the 2016 CP implementation report consistent with the data reported under Article 7 of the Montreal Protocol.

Progress report on the implementation of the third and final tranche of the HPMP

45. Of the 20 refrigeration and air-conditioning (RAC) enterprises that are participating in stage I to convert to HFC-32, three enterprises are still waiting for the market for HFC-32-based equipment to improve before undertaking their conversion and 17 enterprises have completed the conversion of their equipment, though only one enterprise (Panasonic) is manufacturing equipment with the agreed technology. Of the remaining 16 enterprises, eight large- and medium-sized enterprises have manufactured HFC-32-based prototype equipment, while the remaining 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.

46. In the foam sector, the equipment for one of the systems house was delivered and is being installed; the second systems house is undertaking civil works while targeting procurement of the equipment in early 2018. Activities in the refrigeration servicing sector were initiated and will continue through stage II of the HPMP. Finalization of the implementation modalities of the product stewardship programme, upgrade training curriculum and conduct awareness activities are on-going. The project management unit will continue to support HPMP implementation, including preparation of verification report and consultations with industry. The activities for stage I are expected to be completed by the end of 2018.

Level of fund disbursement

47. As of September 2017, of the US $12,692,684 approved, US $10,768,554 (84.84 per cent) had been disbursed (US $7,907,973 for UNDP, US $777,208 for UNIDO, US $1,914,423 for the World Bank, and US $168,950 for the Government of Australia) as shown in Table 5.

[7] The third and final of stage I of the HPMP was approved at the 76th meeting at a total cost of US $1,260,461, consisting of US $901,102, plus agency support costs of US $67,583 for UNDP, and US $271,420, plus agency support costs of US $20,356 for the World Bank.

Table 5. Financial report of stage I of the HPMP for Indonesia (US $)

Agency	Approved (US $)	Disbursed (US $)	Disbursement rate (%)
UNDP	8,901,102	7,907,973	88.84
UNIDO	777,395	777,208	99.98
World Bank	2,714,187	1,914,423	70.53
Government of Australia	300,000	168,950	56.32
Total	**12,692,684**	**10,768,554**	**84.84**

Comments

48. While Indonesia's 2016 consumption (244.64 ODP tonnes) remains well below its Montreal Protocol target (363.51 ODP tonnes), there was an increase of 91.99 ODP tonnes from 2015 (152.65 ODP tonnes). UNDP clarified that the 2015 consumption was well below that in 2013 and 2014, and that the substantial decrease observed in 2015 was temporary and due to the economic downturn in the country; the 2016 consumption reflects the economic recovery and increased stockpiles at enterprises.

49. Noting that three RAC enterprises were waiting for the market for HFC-32-based equipment to improve before undergoing the conversion to HFC-32, the Secretariat sought further information on steps being undertaken to facilitate the conversion, and confirmation that the project would be completed on time and the project completion report submitted to the first meeting of 2019 in line with decision 76/47(d). In addition, the Secretariat sought confirmation that incremental operating costs (IOCs) were being provided in line with decision 77/35. While noting the challenges in the availability of compressors and continued challenges in market acceptance, UNDP emphasized that the Government and UNDP were continuing activities to promote HFC-32; a series of workshops on the web-based application of refrigerant monitoring tool (MAWAS) used to map the needs of RAC service workshops, technicians, and refrigerants used in the country, including HFC-32; a training of heat exchanger computer modelling, including the use of HFC-32 as well as other low-GWP alternatives; a technology forum with participation from suppliers of compressors and other components; translation of a safety guide on flammable refrigerants and a guide on refrigerants designation and safety classification; the preparation of manuals for RAC servicing code of conduct; and updating of curriculum and training programmes on good service practices and servicing of equipment using HCFC-free alternatives, including flammable refrigerants. Furthermore, work is on-going to develop a national standard for installation of RAC equipment that use flammable refrigerants, and a study tour to visit HFC-32 compressor suppliers in China is planned. UNDP also emphasized that activities undertaken under stage II will further facilitate the acceptance in the market of HFC-32-based equipment, including mandatory certification of technicians servicing equipment with flammable refrigerants, and the possible development of regulations that aim to reduce dependency on high-GWP refrigerants in the RAC sector, if the necessary components are available and affordable to enterprises.

50. Upon a request for clarification, UNDP confirmed that IOCs were provided in line with decision 77/35 and noted that Panasonic had produced over one million HFC-32 units for sale in the Indonesian market. UNDP further confirmed that the project completion report would be submitted to the first meeting of 2019.

Recommendation

51. The Executive Committee may wish to take note of the 2016 progress report on the implementation of stage I of the HCFC phase-out management plan for Indonesia, submitted by UNDP.

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

Background

52. On behalf of the Government of the Islamic Republic of Iran, UNDP as the lead implementing agency, has submitted the annual progress report on the implementation of the work programme associated with the fourth tranche of stage I of the HPMP[8] in line with decision 74/43(b).

HCFC consumption

53. HCFC consumption in 2016 was 3,943 mt (272.98 ODP tonnes), as reported in the country programme implementation report and the Article 7 report. This consumption is 28 per cent below the HCFC consumption baseline and 20 per cent below the annual consumption target for 2016 and 2017 in the Agreement between the Government and the Executive Committee (4,698 mt or 342.45 ODP tonnes). The total import quota established for 2017 of 3,461 mt (266.00 ODP tonnes) is also below that target. While consumption of HCFC-22 increased in 2016 due to the lifting of sanctions and increased demand in the refrigeration and air-conditioning (RAC) sector, the consumption of HCFC-141b decreased due to the completion of projects in the PU foam sector and the enforcement of strict imports control.

54. The licensing and quota system for HCFC imports and exports continues to operate effectively. The national ozone unit (NOU) is responsible for issuing licenses for imports of ODS and ODS-containing equipment. A new customs department on-line system has expedited the import request process, has increased the accuracy and reliability of the data and has prevented illegal trade. A ban on imports of HCFC-22-based residential air-conditioners is being considered to enter into force from 1 January 2018.

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

Activities in the PU manufacturing sector

55. Activities implemented include:

(a) *Conversion of eight enterprises in the continuous panels sector (Government of Germany) (30.7 ODP tonnes):* Six enterprises have completed their conversion to HC technology, phasing out 25.4 ODP tonnes of HCFC-141b. One additional enterprise stopped using HCFC-141b and the last enterprise is finalizing commissioning and will complete the project by December 2017;

(b) *Conversion of 11 rigid PU foam enterprises (UNIDO) (88.7 ODP tonnes):* Nine enterprises have completed their conversions to HC technology, resulting in the phase-out of 50.1 ODP tonnes of HCFC-141b. Out of the remaining enterprises, one will complete its conversion in December 2017 and the other one in December 2018; and

(c) *Activities in the air-conditioning (AC) manufacturing sector (UNDP):* The project has been completed, phasing out 29.3 ODP tonnes of HCFC-22. The technology introduced was HFC-410A.

[8] 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.

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

56. Activities in this sector are practically finalized and were presented at the heat ventilation and air-conditioning conference in the country. Activities in recent years have included the monitoring of the results of installing sealed system modifications in the refrigeration systems of two supermarket chains, additional 25 training workshops on good practices in the RAC sector in several provinces, several awareness workshops on energy efficiency and good practices in RAC, and the distribution of technical books to stakeholders.

Level of fund disbursement

57. As of September 2017, of the US $9,994,338 approved, US $9,205,837 had been disbursed as shown in Table 6.

Table 6. 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	4,224,753	97
UNIDO	2,506,277	*2,013,428	80
Government of Germany	2,885,815	2,744,691	95
UNEP	262,000	222,965	85
Total	**9,994,338**	**9,205,837**	**92**

*At the 76th meeting UNIDO reported a disbursement of US $2,130,000, which was erroneous. The figure reported at this meeting is correct.

Comments

58. The Secretariat noted with appreciation the submission of a comprehensive report demonstrating that the Islamic Republic of Iran continues to be in compliance with the HCFC consumption targets established in the Agreement between the Government and the Executive Committee; that the licensing and quota system have been strictly enforced and strengthened through the online system; and that additional stage I activities have been completed. UNDP confirmed that the date of operational completion of stage I of the HPMP continues to be 31 December 2018 as established in the Agreement between the Government and the Executive Committee. The remaining funds balance will also be disbursed before 31 December 2018. No funds balances are expected to be returned to the Multilateral Fund.

59. The Secretariat noted that one enterprise using 2.9 ODP tonnes of HCFC-141b stopped manufacturing foam in 2016 before completing the project. The Government of Germany clarified that the remaining unused funds originally allocated to this enterprise (US $174,175) were reallocated to provide technical assistance to other ongoing conversions in the foam sector. As the level of funds was below 30 per cent of the funding of the last approved tranche (US $813,839), this was considered a minor implementation change and it is now included in the progress report, as established in the flexibility clause of the Agreement.

60. With regard to the refrigeration servicing sector, all activities implemented by the Government of Germany and all the training implemented by UNEP have been completed. Only a few workshops targeting RAC stakeholders will be held by the end of December 2017.

61. Regarding leakage reduction and the possibility of using low-GWP equipment in supermarkets, the Government of Germany reported that the demonstration project yielded positive results in terms of system modifications to prevent leakage. The headquarters of the two supermarket chains involved in the project, as well as another supermarket not targeted by the project, have adapted new and old equipment based on project advice (e.g., flexible connections to gauges, brazed parts, among others). A key driver of this impact has been the training of supermarket managers, who are now implementing the sealed system design. Supermarket owners have indicated that the move to CO_2 or other low-GWP alternatives would first require

a demonstration of the conversion. There are still financial barriers to the import of more advanced low-GWP technology, as well as a lack of low-GWP solutions that could be supplied locally. The majority of systems are still using HCFC-22 or R-400 series. The change to low-GWP systems is a step that will be undertaken during stage II of HPMP.

Recommendation

62. 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 HPMP for Jordan (annual progress report) (UNIDO)

Background

63. On behalf of the Government of Jordan, UNIDO as the lead implementing agency, has submitted the annual progress report on the implementation of the work programme of stage I of the HPMP, in line with decision 75/60(c).

HCFC consumption

64. The Government of Jordan reported HCFC consumption of 66.88 ODP tonnes in 2016, which is 11 per cent below the HPMP target of 74.7 ODP tonnes for 2016, and 21 per cent lower than the established baseline of 83.0 ODP tonnes. The Government also submitted sector consumption data for 2016 under the CP implementation report in September 2017, which was consistent with the data reported under Article 7. The maximum quota for the year 2017 is expected to be 66.40 ODP tonnes.

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

65. The Government continued to implement the licensing system and national regulations particularly the prohibition of manufacturing and import of HCFC-22 based air-conditioning (AC) units; and the mandatory minimum energy performance standard (MEPS) for AC equipment (as of December 2016), which prohibits marketing of equipment below the most energy efficient category; this has facilitated conversion from HCFC-22-based technology.

AC manufacturing

66. The AC sector plan comprising four sub-projects has been completed and all enterprises have ceased the use of 151.5 mt (8.33 ODP tonnes) of HCFC-22 and 10.91 mt (1.2 ODP tonnes) of HCFC-141b in manufacturing as of July 2016. The remaining funds of US $100,123 to be disbursed to the beneficiaries is expected to be completed by end of September 2017. A final workshop for sharing experiences on conversion of manufacturers in the AC sector is planned in the last quarter of 2017. A study tour to Thailand with five beneficiary enterprises was undertaken to help the enterprises learn from the experiences of Thailand on converting to and manufacturing with high-pressure refrigerants in AC manufacturing as well as component manufacturing including compressors.

Technical assistance component

67. Workshop for 40 customs officers and for Standards and Metrology Organisation was completed in 2016 covering implementation of the HPMP and aspects relating to prohibition of import and manufacturing of HCFC-22-based AC units.

68. A three-day training workshop for technicians on drafting of curriculum and teaching manuals for servicing equipment was organised by the NOU/project management unit (PMU) and Vocational Training

Centre (VTC) in May 2016 and 25 certificates were issued. In August 2017, the curriculum and teaching manuals for servicing equipment were finalised, in partnership with Ministry of Environment and Ministry of Education. The remaining activities relating to procurement of recovery and recycling equipment and service tools for training centres and training clinics with new training materials and curricula would be completed by November 2017.

PMU

69. Project monitoring and implementation was carried out primarily relating to monitoring completion of investment projects and organization of workshops for technical support including the service sector; meetings were organized for the National Ozone Committee to discuss and determine annual quotas as well as amendment of the ODS regulation.

Level of fund disbursement

70. As of September 2017, of the US $3,366,017 approved, US $3,033,096 had been disbursed as shown in Table 7.

Table 7. Financial report of stage I of the HPMP for Jordan

Agency	Approved (US $)	Disbursed (US $)	Disbursement rate (%)
UNIDO	2,385,717	2,375,096	99.6
World Bank	980,300	658,000	67.1
Total	**3,366,017**	**3,033,096**	**90.1**

Comments

71. The Secretariat noted the submission of a comprehensive report on progress on the activities of stage I of the HPMP which will be completed by the end of December 2017. Phase-out of HCFC-22 in the AC sector plan is complete; regulations have been implemented for prohibiting import and manufacturing of HCFC-22-based AC as of the end of December 2016. Service sector and technical assistance activities, including measures to sustain training activities for service technicians, were progressing satisfactorily.

72. Regarding the CP data for the years 2013, 2014 and 2015[9], the World Bank indicated that it would work with the Ozone Officer who has been recently appointed by the Government of Jordan on revising this data. Once the data is reviewed, the Government of Jordan will submit the revised CP data reports for 2013 to 2015 to the Secretariat.

73. As of September 2017, the overall disbursement is 90.1 per cent of the total funds approved; the remaining funds would be disbursed or obligated before December 2017 and the project would be financially completed latest by December 2018. In line with decision 75/60(c), the project completion report would be submitted by the first meeting in 2018.

Recommendation

74. 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 Jordan, submitted by UNIDO.

[9] Paragraph 13 of document UNEP/OzL.Pro/ExCom/77/51.

Stage I of the HPMP for Malaysia (annual progress report) (UNDP)

Background

75. On behalf of the Government of Malaysia, UNDP as the designated implementing agency, has submitted to the 80th meeting the annual progress report on the implementation of the work programme associated with the fourth and final tranche of the HPMP[10], in line with decision 77/36.

HCFC consumption

76. The Government of Malaysia reported HCFC consumption of 318.62 ODP tonnes in 2016, which is 27 per cent below the HPMP target of 438.40 ODP tonnes for 2016, and 38 per cent lower than the established baseline of 515.8 ODP tonnes. The Government submitted sector consumption data under the 2016 CP implementation report consistent with the data reported under Article 7 of the Montreal Protocol.

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

77. A three-day foam expert meeting was held in August 2017 to create awareness about the alternatives of HCFC-141b in the sector and to resolve technical issues faced by the systems houses in the introduction of alternatives.

78. The pilot project to introduce CO_2-based systems in the industrial and commercial refrigeration sector has been completed with the installation of a new CO_2-based condensing unit refrigeration system serving a multideck chiller for dairy, beverages, meat, and other foods at a supermarket. The new refrigeration system is expected to result in energy savings and reduced refrigerant leakage.

79. In addition, the Government completed training workshops on good refrigeration practices, including for the safe handling of flammable alternatives, for approximately 330 technicians, and a training for 58 customs officers; six reclaim machines were procured and provided to six centres in June 2017; and the Ozone Protection Unit undertook implementation, monitoring, and public awareness activities to ensure smooth phase-out activities and control of HCFC consumption. The update to regulations to ensure proper refrigerant handling during servicing and proper disposal of HCFC-based equipment is still under review by the Attorney General's office, and expected to be finalized by the end of 2018.

80. The following activities for stage I are expected to be completed by June 2018:

(a) Study tour for foam enterprises and systems house, and development of a guidance document on technical and economic aspects of alternative blowing agents to assist in the selection of blowing agents based on specific applications (US $35,000);

(b) Six technical assistance workshops for technicians and continued information dissemination and seminars on flammable refrigerants, refresher course and workshops for technicians, distribution of servicing equipment to workshops, training of customs officers, and awareness and information outreach (US $651,276); and

(c) Project coordination and monitoring (US $210,149).

[10] The fourth and final of stage I of the HPMP was approved at the 77th meeting at the amount of US $141,295, plus agency support costs of US $10,597 for UNDP.

Level of fund disbursement

81. As of September 2017, of the US $9,587,470 approved, US $8,691,045 (91 per cent) had been disbursed.

Comments

82. Despite the progress in developing low-GWP HCFC-free polyol systems, the Secretariat noted that the expected timeframe for commercialization has been extended by a year relative to the information provided at the 77th meeting. UNDP emphasized the need for additional optimization to improve performance, particularly as it relates to concerns of shrinkage with methyl formate and the higher cost of HFO-1233zd, and that the planned study tour, guidance document, and the new HFO production facility expected to be operational in China in 2018, will facilitate commercialization of the low-GWP HCFC-free polyol systems. The Secretariat concurs with this assessment.

83. The Secretariat noted that, in line with paragraph 14 of the Agreement with the Executive Committee, all project activities were to be completed by the end of 2017, and sought clarification on the reasons for the delay and the expected timeline for the submission of the project completion report. UNDP clarified that delays were encountered in the pilot project to introduce the CO_2-based refrigeration system in the supermarket, as well as in the receipt of reclaim machines from the supplier; it also took the training centres additional time to become familiar with the new online training system. UNDP confirmed that the project completion report would be submitted by the second meeting of 2018 in line with decision 77/36(a). The Secretariat considers that the additional time would enable the implementation of activities to support system houses in the commercialization of the alternative, low-GWP technologies, which would enhance their long-term sustainability, and to complete the remaining training and awareness activities in the refrigeration air-conditioning sector.

Recommendation

84. The Executive Committee may wish:

(a) To note the 2016-2017 progress report on the implementation of stage I of the HCFC phase-out management plan (HPMP) for Malaysia, submitted by UNDP; and

(b) To note that the Government of Malaysia was committed to completing implementation of stage I of the HPMP by 1 June 2018; that no further extension of project implementation would be requested; and that, in line with decision 77/36(a), the project completion report would be submitted to the second meeting in 2018.

Stage I of the HPMP for Mexico (annual progress report) (UNIDO)

Background

85. On behalf of the Government of Mexico, UNIDO as the lead implementing agency, has submitted the annual progress report on the implementation of the work programme associated with the fifth and final tranche of the HPMP[11] in line with decision 75/29(a)[12].

[11] The fifth and final tranche of stage I of the HPMP was approved at the 75th meeting at a total cost of US $1,449,982, consisting of US $226,317 plus agency support costs of US $16,974 for UNIDO, and US $1,122,503, plus agency support costs of US $84,188 for UNDP.

[12] Provision reflected in Annex XII of document UNEP/OzL.Pro/ExCom/75/85.

HCFC consumption

86. The Government of Mexico reported HCFC consumption of 519.66 ODP tonnes in 2016, which is 50 per cent below the 1,033.9 ODP tonnes for the same year in the Agreement between the Government and the Executive Committee, and 55 per cent below the established baseline of 1,148.8 ODP tonnes.

87. The Government of Mexico also reported HCFC sector consumption data under the 2016 country programme implementation report that is consistent with the data reported under Article 7.

88. As in previous years, the phase-out activities in the PU foam and aerosol sectors, the introduction of alternatives to HCFC-141b used for flushing refrigerant circuits during service practices, and the introduction of non-HCFC-22 alternatives in the refrigeration and air-conditioning sector have largely contributed to the sustained decrease in HCFC consumption.

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

Activities in the aerosol manufacturing sector

89. Silimex: The project was successfully completed in December 2014 with the complete phase-out of 11.0 ODP tonnes of HCFC-141b.

Activities in the PU foam manufacturing sector

90. Domestic refrigeration: Mabe has completed its conversion to hydrocarbon (HC), phasing out 55.9 ODP tonnes of HCFCs.

91. Systems houses: The technical conversion of all systems houses has been completed and their formulations for all applications have been developed and are commercially available. The great majority of downstream users included in stage I have also completed the conversions to low-GWP alternatives. A summary of progress achieved on the systems houses project is presented in Table 8.

Table 8. Status of systems houses project

Systems house (SH)	Technologies developed	Project status as of September 2017	Downstream foam users (DSU) as of September 2017		Expected dates for completion*
			Qty	Status	
Acsa/Pumex (merged, operates as Pumex)	Pre-blended cyclopentane Methyl formate (MF) HFO	Conversion completed Formulations developed and commercially available	37	Project completed	SH: Completed DSU: Completed
Aepsa	MF	Conversion completed Formulation developed and commercially available	5	Project completed	SH: Completed DSU: Completed
Bayer (Covestro)	HFC HFO (future)	SH non-eligible	1	Conversion ongoing	SH: Completed DSU: Dec. 2017
Comsisa	MF	Conversion completed Formulation developed commercially available	19	Project completed	SH: Completed DSU: Completed
Dow	HFC HFO (future) Water blown	SH non-eligible	13	Conversion completed	SH: Completed DSU: Completed

Systems house (SH)	Technologies developed	Project status as of September 2017	Downstream foam users (DSU) as of September 2017		Expected dates for completion*
			Qty	Status	
Eiffel	MF Water Methylal Methylal/HFC-365mfc HFO (self-funded) Cyclopentane (self-funded)	Conversion completed Formulations developed and commercially available (MF and Methylal)	93	Conversion completed	SH: Completed DSU: Completed
Huntsman	Water	SH non-eligible	n.a.	Voluntary phase-out	n.a.
Maxima	MF Water HFC/HFO	Conversion completed Formulations developed and commercially available	55	Conversion completed IOC pending	SH: Completed DSU: Completed
Polioles	Water MF HFO (self-funded)	Conversion completed Formulations developed and commercially available	4	Conversion completed	SH: Completed DSU: Completed
Urethane of Mexico	MF	Conversion completed Formulation developed and commercially available	35	Project completed	SH: Completed DSU: Completed
Valcom	MF Methylal with HFC (HFO future)	Conversion completed Formulations developed and commercially available	12	Project completed	SH: Completed DSU: Completed
Zadro	Methylal	Conversion completed Formulation developed and commercially available	14	Project completed	SH: Completed DSU: Completed

*SH: system house; DSU: downstream user.

92. Commercial refrigeration (Fersa, Frigopanel, Metalfrio): Conversion and destruction of ODS-related equipment at Metalfrio (9.2 ODP tonnes of HCFC-141b) was completed in December 2014, and the enterprise is already manufacturing insulation foam based on HC systems. The process for TUV certification[13] is being finalized. Fersa (7.3 ODP tonnes) completed its conversion in 2017, and has obtained TUV certification. Equipment for Ojeda/Frigopanel (6.4 ODP tonnes of HCFC-141b) was delivered, and installation is scheduled to start in October 2017; however, dates may change due to the devastating earthquakes in September 2017.

Activities in the extruded polystyrene (XPS) foam sector

93. At the 79th meeting, the Executive Committee approved the reallocation of US $1,293,558 in savings from the implementation of the PU foam sector plan, to convert two eligible enterprises in the XPS foam sector using HCFCs (Plasticos Espumados and Termofoam Valladolid), and completely phase out the use of HCFC-142b in the country. Currently, both XPS foam enterprises are starting the implementation of their conversion to HFO-1234ze, procurement of equipment is in process and the projects are expected to be completed in July 2019 (24 months duration) as originally proposed.

Activities in the refrigeration servicing sector

94. An overview of the progress in the refrigeration servicing sector and the remaining activities to be completed are presented in Table 9.

[13] TUV (Technischer Überwachungsverein) certification on the safety of products for humans and the environment.

Table 9. Overview of the progress in the refrigeration servicing sector

Activity	A. Overall output as proposed	B. Achieved 1st to 4th tranches	C. Plan of action 5th tranche	D. Achieved 5th tranche	E. Final output stage I	Status
Customs officers training sessions	2	2	0	0	2	Completed, 82 officers trained, including some from other countries in the region
Purchase of refrigerant identifiers	20	12	0	0	12	Completed, 12 refrigerant identifiers purchased for the 12 customs points that have ODS import/export operations
Training manual	4,000	4,000	0	0	4,000	Completed, 4,000 manuals were printed and delivered to the 11 training centres
Train-the-trainer courses	3	2	0	0	2	Completed, 38 trainers from 11 training centres
Technicians trained	4,000	1,000	2,000	1,565	3,000	Ongoing. Since the last report an additional 1,565 technicians were trained for a cumulative total of 2,565. Due to initial delays and the additional time required for signing new agreements with training centres, the target was reduced from 4,000 to 3,000; but equipment procurement was increased as shown below
Purchase of servicing kits	200	0	275	275	275	Ongoing, servicing kits were purchased and are being distributed to the best-trained technicians (October 2016 and February 2017). Number of kits to be provided increased from 200 to 275
Purchase of flushing units	33	22	11	57	79	Completed. 33 sets were delivered to training centres and 46 sets to trained technicians. Number of flushing units distributed increased from 33 to 79
ODP tonnes of HCFC phased out as cleaning agent	23	0	23	0	23	Ongoing, the servicing kits are currently being distributed to technicians. HCFC-141b phase-out will be recorded in 2017
New standards for AC equipment and policy	3	0	3	1	3	Ongoing, new standard "NOM-026-Energy Efficiency for inverter AC" developed. The NOM-021-ENER/SCFI Energy-Efficient for Window AC was updated and published on 7 July 2017. The 023-ENER -2010 energy-efficiency standards for AC equipment is being updated

Level of fund disbursement

95. As of September 2017, of the US $18,066,211 approved, US $14,862,134 (82 per cent) had been disbursed (US $11,110,290 for UNDP, and US $3,751,844 for UNIDO). The balance of US $3,204,077 will be disbursed prior to 2019 (Table 10).

Table 10. Financial report of stage I of the HPMP for Mexico as of September 2017 (US $)

Component	Agency	Funds approved	Funds disbursed		Planned disbursement (Oct. 2016 – 2019)
			(US $)	(%)	
PU foam (Mabe)	UNDP	2,428,987	2,422,275	99.7	6,712
PU foam (systems houses) (*)		9,931,471	8,688,015	87.5	1,243,456
XPS foam (two enterprises)		1,293,558	0	0.0	1,293,558
PU foam (Metalfrío, Fersa, Ojeda)	UNIDO	2,046,110	1,689,949	82.6	356,161
Aerosol (Silimex)		520,916	520,894	100.0	22
Refrigeration servicing sector		1,845,169	1,541,001	83.5	304,168

Component	Agency	Funds approved	Funds disbursed		Planned disbursement (Oct. 2016 – 2019)
			(US $)	(%)	
Total		**18,066,211**	**14,862,134**	**82.3**	**3,204,077**

* A total of US $11,225,029 had been approved for this activity. At the 79th meeting the Committee approved a reallocation of US $1,293,558 for a new activity in the XPS foam manufacturing sector.

Implementation plan for 2017-2018

96. The following activities will be implemented: completion of the conversion of the remaining PU foam downstream users and payment of IOCs; issuance of the TUV certificate to Metalfrío and completion of the conversion at Frigopanel/Ojeda; conversion of two XPS foam enterprises to HFC-1234ze; continuation of training programme in good practices; monitoring of the quota system; finalization of the standards update; and verification of HCFC production in 2017.

Comments

97. The Secretariat notes with appreciation that the Government of Mexico, with the assistance of UNIDO and UNDP, has surpassed its commitments through the implementation of stage I of the HPMP; namely, the country has decreased its consumption of HCFCs beyond the targets in large extent due to the projects completed, close to 300 manufacturing enterprises included in stage I have successfully phased out their use of HCFCs, the Government has used savings generated by the implementation of the PU foam sector plan to phase out additional HCFCs in the XPS foam sector, and a comprehensive programme of training in good practices in refrigeration, tooling and elimination of HCFC emissions has been implemented in the refrigeration servicing sector, among other activities. UNIDO has confirmed that all remaining activities under stage I will be completed before December 2019, the completion date established for stage I in the Agreement between the Government and the Executive Committee.

98. In line with paragraph 7(c) of the Agreement and decision 77/25(b), UNDP submitted a comprehensive list with the names of 291 downstream users assisted by the Multilateral Fund under stage I, grouped by systems house and indicating the subsectors, technologies introduced, equipment provided (where applicable) and whether IOC were included (where applicable). The Secretariat noted that these conversions have already phased out 2,675 mt (or 294 ODP tonnes) of HCFC-141b, which is 98 per cent of the 2,725 mt to be phased out through this project. The number of enterprises in the list is lower than the estimated 335 downstream users used to calculate incremental costs for stage I. However, as explained by UNDP in previous reports, some of the downstream users were converted via foreign-owned systems houses, thereby generating the savings that were subsequently used to phase out HCFC-142b in the XPS foam sector. UNDP also informed that there are still some downstream users to be added to the list, and that the final list will be completed and sent to the Secretariat.

Recommendation

99. The Executive Committee may wish:

(a) To take note of the 2017 progress report on the implementation of stage I of the HCFC phase-out management plan (HPMP) for Mexico submitted by UNIDO; and

(b) To request the Government of Mexico, UNIDO and UNDP to include in the next progress report of stage I of the HPMP to be submitted to the last Executive Committee meeting in 2018 the final list of downstream foam enterprises assisted by the Multilateral Fund under stage I, including their HCFC-141b consumption phased out, subsector, baseline equipment and technology adopted.

Request for extension of stage I of the HPMP for Nigeria (UNDP/UNIDO)

Background

100. Stage I of the HPMP for Nigeria was approved at the 62nd meeting to reduce HCFC consumption by 10 per cent of the baseline by 1 January 2015, at the amount of US $4,444,948 excluding support costs. The fifth and last tranche was approved at the 75th meeting at the amount of US $493,882 (US $299,974 for UNDP and US $193,908 for UNIDO), excluding support costs.

101. Stage I of the HPMP for Nigeria was expected to be completed by December 2016 as per the Agreement between the Government and the Executive Committee. However, the conversion of the system house and downstream users in the PU foam sector was delayed due to the exchange of the local currency with the US dollars which required to identify another way to import the alternative blowing agent. This issue has been addressed, the conversion of the system house is progressing and assistance to the downstream users will be provided during 2018. Therefore, UNDP on behalf of the Government of Nigeria requested the consideration of an extension of stage I until 31 December 2018.

Comments

102. The Secretariat considers that this extension will allow finalization of the project in the PU foam sector phasing out 45.41 ODP tonnes of HCFC-141b and will set the basis for the conversion of additional downstream users included in stage II expected at the 81st meeting.

Recommendation

103. The Executive Committee may wish to consider approving extension of the duration of stage I of the HPMP for Nigeria to December 2018, on the understanding that no further extensions will be requested and that the project completion report would be submitted to the first meeting in 2019.

Progress report on the implementation of the work programmes associated with stage I of the HPMP for Viet Nam (World Bank)

104. The World Bank, as the designated implementing agency, reported that stage I of the HPMP for Viet Nam was completed on 30 June 2017. At the time of finalization of the present document, the project completion report was under preparation so that it could be submitted by the last meeting of the Executive Committee in 2017 in line with decision 76/49(e).

Recommendation

105. The Executive Committee might wish:

(a) To note the completion of stage I of the HCFC phase-out management plan (HPMP) for Viet Nam;

(b) To request:

(i) An update from the Secretariat on the submission of the project completion report; and

(ii) Any remaining balances to be returned to the 81st meeting.

Stage I of HPMPs for Brazil and China (annual progress reports)

106. On behalf of the Governments of Brazil and China, the relevant lead implementing agency, has submitted to the 80th meeting the annual progress report on the implementation of the work programme of stage of I the HPMP. The relevant reports and the Secretariat's comments and recommendations can be found in the documents listed in Table 11.

Table 11: Annual progress reports and verification reports

Country	Project title	Agency	Decision	Document number	Recommen-dation
Brazil	HCFC phase-out management plan (stage I) (2017 progress report)	UNDP	75/53(b)	80/34	Para. 22
China	HCFC phase-out management plan (stage I) (2017 progress report) (extruded polystyrene foam sector plan)	UNIDO	75/54(b)	80/37	Para. 32
China	HCFC phase-out management plan (stage I) (2017 progress report) (polyurethane rigid foam sector plan)	IBRD	75/55(b)	80/37	Para. 50
China	HCFC phase-out management plan (stage I) (2017 progress report) (industrial and commercial refrigeration and air conditioning sector plan)	UNDP	75/56(b)	80/37	Para. 64
China	HCFC phase-out management plan (stage I) (2017 progress report) (room air-conditioner manufacturing sector plan)	UNIDO	75/57(b)	80/37	Para. 81
China	HCFC phase-out management plan (stage I) (2017 progress report) (solvent sector plan)	UNDP	75/29(a)	80/37	Para. 91
China	HCFC phase-out management plan (stage I) (2017 progress report) (refrigeration servicing sector including enabling programme)	UNEP/ Japan	75/29(a)	80/37	Para. 99

107. The Executive Committee may wish to consider the recommendations of the Secretariat as set out in the relevant documents in Table 11.

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

Update on the progress in implementation of low-GWP demonstration projects approved at the 74th, 75th and 76th meetings (UNDP, UNEP, UNIDO and World Bank)

108. 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[14]) project; six in the foam sector (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)).

[14] The demonstration project in West Asia on promoting refrigerant alternatives for high-ambient-temperature countries referred to as PRAHA-II.

109. Among the criteria applied when selecting these projects was that they should aim for a relatively short implementation period for the results to be used for activities under stage II of HPMPs, and would be considered financially completed 12 months after the intended completion date (decision 72/40(b)).

110. Noting that eleven projects were expected to be completed by the 80th meeting, the Secretariat requested an update on the progress in implementation of the projects at the Inter-Agency Coordination Meeting (IACM).[15] Agencies indicated that for four projects for which dates of completion had passed, activities had not yet started nor had the project document for implementation been signed (i.e., South Africa, Thailand and the two air-conditioning projects in Saudi Arabia). Following the IACM, the Secretariat requested a further update, noting that the Secretariat would recommend that any project whose completion date was on or before the 80th meeting and that is not almost complete be cancelled and the funds returned to the 80th meeting, including projects for which no agreement had yet been signed and projects for which no disbursement had yet occurred. Table 12 summarizes the update provided for those projects that were to be completed by the present meeting.

Table 12. Update on the progress in implementation of the feasibility studies on district cooling and low-GWP demonstration projects to be completed by the 80th meeting

Country	Project title (code)	Amount approved (US $)*	Comple-tion date	Update on the progress in implementation
China	Demonstration project for ammonia semi-hermetic frequency convertible screw refrigeration compression unit in the industrial and commercial refrigeration industry at Fujian Snowman Co. Ltd. (CPR/REF/76/DEM/573)	1,026,815	Nov-17	Fujian Snowman Co. Ltd. has completed three prototype trail production, and installation of performance testing equipment. Project expected to be completed by end of 2017 or by the first quarter of 2018. A project completion report will be submitted to the 82nd meeting.
Colombia	Demonstration of HC-290 (propane) as an alternative refrigerant in commercial air-conditioning manufacturing at Industrias Thermotar ltd (COL/REF/75/DEM/97)	500,000	Jun-17	The project is advancing as planned. Prototyped developed, and the new equipment at the manufacturing plant was installed. The project is expected to be completed by April 2018, with the final report to be submitted to the 81st meeting.
Colombia	Demonstration project to validate the use of hydrofluoro-olefins for discontinuous panels in Article 5 parties through the development of cost-effective formulations (COL/FOA/76/DEM/100)	248,380	May-17	HFOs for testing imported, formulations developed, field tests conducted, and results are being analyzed. All field testing has been completed. Final report to be submitted to the 81st meeting.
Costa Rica	Demonstration of the application of an ammonia/carbon dioxide refrigeration system in replacement of HCFC-22 for the medium-sized producer and retail store of Premezclas Industriales S.A. (COS/REF/76/DEM/55)	524,000	Jul-17	Procurement completed and installation of new equipment is in progress. The project is expected to be completed by November 2017, and the final report submitted to the 81st meeting.

[15] Montreal, 5 – 7 September 2017.

Country	Project title (code)	Amount approved (US $)*	Comple-tion date	Update on the progress in implementation
Egypt	Demonstration of low-cost options for the conversion to non-ODS technologies in polyurethane foams at very small users (EGY/FOA/76/DEM/129)	295,000	May-17	Delays due to internal clearance procedure of the Government. Necessary security clearance was granted in October 2017. In the meantime, market research on equipment costs and modification opportunities conducted. The project will purchase 2-3 dispenses for trials before a final report can be produced. UNDP aims to complete all tasks by June 2018. Additional reports to be provided next year.
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 (MOR/FOA/75/DEM/74)	280,500	Mar-17	None received
Saudi Arabia	Demonstration project at air-conditioning manufacturers to develop window and packaged air-conditioners using low-global warming potential refrigerants (SAU/REF/76/DEM/29)	1,300,000	May-18**	Agreement with beneficiary not yet signed, no activities yet implemented
Saudi Arabia	Demonstration project on promoting HFO-based low-global warming potential refrigerants for air-conditioning sector in high ambient temperatures (SAU/REF/76/DEM/28)	796,400	May-17	Project document for implementation not yet signed, no activities yet implemented
Saudi Arabia	Demonstration project for the phase-out of HCFCs by using HFO as foam blowing agent in the spray foam applications in high ambient temperatures (SAU/FOA/76/DEM/27)	96,250	Sep-17	None received
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 (SOA/FOA/76/DEM/09)	222,200	Sep-17	Agreement with beneficiary not yet signed, no activities yet implemented
Thailand	Demonstration project at foam system houses to formulate pre-blended polyol for spray polyurethane foam applications using low-global warming potential blowing agent (THA/FOA/76/DEM/168)	352,550	May-17	Project document for implementation not yet signed, no activities yet implemented
Regional (West Asia), PRAHA-II	Promoting alternative refrigerants in air-conditioning for high ambient countries in West Asia (PRAHA-II) (ASP/REF/76/DEM/59 and 60)	700,000	Nov-17	None received
The Dominican Republic	Feasibility study for district cooling in Punta Cana (DOM/REF/74/TAS/57)	91,743	May-16	Project completed in 2016. Final report to be approved by the Punta Cana Foundation, and submitted to the 81st meeting

Country	Project title (code)	Amount approved (US $)*	Comple-tion date	Update on the progress in implementation
Egypt	Feasibility study for district cooling in New Cairo (EGY/REF/75/TAS/127 and 128)	27,223	Nov-16	Mission conducted, terms of reference finalized, and project team assembled. Site selection still under consultation with the Government. Final report and completion of the project planned for mid-2018.
Kuwait	Feasibility study comparing three not-in-kind technologies for use in central air-conditioning (KUW/REF/75/TAS/28 and 29)	27,223	Nov-16	Mission conducted, terms of reference finalized, and project team assembled. Site selection still under consultation with the Government. Final report and completion of the project planned for mid-2018.

* 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.

111. In addition to the projects in Table 12, UNDP provided an update on the implementation of the demonstration of HCFC-free low-GWP alternatives in the refrigeration in fisheries sector in the Maldives (approved for US $141,000 at the 76th meeting, with a date of completion of May 2018). UNDP reported that the Government has selected R-448A as the replacement alternative. R-448A is a non-flammable HFO-HFC blend (i.e., HFO-1234yf, HFO-1234ze, HFC-32, HFC-125 and HFC-134a; 20/7/26/26/21 per cent) that has a lower GWP (1,386) than the currently used HCFC-22 (1,810) or the currently used alternative, R-438A (2,265). UNDP is seeking guidance whether the country can proceed with the demonstration project using this alternative.

112. The Secretariat noted that the selected technology for demonstration has a GWP of 1,387 and inquired which technologies were considered that led to its selection. The Secretariat advised UNDP to continue exploring other alternatives with a lower GWP. The Secretariat believes proceeding with the demonstration project using this technology may not meet the objective of demonstrating low-GWP alternatives, and seeks the guidance from the Executive Committee on how to proceed.

Recommendation

113. The Executive Committee may wish:

(a) To note the update on the progress in implementation of the demonstration project for ammonia semi-hermetic frequency-convertible screw refrigeration compression units in the industrial and commercial refrigeration industry at Fujian Snowman Co., Ltd in China provided by UNDP, that no further extension of project implementation would be requested, and to request UNDP to submit the final report no later than the 82nd meeting;

(b) To note the update on the progress in implementation of the demonstration of R-290 (propane) as an alternative refrigerant in commercial air-conditioning manufacturing at Industrias Thermotar ltd in Colombia provided by UNDP, that no further extension of project implementation would be requested, and to request UNDP to submit the final report no later than the 81st meeting;

(c) To note the update on the progress in implementation of the demonstration project to validate the use of hydrofluoro-olefins for discontinuous panels in Article 5 Parties through the development of cost-effective formulations in Colombia provided by UNDP, that no further extension of project implementation would be requested, and to request UNDP to submit the final report no later than the 81st meeting;

(d) To note the update on the progress in implementation of the project on demonstration of the application of an ammonia/carbon dioxide refrigeration system in replacement of

HCFC-22 for the medium-sized producer and retail store at Premezclas Industriales S.A provided in Costa Rica provided by UNDP, that no further extension of project implementation would be requested, and to request UNDP to submit the final report no later than the 81st meeting;

(e) To note the update on the progress in implementation of the demonstration of low-cost options for the conversion to non-ODS technologies in polyurethane foams at very small users in Egypt provided by UNDP, to agree to extend the completion of the project to 31 December 2018, that no further extension of project implementation would be requested, and to request UNDP to submit the final report no later than the 83rd meeting;

(f) To cancel the project 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 in Morocco and that remaining funds be returned to the 80th meeting;

(g) To cancel the demonstration project on promoting HFO-based low-global warming potential (GWP) refrigerants for the air-conditioning sector in high ambient temperatures in Saudi Arabia and that remaining funds be returned to the 80th meeting;

(h) To cancel the demonstration project at air-conditioning manufacturers to develop window and packaged air-conditioners using lower GWP refrigerants in Saudi Arabia and that remaining funds be returned to the 80th meeting;

(i) To note that no update on the progress in implementation of the demonstration project for the phase-out of HCFCs by using HFO as foam blowing agent in the spray foam applications in high ambient temperatures in Saudi Arabia was provided by UNIDO and that no extension of project implementation was requested, and to request UNIDO to submit the final report no later than the 81st meeting;

(j) To cancel the demonstration project on the technical and economic advantages of the vacuum assisted injection in a discontinuous-panel plant retrofitted from HCFC-141b to pentane in South Africa and that remaining funds be returned to the 80th meeting;

(k) To cancel the demonstration project at foam system houses in Thailand to formulate pre-blended polyols for spray polyurethane foam applications using a low-GWP blowing agent and that remaining funds be returned to the 80th meeting;

(l) To note that no update on the progress in implementation of the project in West Asia promoting refrigerant alternatives for high-ambient-temperature countries (PRAHA-II) was provided by UNEP and UNIDO and that no extension of project implementation was requested, and to request UNEP and UNIDO to submit the final report no later than the 81st meeting;

(m) To note the update on the progress in implementation of the feasibility study for district cooling in Punta Cana in the Dominican Republic provided by UNDP and to request UNDP to submit the final report no later than the 81st meeting;

(n) To note the update on the progress in implementation of the feasibility study for district cooling in New Cairo in Egypt provided by UNEP and UNIDO and to request the implementing agencies to submit the final report no later than the 82nd meeting;

(o) To note the update on the progress in implementation of the feasibility study comparing three not-in-kind technologies for use in central air-conditioning in Kuwait provided by

UNEP and UNIDO and to request the implementing agencies to submit the final report no later than the 82nd meeting; and

(p) To request UNDP to continue exploring other low-GWP alternatives for the fisheries sector in the Maldives and report to the 81st meeting on the progress of the demonstration project, and where no low-GWP alternatives are available for the sector, consider the cancellation of the demonstration project.

PART IV: FINANCIAL AUDIT REPORTS FOR THE CFC PRODUCTION, HALON, PU FOAM, PROCESS AGENT II, REFRIGERATION SERVICING AND SOLVENT SECTORS IN CHINA

Background

114. In line with decisions 71/12(b)(ii) and (iii)[16], 72/13[17], 73/20(b)[18], 75/18[19] and 77/26(b)[20], the Government of China has submitted, through the relevant bilateral and implementing agencies, annual progress reports, audit reports, and interest accrued during the implementation of the CFC production, halon, PU foam, process agent II, refrigeration servicing and solvent sector plans to the 80th meeting.

Planned budgets and progress reports

115. Table 13 presents an overview of fund disbursements as at 30 June 2016, disbursements between 1 July 2016 and 30 June 2017, fund balances, and the planned completion dates for each of the sector plans. As of 1 July 2017, remaining balances amounted to US $25,896,325.

[16] The Committee invited the Government, through the relevant implementing agency, in future financial audit reports, to provide data on all funds that were being held by the Government for disbursement to beneficiaries, and the interest accrued from those balances, on the process agent II, solvent and the refrigeration servicing sector plans; and information on progress related to the work plans for the sector plans and its proposal on how to use potential balances.

[17] The Committee invited the Government, through the relevant implementing agency, to submit to the 73rd meeting the financial audit reports for the process agent II, solvent and CFC refrigeration servicing sectors, together with the plans for the remaining funds for the halon, CFC production, foam, process agent II, solvent, and CFC refrigeration servicing sectors, describing how they would be used for activities related to ODS phase-out and allow for the completion of those sector plans by the end of 2018.

[18] The Government and the relevant bilateral and implementing agencies were requested to submit annual progress reports, audit reports, and interest accrued during the implementation of the CFC production, halon, PU foam, process agent II, refrigeration servicing and solvent sector plans, until the completion of all activities no later than 31 December 2018, and to submit project completion reports for the sector plans no later than the first meeting in 2019.

[19] The Government was invited to include the results of the activities on the screening and evaluation of CFC-free substitutes and the development of new substitutes in a report to be submitted when those activities had been completed; to collect information where available on halon recovery as part of its collection of information on CFC recovery during visits to ship dismantling centres; and to undertake a study on its country's production of CTC and its use for feedstock applications and to make the results of the study available to the Committee by the end of 2018.

[20] The Government was requested to provide to the 79th meeting final study reports on all research and development projects undertaken with funds from the Multilateral Fund under the CFC production sector.

Table 13: Planned budgets for the use of remaining funds (US$)

Activity	Funding as at 31 December 2009	Balance as at 30 June 2016	New disbursement	Balance	Completion date
CFC production: Total approved US $150,000,000 (World Bank)					
Recruitment for technical support, and organization of technology workshop on alternatives	500,000	-	-	-	2014
ODS import and export management MIS	500,000	-	-	-	2015
Research and development on ODS alternatives	4,200,000	1,766,364	977,508	788,857	2017
Supervision and management	-	233,411	-	233,411	2018
Operation cost for China Compliance Centre (CCC)	3,300,000	-	-	-	N/p
Total	8,500,000	1,999,774	977,508	1,022,267	
Halon sector: Total approved US $62,000,000 (World Bank)					
Halon-1211 stock maintenance and leakage prevention		1,500,000	-	1,500,000	2018
Halon banking management centre establishment and operation		710,900	-	710,900	2016
Establishment and capacity building for halon-1301 recycling centre		821,414	-	821,414	2017
Upgrade and improve halon-1211 recycling demonstration centre		300,000	-	300,000	2017
Develop management information system for halon banking		800,000	-	800,000	2018
Inventory investigation and registration of halon users nationwide		2,000,000	-	2,000,000	2017
Operation cost for collection transportation, recycling and reclamation		1,500,000	-	1,500,000	2018
Enhancing capacity-building for halon recycling centres		500,000	-	500,000	2018
Disposal costs of contaminated halon and residue		1,408,397	-	1,408,397	2018
Supervision and management for capacity-building activities for halon feedstock use and the prevention of illegal production		1,269,267	18,624	1,250,643	2018
Investigation on halon uses and servicing for civil aviation		400,000	-	400,000	2018
Portable halon detection equipment for recycling centres		500,000	-	500,000	2018
Total		11,709,979	18,624	11,691,355	
Process agent II: Total approved US $46,500,000 (World Bank)					
Capacity building for local EPBs		384,802	96,446	288,357	2017
Research on ODS substitution and development of trends of alternative technologies		318,519	285,319	33,200	2018
CTC residue disposal		5,445,970	-	5,445,970	2018
Study on production of CTC and its use for feedstock applications		100,000	-	100,000	2018
Monitoring, management and post evaluation		1,613,246	8,197	1,605,050	2018
Total		7,862,538	389,961	7,472,577	

Activity	Funding as at 31 December 2009	Balance as at 30 June 2016	New disbursement	Balance	Completion date
PU foam: Total approved US $53,846,000 (World Bank)					
Screening and evaluation of CFC-free substitutes and development of new substitutes	2,660,000	1,312,048	1,041,113	270,935	2016-2017
Additional provincial foam activities (capacity building for 11 provinces)	3,100,000	1,030,532	270,000	760,532	2016-2017
Technical service for the foam enterprise for better application of new alternatives	1,400,000	743,510	368,133	375,377	2016-2017
Continue monitoring of CFC phase-out in the foam sector	1,050,000	723,806	142,982	580,824	2017-2018
Project monitoring and management		345,922	171,644	174,278	2017-2018
Total	8,210,000	4,155,818	1,993,872	2,161,946	
Refrigeration servicing: Total approved US $7,884,853 (Japan, UNEP, UNIDO)					
Ongoing activities (e.g., eight training centres, training on disposal ships sector, Shenzhen demonstration project)		264,736	126,088	138,648	2018
Training programmes for ICR/RAC sub-sectors		947,168	210,000	737,168	2018
Research on leakage of refrigeration during R-290 RAC servicing and operation		432,788	-	432,788	2018
Data survey		165,434	-	165,434	2018
Monitoring and management		95,846	-	95,846	2018
Total		1,905,972	336,088	1,569,884	
Solvent sector: Total approved US $52,000,000 (UNDP)					
Combating ODS illegal activities: capacity building for 10 local customs offices		413,305	-	413,305	2017
Capacity building for ODS-related personnel at 14 provinces		797,500	155,000	642,500	2018
Public awareness and publicity activities		193,840	54,096	139,744	2018
Alternative technology assessment and research		207,083	-	207,083	2017
Electronic file management system		400,000	346,337	53,663	2018
Activity management and monitoring		568,470	46,468	522,003	2018
Total		2,580,199	601,901	1,978,298	

116. Financial audits were conducted by Daxin Certified Public Accounts LLP according to national standards. The audit opinion was that the grant and expenditure statements were in compliance with the accounting standards of China and have been fairly and justly presented by the Foreign Economic Cooperation Office/Ministry of Environmental Protection (FECO/MEP) of China.

117. The activities implemented in each sector plan between 1 July 2016 and 30 June 2017 are summarized below.

CFC production sector

118. US $977,508 has been disbursed since the last progress report. Recruitment of national and international expertise for technical support; ODS import and export management activities; and a technology workshop on ODS alternatives, have been completed. A dedicated optical data transmission

system had been established between the ODS Import/Export Management Office and Customs. Thirteen proposals for research and development on ODS alternatives have been selected and completed (eight projects have been fully funded, while final payment for the remaining five projects will take place by the end of 2017). The research and development activities are listed in Table 14.

Table 14: Summary of research and development activities under the CFC production sector plan

Project application unit	Chemicals related to the study	US $
Zhejiang Lantian Environmental Protection High-tech Ltd. *and* Zhejiang Xindakeen Fire Industrial Co., Ltd.	Perfluoro ketone, fire-extinguishing agent, 1 GWP. Development new production technology and research applications	657,900
Sinochem Jindai Environmental protection Co., Ltd., Zhejiang Research Institute of Chemical Industry and Nanjing Forestry University	HFC-1234ze, 6 GWP, refrigerant and blowing agents. Research and develop new production technology using HFC-1234ze	657,900
Zhejiang Huanxin Fluoro Materials Ltd.	HFC-1234yf, 4 GWP, refrigerant for automotive air conditioning. Research and develop new production technology using HFC-1234yf	657,900
Changshu 3F Zhonghao new Chemical Material Co., LTD	HFC-1234yf, 4 GWP, refrigerant for automotive air conditioning. Research and develop another new production technology using HFC-1234yf	643,998
Zhejiang Research Institute of Chemical Industry	Survey of system to evaluate ODS alternative performance	82,300
Zhejiang Lantian Environmental Protection High-tech Ltd. *and* Zhejiang University	HFC-41, 0 ODP, 92 GWP, refrigerant. HFC-41 refining technology and study of its application	82,300
Beijing University of Chemical Technology	Study and select new production process using HFC-1234yf and HFC-1234ze in laboratory through testing of different technical processes	80,500
Electrochemical Factory of Zhejiang Juhua Co., Ltd. *and* Technical Centre of Zhejiang Juhua Group	Foaming agent HFE-254pc, 0 ODP, 25 GWP. Research and develop new production technology using HFE-254pc	306,243*
Zhejiang Quhua Fluoro Chemical Ltd. *and* Technical Centre of Juhua Group	Research of blends of HFC-1234yf and HFC-1234ze, 0 ODP, low-GWP, refrigerants. New application study	306,243*
Technical Centre of Juhua Group And Electrochemical Factory of Zhejiang Juhua Co., Ltd.	Research and develop the preparative technique of HFC-1336mzz	299,806
Zhejiang Research Institute of Chemical Industry	Research and develop the analytical method and related standards for HFOs	49,968
Shandong Hua'an New Material Ltd.	Research and develop the design and optimization of HFO-1234yf equipment	299,806
Sinochem Jindai Environmental protection Co., Ltd.	Research and develop the gaseous phase catalytic synthesis technology of HFO-1234yf and the development of catalysts	261,877
Total		**4,418,250****

* Contracts were signed in RMB, so the US$ contract amount changed after the actual disbursement was completed.

** The contract amounts for 13 projects were adjusted from US $4,418,253 in the last report to US $4,386,7401, as a result of adjustments to two contracts based on actual disbursements.

119. The funding balance of US $233,411 is for monitoring and management activities, including consultancy, training, evaluation and verification, which will be conducted by FECO to achieve sustainable compliance with CFC phase-out.

Halon sector

120. US $18,624 has been disbursed since the last progress report. FECO has been making continuous efforts to address all issues related to the halon bank and has held coordination meetings at different levels. The issue of transport of halons as non-hazardous waste had been resolved. The contract for the establishment of a halon-1301 recycling centre was signed in 2015 and the second payment was disbursed in August 2017, with a balance of US $500,000 to be disbursed in the first half of 2018. The contract for the halon recycling management centre was signed in the beginning of 2016, and the second payment was disbursed in August 2017. To ensure the sustainability of the halon bank's operation, the plan may need to continue to 2018.

Process agent II

121. US $389,961 has been disbursed since the last progress report. The six environmental protection bureaus (EPBs) with CTC and other ODS producers have submitted reports and fulfilled the conditions required in their contract. After the final project acceptance procedures by FECO, the last payment will be disbursed by the end of 2017. Five contracts to evaluate demand for CTC and associated leakage, and assess the environmental impact of CTC emissions had been signed, and four of the contracts have been completed.

122. FECO established a panel (one hazardous waste expert and one chemical expert) to carry out a feasibility analysis and evaluation for the safe disposal of CTC residues considered to be hazardous waste, and which must comply with specific regulations. The panel collected data through site visits to main CTC residue producers, incinerators and local EPBs, and prepared a report. Based on the report, a project proposal has been developed for the construction of a CTC residue incinerator at an estimated cost of US $5.4 million. The project aims to support capacity building for methane chloride producers to dispose of the distillation residues from CTC refining and CTC conversion facilities. For large producers, the construction of new incinerators or upgrading of existing incineration facilities will be partially financed by the Multilateral Fund, while major investments will be borne by the enterprises. For small producers and producers without the intention to build their own incinerators, the subsidy will be provided for CTC residue disposal by qualified hazardous waste treatment centres. After the approval procedures by FECO, this project is expected to be launched in October 2017 and completed by the end of 2018.

123. Although ODS production of CTC for controlled uses has been completely phased out, CTC is a by-product of the methane chloride industry. Accordingly, it is important to continue monitoring production and feedstock consumption of CTC, and other substances related to CTC; providing training to stakeholders (e.g., associations, producers, feedstock users, officers from EPBs and Customs); upgrading the ODS data reporting system; providing portable ODS detectors for local Customs and EPBs officers; and undertaking evaluations and verifications, as required.

124. The study on China's production of CTC and its use for feedstock applications will commence in October 2017 and the results will be made available by the end of 2018.

PU foam

125. US $1,993,872.38 has been disbursed since the last progress report. Ten proposals were selected to support the development of formulations with zero-ODP and low-GWP blowing agents at low prices that could be used by small and medium size enterprises (SMEs), and formulations of pre-blended polyol systems to optimize the stability, performance and insulation properties of foam products. FECO, with the assistance of independent financial and technical experts, conducted on-site verifications of the ten projects before funding was disbursed. The independent experts reviewed progress reports and financial documentation, evaluated project performance against the milestones stipulated in the contract, and

provided suggestions for adjustments. So far, six projects have been completed and the remaining four are expected to be completed during the first half of 2018.

126. In June 2017, the industrial association and sector experts recommended that issues related to the adoption of low-GWP alternative technologies by the spray foam sub-sector be addressed, giving due consideration to the low ambient temperature during the winter in many areas of China. Accordingly, FECO launched a research activity to test the dimensional stability, insulation performance, and other foam properties, to be completed by June 2018; the research will also analyze and explore the economic feasibility of using HFO/HFO mixtures.

127. FECO has signed contracts with EPBs in 11 provinces/cities aimed at enhancing public awareness of ozone layer protection, strengthening sustainable compliance capability, and ensuring that no CFCs or other controlled ODS would resurge post 2010. By 30 June 2017, eight local EPBs had fulfilled the goals. The final commissioning procedures will take place in September 2017.

128. In December 2014, FECO signed contracts with four systems houses; production and laboratory equipment has been installed, and trials and tests of new pre-blended polyols based on alternative blowing agents have been completed. Currently, the systems houses are providing technical services to downstream foam enterprises as stipulated in the contract. The project is expected to be completed by the end of 2017.

129. Under the monitoring component, in 2014, FECO signed contracts with four provinces (i.e., Hebei, Henan, Shandong and Tianjin), where the majority of systems houses and foam enterprises are located, to visit chemical dealers, systems houses, and foam enterprises to collect samples of blowing agents, pre-blended polyol systems, and final foam products. Over 400 foam enterprises have been visited, and thousands of samples have been collected. To increase the effectiveness of the monitoring activities, and in order to balance the geographical distribution of the foam enterprises, FECO signed a contract with Sichuan Province in January 2017. Additionally, FECO has organized training and technical assistance workshops and has conducted on-site verifications when needed.

CFC refrigeration servicing sector

130. US $336,088 has been disbursed since the last progress reports. FECO has established 13 training centres (in 13 different cities) to implement vocational training courses for servicing technicians. As of July 2017, more than 4,100 technicians, trainers and students have been trained (three of the centres have completed the training programme).

131. As China needs additional training centres, FECO has decided to establish two special training centres on R-290 in 2017, using US $340,000 of the funding available from the CFC phase-out plan. One centre provides training on the specific and detailed requirements of operation-on-installation and servicing in the refrigeration and air-conditioning sector, and the other provides training on CO_2 refrigeration equipment including heat pumps, water heaters and cold chains. Additional funding will be provided through the HCFC servicing sector plan under stage I of the HPMP. It is expected that 400 trainers and technicians will be trained before the end of 2018. The remaining budget will be used on establishing more good-practice training centres.

132. FECO has allocated US $432,788 for research and training on refrigerant leakage control during operation and servicing of R-290-based air-conditioning systems; and has initiated two surveys: one of the disposal-ships sector, and one of the cold chain in supermarkets.

133. Monitoring and management activities (including consultancy, training, evaluation and verifications) will be conducted by FECO to achieve sustainable compliance with CFC phase-out.

Solvent sector

134. US $601,901 has been disbursed since the last progress report. Officers from ten customs offices received training on ODS-related knowledge in order to strengthen their capacity to combat illegal ODS import and export. This activity will be completed by the end of 2017. Assistance has also been provided to 14 provinces to develop implementation plans and train local EPB officers. As of 30 June 2017, more than 3,000 local officers and ODS enterprise representatives had been trained and over 15,000 people had participated in public awareness activities. Local EPBs organized more than 15 on-site inspections of ODS enterprises. Implementation of activities will be completed by the end of 2017 in 10 local EPBs, and by mid-2018 in the four reminding EPBs.

135. FECO published two books and one supplementary issue of the "World Environment" periodical related to compliance achievements and the experience of Montreal Protocol implementation in China, and to promulgate scientific knowledge on ozone layer protection. Research on alternative technologies was conducted at five institutions[21] and focused on new alternative solvents, and on silicone oil optimization. Activities have been completed at four of the institutions and will be completed in the fifth institution by the end of 2017. FECO also established an electronic management system for ODS-related documents (i.e., 31 sector plans with a large number of various types of documents). Management and monitoring activities, including training, verifications, and evaluations, have been implemented.

Interest accrued

136. Table 15 presents the amount of interest collected.

Table 15. Interest reported from sector plans in China

Sector	Cumulative interest (US $)
CFC production, halon, process agent II, and PU foam	18,272
Refrigeration servicing	87,990
Solvent	302,194
Total	**408,456**

137. The interest accrued for the solvent sector is significantly higher than that accrued for the other sectors, as interest from RMB accounts is much higher than interest from US dollar accounts.

Comments

138. There has been progress in implementing activities in the different sector plans associated with the fund balance; however, a balance of US $25.89 million remained as of 1 July 2017, i.e., 50 per cent disbursement of the amount of US $52.0 million[22] that was available at 31 December 2009 (of the US $372.2 million originally approved for the plans).

139. Upon request for confirmation, the implementing agencies indicated that the funding balances associated with each of the sector plans would be fully disbursed by the end of 2018 and that the project completion reports would be submitted to the first meeting of the Executive Committee in 2019. It is expected that the balance of US $1,022,267 associated with the CFC production sector plan will be disbursed by the end of 2017, with a possibility of extending into 2018; regardless, the project completion report will be submitted by the first meeting in 2019.

[21] Beijing Yuji, Dongyang Weihua, Shanghai Xilikang, Quzhou Sancheng and Huaxia Shenzhou.

[22] The figure is estimated because data as at 31 December 2009 was not provided for the process agent II sector; therefore, the data from 31 December 2013 was used for that sector's 2009 balance.

140. For each of the sector plans, further clarification was sought from relevant bilateral and implementing agencies, as summarized below:

141. With regard to the CFC production sector plan, the World Bank reported as follows:

(a) The World Bank will provide final reports on all research and development projects undertaken with funds from the Multilateral Fund under the CFC production sector, in line with decision 77/26(b);

(b) The World Bank reported that through the evaluations, verifications, analysis of samples and other activities being implemented by the Government, it has been established that, from 2016, there has been no CFC production in China. The CFC stockpiles with producers have been monitored and have been reported on by producers as used only for servicing and for manufacturing metered dose inhalers; and

(c) The scope of the activities undertaken under the CFC production sector plan had included the selection, evaluation, technical route development and application research of low-GWP alternatives to HCFCs and HFCs, providing advice and guidance to the HCFC producers on the prospects of HCFC alternative development.

142. With regard to the halon sector, the World Bank reported that halon recycling has been a very difficult activity, and that the Government is continuing its implementation efforts. After a long period of coordination and consultation, the halon recycling system was reconsidered and reconstructed in 2014. The establishment of the halon recycling management centre and the halon-1301 recycling centre were the first step, to be followed by additional recycling centres. A halon recycling information system is planned and will be established to manage all available information on the use, recycling, reclamation and reuse of halon. The plan is to initiate halon recycling practices under the new system in the near future and to further optimize the operation of the system. All efforts are being made to complete the work plan according to schedule.

143. With regard to the process agent II sector, the World Bank reported as follows:

(a) As a result of capacity-building activities, the local EPBs have set up ODS management offices; specialized communication channels have been established for enterprises to report their ODS production and consumption data including HCFCs; According to the current regulation, enterprises with annual HCFC consumption of more than 100 mt must apply for consumption quota from the Ministry of Environmental Protection, while consumers of less than 100 mt must register with the provincial EPBs; and HCFC dealers with sales below 1,000 mt/year are required to register with the provincial EPBs. In addition, EPBs have provided training for enterprises on national ODS policy actions and management requirements, and have organized on-site inspections of ODS producers, consumers and dealers. Public awareness activities have also been implemented;

(b) The results of the research on ODS substitutions, and the development trend of proposed alternative technologies will enhance enterprises' knowledge about low-GWP alternatives to HCFCs and HFCs, and the economic and technical impact of conversion to such alternatives;

(c) Since CTC residue is specified as a type of hazardous waste in China, the construction or upgrading of incinerators must comply with relevant laws and regulations and meet the technical standards and specifications for hazardous waste applied in China. Furthermore, enterprises are required to strictly obey current regulations regarding hazardous waste

when disposing of residue. The entire process will be supervised and monitored by local EPBs; and

(d) The Government of China has decided to continue monitoring the production and feedstock consumption of CTC after the project is completed, in order to meet its commitments under the work plan and the Agreement for the process agent II sector plan regarding CTC phase-out linked to any future process agent applications to be approved by the Parties.

144. With regard to the PU foam sector plan, the World Bank reported as follows:

(a) In general, the technical assistance and research activities have studied the technical and economic feasibility of available zero ODP and low GWP technologies. The results of these activities have facilitated foam beneficiary enterprises in selecting alternative technologies during stage I of the HPMP, that have led to the conversion of 35 foam enterprises so far. The result has also assisted in determining the alternative technology to be introduced under stage II of the HPMP to achieve complete and sustainable phase-out of HCFCs in the entire polyurethane foam sector by 2026. Since some of the technical assistance activities are still ongoing, the final report has not yet been completed;

(b) The four systems houses that have received funding are in addition to those funded under stage I of the HPMP, and focus on water-blown pre-blended polyol technology. The systems houses have completed the installation of production facilities and trial production. The new polyol formulations have overcome the challenges of increased viscosity and low polyol mobility, and the final foam products' dimensional stability and overall performance is considered satisfactory by end users; and

(c) The public awareness activities have enabled the 11 provincial EPBs to establish channels for enterprises to report on their annual HCFC consumption levels; set up ODS management offices, and reach out to promote policies and the quota system. Furthermore, foam enterprises have been made aware of ODS phase-out timelines and the application procedures under the Fund. Alternative technologies and training for end-users have been provided at technology workshops.

145. With regard to the refrigeration servicing sector, UNIDO reported as follows:

(a) The training centres under the CFC servicing sector are aimed at training technicians and students in refrigeration servicing to learn good practices in HCFC refrigeration and acquire knowledge about alternative technologies in order to eliminate barriers to the introduction of such alternatives. A total of 22 training centres have been established so far, 13 of which have been financially supported with unspent funds from the CFC servicing sector.

(b) The two special training centres related to R-290 and CO_2 refrigerants will assist in the adoption those alternatives to HCFCs and ensure proper servicing of R-290- and CO_2-based appliances; and

(c) The amount of refrigerants used in ships is considerably high; it is expected that the survey of the disposal ships sector will facilitate the development of strategies to reduce the release of HCFCs. In stage II of the servicing sector plan, the supermarket subsector will be a focus of planned interventions. The objective of these two surveys is to investigate the basic situation of refrigeration systems and their operating conditions.

146. With regard to the solvent sector, UNDP reported as follows:

(a) The 14 provincial EPBs have established communication channels for enterprises to report their annual consumption, set up ODS management offices, and undertake outreach activities to advertise policies and the quota system;

(b) Information on the Multilateral Fund procedures and phase-out schedules has been provided to a large number of solvent enterprises; these activities have made it easier for eligible enterprises to apply for funding from FECO, and for ineligible enterprises to better plan their conversion activities;

(c) Technology workshops were also organized to introduce key alternative technologies conduct training. Products using alternative technologies were also exhibited to workshop;

(d) In 10 local EPBs, additional customs officers and frontline officers who check cargoes on a daily basis received additional training;

(e) Based on the results of research activities under the solvent sector plan, nine HCFC-based solvent enterprises were able to select suitable technologies, leading to the successful completion of their conversions. The results also assisted in determining the alternative technologies to be selected during implementation of stage II of HPMP, achieving the complete and sustainable phase-out of HCFCs by 2026. As some of the research activities are still ongoing, a detailed report will be submitted together with the next progress report; and

(f) The electronic file management system has been operational in FECO since 1 July 2017. The system includes HCFC phase-out documents, especially those related to the beginning of stage II of the HPMP, which has facilitated the procedures and record-keeping of the related divisions. The system will continue to record new HCFC phase-out documents, and some important historical ODS documents will be scanned as records and for use as knowledge resources.

Recommendations

147. The Executive Committee may wish:

(a) To note, with appreciation, the financial audit reports for the CFC production, halon, polyurethane (PU) foam, process agent II, refrigeration servicing and solvent sectors in China, contained in document UNEP/OzL.Pro/ExCom/80/12;

(b) To note with appreciation that, with the funding balances available in the CFC production, halon, PU foam, process agent II, refrigeration servicing and solvent sectors, the Government of China has implemented a large number of research, technical assistance and awareness activities that have facilitated the introduction of low-global-warming potential alternative technologies in the various sectors, as well as the phase-out of HCFCs and the phase-down of HFCs; and

(c) To further note with appreciation that the Government of China has confirmed that the funding balances associated with each of the sector plans will be fully disbursed by the end of 2018; that relevant research and technical assistance reports will be submitted to the last meeting of 2018, and that the project completion reports will be submitted to the first meeting of the Executive Committee in 2019.

PART V: ODS WASTE DISPOSAL PROJECTS

Background

148. At the 79th meeting, the Executive Committee requested, *inter alia*, bilateral and implementing agencies to submit final reports on outstanding ODS disposal pilot projects[23] 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)). In addition, at the Inter-agency Coordination Meeting[24] the relevant implementing agencies informed the Secretariat that the ODS waste disposal projects for Algeria and the regional technical assistance for Africa would be cancelled, and funds would be returned to the Multilateral Fund.

149. In line with decision 79/18(d), the final reports for two pilot projects had been submitted for Mexico (UNIDO and France), and for the Europe and Central Asia (ECA) region (UNEP and UNIDO), and two detailed progress reports for China (Japan and UNIDO), and Nigeria (UNIDO). These reports are summarized below. Full reports for Mexico and the ECA region are attached to the present document.

Mexico: Pilot demonstration project for disposal of unwanted ODS (Final report)

150. The objective of the pilot demonstration project for Mexico was the disposal of the 166.7 metric tonnes (mt) of CFC-12 from old refrigerators and air-conditioners, and 7.0 mt from chillers. The demonstration project destroyed 113.0 mt of unwanted CFC-12.

151. In addition to ozone and climate benefits, the project encouraged the first Mexican facilities to obtain licenses to incinerate and co-process ODS waste, and proved the feasibility of ODS destruction using two different technologies: argon plasma arc and cement kiln. Mexico has two companies with the necessary authorizations from the Government, which were issued after satisfying relevant safety and environmental standards associated with ODS destruction.

152. The final report provides details on the phased implementation of the project. Preliminary activities consisted of training and recovery equipment endowment to home appliances replacement programme (HARP) centres, monitoring, reporting and verification (MRV) system design, awareness workshop, and implementation of ODS destruction pilot tests and licensing approval for two Mexican companies. Aggregation and consolidation of ODS banks were achieved and approximately 74.0 mt of unwanted CFC-12 banks were destroyed in the argon plasma; and an additional 39.0 mt were destroyed between 2016 and 2017.

153. The report states that the argon plasma arc is a cutting-edge destruction technology and is the cleanest; however, its limitation is the high cost. Cement kiln proved to be the most cost-effective ODS destruction technology, noting that the cement manufacturing industry in Mexico has long experience in handling hazardous waste, other than ODS. Project lessons are provided in the final report.

ECA region: Demonstration of a regional strategy for ODS waste management and disposal (Final report)

154. The objective of the pilot demonstration project for three countries – Bosnia and Herzegovina, Croatia and Montenegro in the ECA – was to evaluate a regional approach for ODS waste disposal in terms of cost-effectiveness and sustainability, particularly in LVC countries that do not have their own ODS destruction facilities.

[23] Final reports of the pilot projects for Georgia, Ghana and Nepal were submitted to the 79th meeting.
[24] Montreal, 5 – 7 September 2017.

155. The project aimed at destroying 29.07 mt of ODS waste from the three countries. It collected mainly CFCs, HCFCs and small amounts of HFCs. A total of 41.37 mt of waste were destroyed, including 32.79 mt of ODS waste. It was not feasible to separate ODS waste from non-ODS waste, meaning that all collected quantities were destroyed under the project. The cost-effectiveness of the project was US $8.01/kg calculated based only on the portion of ODS waste destroyed, exceeding the expected cost-effectiveness of US $12.02/kg. Therefore, the overall cost estimate of the project is US $262,622, and any balances will be returned to the Multilateral Fund after financial completion of the project.

156. The final report highlights that both legislation and institutional arrangements of the beneficiary countries did not support the aggregation of ODS waste at the regional level, synchronization of the shipments from different countries, and synergies with persistent organic pollutants (POPs) destruction.

157. The project facilitated the establishment of the Regional Cooperation Forum (RCF) as a communication platform that provided, *inter alia*, a list of equipment and tools that are necessary for proper aggregation of waste; check list for laboratory analysis of ODS waste; list of eligible destruction facilities in the European Union (EU); and recommendations and lessons learned.

158. Some lessons include improved knowledge on legislation in the EU and project countries, which does not allow the aggregation of ODS waste at regional level because ODS waste is classified as hazardous waste; need for national legislation of the country in which destruction is to take place to allow the import of waste mixtures containing ODS for destruction; a list of destruction facilities in EU countries that accept waste mixtures containing ODS for destruction would be useful to other countries in the ECA region; and environmental taxes on refrigerants contributing to ozone layer depletion and climate change might feed into environmental funds to finance the environmentally sound disposal of refrigerant waste in the long-term.

China: Progress report on the pilot demonstration project on ODS waste management and disposal

159. The objective of the pilot demonstration project for China was to explore treatment to the collected ODS wastes and set up a sustainable model for ODS wastes destruction, and the disposal of 192.0 mt of ODS wastes, particularly CFCs banks. A total of 88.42 mt (46 per cent of target) of CFCs had been destroyed as of September 2017.

160. The project had provided for local environmental protection bureaus (EPBs) to undertake verification activities such as on-site visits, and collect information on ODS recycling enterprises, destruction procedures applied and related cost; and record ODS recycling equipment and its operational status. The verification of some large refrigeration servicing facilities found that this sector only uses HCFCs (i.e., there are no CFCs for disposal). The report indicated that recycling and disposal of the unwanted ODS would be expedited in order to complete the project in 2017.

Nigeria: Progress report on the pilot demonstration project for disposal of unwanted ODS

161. The objective of the pilot demonstration project for Nigeria was to demonstrate a business model for ODS waste management from collection to disposal, build the capacity of operators in the waste management sector and end-users on the proper handling and management of ODS waste, and the disposal of 84.0 mt of CFC-12 which had been collected from industrial sources, particularly from oil refineries to a destruction facility outside Nigeria.

162. ODS aggregation exercise undertaken in 2014 showed that the country had CFC-12 stocks totalling 1.5 mt, and stocks that had been previously reported were in most cases not found as some of the oil companies had disposed of the stocks themselves, some other companies had sold them while some claimed no knowledge of any stocks. The progress report does not provide data on ODS waste destroyed by companies.

163. In 2016, the Government introduced ozone regulations that provide for, among others, mandatory destruction of ODS wastes, guidelines for destruction facilities including emission limits, and extend responsibility of end-of-life waste equipment to producers.

164. Of the total approved budget of US $911,724, US $263,774 had been disbursed or obligated, leaving a balance of US $647,948. The remaining funds would be used towards transportation for export to the contracted destruction facility and final destruction. Companies were expected to bid in the last quarter of 2017 for the destruction of the aggregated ODS wastes.

Comments

165. The Secretariat noted that the following aspects of decision 58/19 were included in the final reports for Mexico and the ECA region:

(a) The estimated amount of ODS that was eventually destroyed by the project;

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

(c) Detailed steps of the overall process; and

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

166. In the case of China, progress has been achieved in the implementation of the pilot project, and is on track to completing the activities at the end of 2017. The country has also committed to submit a final report to the 81st meeting.

167. The Secretariat noted that in the case of Nigeria, the project proposal indicated a target of 84.0 mt of unwanted ODS for disposal; however, the aggregation exercise undertaken showed that the country had only 1.5 mt. The report did not indicate progress in terms of ODS waste destruction, and at the time of the progress report's issuance in September 2017, contracts with destruction companies had not yet been finalized. It was also noted that the ODS waste collected would be destroyed domestically as the quantities collected are too small to allow for a cost-effective export for destruction; an adjustment on the funding would be made to account for the lesser amount of ODS destroyed than targeted, and the remaining balance will be returned to the 82nd meeting. UNIDO indicated that it would provide a further update on the status of this project at the 80th meeting, and noted that the Government of Nigeria is committed to complete this by the 81st meeting, in line with decision 79/18(d).

Recommendation

168. The Executive Committee may wish:

(a) To note, with appreciation, the final reports on the pilot ODS waste management and disposal projects for Mexico, submitted by UNIDO and France, and for the Europe and Central Asia region, submitted by UNEP and UNIDO;

(b) 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;

(c) To note the detailed progress reports on the pilot ODS waste management and disposal projects for China, submitted by Japan and UNIDO, and for Nigeria, submitted by UNIDO;

(d) To reiterate decision 79/18(d), requesting bilateral and implementing agencies to submit final reports of outstanding ODS disposal pilot projects to the 81st meeting (i.e., China, Cuba, Lebanon, Nigeria and Turkey), and to return to the 82nd meeting unspent balances for projects where final reports have not been submitted.

PART VI: ONGOING CHILLER PROJECTS

Background

169. In line with decision 79/19(b)(i), bilateral and implementing agencies submitted status reports for the four ongoing chillers projects, as summarised in Table 16.

Table 16. 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	Issuance and dissemination of publications related to the project have been completed, and thus all substantial activities are complete. UNDP would submit a detailed report to the 81st 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	Work on contract for local overhaul for commissioning of chillers in the Sudan started by mid-July 2017 and is expected to be completed by end of 2017; after this, the commissioning of chiller would be completed. The project is expected to be operationally completed by April 2018 and financially completed by April 2019; 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. **Argentina:** To-date, three chillers have been replaced. The project implementation unit at the Secretariat of Industry and Commerce (UEPRO) is expected to invite new potential beneficiaries. Conversion of 20 CFC-based chillers to alternatives is expected to save 95,000 CO_2 tonnes per year only based on refrigerant component without considering energy efficiency gains. Energy efficiency gains will be monitored during implementation. **India:** The project was operationally completed as of 31 December 2014 and savings of US $481,628 were returned in May 2016; 34 chillers were replaced with recovery and storage of about 7 mt of CFCs. The power requirement for refrigeration of 1 TR capacity was 0.63 kilowatt as against the target of 1 kilowatt planned for the project. **Indonesia:** The project was cancelled as it failed to obtain endorsement from the Global Environment Facility (GEF) due to the possibility of use of HFC-based refrigerants in the replacement chillers. **Jordan:** All 20 CFC-based chillers have been replaced, 15 supported through a partial Multilateral Fund grant. Four mt of CFCs were recovered and stored on a Government site pending disposal. The energy saving as tested in five sites was in the range of 17.0 to 24.4 per cent. **Philippines (the):** The project was completed as of 31 December 2016 and financially closed by mid-2017; 72 chillers were replaced. Estimated energy savings was 151.4 GWh.

Country	Project title	Agency	Meeting	Funds approved (US $)	Planned date of completion	Status of progress
						No project activities were initiated for China, Malaysia and Tunisia. As per decision 79/19(b)(ii), the project completion report would be submitted no later than December 2018 and fund balances would be returned no later than June 2019. The total funds committed so far amount to US $3,735,556, and reported savings amount to US $3,149,056, taking into account unallocated amount for the China, Malaysia and Tunisia chiller project, Indonesia chiller energy-efficiency project and savings from the Jordan project.

Comments

170. The Secretariat noted that there was progress in the ongoing projects with some of the projects at advanced stages of completion and the request for extension of the completion date in one component of the strategic demonstration project in Africa. The Secretariat notes that this extension is requested due to an unforeseen delay in completing the overhaul work of chillers in the Sudan and would facilitate successful completion of this component of the Africa chiller project.

Recommendation

171. The Executive Committee may wish:

(a) To reiterate decision 79/19(b)(ii);

(b) To take note of the progress report on the ongoing chiller projects submitted by UNDP, the World Bank, and the Governments of France and Japan;

(c) With respect to the strategic demonstration project for accelerated conversion of CFC chillers in five African countries (AFR/REF/48/DEM/35):

(i) To approve the extension of the completion date, on an exceptional basis, to April 2018; and

(ii) To request the Government of Japan to submit the project completion report no later than October 2018 and the final report to the 82nd meeting, and to return fund balances no later than April 2019.

PART VII: SECTOR PLAN FOR THE PHASE-OUT OF METHYL BROMIDE PRODUCTION IN CHINA

Status of implementation for the phase-out of methyl bromide production for China (UNIDO)

172. UNIDO, on behalf of the Government of China, had submitted to the 80th meeting, a report on the status of implementation of the sector plan for the phase-out of methyl bromide (MB) production, and the 2014-2016 verification reports for controlled and feedstock uses, in line with decision 73/56(b).

Background

173. At its 47th meeting, the Executive Committee approved the sector plan for the phase-out of MB production at a total cost of US $9,790,000 plus agency support costs for UNIDO. The Executive Committee approved the fourth (and final) tranche at the 73rd meeting, on the understanding that the Government would continue to use existing balances to undertake activities for the phase-out of MB production, and that all project activities would be completed no later than 31 December 2018, and requested the Government and UNIDO to submit the project completion report no later than the first meeting in 2019 (decision 73/56).

174. As of the 73rd meeting, a total of US $3,274,896 had been disbursed. The remaining funding for activities was US $6,515,104, which was allocated according to the following work plan:

Table 17. 2014-2018 work plan

Activity	Budget (US $)
Compensation to the three producers	1,140,000
Final compensation to MB producers	1,850,000
Monitoring and supervision (Foreign Economic Cooperation Office (FECO))	220,000
Audit (UNIDO)	20,000
General Administration of Quality Supervision, Inspection and Quarantine (AQSIQ) activities	2,000,000
MB alternatives registration	1,000,000
Project completion report	190,000
International consultants	90,000
Not allocated	5,104
Total	**6,515,104**

175. The Agreement with the Executive Committee specified a maximum annual allowable production of MB for controlled uses in 2014 of 83.3 metric tonnes (mt). For 2015 and beyond, that maximum was set to zero save for quarantine pre-shipment (QPS), feedstock and critical uses to be approved by Parties. The Parties authorized critical-use exemptions (CUEs) of 114 mt and 99.8 mt for China for 2015 and 2016, respectively. The 2014-2016 verification report confirmed that China's production was consistent with the Agreement. The Government reported under Article 7 of the Montreal Protocol MB production that is consistent with the verification report; at the time of finalization of the current document, Article 7 data for 2016 is not yet available.

Table 18. 2014-2016 Article 7 and verified MB production, and 2015-2016 authorized CUEs for China (mt)

MB production	2014	2015	2016
Article 7 production for controlled uses	83.3	113.8	n/a
Verified production for controlled uses	83.3	113.9	99.7
CUEs authorized by the Parties	n/a	114	99.8

Progress report from 2014 to 2017

176. The US $1,140,000 compensation to the three MB producers has been disbursed. Payments have been agreed for the additional US $1,850,000 final compensation to the producers based on a proportional compensation and will cover the period 2016-2018 during which time MB producers have to comply with MB production and sale regulations and undergo FECO's periodic verifications (Table 19).

Table 19. 2016-2018 final compensation (US $) to MB producers

Enterprise	2016	2017	2018	Total
Lianyungang Dead Sea Bromine Compounds Co., Ltd.	380,000	285,000	285,000	950,000
Linhai Jianxin Chemical Co., Ltd.	280,000	210,000	210,000	700,000
Changyi City Chemical Plant	80,000	60,000	60,000	200,000
Total	**740,000**	**555,000**	**555,000**	**1,850,000**

177. The payment of US $740,000 has been disbursed for 2016. As the verification of production can only occur the subsequent year, the 2017 and 2018 payments will be disbursed in 2018 and 2019, respectively.

178. Of the US $220,000 allocated to FECO for monitoring and supervision, US $166,954 have been disbursed. The remaining US $53,055 will be used in 2017 and 2018 for similar activities. US $20,000 for the independent audits have been disbursed.

179. Of the US $2,000,000 allocated for the coordination mechanism with AQSIQ to reinforce the Government's management and supervision on MB consumption for QPS use, contracts for five projects totalling US $1,510,220 have been signed (Table 20), with US $611,570 related to 2016 disbursed. FECO is undertaking the procurement process for training and public awareness (US $200,000) and the management information system (US $289,780); the procurement process is expected to be completed by December 2017 and the projects implemented and completed in 2018.

Table 20. Funding for technical assistance cooperation projects with AQSIQ (US $)

Project	2016	2017	2018	Total
Survey of MB consumption for QPS uses	48,472	24,236	8,079	80,787
Evaluation, research and demonstration of emission reduction technology for QPS use	268,537	134,268	44,756	447,561
Research and assessment of MB alternatives for QPS use in export/import of log and wood packaging material	116,181	232,363	38,727	387,271
Research on policies and regulations for MB QPS use	44,016	44,016	58,688	146,720
Research, assessment and demonstration of MB alternatives for export/import of fruits	134,364	268,729	44,788	447,881
Total	**611,570**	**703,612**	**195,038**	**1,510,220**

180. A notice inviting proposals for research, development and registration of MB alternatives was issued on 23 June 2015. Twenty-five proposals were submitted and ten projects selected; contracts totalling US $1,000,000 for those projects have been signed, with the 2016 payment (US $300,000) disbursed and the 2017 payment (US $461,165) expected to be disbursed by the beginning of 2018. The 2018 payment (US $238,836) is expected to be disbursed by the end of 2018 or early 2019. All projects will be completed in 2018.

181. Of the US $90,000 allocated for international consultants, US $72,453 have been disbursed; a further US $12,009 is expected to be disbursed in November 2017 after the submission of the final report on the monitoring and evaluation training, and the remaining US $5,538 will be used in 2018 for consultancy services to assist FECO to finalize the project completion report. FECO is finalizing the terms of reference for the project completion report and anticipates signing the contract in 2017 and completing all activities in 2018.

Verification reports

182. The verification for controlled uses of MB to audit production and sales in the three MB production enterprises was carried out from 18 to 28 June 2017. The verification team concluded that none of the three enterprises has produced controlled uses of MB exceeding the quotas and production is within the limit of industry plans; all the enterprises can implement relevant regulations on production and consumption of MB issued by the Government; and none of the enterprises has increased its baseline production capacity. One enterprise, Changyi City Chemical Plant, has updated its equipment while keeping the same production capacity; the other two enterprises have made no changes to their production equipment.

183. The verification for raw material for feedstock was carried out from 20 June to 20 July 2017. The verification team concluded that the amount of MB consumed as feedstock was 1,548 mt in 2014, 1,528 mt in 2015 and 2,283 mt in 2016. With respect to the enterprises surveyed that use MB as a feedstock for the production of other chemicals, all of them are legal manufacturing enterprises; have kept standardized records; have had the amounts of MB purchased verified to match closely to the sales volume provided by the manufacturing enterprises; have had their invoices verified with production enterprises; obey strictly the relevant regulations and use MB as a raw material to manufacture stable intermediate or final products without illegal resale or use for other purposes; and have production processes that ensure that all MB is consumed in the course of manufacturing the final product. There were no recommendations from the verification teams for the period 2014-2016.

Comments

184. The Secretariat noted with appreciation the progress in implementing the agreed work plan. Upon a request for clarification, UNIDO confirmed that all project activities would be completed no later than 31 December 2018 in line with decision 73/56(a), while noting that for administrative reasons some final disbursements may occur in early 2019 (i.e., disbursement related to the project completion report, the production audit, and three technical assistance projects related to research, development and registration of MB alternatives). UNIDO also confirmed that a project completion report would be submitted to the first meeting of 2019, in line with decision 73/56(b).

185. Upon request for a clarification, UNIDO explained that due to an inadvertent oversight a feedstock verification in 2013 was not conducted. The Secretariat also noted a small difference in 2014 (33.82 mt) and 2015 (1.48 mt) between the verified production of MB for QPS and that reported by the Government of China under Article 7 of the Montreal Protocol. UNIDO clarified that QPS production reported under Article 7 is based on domestic and export sales, while the verification report also accounts for any MB returned by a customer to a producer for various reasons, as well as any changes in the inventory held by the producers. As the verification report indicated that no MB was exported for controlled uses, and noting that the Parties authorized CUEs for several countries that do no report production of MB, UNIDO confirmed no such exports were made.

Conclusion

186. The Secretariat notes that the verified MB production and that reported under Article 7 of the Montreal Protocol are consistent with that allowed under the Agreement. There has been significant progress in implementing activities according to the agreed work plan, with a total of US $3,050,968 disbursed since the 73rd meeting. An additional US $715,621 are expected to be disbursed by 31 December 2017, with the remaining US $2,748,515 to be disbursed in 2018 and early 2019.

Recommendation

187. The Executive Committee may wish:

(a) To note the report on the status of implementation of the sector plan for the phase-out of methyl bromide (MB) production in China, submitted by UNIDO;

(b) To recall that all remaining project activities will be completed no later than 31 December 2018; and

(c) To request the Government of China and UNIDO to continue submitting annual reports on the status of implementation of the sector plan for the phase-out of MB production and the project completion report to the Executive Committee no later than the first meeting in 2019.

Annex I

PROJECTS THAT ARE CLASSIFIED AS "SOME PROGRESS" AND ARE RECOMMENDED FOR CONTINUED MONITORING

Country/project code	Agency	Project title
China (CPR/ARS/56/INV/473)	UNIDO	Sector plan for phase-out of CFCs consumption in MDI sector
Egypt (EGY/ARS/50/INV/92)	UNIDO	Phase-out of CFC consumption in the manufacture of aerosol metered dose inhalers (MDIs)
Sudan (the) (SUD/FUM/73/TAS/36)	UNIDO	Technical assistance for the final phase-out of methyl bromide in the post-harvest sector
Syrian Arab Republic (SYR/REF/62/INV/103)	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

Annex II

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

Country	Agency	Project title/project code	Recommendation
Cuba	UNDP	Institutional strengthening – Phase X: 1/2016-12/2017 (CUB/SEV/75/INS/54)	To monitor the signing of the Agreement between the Government and UNDP noting that the delay is due to Government internal changes and procedures.
Lebanon	UNDP	HCFC phase-out management plan (stage II, first tranche) (refrigeration servicing sector) (LEB/PHA/75/INV/87)	To monitor low disbursement rate of approved funds, noting that the activities were planned to start by June/July 2017.
Lebanon	UNDP	HCFC phase-out management plan (stage II, first tranche) (project management and coordination) (LEB/PHA/75/TAS/88)	To monitor low disbursement rate of approved funds, noting that the recruitment of consultants is taking longer than planned.
Saint Kitts and Nevis	UNDP	HCFC phase-out management plan (stage I, first tranche) (STK/PHA/64/TAS/16)	To monitor low disbursement rate of approved funds.
Central African Republic (the)	UNEP	HCFC phase-out management plan (stage I, first tranche) (CAF/PHA/64/TAS/22)	To monitor the resumption of activities in the country.
Guatemala	UNEP	HCFC phase-out management plan (stage I, third tranche) (GUA/PHA/75/TAS/50)	To monitor low disbursement rate of approved funds, noting that the first disbursement has not been released yet.
Guyana	UNEP	HCFC phase-out management plan (stage I, second tranche) (GUY/PHA/74/TAS/24)	To monitor low disbursement rate of approved funds, noting that the first disbursement has not been released yet.
Kuwait	UNEP	HCFC phase-out management plan (stage I, first and second tranches) (refrigeration servicing sector and monitoring and verification) (KUW/PHA/66/TAS/19); (KUW/PHA/74/TAS/23)	To monitor implementation progress and low disbursement rate noting that the country faced some issues in finalizing the financial report due to internal administrative restructuring.
Mozambique	UNEP	HCFC phase-out management plan (stage I, second tranche) (MOZ/PHA/73/TAS/25)	To monitor low disbursement rate of approved funds noting that the signing of the agreement was delayed due to structural and administrative changes in the Ministry.
Nauru	UNEP	Institutional strengthening – Phase V: 8/2014-7/2016 (NAU/SEV/72/INS/09)	To monitor the signing of the Agreement between the Government and UNEP, noting that the new Ozone Officer has been recently appointed by the Government.

Country	Agency	Project title/project code	Recommendation
Qatar	UNEP	HCFC phase-out management plan (stage I, first tranche) (refrigeration servicing sector) (QAT/PHA/65/TAS/17)	To monitor low disbursement rate of approved funds, noting that the Agreement has not been signed.
Albania	UNIDO	HCFC phase-out management plan (stage I, third tranche) (ALB/PHA/75/INV/30)	To monitor low disbursement rate of approved funds, noting that the work plan was agreed in June 2017.
Algeria	UNIDO	HCFC phase-out management plan (stage I, first tranche) (activities in the refrigeration servicing sector including phase-out of HCFC-141b used for flushing, and project monitoring) (ALG/PHA/66/INV/77)	To monitor low disbursement rate of approved funds, noting that the activities related to the verification of the baseline equipment and training of customs officers could not be implemented due to communication issues with the national ozone unit.
Central African Republic (the)	UNIDO	HCFC phase-out management plan (stage I, first tranche) (CAF/PHA/64/INV/21)	To monitor the resumption of activities in the country.
Iraq	UNIDO	Preparation of a HCFC phase-out management plan/ investment activities in air-conditioning sector (stage II) (IRQ/PHA/73/PRP/19) (IRQ/REF/73/PRP/20)	To monitor the HCFC phase-out management plan preparation project due to the security situation in the country, noting that a coordination meeting with stakeholders has been held and data is being collected.
Iraq	UNIDO	HCFC phase-out management plan (stage I, second tranche) (refrigeration servicing sector) (IRQ/PHA/74/INV/23)	To monitor implementation progress and disbursement rate of approved funds 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, noting that the equipment for the two beneficiaries is held by the manufacturer.
Morocco	UNIDO	HCFC phase-out management plan (stage I, first tranche) (refrigeration servicing sector) (MOR/PHA/65/INV/68)	To monitor the completion of the audit.
Morocco	UNIDO	HCFC phase-out management plan (stage I, second tranche) (refrigeration servicing sector) (MOR/PHA/68/INV/69)	To monitor low disbursement rate of approved funds.
Tunisia	UNIDO	Institutional strengthening – Phase VIII: 4/2015-4/2017 (TUN/SEV/74/INS/64)	To monitor low disbursement rate of approved funds due to focus on activities from the previous phase.

Annex III

TEXT TO BE INCLUDED IN THE UPDATED AGREEMENT BETWEEN THE GOVERNMENT OF BAHRAIN AND THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR THE REDUCTION IN CONSUMPTION OF CHLOROFLUOROCARBONS AND HYDROCHLOROFLUOROCARBONS

(Relevant changes are in bold font for ease of reference)

16. This updated Agreement supersedes the Agreement reached between the Government of Bahrain and the Executive Committee at the 68th meeting of the Executive Committee.

APPENDIX 2-A: THE TARGETS, AND FUNDING

Row	Particulars	2012	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Total
1.1	Montreal Protocol reduction schedule of Annex C, Group I substances (ODP tonnes)	n/a	51.90	51.90	46.17	46.71	46.71	46.71	33.74	**33.74**	**33.74**	**33.74**	n/a
1.2	Maximum allowable total consumption of Annex C, Group I substances (ODP tonnes)	n/a	51.77	51.77	46.45	45.39	43.54	37.27	31.66	**31.66**	**31.66**	**31.66**	n/a
2.1	Lead IA (UNEP) agreed funding (US $)	120,000	145,000	0	**0**	0	**0**	**125,000**	**0**	**55,000**	**0**	**25,000**	470,000
2.2	Support costs for Lead IA (US $)	15,600	18,850	0	**0**	0	**0**	**16,250**	**0**	**7,150**	**0**	**3,250**	61,100
2.3	Cooperating IA (UNIDO) agreed funding (US $)	549,455	0	0	**0**	0	**0**	**936,646**	**0**	**720,384**	**0**	**132,500**	2,338,985
2.4	Support costs for Cooperating IA (US $)	38,462	0	0	**0**	0	**0**	**65,565**	**0**	**50,427**	**0**	**9,275**	163,729
3.1	Total agreed funding (US $)	669,455	145,000	0	**0**	0	**0**	**1,061,646**	**0**	**775,384**	**0**	**157,500**	2,808,985
3.2	Total support costs (US $)	54,062	18,850	0	**0**	0	**0**	**81,815**	**0**	**57,577**	**0**	**12,525**	224,829
3.3	Total agreed costs (US $)	723,517	163,850	0	**0**	0	**0**	**1,143,461**	**0**	**832,961**	**0**	**170,025**	3,033,814
4.1.1	Total phase-out of HCFC-22 agreed to be achieved under this Agreement (ODP tonnes)												22.77
4.1.2	Phase-out of HCFC-22 to be achieved in previously approved projects (ODP tonnes)												0.00
4.1.3	Remaining eligible consumption for HCFC-22 (ODP tonnes)												28.69
4.2.1	Total phase-out of HCFC-141b agreed to be achieved under this Agreement (ODP tonnes)												0.44
4.2.2	Phase-out of HCFC-141b to be achieved in previously approved projects (ODP tonnes)												0.00
4.2.3	Remaining eligible consumption for HCFC-141b (ODP tonnes)												0.00
4.3.1	Total phase-out of HCFC-141b contained in imported pre-blended polyols agreed to be achieved under this Agreement (ODP tonnes)												0.00
4.3.2	Phase-out of HCFC-141b contained in imported pre-blended polyols to be achieved in previously approved projects (ODP tonnes)												0.00
4.3.3	Remaining eligible consumption for HCFC-141b contained in imported pre-blended polyols (ODP tonnes)												10.11

United Nations Industrial Development Organization



Demonstration Project for Disposal of Unwanted ODS in Mexico

2017

United Nations Industrial Development Organization

And the Government of France

Demonstration Project for Disposal of Unwanted ODS in Mexico

Project Manager:

Riccardo Savigliano

Prepared by:

Alan Bastida &
Conrado Martínez

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Acronyms

CAA	Clean Air Act
CEMS	Continuous Emissions Monitoring System
CFC	Chlorofluorocarbon
CRT	Climate Reserve Ton
DRE	Destruction and Removal Efficiency
EPA	Environmental Protection Agency of the United States
FIDE	Trust Fund for Electricity Savings (as per its acronym in Spanish)
GoM	Government of Mexico
GWP	Global Warming Potential
HARP	Home Appliances Replacement Program
HCFC	Hydrochlorofluorocarbon
HFC	Hydrofluorocarbon
HPMP	HCFC Phase-Out Management Plan
LGPGIR	General Law for Prevention and Integral Management of Residues (as per its acronym in Spanish)
MLF	Multilateral Fund for the Implementation of Montreal Protocol
MP	Montreal Protocol on Substances that deplete the Ozone Layer
MRV	Monitoring Reporting and Verification
NOM	Mexican Official Standard (as per its acronym in Spanish)
NPP	National CFC Phase-Out Plan
ODS	Ozone Depleting Substances
PLASCON	Argon Plasma Arc
R&R Center	Recovery and Recycling Centers
RAC	Refrigeration and Air Conditioning
RCRA	Resource Conservation and Recovery Act
SEMARNAT	Ministry of Environment and Natural Resources (as per its acronym in Spanish)
SISSAO	ODS Information and Tracking System (as per its acronym in Spanish)
TEAP	Technology and Economic Assessment Panel
THC	Total hydrocarbons
TPS	Total Suspended Particles
UNEP	United Nations Environmental Programme
UNIDO	United Nations Industrial Development Organization

Executive Summary

Mexico´s Demonstration Project for unwanted ODS disposal has been one of the first project supported by the Multilateral Fund for high volume consumption Article 5 countries to be successfully realized. Its implementation led to the environmentally-sound destruction of 113 tonnes of unwanted ODS banks, which implied the mitigation of over 504 thousand tCO_2e. In other words, this mitigation is equivalent to the emissions that would have been produced by 140 thousand vehicles in circulation during one year.

Beyond ozone and climate benefits, the Demonstration Project encouraged the first Mexican facilities to obtain license authorizations to incinerate and co-process unwanted ODS, while proving the feasibility of ODS destruction using two different technologies: Argon plasma arc and Cement kiln.

The Demonstration Project outcomes will contribute to develop cost-effective financing schemes that enable the destruction of additional amounts of ODS, while the lessons accumulated during its implementation will help relieve associated barriers to implement future unwanted ODS disposal projects.

Project justification

The Montreal Protocol on Substances that deplete the Ozone Layer has successfully controlled the production and consumption of Ozone Depleting Substances (ODS) across the world. However, this has led, in certain cases, to the accumulation of unwanted ODS banks from refrigeration, air conditioning, aerosols and foams, among other sectors.

Following previous decisions in order to address ODS banks disposal, the Executive Committee of the Multilateral Fund approved in 2011 the funding of a Demonstration Project for disposal of unwanted ODS in Mexico, to be implemented by UNIDO and the Government of France.

In the last years, Mexico has been phasing out ODS through different programs, including the NPP and HPMP, as well as energy efficiency initiatives. As a result this projects, an increasing amount of waste ODS stockpiles has emerged.

Sources of ODS banks in Mexico

Banks of unwanted ODS were collected principally from stockpiles out of specification materials, end-of-life appliances recovery programs and confiscation of illegal trading. One of the most relevant banks resulted from the virgin CFCs accumulated in the pharmaceutical industry followed by the unwanted ODS generated as a result of FIDE´s Home Appliances Replacement Program (HARP), a financing scheme to replace old and inefficient refrigerators and air conditioners. Likewise, important quantities of HCFC-22 were seized by customs officers in Mexico.

Unwanted ODS from different sources were handled by Recovery and Recycling Centers, which are certified entities enabled to manage hazardous waste ODS, as per Mexican regulations.

Mexico's Demonstration Project destroyed 113 tonnes of unwanted ODS banks, as summarized in Table 1.

Table 1 ODS banks destroyed in Mexico´s Demonstration Project

ODS banks source	Amount (tonnes)
Pharmaceutical industry	36
HARP program	35
Illegal trading prevention	27
R&R Centers	15
Total	**113**

Source: UNIDO and SEMARNAT.

Legislation and regulations

Destruction of unwanted ODS is regulated by Technology and Economic Assessment Panel, an advisory body to the Montreal Protocol Parties, that established the list of ODS destruction technologies which comply performance and environmental criteria set by the Parties of the Montreal Protocol. Thirteen technologies were identified, including Argon plasma arc and cement kiln, among other.

Furthermore, as unwanted ODS banks are classified as hazardous waste by Mexican regulations, several procedures have to be followed by generators, importers, exporters and handling, transportation and disposal service providers. Transboundary movements of hazardous waste also follow international policies, including Basel Convention requirements.

Before 2011 no facilities within Mexico were licensed to destroy unwanted ODS. As a result of the implementation of the Demonstration Project, two companies were granted such authorizations by Mexican authorities, after attesting no safety or environmental concerns were risen due to ODS destruction at their facilities.

Demonstration Project implementation and outcomes

Mexico´s Demonstration Project implementation was performed in phases, according to the progressive consolidation of ODS banks and the alleviation of other barriers which arose during the project lifetime. Though the project was approved in 2011, certain preliminary activities were performed between 2011 and 2013. A relevant aspect which delayed the project implementation was the difficulty to consolidate ODS banks, as HARP centers were not recovering predicted amounts of waste refrigerant. Preliminary activities consisted of training and recovery equipment endowment to HARP centers, design of MRV system, organization of awareness workshop and, most noticeably, execution of ODS destruction pilot tests and licensing approval for Mexican companies.

<u>Stage 1A</u>

Actual implementation of the Demonstration Project began in 2014 (Stage 1A), in which ODS banks were intended to be exported to the USA for disposal, as no authorized facilities were

available within Mexico by that time. This stage was not implemented up to the point of the destruction phase, since handling and exportation costs were higher than expected. Nonetheless, aggregation and consolidation of ODS banks was achieved during Stage 1A (Table 2).

Stage 1B

Following the attempt to export ODS banks, by March 2014, the first Mexican facility got the approval to destroy ODS. This facility was a state of the art Argon plasma arc, operated by Quimobásicos in the city of Monterrey, located in the northwest of Mexico. Stage 1B was implemented in the fall of 2015 and ended at the beginning of 2016. During this stage about 74 tonnes of unwanted ODS banks were destroyed in the Argon plasma arc, involving a reduction equivalent to 351 thousand tCO_2e. Overall implementation costs (including handling, transportation, destruction and MRV) were in average 9.2 USD per kg of ODS destroyed (Table 2).

Stage 2

The second stage of the Demonstration Project was executed after Holcim Mexico acquired a license to co-process unwanted ODS at their cement kiln situated in the southeast of Mexico in the municipality of Tecomán. Moreover, a second batch of ODS banks had been collected and stored. Between 2016 and 2017 Holcim Mexico destroyed about 39 tonnes of unwanted ODS, which are equivalent to the reduction of 153 thousand tCO_2e. Overall implementation costs (including co-financing of ODS transportation by generators and destruction and MRV by destruction facility) were in average 8.0 USD per kg of ODS destroyed (Table 2).

Table 2 Summary of Demonstration Project stages and outcomes

Project phases	Technology and destruction Facility	Status	Unwanted ODS destroyed (tonnes)	GHG emission reductions (thousand tCO_2e)	Implementation costs (USD/kg ODS)	Cost-effectiveness (USD/tCO_2e)
Stage 1A	Export to USA	Not executed	0	0	11.0[a]	NA
Stage 1B	Quimobásicos Argon plasma arc	Completed	74	351	9.2	1.9
Stage 2	Holcim Mexico cement kiln	Completed	39	153	8.0	2.0
Total			**113**	**504**	**9.4**[b]	**2.0**

[a] Intended but not implemented costs
[b] Average cost

1 Background

The Government of Mexico (GoM) has been very active in implementing the NPP and HPMP[1] during the last years, phasing-out Chlorofluorocarbons (CFCs) and advancing on the phase-down of Hydrochlorofluorocarbons (HCFCs). One of the effects of these activities has been the accumulation of ODS banks along the country, which are not readily managed and treated due to several technical and economic barriers.

Most of these residual banks contain CFCs and HCFCs, chemicals that feature both ozone depleting effects and high global warming potential. Due to these overlapping impacts, proper handling and destruction of unwanted ODS could provide co-benefits allowing the accelerated recovery of the ozone layer and mitigation of the climate change.

Due to its leadership within the region, in 2011 Mexico was appointed by the Multilateral Fund to implement one of the first pilot ODS disposal projects, henceforth **Demonstration Project**. This project would allow to test feasibility of ODS destruction technologies and generate know-how to prove cost-efficiency of such projects among Article 5 countries.

1.1 Approval of Mexico's Demonstration Project

The Montreal Protocol on Substances that Deplete the Ozone Layer (MP), the protocol to the Vienna Convention on the Protection of the Ozone Layer, has been successful at reducing global production and consumption of Ozone Depleting Substances (ODS). Following decision XX/7[2] in 2008, the Parties requested the Executive Committee of the Multilateral Fund (MLF) to consider pilot projects covering transportation, storage and destruction of ODS, with a focus on assembled stocks with high net global warming potential (GWP), and in regionally diverse Article 5 countries.

During the 57th and 58th meetings of the Executive Committee in 2009, the MLF provided grants through UNIDO and the World Bank, respectively to develop a pilot ODS disposal demonstration project for Mexico, based on the fact that it showed feasibility and included methods of leveraging co-funding.

Finally, on the 63rd Meeting in 2011 the Executive Committee decided to approve funding for a demonstration project on ODS waste management and disposal in Mexico amounting to US $1,427,915 to be implemented by the Government of France and UNIDO.

Unlike the original project proposal, which included a financial leverage through sales of carbon credits in the voluntary carbon market, the actual project was approved in line with Decision 63/28 of the Executive Committee as state below:

a) To note with appreciation the submission by the Government of Mexico of a demonstration project for ODS destruction to destroy a total of 166.7 metric tonnes of ODS waste;

[1] NPP: National CFC Phase-Out Plan; HPMP: HCFC Phase-Out Management Plan.

[2] Twentieth Meeting of the Parties (Doha, 16-20 November 2008). Decision XX/7: Environmentally sound management of banks of ozone depleting substances. Paragraph 2.

b) To approve the implementation of a demonstration project for ODS destruction in Mexico, in line with decision 58/19, at the amount of US $1,427,915, comprising US $927,915, plus agency support costs of US $69,594 for UNIDO, and US $500 ,000, plus support costs of US $65,000 for the Government of France, noting that approval was on the understanding that:

   i. No further funds would be available for Mexico for any ODS disposal projects in the future;
   ii. Any marketing of greenhouse gas (GHG) emission reductions generated by or associated with the project would be subject to a decision by the Executive Committee; and

c) To establish a monitoring system for the operation and the activities associated with the ODS disposal demonstration project and to report thereon to the Executive Committee at the completion of the project in 2014, ensuring that no marketing of GHG emission reductions had taken place.

Therefore, the restriction to produce carbon credits radically modified the original project scope and objectives which included, among others, the creation of producer responsibility legislation and a new facility for de-manufacturing end-of-life refrigerators and recovering of ODS including foams blowing agents.

Following project approval under aforementioned provisions, activities were rearranged as indicated below:

- Original ODS destruction target is maintained at 166.6 tonnes of ODS waste.
- Scope of substances are widened from CFC-12 only (due to Voluntary Carbon Market provisions) to other ODSs as no limitations prevailed any more.
- Destruction activities in the US were still considered as a viable alternative due to non-existence of available facilities in Mexico at the time of the project approval.
- A dedicated monitoring system would be established for the operation and activities associated with the ODS disposal demonstration project.
- Contrary to preliminary estimations, ODS recovery rates at HARP centers were lower than expected, therefore leading to the need of further developing capacities and identification of additional consolidated ODS banks.

1.2 Unwanted ODS in Mexico

Mexico´s Demonstration Project was sourced from various ODS stockpiles found along the country, which were originated from ODS phase-out projects and energy efficiency activities.

One of the main sources of ODS banks in Mexico came from the implementation of the Home Appliances Replacement Program (HARP) by the Trust Fund for Electricity Savings (FIDE), a national energy efficiency program which provided support for replacement and safe disposal of about 1.9 million units of old and inefficient refrigeration and air conditioning (RAC) equipment between 2009 and 2012 (The World Bank, 2016).

Other sources of ODS banks included the national network of Recovery and Recycling Centers established since 2007 with support of SEMARNAT and UNIDO. Additionally, ODS confiscated from illicit traffic at customs and certain stocks of propellants within the pharmaceutical sector after CFCs phase-out activities also increased existing banks which needed an environmentally-sound management and destruction.

1.3 Former ODS destruction activities in Mexico

Prior to the ODS disposal project approved by MLF in 2011, Mexico had performed an ODS destruction test at one of the state-of-the-art cement kilns facilities within Mexico. This test was funded and executed in 2008 by Holcim Mexico with the support and coordination of SEMARNAT and UNIDO. In this destruction test, 794 kg of a CFC-12 and HCFC-22 blend were fed into the main burner of the cement kiln, while performance and environmental criteria were monitored according to national standards and TEAP recommendations[3]. Though only a small destruction test, these results showed that infrastructure capacity, and technical and environmental conditions were satisfactory for the future implementation of a full-scale project in Mexico.

Other relevant studies had been performed before the implementation of the ODS destruction project. As part of the HARP activities, UNIDO and the World Bank provided a grant to Mexico to carry out a study that identified sources of unwanted ODS in Mexico, and for their transportation, packaging, storage and final disposal. This study[4], particularly, assessed ODS disposal methodologies and criteria addressed to CFCs collected in the HARP project, which was financed by the International Bank for Reconstruction and Development in the World Bank Group. One of the main objectives was to analyze the funding mechanism of ODS disposal projects through voluntary carbon markets (Pandey, 2012). It is worth mentioning that later in 2011, it was established that any marketing of GHG emission reductions generated by MLF-supported ODS disposal projects would be subject to a decision by the Executive Committee (decision 58/19).

1.4 ODS destruction projects via Voluntary Carbon Markets

The Climate Action Reserve (CAR) is a carbon offset program in the USA. This program was initially launched in California and later reached across the USA and abroad. The CAR encourages GHG emission reductions projects while ensuring environmental benefits, integrity and transparency. It is the largest accredited registry for the California compliance market and has a key role for the cap-and-trade program. In the voluntary market, CAR has established high quality standards for the carbon offset projects, oversees independent third-party verification bodies and issues and tracks the transaction of carbon credits (Climate Reserve Tonnes or CRTs) (Climate Action Reserve, 2015). Issuance of CRTs from some project types are also eligible in Mexico.

The CAR currently has 5 project protocols which are available for projects located within Mexico[5]. In particular, the Mexico Ozone Depleting Substances Project Protocol is applicable to ODS

[3] See chapter on International standards for ODS disposal for further detail.

[4] Study on Disposal of ODS Collected from Refrigerator and Air Conditioners under the Mexican Efficient Lighting and Appliances Program. March 2012.

[5] Boiler efficiency, Forest, Landfill, Livestock and ODS. For more information see: www.climateactionreserve.org/how/protocols/

sourced from Mexico and destroyed at facilities in Mexico. Before this protocol was launched in 2015, the United States Ozone Depleting Substances Project Protocol and the Article 5 Ozone Depleting Substances Project Protocol provided guidance for projects that destroy ODS sourced from the US or Article 5 countries, respectively. These protocols were first adopted in February 2010.

Between 2010 and 2012 two projects registered using the Article 5 ODS project protocol, which ODS were sourced from Mexico. Project details are summarized in Table 3.

Table 3 Article 5 ODS projects registered in CAR sourcing ODS from Mexico

Project Developer	Destruction facility in the US	ODS destroyed	ODS source in Mexico	ODS destroyed (tonnes)
Remtec	Remtec Clean Harbors El Dorado, Arkansas	Virgin ODS (CFC-12) stockpiles	Quimobásicos facilities in Monterrey, Mexico	285
OEKO Service Luxembourg (OSL)	Remtec Clean Harbors El Dorado, Arkansas	Unwanted ODS (CFC-12) from end-of-life appliances	Ecofrigo R&R Center in Celaya. Mexico	13

Source: Own elaboration based on Climate Action Reserve (2017).

2 ODS Banks

ODS banks for the implementation of the Demonstration Project were sourced from mainly four different activities and programs:

1) Mixed ODS from Recovery and Recycling Centers.
2) Mixed ODS from Home Appliances Replacement Program.
3) Virgin CFC-11, CFC-12 and CFC-114 stockpiles from pharmaceutical industry phase-out projects.
4) Out-of-specification ODS from Illegal trading prevention activities at customs.

It is relevant to highlight that regardless of the original point sources of the ODS waste, all of the stockpiles had to be consolidated by the Recovery and Recycling Centers (R&R Centers), as they are the only service providers authorized to handle hazardous waste, including discarded and unwanted CFCs, HCFCs and Hydrofluorocarbons (HFCs).

As further explained below, the Demonstration Project destroyed a total of 113 tonnes of unwanted ODS banks, as summarized in Table 4.

Table 4 ODS banks disposed in Mexico´s Demonstration Project

ODS banks source	Amount (tonnes)
Pharmaceutical industry	36
HARP program	35
Illegal trading prevention	27
R&R Centers	15
Total	**113**

Source: UNIDO and SEMARNAT.

2.1 Role of Recovery and Recycling Centers

It is important to mention that since CFCs and HCFCs wastes are classified in Mexico as a hazardous residues according to the current national regulations, every ODS bank has to be consolidated, transported and handles by a fully certified company with all the required permits. In the case of ODS, these companies are represented by the R&R Centers disseminated all around the country.

R&R Centers constitute the main places for ODS stockpiled in Mexico. These centers were created in 2007 as part of the NPP, when SEMARNAT and UNIDO implemented a program for the installation of 14 recycling centers through Mexico in order to provide recovery, recycling and storage services to refrigeration technicians, FIDE´s HARP centers, RAC service and maintenance companies, customs offices, the pharmaceutical sector, among other stakeholders.

Figure 1 Recovery and Recycling (R&R) Center facilities in Celaya, Mexico



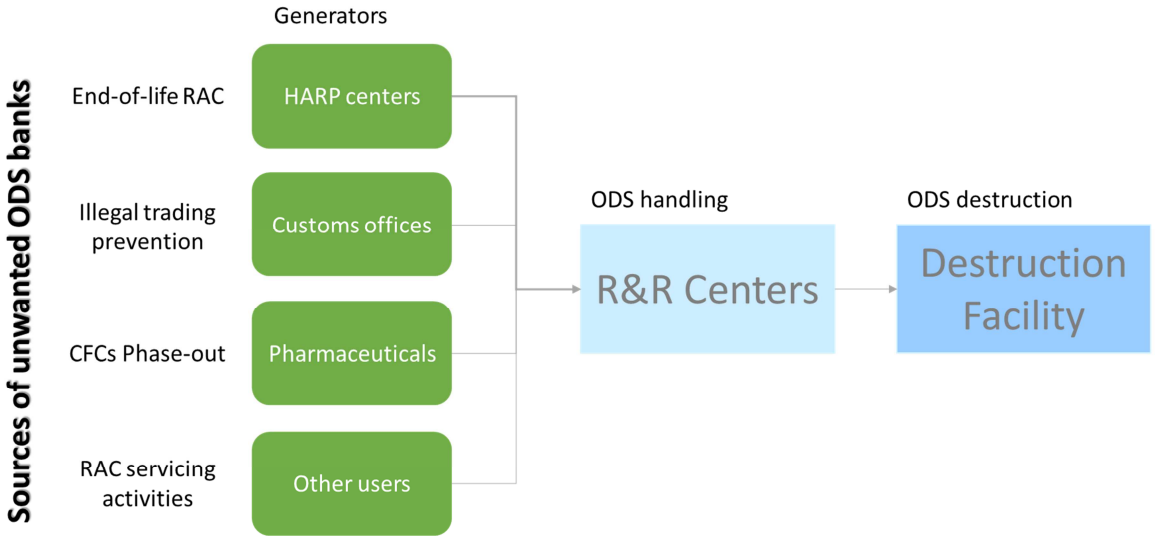
Source: SEMARNAT.

2.2 Sources of unwanted ODS in Mexico

ODS banks that need to be discarded because they are no longer useful, pose relevant concerns to the global climate because they threaten to leak into the atmosphere if they are not correctly handled, stored and destroyed.

Several activities ranging from appliances energy efficiency programs, confiscation of illicit ODS at customs, implementation of ODS phase-out projects (through NPP and HPMP) and national actives in order to support proper management and disposal of ODS have resulted in large amounts of ODS banks in Mexico that need to be handled in an environmentally-sound manner. As depicted in Figure 2, ODS banks were collected and handled by R&R Centers. Each source of unwanted ODS is briefly described below.

Figure 2 Unwanted ODS aggregation and handling by R&R Centers



Source: Own elaboration.

2.2.1 Home Appliances Replacement Program in Mexico (HARP)

One of the main sources of ODS banks for Mexico´s Demonstration Project came from the implementation of the HARP. Since 2005 the GoM through the FIDE, implemented this national energy efficiency program which provided support for replacement and safe disposal of old domestic refrigerators and air conditioning units. This project, implemented in two phases, 2005-2008 and 2009-2012, replaced over 1.7 million refrigerators and 200 thousand air conditioners contributing to energy savings of 9,242 gigawatt hours. (The World Bank, 2016). Old RAC units were collected from customers and substituted for new energy efficient units while the old ones were sent to scrapping centers established by FIDE for dismantling and recovery of materials, including refrigerants, resulting in large quantities of ODS stockpiles.

FIDE established 110 scrapping centers for receiving all the old equipment. In the NPP framework, 98 HARP centers were equipped as well as the FIDE's current infrastructure was enhanced using national recovery and recycling network. For this purpose, 14 training centers covering the country and managing the program using a regional approach were selected.

These facilities recover ODS from domestic refrigerators and air conditioners using a two-step approach:

1. In Step I, the refrigerant (mainly CFC-12, HCFC-22 and HFC-134a) and the oil are removed from the refrigeration cycle; refrigerant is recovered; while the oil is removed directly to the compressor.
2. In Step II, the appliances without refrigerant and oil are dismantled, materials such as copper and polyurethane foam insulation panels are sorted in order to dispose properly.

While this program was a big success in terms of energy efficiency, recovery rates of ODS were low during the first phase.

Through the dismantling and recovery activities, about 35 tonnes of refrigerant waste were collected by the end of the program which were dispersedly stored throughout Mexico.

Figure 3 End-of-life RAC appliances from HARP program



Source: SEMARNAT.

2.2.2 Prevention of ODS illegal trade

When consumption of substances is controlled or restricted, this usually creates a potential black market and ODS are no exception to this rule. That is the reason why the MP has required all parties to implement an import/export licensing system to track commerce and facilitate data collection.

Training has also been a key to curtailing illegal trade. As part of the NPP and HPMP, the GoM and UNIDO have conducted workshops to train customs and other officials on ODS illegal trade. The importance of these programs is becoming increasingly apparent, not just for the Montreal Protocol, but for other environmental agreements.

According to the Mexican Customs Law, all the materials confiscated from illegal trade must to be sent directly to destruction with no possibility to obtain incomes for its sales or other sources such as carbon credits.

ODS confiscated from illicit trade at customs are an extraordinary achievement, nevertheless they suppose a continuous increment of refrigerants waste to be managed. Also, illegal refrigerants storage represents a high cost for customs offices, so it is necessary to send the confiscated banks to an appropriate R&R Center which can consolidate the ODS in a proper DOT cylinders, and after the correct handling, confiscated ODS must to be shipped to the destruction facilities.

One of the most notable efforts to stop illegal trade in Mexico has been performed at the Manzanillo Customs Office located in the southeast of Mexico, where trained customs officers have detected and confiscated important amounts of illegal ODS. Thanks to these actions, 27 tonnes of confiscated ODS were handled and destroyed as part of this project.

Figure 4 Terminal Container at Mexican customs



Source: SEMARNAT.

2.2.3 Pharmaceutical Industry

Since the phase-out of CFCs was first agreed, the pharmaceutical industries have to research into alternative substances to use as propellants in the aerosol manufacturing, particularly MDIs. The result is that technically and economically feasible alternatives to CFCs now exist and are available almost everywhere. The increased availability of clinically effective, technically and economically feasible alternatives meant that CFCs no longer could be authorized for the manufacture of MDIs.

Due to the NPP implementation in Mexico, two pharmaceutical industries based in the country, SALUS Labs and Boehringer Ingelheim, had to change the substances they used as propellants, mainly CFCs. NPP activities included funding for new aerosol filling machines, propellant pumps, ventilation and extraction systems, as well as other safety equipment and technical assistance. This change in the manufacturing scheme generated important CFC banks of which 36 tonnes were destroyed in the Demonstration Project.

Figure 5 Unwanted ODS stockpiles from pharmaceutical industries generated after phase-out of CFC blends used as propellants in meter-dosed inhalers



Source: SEMARNAT.

2.2.4 ODS banks collected by R&R Centers from other users

As mentioned before, R&R Centers began to operate in 2007, and they were responsible for recovering refrigerants contained in appliances and systems. They offered these services to refrigeration technicians and other users interested in the correct disposal of refrigerant gases such as hotels, restaurant and supermarkets. Originally, R&R were thought to recover or recycle refrigerant available for reuse, which would reduce the need for virgin refrigerants and allow existing equipment to operate until the end of its economic life.

R&R Centers played a key role for the HARP as they worked coordinately with the FIDE centers mainly for refrigerant recovery activities, nevertheless they continued to execute their regular services and accumulated additional unwanted ODS banks that needed to be destroyed. 15 tonnes that were stored in the R&R centers were disposed as part of the Demonstration Project.

Figure 6 ODS recovery by Mexican servicing technicians



Source: SEMARNAT.

3 Legislation and regulations

While there are several technologies that have been recommended and approved by the Parties to the MP, there are other relevant international and local regulations that must be taken in to account for the handling and disposal of unwanted ODS, as in some countries like Mexico, they are considered hazardous waste.

3.1 International standards for ODS disposal

In 1990 the Technology and Economic Assessment Panel (TEAP) was established as the technology and economics advisory body to the Montreal Protocol Parties. TEAP provides, at the request of Parties, technical information related to the alternative technologies that have been investigated and employed to make possible the elimination of ODS (such as CFCs and Halons), that harm the ozone layer.

The TEAP released a report in 2002 on recommendations of ODS destruction technologies. The report assessed 45 technologies out of which sixteen met screening criteria, while twelve met recommended criteria specific to ODS destruction performance[6] of technologies for destruction of concentrated and diluted (foams) sources (UNEP/TEAP, 2002).

Technical performance criteria that represent the minimum destruction and removal efficiencies and maximum emissions of pollutants to the atmosphere in order to get approval by the Parties of the MP as ODS destruction technologies are summarized in Table 5.

Table 5 Summary of technical performance criteria for destruction of ODS stocks

Performance qualification	Units	Diluted sources	Concentrated sources
DRE	%	95	99.99
PCDDs/PCDFs[a]	ng-ITEQ/Nm^3	0.5	0.2
HCl/Cl_2	mg/Nm^3	100	100
HF	mg/Nm^3	5	5
HBr/Br_2	mg/Nm^3	5	5
Particulates (TSP)	mg/Nm^3	50	50
CO	mg/Nm^3	100	100

[a] PCCDs: Polychlorinated dibenzo-paradioxins; PCFDs: Polychlorinated dibenzofurans.

Source: UNEP/TEAP (2002).

Moreover, three of the technologies were in commercial use by the time of the report publication[7]. The TEAP identified the following technologies for destruction of concentrated and diluted ODS, that complied with the technical performance criteria and the technical capability specification, which included demonstration of destruction of CFCs, HCFCs, or halons at least on

[6] Screening criteria developed by UNEP TFDT for technologies to be used by signatories of the MP to dispose of surplus inventories of ODS are 1) Destruction and Removal Efficiency (DRE), 2) Emissions of dioxins/furans, 3) Emissions of other pollutants (acid gases, particulate matter, CO), 4) Technical capability.

[7] These were Argon plasma arc, Reactor cracking, and High temperature incineration technologies, eg MSW incinerators, rotary kiln incinerators.

pilot or demonstration scale, and a capacity of not less than 1.0 kg/h, in the case of concentrated CFCs and HCFCs:

Concentrated sources:	**Diluted sources (foams):**
• Cement kilns • Liquid injection incineration • Gaseous/Fume Oxidation • Reactor cracking • Rotary kiln incineration • Argon plasma arc • Inductive-Coupled Radio-Frequency Plasma • Nitrogen Plasma Arc • Microwave Plasma • Gas phase catalytic dehalogenation • Super-heated steam reactor	• Municipal solid waste incinerators • Rotary kiln incinerators

Source: UNEP/TEAP (2002).

3.2 National regulations on ODS handling and disposal

Unwanted ODS are categorized as a "hazardous waste" under the Mexican regulation. Therefore, several restrictions and indications must be followed in order to handle, transport and dispose such substances, as further described below.

The LGPGIR is a general law that regulates management of solid residues, including hazardous waste. Other Mexican Official Standards relevant for ODS handling are NOM-052-SEMARNAT-2005, which identifies waste classified as hazardous. NOM-002-SCT-2001 and NOM-003-SCT-2008 establish transportation and labelling specifications for hazardous waste. Furthermore, NOM-098-SEMARNAT-2002 determines performance and environmental criteria which waste incineration facilities must comply. On the other hand, NOM-161-SEMARNAT-2011 stipulates the special handling wastes which are subject to a Waste Management Plan, and includes end-of-life RAC equipment produced by so-called large generators. Finally, NOM-040-SEMARNAT-2002 regulates emissions and performance of cement facilities. These regulations are further described in Table 6.

Table 6 Applicable regulations to unwanted ODS in Mexico

Regulation of unwanted ODS	Applicable legislation	Description
Waste management	LGPGIR	General law that regulates solid waste management activities, including that of hazardous waste (generation, handling, transportation and disposal).
	NOM-052-SEMARNAT-2005	Classification and identification of hazardous waste (standard). It classifies unwanted ODS as hazardous waste.
	NOM-002-SCT-2011	Transportation of hazardous materials and waste.
	NOM-003-SCT-2008	Packaging and labeling of hazardous materials and

Regulation of unwanted ODS	Applicable legislation	Description
		waste.
	NOM-161-SEMARNAT-2011	Classification of special management waste and waste management plans. It includes refrigerators and air conditioners discarded by large generators.
Disposal / Destruction	NOM-098-SEMARNAT-2002	Environmental criteria for waste incineration facilities.
	NOM-040-SEMARNAT-2002	Environmental criteria for cement manufacturing facilities, including co-processing.
Import and export	Basel Convention	Trans-boundary movements of hazardous waste (International treaty).
	LGPGIR and its rules of procedure (*reglamento*).	It specifies obligations and procedures for hazardous waste import and export into and from Mexico.

3.2.1 Handling of unwanted ODS hazardous waste

The **General Law for Prevention and Integral Management of Residues** (LGPGIR) [8] issued in 2003, determines that the federal government, through SEMARNAT, is responsible for regulating hazardous waste (Art. 7-II) and authorizing provision of handling services (Ar. 7-IX).

The Title Fifth of the law establishes all the provisions and considerations applicable to the handling and management of hazardous waste. It determines there are three categories of generators of hazardous waste: large (>10 tonnes per annum), small (equal or more than 400 kg and less than 10 tonnes per annum) and micro generators (<400 kg per annum) (Art. 44). Large generators must be registered after SEMARNAT, they should present a Management Plan and report their generation (Art. 46). Micro-generators are regulated and controlled by either state or municipal governments, according to the local legislation (Art. 49). The following activities, among others, are subject to an authorization from SEMARNAT: waste management service provision, utilization of hazardous waste in production processes, collection and storage, incineration, transport, confinement, thermal treatment, import and export (Art. 50).

All types of generators are obliged to identify, classify and handle the hazardous waste they produce (Art. 45). They must hire handling services of authorized companies. The handling and disposition liability falls on the hazardous waste generator and on the service providers when waste are transferred to these (Art. 42).

In regards hazardous waste generated at households, housing units, offices, institutions, dependencies and entities in quantities equal or less than micro generators shall follow municipal authorities' requirements on solid waste management (Art. 23).

[8] Ley General para la Prevención y Gestión Integral de los Residuos (last version published in DOF, 22-05-2015).

Currently waste legislation does not include any provisions on extended producer responsibility, though this has been analyzed as a relevant gap on the waste management regulation in Mexico[9]. Nevertheless, LGPGIR update discussions, including extender producer responsibility, have been halted during this administration. **LGPGIR rules of procedure** (*reglamento*)[10] establish a series of proceedings and specifications that must be fulfilled on topics such as the preparation of waste management plans, authorizations of hazardous waste handling, imports and exports of hazardous waste, remediation of polluted sites, as well as means of control, inspection and enforcement available to the authorities.

The regulation specifies the following means to identify a hazardous waste (Art. 35): those considered in LGPGIR, those included and listed in Mexican Official Standards (NOM), mixture of hazardous waste with other type of waste, as well as those identified by the generator based on experience (Art. 37).

Chapter III of the Forth Title describes the requirements and procedures to authorize handling activities of hazardous waste. The Chapter IV of the Title IV (bis) establishes several operation criteria on hazardous waste handling activities for generators and service providers, including storage, collection and transport, reuse, recycling and co-processing, treatment and disposal (Art. 82 to 106).

In regards to transport of hazardous waste from generation sources, according to Art. 86, generators must deliver a manifest, which states the volume and handling activities, to the authorized service provider (Art. 86).

The **NOM-052-SEMARNAT-2005**[11] establishes the procedures to identify a hazardous waste, including a list of such and their hazard characteristics. The standard includes five lists of hazardous waste, according to 1) specific source, 2) non-specific source, 3) out-of-specification or out-of-date chemical products (acute toxics), 4) idem (chronic toxics), and 5) waste subject to particular handling conditions.

This standard explicitly mentions two ODS substances as hazardous waste: CFC-12 and CFC-11 in the list number four regarding out-of-specification or out-of-date chemical products that pose environment toxicity.

In the case of other ODS waste, including CFCs and HCFCs, not explicitly listed, NOM-052 also determines that if certain kind of waste are not included in the lists, these might be identified as hazardous based on scientific knowledge or empiric evidence of their hazard characteristics[12]. This

[9] See, for example, the discussion by Dra. Cristina Cortinas on extended producer responsibility in the Mexican regulation on hazardous waste: http://www.ceja.org.mx/articulo.php?id_rubrique=193&id_article=2111.

[10] Reglamento de la Ley General para la Prevención y Gestión Integral de los Residuos (last version published on DOF, 31-10-2014).

[11] NORMA Oficial Mexicana NOM-052-SEMARNAT-2005, Que establece las características, el procedimiento de identificación, clasificación y los listados de los residuos peligrosos (published in DOF, 23-06-2006).

[12] Explosive, Biological and Infectious, Corrosive, Reactive, Flammable, Environmental Toxic.

would be the case of other ODS waste, which are normally mixed with used lubricant oils. These are classified as hazardous waste subject to management plan in LGPGIR Article 31-I. According to these criteria, all of the discarded ODS from servicing and scrapping should be considered hazardous waste, subject to applicable regulations.

NOM-002-SCT-2011[13] identifies and classifies the most usually transported hazardous substances and materials, and it is based on the Model Regulation for Transportation of Hazardous Goods of the United Nations, which is used by the North America Free Trade Agreement signatory parties. The standard is mandatory to all dispatchers, carriers and recipients of dangerous substances and materials, transported through terrestrial, maritime and aerial general communication pathways.

The list of substances of this standard includes several common refrigerants, such as CFC-12, HCFC-22, HFC-134a, R-404A, HFC-143a, among others. It also includes provisions for generic refrigerants, which are Not Specified Somewhere Else (NEP, as per its acronym in Spanish), only applicable to non-flammable and non-toxic gases.

NOM-003-SCT-2008[14] establishes the characteristics, dimensions, symbols and colors of labels that packaging and wrapping must carry, in order to identify the risk class that hazardous substances, materials and waste pose during their transportation. This standard is based on the Model Regulation for Transportation of Hazardous Goods of the United Nations, which is used by the North America Free Trade Agreement signatory parties.

NOM-161-SEMARNAT-2011[15] establishes the criteria to determine which special handling wastes are subject to a Waste Management Plan, in terms of LGPGIR and its regulation, as well as a list of those wastes.

Among the special handling waste classified in this standard and subject to a waste management plan are included a list of products discarded at end of its lifetime, and includes a category of products which are generated by a large generator (as defined by LGPGIR). In this list the refrigerators and air condoning units are found.

[13] NORMA Oficial Mexicana NOM-002-SCT-2011, Listado de las substancias y materiales peligrosos más usualmente transportados (published in DOF, 27-01-2012).

[14] NORMA Oficial Mexicana NOM-003-SCT-2008, Características de las etiquetas de envases y embalajes, destinadas al transporte de substancias, materiales y residuos peligrosos (published in DOF, 15-08-2008).

[15] NORMA Oficial Mexicana NOM-161-SEMARNAT-2011, Que establece los criterios para clasificar a los Residuos de Manejo Especial y determinar cuáles están sujetos a Plan de Manejo; el listado de los mismos, el procedimiento para la inclusión o exclusión a dicho listado; así como los elementos y procedimientos para la formulación de planes de manejo (Which establishes the criteria to classify the Waste of Special Management and determine which are subject to Management Plan; the list of these, the procedure for their inclusion or exclusion to that listing; as well as the elements and procedures for the formulation of the management plans) (published in DOF, 01-02-2013).

Figure 7 Unwanted ODS are classified as hazardous waste in Mexico



Source: SEMARNAT.

3.2.2 Import and export of unwanted ODS hazardous waste

In terms of import and export of hazardous waste, **LGPGIR** stipulates that the federal government is empowered to approve the importation, exportation or transit of hazardous waste across the national territory (Art. 7-XIII).

Moreover, LGPGIR specifies that hazardous waste imports are only allowed into the country if they are to be reused or recycled (Art. 85). The import of persistent organic compounds is utterly forbidden under any circumstances (Art. 86). In order to authorize export of hazardous waste, this will be issued only when those requesting it have the prior consent of the importing country and, where applicable, the government of the countries through which the waste travel (Art. 87), as per Basel Convention requirements. Moreover, when requesting an import or export authorization, it is necessary to present insurance or guarantee policy for any contingencies and payment of damages that could arise during movement of the hazardous waste (Art. 89).

The Fifth Title of **LGPGIR rules of procedures** describes the requirements and proceedings that must be followed in order to import and export hazardous waste, as well as their return, following LGPGIR considerations.

3.2.3 Unwanted ODS destruction

In Mexico there is no specific regulation on disposal of ODS. However, as these are considered as hazardous waste, the same criteria and provisions are applicable to these. Regarding disposal of unwanted ODS, i.e. their destruction, **LGPGIR** Articles 61, 62 and 63, establish the conditions that must be followed for incineration, thermal treatment and co-processing of solid residues[16], including compliance with national standards and international treaties, and monitoring specifications. SEMARNAT should specify if certain types of waste are not susceptible for incineration or co-processing as alternative fuels, due to environmental concerns.

According to the **LGPGIR rules of procedure**, Chapter III of the Forth Title describes the requirements and procedures to authorize handling activities of hazardous waste. In order to authorize recycling and co-processing of hazardous waste, the requester must describe in regards the facility, procedures and methods, waste load capacity, emissions and control parameters, energy balance and waste´s calorific value, among others (Art. 49-III). Furthermore, a facility willing to provide incineration services must indicate the type of process applied, capacity, process temperature, efficiency, gas residence time, feeding system characteristics, fuels utilized, monitoring and control of emissions provisions (Art. 48.-VI), as well as a test protocol proposal (Art. 51-I). These requirements are applicable to pyrolysis, plasma and gasification technologies as well.

NOM-098-SEMARNAT-2002[17] sets the operation specifications, as well as the atmospheric emission limits applicable to waste incineration facilities. This standard is not applicable to

[16] Environmentally-sound integration of any type of waste that is generated by an industry or a known source, and used a feedstock in other productive process (Art. 5-IV).

[17] NORMA Oficial Mexicana NOM-098-SEMARNAT-2002, Protección ambiental – Incineración de residuos, especificaciones de operación y límites de emisión de contaminantes (published in DOF, 01-10-2014).

crematory and industrial furnaces or boilers which use residues as fuel.

As per this standard, incineration includes any kind of thermal oxidation processes, under controlled conditions, that complies with efficiency, efficacy and environmental criteria established in the NOM-098. This definition, according to the standard, includes pyrolysis, gasification and plasma technologies, whenever the fuel byproducts generated in those processes are brought under oxygen-rich combustion.

The standard forbids the incineration of bio-accumulative and persistent organic compounds, organochlorine-based pesticides and waste batteries that contain toxic metals, as long as there is a more suitable treatment technology, as established in LGPGIR.

Among the performance criteria for incineration facilities, the standard foresees that the facility design, installation and operation must warrant a minimum temperature of the incineration gases of 850 °C, for at least two seconds, in the case of non-hazardous waste. For hazardous waste these conditions should be of at least 1,100 °C during at least two seconds.

Table 7 Emissions limits for waste incineration facilities

Pollutant	Emission limit	Units	Measurement frequency
CO	63	mg/m^3	Continuous
HCl	15	mg/m^3	Quarterly
NO_x	300	mg/m^3	Biannual
SO_2	80	mg/m^3	Biannual
Arsenic, Selenium, Cobalt, Nickel, Manganese, Tin	0.7	mg/m^3	Biannual
Cadmium	0.07	mg/m^3	Biannual
Lead, Total Chromium, Copper, Zinc.	0.7	mg/m^3	Biannual
Mercury	0.07	mg/m^3	Biannual
Dioxins and Furans TEQ (New facilities)	0.2	ng ITEQ/m^3	Annual
Dioxins and Furans TEQ (Existing facilities)	0.5	ng ITEQ/m^3	Annual

Source: Own elaboration based on NOM-098-SEMARNAT-2002.

NOM-040-SEMARNAT-2002[18] establishes atmospheric emission limits for facilities that manufacture cement.

This standard defines three types of fuels which combustion is allowed, following certain requirements: 1) conventional fuels or fossil fuels, such as natural gas and petroleum coke; 2) formulated fuels are those controlled mixtures of liquid or solid residues, including hazardous waste, with sizable calorific value, and produced in a dedicated and authorized plant; 3) recovery

[18] NORMA Oficial Mexicana NOM-040-SEMARNAT-2002, Protección ambiental – Fabricación de cemento hidráulico – Niveles Máximos Permisibles de emisión a la atmósfera (published in DOF, 18-12-2002)

fuels are those waste or materials, with calorific value is higher than 15 MJ/kg, and with no need to be formulated previously. Among recovery fuels include used oils and lubricants, textiles impregnated with the former, tires, as well as non-hazardous waste. The standard excludes in the composition of formulated fuels the following: pesticides, polychlorinated dioxins, polychlorinated dibenzofurans, radioactive waste, compressed gases, biological and infectious waste, cyanides and organochlorine compounds.

The standard NOM-040 sets emission limits of atmospheric pollutants for different production processes, cement types (gran and white) and geographical locations within the country (Table 8). Furthermore, it determines the fraction of conventional fuels that are allowed to be substituted by formulated or recovery fuels, and the corresponding emissions control and monitoring provisions that must be fulfilled accordingly.

It is further clarified that whenever a cement facility uses recovery or formulated fuels that contain hazardous waste (including ODS), it should therefore request an authorization from SEMARNAT, in terms of the applicable regulations.

Table 8 Key emission parameters for cement manufacturing facilities

Parameter	Units	Emissions limits [a]
CO	mg/m^3	3,000 – 4,000
HCl	mg/m^3	70
NO	mg/m^3	800 - 1,200
SO_2	mg/m^3	400 – 1,200
Total Hydrocarbons (HC)	mg/m^3	70
Dioxins and furans	ng ITEQ/m^3	0.2

[a] Emission limits for gray cement production. Range applicable to different geographical locations.

Source: Own elaboration based on NOM-040-SEMARNAT-2002.

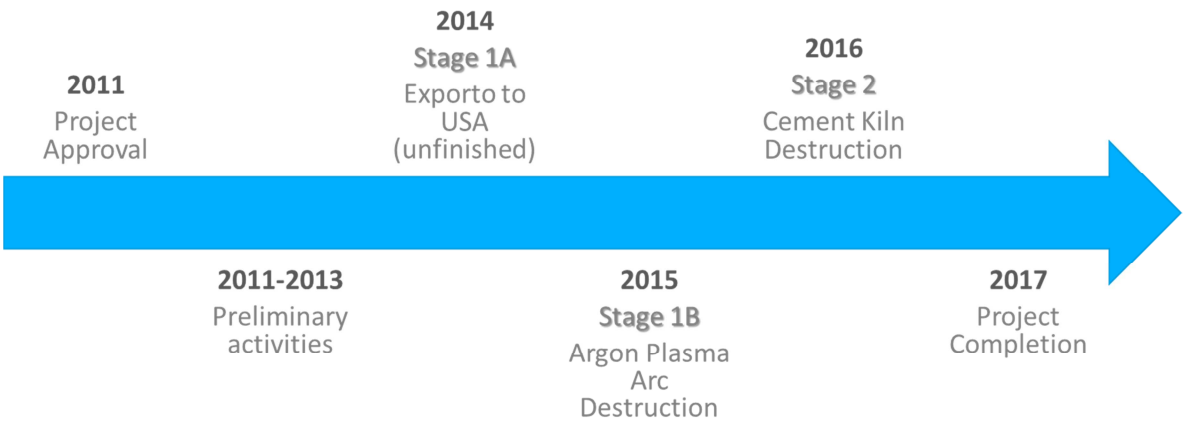
4 ODS destruction project implementation

Mexico´s Demonstration Project was implemented in phases, according to the progressive consolidation of ODS banks and the alleviation of other barriers which arose during the project lifetime. Several preliminary activities were performed between 2011 and 2013, including training to HARP centers, equipment of the training centers, upgrading of the recycling centers, design of Monitoring, Report and Verification (MRV) system, organization of awareness workshop and execution of ODS destruction pilot tests and licensing approval for Mexican companies.

Actual implementation of the Demonstration Project began in 2014 (Stage 1A), in which ODS banks were intended to be exported to the USA for disposal, as no authorized facilities were available within Mexico by that time. This stage was not implemented up to the point of the destruction phase, since handling and exportation costs were higher than expected.

In 2014 and 2015, two Mexican companies were granted license authorizations to destroy ODS using two different technologies, respectively. Stage 1B implemented by Quimobásicos in 2015 led to destroy about 74 tonnes of ODS using Argon plasma arc. Accordingly, Stage 2 implemented by Holcim Mexico in 2016 destroyed 39 tonnes of ODS at one of their cement kilns. The 113 tonnes of unwanted ODS disposed resulted in the mitigation of 504 thousand tCO_2e, as further explained in the following sections.

Figure 8 Project implementation timeline



4.1 Preliminary activities

As the Demonstration Project was a first-of-its-kind in Article 5 countries, there were a number of tasks which needed to be carried out for a smooth implementation. In first place, disposal facilities within Mexico had to be authorized to destroy unwanted ODS, as they are classified like hazardous waste. On the other hand, though Mexico´s program to replace old household (HARP) had been very successful, optimum disposal of ODS refrigerant gases was still an issue, especially among small scrapping centers which lacked advanced expertise. Furthermore, the GoM deemed appropriate to perform an awareness workshop among local stakeholders, considering that a level of concern had arisen among local NGOs as this was the first time such a project was implemented

in the country. Finally, the design and implementation of a MRV system was required as per the Executive Committee decision.

4.1.1 Pilot tests and license to destroy ODS waste in Mexico (Stage 1B and 2)

As further described, the Demonstration Project was finally implemented in two stages involving two different facilities in Mexico and two technologies, i.e. Argon plasma arc and Cement kiln. Since unwanted ODS banks are classified as hazardous wastes in Mexico their destruction via incineration, recycling or co-processing, must comply with stringent regulations. In particular they had to be issued with a destruction license, which involves the realization of destruction pilot tests that warrant compliance of environmental and performance criteria, in addition to further legal, technical and environmental requirements.

For instance, in the case of hazardous waste incineration processes, which include destruction in argon plasma arc, NOM-098-SEMARNAT-2002 requires to facility owners to perform a test protocol, in which the system destruction efficiency, emissions control and monitoring and other environmental specifications are tested and verified by SEMARNAT[19]. Similarly, NOM-040-SEMARNAT-2002 includes similar provisions for co-processing hazardous waste, including the test protocol.

As part of the Demonstration Project two test protocols were performed, one connected to Phase 1B for Argon plasma arc destruction, and one more for Phase 2 for cement kiln destruction. Phase 1A does not apply to this requisite as destruction was intended at the US. In this case only exportation licensing applies, as it would be mentioned in section 4.2.

In 2013, Quimobásicos performed an incineration test protocol of ODS hazardous waste at its Plasma II facility located in northern Mexico, and utilizes state-of-the-art Argon plasma arc (PLASCON) technology. The test protocol was executed in four cycles, consisting of the following compositions. First and second cycles with 120 kg 100% HFC-134a each, and third and fourth cycles with 120 kg of 85%/15% HFC-134a/HCFC-22 each. Quimobásicos staff and representatives of SEMARNAT, PROFEPA, the local environmental agency, and other industrial stakeholders, were present during the different destruction tests.

In each one of the four destruction tests a validation of the ODS purity was analyzed by an authorized lab. Later on, the ODS were fed into the plasma arc, and outflow emissions were sampled for their analysis. It is worth mentioning that the ODS samples were analyzed in the USA, since there a no certified labs in Mexico. The average destruction and removal efficiency of the test was 99.9994%[20].

Following the verification of the protocol test results and compliance of other relevant requirements, SEMARNAT issued in 2014 the first license to incinerate ODS hazardous waste in Mexico to Quimobásicos. This license allowed the company provide services to destroy ODS waste

[19] Facility owners shall follow the procedure specified in “Trámite SEMARNAT-07-012” (Authorization of hazardous waste handling for reuse, recycling, treatment or incineration) (DOF, 29-05-2003). The protocol test is supervised and verified by the General Direction of Hazardous Materials and Activities (DGGIMAR)

[20] See Annex III. ODS destruction pilot test results in Argon plasma arc, for further details.

up to 525.6 tonnes per year, including collection and storage, pretreatment (cleaning and filtering), destruction using Argon plasma arc technology, and their effluents control and treatment. This authorization was valid for two years and established monitoring and reporting provisions. The overall license issuance process took two years, and about eight months from the pilot test completion. Annex III. ODS destruction pilot test results in Argon plasma arc, describes further details of the pilot test results.

Stage 2 Cement kiln pilot test and license

In May 2015 Holcim Mexico and sister company Geocycle (formerly Ecoltec) performed a destruction pilot test at one of their most advanced cement kiln facilities located in Tecomán in the Southwest state of Colima. Prior to the Demonstration Project this plant already was authorized for co-processing of alternative fuels, including hazardous materials and waste.

In the pilot test about two tonnes[21] of a mixture of unwanted refrigerant wastes from ODS banks were destroyed. The ODS wastes were fed together with conventional and alternative fuels into the kiln #1 of Tecomán plant. Geocycle oversees the formulation and supply of fuels into the cement kiln operated by Holcim Mexico. Moreover, Geocycle performed sampling and analysis of fuels and waste fed into the cement kiln.

The feeding of ODS was performed through a dedicated installation built for this purpose. The ODS were fed into the kiln´s main burner, while the fuels were fed in parallel by existing supplying systems. Pilot test average feed rate were 43 and 153 kg/h, in each of the test dates.

Outflow emissions were measured in Continuous Emission Monitoring Systems according to NOM-040-SEMARNAT-2002 provisions for NO_x, SO_2, HCl, CO, particles and hydrocarbons. Moreover, punctual measurements were performed to analyze Dioxins and Furans, heavy metals and ODS.

Destruction efficiency of ODS was calculated at 99.99865%, while emissions remained below the NOM-040-SEMARANT-2002 and Montreal Protocol criteria. It was moreover proven that the clinker quality was not altered due to the destruction of ODS. A reduction of NO_x concentrations was also identified during the pilot test as a co-benefit. In summary, it was validated that ODS destruction in the cement kiln facilities is compatible with the clinker manufacturing process, while compliance of efficiency and emission parameters is achieved.

Following the verification of the protocol test results and compliance of other relevant requirements, SEMARNAT issued in 2015 the first license to recycle and co-process (and the second one to destroy) ODS hazardous waste in Mexico to Holcim plant in Tecomán. The license was issued for 3.5 years and established handling, monitoring and reporting provisions, while allowing them to co-process CFCs, HCFCs, HFCs and their blends. The process to issue this license took about 18 months from the moment the company start activities with respect to the modification to its previous license, which did not include ODS co-processing.

[21] As this gas was sourced from the collected banks, it is further quantified in the total amount of unwanted ODS destroyed.

4.1.2 Training scheme for HARP centers

By the time of the Demonstration Project implementation, over a hundred of HARP scrapping centers were in operation, while their unwanted ODS were sent to one of the 14 R&R centers along the country. Though HARP centers had been provided with ODS recovery and collection equipment within previous projects, it was recognized through SEMARNAT´s monitoring that technicians at these centers needed further training on safe and environmental handle of unwanted ODS in order to increase their recovery rates.

In order to overcome this barrier, under the HPMP framework, UNIDO with support of SEMARNAT, organized a training scheme in which 14 technical schools were supplied with equipment, while two certified instructors were appointed to provide the courses, which involved theoretical and practical training on issues such as analysis and detection of ODS, recovery methods and good handling practices, and ODS environmental impact.

Between October and November 2011, 14 courses were given in which 360 staff members were trained, including technicians from HARP centers, R&R centers, schools, as well as FIDE officers involved in the HARP program. The activities of this training scheme under the R&R training programme gave rise to in an increase in more than 100% of the ODS recovery rates per appliance, leading to the collection of additional 35 tonnes of refrigerant waste to be handled and disposed the Demonstration Project.

Figure 9 Unwanted CFC-12 recovered



Source: SEMARNAT.

4.1.3 MRV system design and implementation

After the Executive Committee decision on the 63rd Meeting to approve the implementation of Mexico´s Demonstration Project, it was required to establish a monitoring system for the operation and activities associated to the project.

An MRV system was built on the ODS Information and Tracking System (SISSAO), which is managed by SEMARNAT through the National Ozone Unit, and has enabled the implementation of NPP and HPMP plans. SISSAO has five modules, three of them which are directly related to the ODS disposal project.

Table 9 SISSAO Modules

1)	Monitoring of ODS Imports, Exports and Production
2)	Monitoring of R&R Centers
3)	Registry of gases, foams and lubricant oil recovered at FIDE´s HARP Centers
4)	Monitoring of ODS destruction facilities
5)	Implementation of Methyl bromide projects

Source: (SEMARNAT, 2005).

Modules 2 tracks down the information related to the activities of the R&R Centers, including the amounts of substances they recover, recycle and dispose. Module 3 was designed to serve specifically the HARP Centers, and included a registry system where the amounts of appliances, foams, refrigerants and lubricant oil. It also allowed the users to specify the R&R Centers to which unwanted ODS were sent. Module 4 is a dedicated interface that allows the monitoring of ODS disposal from the destruction facilities side.

Module 4, as the core of the Demonstration Project MRV, is integrated by three subsystems, one of each serve, respectively, the ODS generators, the destruction facilities and the authority (SEMARNAT) which is also the system manager.

Each of the three subsystems allow the users to report and validate the information regarding the quantities and specifications of unwanted ODS to be destroyed, the information of transport service providers from the generation point source to the R&R Centers and from these ones to the destruction facilities. It also allows destruction facilities to report the details of the destruction events, including the amount, destruction period, destruction rate, efficiency of destruction and removal, dioxins and furans, HCl and HF emissions. Moreover, the authority is enabled to check and validate the information on recovery of unwanted ODS banks for destruction, as well as to approve the Destruction Certificate. This certificate is the final verification evidence of the unwanted ODS disposal, and it is required to be submitted by the destruction facility in order to apply for the ODS destruction payment issuance.

Figure 10 Subsystems within the MRV ODS destruction module

ODS generator	Report of unwanted ODS for destruction, including hired transport and destruction service providers. ODS release for destruction (release and delivery of unwanted ODS).
Destruction Facility	Consultation and validation of ODS sent for destruction. Report of information and proves of destroyed ODS. Destruction Certificate. Return of empty containers to the ODS generators.
Authority (Administrator)	Consultation of ODS recovery from authorized R&R Centers. Validation of destroyed ODS amounts and issuance of the Destruction Certificate.

Source: SEMARNAT.

Figure 11 ODS destruction monitoring at Holcim Mexico



Source: SEMARNAT.

4.1.4 Awareness workshop

Being a first-of-its-kind project in Mexico, the Demonstration Project initially arose concerns among certain stakeholders. These concerns indicated that there was a degree of misperception of such type of projects, in terms of the climate and ozone layer benefits and the local safety and environmental assurance of the destruction technologies to be used.

In 2012, after the Demonstration Project was approved, the GoM and UNIDO organized an awareness workshop, which purpose was to communicate to the society the benefits of the ODS Demonstration Project. This workshop accounted with the participation of local parties, including NGOs, academia and other stakeholders. The organization of this workshop was very relevant and it allowed for a smooth implementation of the project. In particular, it clarified the global and local benefits that the project would bring about.

4.2 Stage 1A. Handling and Destruction of unwanted ODS in the United States of America

The Stage 1 of the Demonstration Project was the first destruction trial performed in which ODS banks were to be exported to a ODS destruction facility in the USA. The activities initiated in 2013 involving the bidding process, the aggregation of ODS banks in one centralized facility as well as the procedure to issue export and import permits. The so-called Stage 1A was not culminated due unexpectedly high costs involved in the handling, transport and disposal of the ODS in authorized destruction facilities in the USA.

4.2.1 Bidding Process

In 2013 UNIDO launched an international bidding process in order to undertake the transport and destruction of 74.1 tonnes of ODS waste banks collected in Mexico. There were no restrictions or prerequisites to perform this locally or at a foreign facility. However, at the time Stage 1A bidding was unveiled no companies in Mexico were authorized to destroy ODS even if TEAP-recommended technologies were available in the country (i.e. Argon plasma arc and Cement kilns).

After evaluation of all received offers, a contract was awarded to a consortium consisting of companies RemTec (United States) and PGES (Saudi Arabia). After signature of the contract, the selected consortium initiated implementation works with the centralization of all the ODS, aggregated ODS would be transported by land from centralized facilities in Mexico to RemTec and Veolia's facilities located in Ohio and Texas, respectively, and they would be transported in special tanks and ISO containers.

59 tonnes of CFCs, HCFCs and HFCs blends were to be destroyed at RemTec's Plasma Arc, while 16 tonnes of virgin CFC-11 would be destroyed at Veolia´s high-temperature incineration facilities. These two facilities complied with TEAP emission and performance standards, while these companies have extensive experience in the field.

4.2.2 ODS regulations in the USA

ODS waste import into the USA must comply with several environmental requirements. Federal regulations include, mainly, the Stratospheric Ozone Protection Regulations under the Clean Air Act (CAA), and the Resource Conservation and Recovery Act (RCRA).

As part of the CAA and its phase-out plan, ODS are regulated as Class I or Class II controlled substances[22]. Among Class I, CFCs, have been completely phased out, while new production and import of Class II, HCFCs, will be phased out by 2020. Importing of virgin and used Class I or Class II ODS must comply with particular requirements, including recordkeeping and reporting (40 CFR 82.13). For example, virgin Class I ODS imports are forbidden unless it they fall under certain exemptions, including their transformation or destruction (EPA, 2017a).

On the other hand, RCRA regulates ODS classified as hazardous waste, which is relevant both for import authorization and destruction facilities regulation and compliance. Whether an ODS is considered a hazardous waste or not depends on the RCRA provisions, as specified in 40 CFR Part 61, Subpart D. ODS or ODS-containing waste may fall in one of the following categories: wastes from non-specific sources (Code F), commercial chemical products (Code U), characteristic wastes (Code D), or wastes from specific sources (Code K). In general, Code F applies to CFCs, HCFCs, among other, which have been used as solvents prior to disposal. Meanwhile, Code U applies to ODS which are discarded in pure form, as it was the case for CFC-11 waste from pharmaceutical industry in the Demonstration Project. Code D includes ODS that may exhibit ignitability, corrosively, reactivity or toxicity characteristics, being the last one the most likely as in the case of carbon tetrachloride wastes. Code K applies to ODS produced in specific sources, such as carbon tetrachloride production wastes. (ICF International, 2009)

According to CAA, surplus ODS must be stored, reused (after recycling or reclamation), or destroyed. Currently, the following facilities are commercially available to destroy ODS in the USA. It must be noted that not all the facilities necessarily are allowed to manage hazardous waste ODS.

Table 10 ODS Destruction Facilities in the USA

Company name	Facility Location
Chill-Tek, Inc.	Las Vegas, Nevada
Clean Harbors Environmental Services, Inc.	Aragonite, Utah (Aragonite)
	El Dorado, Arkansas (El Dorado)
	La Porte, Texas (Deer Park)
A-Gas Americas (Rem Tec)	Bowling Green, Ohio
Veolia ES Technical Solutions, L.L.C.	Sauget, Illinois
	Port Arthur, Texas

Source: EPA (2017b).

[22] Class I substances have an ozone depletion potential of 0.2 or higher, and include halons, CFCs, methyl chloroform, carbon tetrachloride, and methyl bromide. Class II have an ozone depletion potential less than 0.2, and are all HCFCs

It is relevant to point out that in the Stage 1A of the Demonstration Project, one of the destruction facilities that had been selected was authorized to destroy pure CFC-11 (Code U) hazardous waste ODS (i.e. Port Arthur´s incinerator), while the other (i.e. Rem Tec´s argon plasma arc) was able to destroy only non-hazardous waste ODS, as per RCRA considerations, which included the rest of unwanted CFCs, HCFCs and HFCs[23].

4.2.3 Export and import of hazardous waste from Mexico to the USA

Transboundary movement of hazardous waste is subject to international treaties, such as the Basel Convention and OCDE decisions, as well as national regulations, in which exporting, importing and transit countries rulings are relevant. In the Demonstration Project Stage 1A, the approval process involved the issuance of a hazardous waste export authorization from the Mexican government through SEMARNAT and an import approval from the U.S. EPA. This process took about one year to be completed.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal[24] was adopted in 1989 and entered into force in 1992, currently having 186 ratified Parties[25]. It states the obligations on transboundary movements of wastes between Parties. Most remarkably, the Convention requires that exporting States must notify in writing to any States concerned of any proposed transboundary movement of hazardous wastes. Importing States, as well as transit States, shall consent, deny or request further information on the movement, and notify the final response to the concerned States which are Parties. No transboundary movements shall commence before this procedure takes place.

In addition, the Basel Convention Ban Amendment[26] forbids the export of hazardous waste from OCDE countries to non-OCDE Countries, which are intended for final disposal or which are included in Annex I of the Convention and are destined for reuse, recycling or recovery. Due to this decision Mexico may only allow export of hazardous wastes to OCDE countries, the European Union and Liechtenstein.

It is worth mentioning that the USA is signatory of the Basel Convention but it has not ratified it as a Party. However, Mexico and the USA have signed a cooperation agreement on environmental protection of their common border, known as “La Paz Agreement” or “Acuerdo de la Paz”[27]. Annex III, signed in 1986, which deals with transboundary movements of hazardous wastes and materials, fits the Basel Convention Article 11 on multilateral agreements, and establishes very similar procedures for transboundary movements of hazardous waste, including the requirement for prior notification between concerned countries.

[23] For a full list of RCRA-permitted hazardous waste facilities see: https://www3.epa.gov/enviro/facts/rcrainfo/search.html.
[24] Full text available at: http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx.
[25] http://www.basel.int/Countries/StatusofRatifications/PartiesSignatories/tabid/4499/Default.aspx
[26] See: http://www.basel.int/Implementation/LegalMatters/BanAmendment/Overview/tabid/1484/Default.aspx.
[27] See full text in: https://www.epa.gov/sites/production/files/2015-09/documents/lapazagreement.pdf.

Article XI within the Annex III of the Agreement establishes that any hazardous waste generated in manufacturing or economic processes, from which raw materials have been used and temporarily admitted, shall be continued to be readmitted by the country of origin of the raw materials.

Hazardous waste transboundary procedures must be followed by interested parties whenever wastes to be moved or traded fall into a relevant category, which in the case of Mexico includes the following lists of wastes (SEMARNAT, n.d.):

1. Basel Convention Annexes I, II, VII and IX, as well as those defined as hazardous wastes under the legislation of any of the exporting, importing or transiting Parties.
2. OCDE decision C (2002)107, Appendixes 1 and 4.
3. La Paz Convention Annex III.
4. LGPGIR Article 31.
5. NOM-052-SEMARNAT-2005 lists and identification criteria.
6. Customs Article 6 for goods regulated by SEMARNAT (DOF, 30-junio-2007).

According to Mexican LGPGIR and its regulation, exporters of hazardous waste must fulfill the following requirements in order to get an authorization:

- Export manifest.
- Proof of address of the exporter.
- Description of the measures to control environmental contingencies.
- Export notification according to Basel Convention or applicable treaties, and OCDE´s movement form.
- Acceptance letter of the importing company.
- Insurance policy of the exporting company.
- Payment.

4.2.4 Handling and storage of ODS banks

As previously described, ODS banks were spread along the country among HARP centers, customs warehouses, pharmaceutical industry facilities and R&R Centers. Provided that unwanted ODS feature hazardous properties it is required to comply with regulations and provisions related to handling, transport and disposal of such materials, particularly if they are via exported to the USA for their destruction.

In order to comply with the relevant regulations and to ease the logistics and monitoring of the unwanted ODS destruction, the identified banks needed to be further consolidated in large containers and in key locations, preferably handled by a single authorized service provider[28].

The company designated by the aforementioned awarded consortium to perform this task was Ecofrigo S.A. de C.V., an R&R Center located on the center of Mexico. Ecofrigo is a leading provider of handling services for old refrigeration and air conditioning equipment and unwanted ODS.

[28] This was particularly relevant in the case the ODS banks were to be exported for disposal, as it was originally planned in the initial phase of the project, as the import-export permit process is complex and lengthy. Therefore it is recommended that a single entity request such permit.

As previously mentioned, under the R&R training programme Ecofrigo was one of the 14 companies supported by UNIDO and SEMARNAT to purchase new equipment and tools to enable recovering and recycling activities as well as allow proper storage of unwanted ODS banks generated and identified along the country.

Figure 12 Aggregation containers for ODS consolidation, storage and handling



Source: SEMARNAT.

4.2.5 Costs

At the time o project preparation, project implementation costs were estimated at about 780 thousand USD or 10.5 USD per kilogram of ODS destroyed. ODS destruction accounted for about half of the project costs, while local and international transportation represented 13% of the cost structure. These costs are applicable to the destruction of about 74 tonnes of ODS waste that were meant to be destroyed in two different destruction facilities in the USA during 2015. During the implementation, it was identified that project costs were heavily underestimated by the designated company, since consolidation and internal transportation costs were not thoroughly taken into account in the economic offer. Furthermore, the fees related to cover the environmental insurance policy, and requirements related to transboundary movements of hazardous waste (i.e. Basel Convention and other bilateral treaties) had not been considered in the project structure. Due to this situation, Stage 1A could not be fully executed, while only transportation of ODS banks from generation sources to the R&R Center Ecofrigo for consolidation was performed. These costs related to these activities are summarized below.

Table 11 Stage 1A Project costs for internal transportation and consolidation of unwanted ODS banks

Project concepts	Total Cost (USD)	Unit Price (USD/kg)
Transportation within Mexico	42,000	0.6
Consolidation & Centralization	58,000	0.8
Total	**100,000**	**1.4**

Source: UNIDO.

4.3 Stage 1B. Handling and Destruction of unwanted ODS in Argon plasma arc in Mexico

Following a first attempt to perform the destruction activities of the Demonstration Project in the USA, UNIDO acknowledged the advancement that had been took along during Stage 1A and decided to launch a second international bidding process, which resulted fruitful as already one facility in Mexico had been issued an ODS waste incineration permit. After a comprehensive technical evaluation by UNIDO, the Mexican company Quimobásicos was chosen to perform the first stage of the Demonstration Project, which involved 74.1 tonnes of unwanted ODS destroyed in a state-of-the-art Argon plasma arc, one of the ODS destruction technologies recommended by the TEAP. The destruction was performed between October 2015 and January 2016, complying with local and Montreal Protocol´s environmental and performance criteria, and rendering the first demonstration of an MLF-supported ODS destruction project.

4.3.1 Bidding Process

After a second bidding process initiated by UNIDO in 2015, the Mexican company Quimobásicos was designated to implement the first stage of the Demonstration Project, which involved final transportation of ODS from the storage location and their destruction via argon plasma arc. Unlike the first bidding process, this one did not involve the consolidation of the ODS banks, as this had been already performed during Stage 1A.

It should be emphasized that this second bidding process was successful due to the fact Quimobásicos had recently acquired the first incineration license to destroy hazardous waste ODS in Mexico[29] .This was one of the main requisites bidders must prove. By that time, Quimobásicos was the only company allowed to provide such services.

4.3.2 Quimobásicos Argon plasma arc facility

PLASCON technology is an *in-flight* plasma process in which waste stream is mixed directly with the inert argon plasma jet. In this process, wastes are rapidly heated to about 2,500 °C, where pyrolysis takes place. As steam is injected with the waste, oxygen ensures any carbon is converted to CO_2. Hydrogen moreover prevents formation of CF_4. The pyrolysis phase is followed by rapid alkaline quenching from about 1,200°C to less than 100°C, which prevents formation of dioxins and furans. Quenched gas is scrubbed with alkaline liquor to neutralize HCl and other gases. The off-gas consists mainly of CO_2 and Ar. This technology is recommended by TEAP, which reports DRE values that exceed 99.9998%, while its technical and commercial capability to destroy ODS

[29] See section on Pilot tests and license to destroy ODS waste in Mexico.

have been proven. (UNEP/TEAP, 2002)

Quimobásicos PLASCON unit has a capacity to destroy between 40 to 60 kilograms per hour of ODS. The facility consists of an ODS feeding tank, a main torch device, a cooling chamber, an alkaline tank and a gas absorption column. The unit is fully automated, controlled and monitored via PLC. A prior preparation phase in which oil is removed from the ODS stream is performed in a two-stage separation process. Liquid effluents are neutralized and transferred to a water treatment plant.

The PLASCON unit typically has more than 99.999% of destruction efficiency, and emissions to the atmosphere are substantially lower than recommended standards (typical results 0.000802 ng/m^3). Dioxins and furans emissions are null because the temperature is ultrahigh (up to 12,500 °C) and residence time is very short (23 milliseconds).

Figure 13 Argon plasma arc at Quimobásicos facilities in Monterrey, Mexico



Source: SEMARNAT.

4.3.3 Project MRV

The project MRV involves a series of activities to verify the amount of unwanted ODS destroyed, as well as that safety and environmental provisions are fulfilled. In every destruction cycle, batches of unwanted ODS are received at Quimobásicos facilities, while containers are inspected for leakages, weighed, registered and identified. Received ODS are transferred to storage tanks, which later are fed into the PLASCON unit for destruction.

Unwanted ODS collected in the storage tank are sampled and analyzed prior to their destruction. The identification and quantification of ODS is made by gas chromatography at the certified lab

present in the facility. These results are reported and registered and then destruction can take place. While destruction takes place, PLASCON operational conditions, oil content, emissions, %ODS destroyed and effluent pH are registered via PLC and a logbook. Destruction results are finally reported in the SISSAO system to SEMARNAT, which upon verification issues the related destruction certificate.

Weight and composition of destroyed ODS batches is compared to the originally reported figures in order to guarantee that the required amount of unwanted ODS is destroyed. Relevant procedures are taken in order to empty, refurbish and load cylinders into the truck to send them back to generators.

In the Stage 1B of the Demonstration Project 74.1 tonnes of unwanted ODS were destroyed by Quimobásicos in four destruction cycles from August to December, 2015. Every destruction cycle lasted about a month in average.

4.3.4 Costs

Destruction costs at Argon plasma arc by Quimobásicos in Mexico were $9.2 USD per kg of ODS in 2015. This include transportation of ODS batches from storage facility in Celaya, Mexico to Quimobásicos in Monterrey, Mexico, ODS handling and destruction in the PLASCON unit and MRV. These unitary prices are representative to the destruction of more than 15 tonnes of ODS.

Table 12 Stage 1B Project costs for unwanted ODS destruction using Argon plasma arc in Mexico

Project concepts	Unit Price (USD/kg)
Transportation from storage facility to Quimobásicos	0.5
ODS handling and destruction in PLASCON unit	7.4
MRV	0.1
VAT	1.3
Total	**9.2**

Source: Quimobásicos and UNIDO.

4.4 Stage 2. Handling and Destruction of ODS in a cement kiln in Mexico

In 2015 the cement manufacturing company Holcim Mexico was authorized by SEMARNAT to co-process unwanted ODS at one of its facilities located in Tecomán, Colima. By this time, a second batch of unwanted ODS had been collected at different R&R Centers throughout the country. Moreover, a surplus amount of resources from the Demonstration Project were left after Phase 1B was completed. These circumstances gave rise to the launch of a second bidding process by UNIDO, in which Holcim Mexico was appointed to execute Phase 2 of the project that destroyed 39 tonnes of unwanted ODS. Overall the implementation was very successful, as this was the second destruction technology tested during the Demonstration Project, while a cost reduction was achieved in comparison to the first stage.

4.4.1 Bidding Process

After completing the destruction of a first batch of unwanted ODS amounting to 74.1 metric tons, a new international bidding process was open by UNIDO in 2015 with the aim of undertaking the

destruction of 60.9 additional metric tons of ODS from different sources. Upon the evaluation of all received offers, and in line with the agreement between SEMARNAT and UNIDO by which all contract-related activities have to be undertaken in Mexico, a contract was awarded to Holcim Mexico. After signature of the contract, the selected company will initiate implementation activities in the second half of 2016.

In the bidding process, all offers were reviewed and evaluated in accordance with UNIDO's rules and regulations by which the most cost-effective and technically acceptable offer was awarded the contract. However, the proposed total price was in all cases above the available budget and, consequently, the contractor was approached with a request to reduce the unit price per kilogram to be destroyed. Unfortunately, the company was unable to provide any discount and, therefore, it was agreed to reduce the scope of supply from 60.9 tons to 37.2 tons in order to be able to match the funds available. This company had been recently authorized to co-process ODS hazardous waste at one cement kiln facility located in its Tecomán plant in Mexico[30].

Taking into consideration the remaining funds, in Stage 2 of the Demonstration Project, ODS banks were not aggregated nor stored in a single storage facility, as it was performed in Stage 1 (A and B). In the second stage, the transportation of ODS banks from the source point (i.e. customs office, R&R centers, pharmaceuticals) to Holcim Mexico facilities were covered by the generators themselves. This co-financing strategy was achieved thanks to the collaboration among Mexican authorities, the generators and service providers, and allowed the destruction of a larger batch, as transportation costs account for about 10% of the overall unitary destruction costs. ODS bank generators were required a competent handling service provider authorized to transport hazardous waste. On the other hand, Holcim Mexico was committed to receive, handle and destroy the unwanted ODS via co-processing at the cement kiln facilities.

For the amounts not covered by the project (a total of 23,7 tons), Holcim Mexico has committed to provide the same price (US$ 6 per kg plus VAT) to those companies who decide to destroy this remaining quantities at its facilities.

4.4.2 Cement kiln destruction at Holcim

Cement kilns are one of the technologies recommended by the TEAP to destroy unwanted ODS. Cement kilns are tilted, rotating brick-lined cylinders. Raw materials are fed into the rotating in the top (cold) side of the rotating cylinder and they are slowly transformed in to clinker which is received at the lower side of the kiln. As temperatures in the kiln´s burning zone are over 1,500°C and residence times are up to 10 seconds, these facilities are adequate to destroy ODS, and other hazardous substances. Acid gases produced by ODS thermal destruction are neutralized by the alkaline clinker that is being produced. It is relevant to optimize and control the feeding rate of ODS in order to guarantee fluorine and chlorine feed contents are below the required operating conditions. While no additional emissions are expected due to destruction of ODS, cement kiln facilities require modification of the feeding systems as well as a stringent monitoring of hazardous emissions (UNEP/TEAP, 2002).

[30] See section on Pilot tests and license to destroy ODS waste in Mexico.

Tecomán's cement kiln is 55 m in length and 4.4 m in diameter. The hot end of the kiln is maintained between 1,500-2,000°C. The production capacity of the kiln is 5,000 tonnes of clinker per day, while the ODS can be fed at 35 kg/h as minimum. Gas effluent from the cement kiln are controlled with in a bag house, where dust and particles are collected, while other emissions comply with NOM-040-SEMARNAT-2002 limits and ODS DRE has been certified above the Montreal Protocol requirements. No liquid wastes are generated in the process.

Figure 14 Cement kiln at Holcim Mexico facilities in Colima, Mexico



Source: SEMARNAT.

4.4.3 Project MRV

The project MRV involves a series of activities to verify the amount of unwanted ODS destroyed, as well as that safety and environmental provisions are fulfilled. In every destruction cycle, batches of unwanted ODS are received at Holcim Mexico facilities. Geocycle tracks down the shipment of ODS banks with each of the generators and programs its arrival to cement kiln facilities. The loaded transport is weighed in a certified scale and registered in an electronic log along with the identification data of the transport, including its manifest for hazardous waste handling. Geocycle must verify that the transport service provider

Upon arrival of the ODS batches, there are inspected and registered in the system. Unloaded transport is weighed and registered in the electronic log, while a printed copy is given to the driver. ODS containers are stored in the warehouse until destruction takes place.

The destruction process begins with the cylinders transported to the ODS feeding area and weighed in an electronic scale. The cylinder is connected to the main burned feeding system and to an air purge. Once the cylinder is empty of contents it is weighed in order to determine the

amount of gas that has been destroyed. Empty tanks are replaced for new ones until the whole shipment has been destroyed. A destruction certificate is generated for each of the shipments.

Each one of the ODS containers received is analyzed to verify its composition. For this purpose, a non-dispersive infrared refrigerant analyzer is utilized. In the registration system tank and gas weighs are reported, as well as the ODS composition of each tank. Moreover, the following information of destruction is registered:

1. Initial and final date of destruction
2. ODS feed rate
3. DRE
4. Emission concentration of HCl
5. Emission concentration of HF
6. Emission concentration of Dioxins and Furans
7. Batch identification number

In the Stage 2 of the Demonstration Project a total of 39.1 tonnes of unwanted ODS were destroyed by Holcim Mexico from October 2016 to February 2017, as previously mentioned, 1.9 metric tonnes were destroyed in the pilot test, while 37.2 metric tons were co-process in project implementation.

Destruction results are finally reported in the SISSAO system to SEMARNAT, which upon verification issues the related destruction certificate.

4.4.4 Costs

Overall costs of Stage 2 were $8.0 USD per kg of ODS in 2015. The main components corresponds to the ODS destruction in the cement kiln at 6.0 USD/kg. Handling and transportation paid by the ODS generators, via the co-financing scheme, accounted in average for about 1.0USD/kg (Table 13).

Table 13 Stage 2 Project costs for unwanted ODS destruction at cement kiln

Project concepts	Unit Price (USD/kg)
Handling and transportation within Mexico (co-financed by the generator)	1.0
ODS destruction at cement kiln and MRV	6.0
VAT	1.0
Total	**8.0**

Source: Holcim Mexico and UNIDO.

4.5 Comparison of destruction scenarios

In summary, Stage 1A destruction phase was not implemented due to underestimation of the intended costs. Stage 1B and Stage 2 were successfully implemented in Mexico at Argon plasma arc and cement kiln facilities, respectively. The Demonstration Project determined that these two facilities acquired the first permits to destroy unwanted ODS in Mexico, therefore paving the way

for other organizations.

Before starting the procedures for the final disposal of the received unwanted chemicals, the two destruction facilities performed a detailed laboratory analysis (HPLC technology and infrared analysis) of the composition of the received chemicals to be destroyed in order to properly define and optimize the set-up of their respective destruction modalities. According to their assessments, the exact composition of the 113 tonnes of unwanted blends being destroyed are summarized in Table 14.

Table 14 Summary of unwanted ODS destroyed with Mexico's Demonstration Project

Unwanted ODS destroyed (tonnes)			
ODS	**Stage 1B** Argon plasma arc	**Stage 2** Cement kiln	**Overall project**
CFC-11	21.6	3.2	24.7
CFC-12	3.2	8.0	25.3
CFC-114	0.1	0.4	0.5
HCFC-22	22.5	17.6	40.1
HCFC-141b	0	0.2	0.2
HFC-134a	12.6	8.8	21.5
R-407	0	0.9	0.9
Total	**74.1**	**39.1**	**113.2**

Source: SEMARNAT.

More details are available in Annex III and Annex IV of the same report.

This destruction represents the mitigation of about 504 thousand tCO_2e, in both project stages[31]. In turn, this figure is equivalent to the GHG emissions that would have been produced by about 200 thousand vehicles in circulation during one year[32].

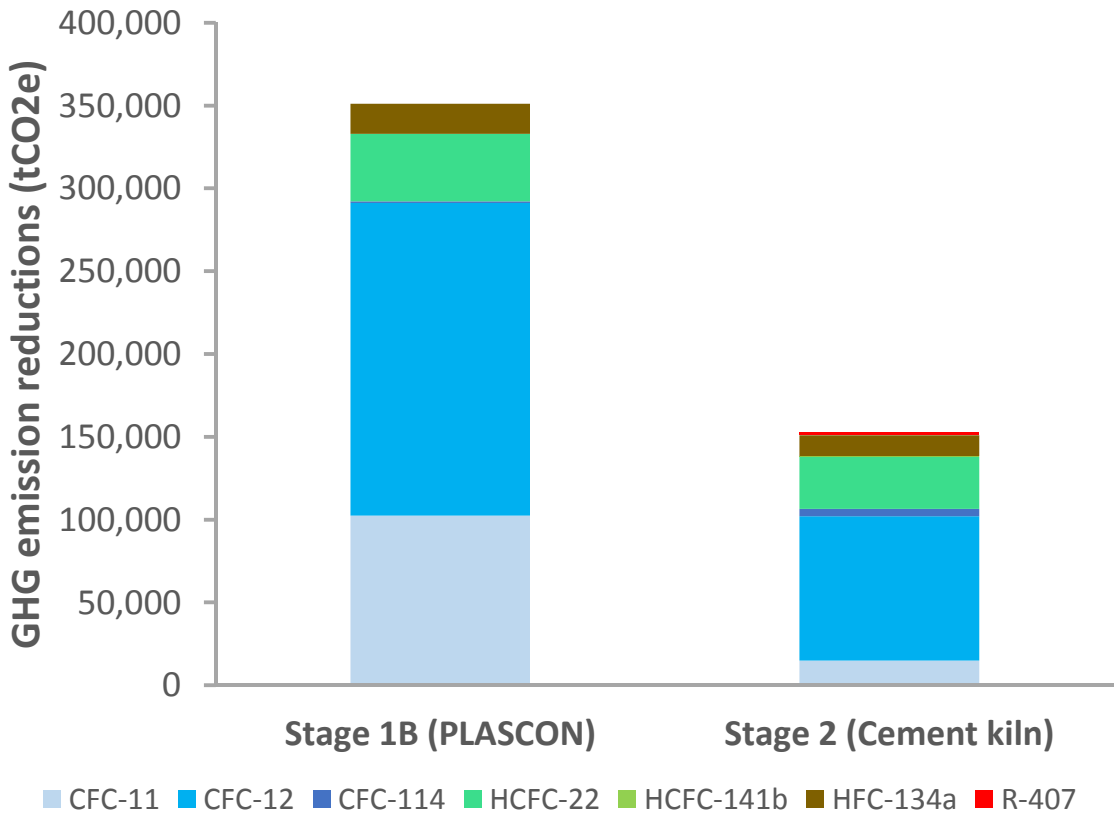
Though HCFC-22 share is the largest in tonnes of substance, its GWP is about 50% of CFC-12, the ODS with the highest value. Therefore, the largest contribution of CO_2 reductions corresponds to CFC-12 destruction (38%), which came from HARP, R&R centers and pharmaceuticals. Climate mitigation is followed by the contribution of HCFC-22 (28%), sourced mainly from customs confiscations and end-of-life appliances. CFC-11 from pharmaceuticals contributed with 22% of GHG reductions, while HFC-134a accounts for 11% (Figure 15) sourced from the blend of refrigerant recovered in domestic refrigerators.

It has to be emphasize two important issues: first one is that all HFC destroyed under this project was contained within an unwanted blend of CFC-12 and HFC-134a recovered from the fridges which could not be recycled or separated before destruction, and the second issue, HCFC-22 destroyed under the project was connected directly from confiscation of illegal trading, so at the time of the consolidation, the exact composition of the ODS was not known due to several

[31] GHG emission reductions estimated with GWP 100-years, from IPCC Fourth Assessment Report: Climate Change 2007. Working Group I: The Physical Science Basis. 2.10.2 Direct Global Warming Potentials, Table 2.14.
[32] Considering an average CO2 emission factor of 3.6 tCO2/vehicle/year in Mexico City.

customs rules which prohibit the analysis of this kind of materials before to abandon the customs facilities. The seized refrigerant cylinders were generally labeled as "*Illegal Freon*", leading to the confusion on their exact composition. Furthermore, the exact composition of those cylinders was found to be mixtures of different refrigerant, including CFC-12, other ODSs and various HFCs.

Figure 15 GHG emission reductions achieved with ODS destruction in Mexico´s Demonstration Project



Note: GHG emission reductions estimated with GWP 100-years, from IPCC Fourth Assessment Report: Climate Change 2007, 2.10.2 Direct Global Warming Potentials, Table 2.14.

Source: SEMARNAT.

A comparison of technical, environmental, economic and legal aspects for each implementation stage is summarized in Table 15. In brief, exportation to the USA (Stage 1A) turned out unfeasible due to increased export costs while regulatory requisites are stringent. Stage 1B and 2 were both successful. Argon plasma arc destruction (Stage 1B) advantages are high destruction efficiency and low emissions and byproducts, however current market is reduced, destruction costs are high and is not compatible with ODS imports due to regulatory restrictions. On the other hand, cement kiln (Stage 2) features lower implementation costs and the possibility to co-process ODS waste as part of a valuable product (cement). Moreover, cement co-processing could be suitable for unwanted

ODS importations for destruction, as hazardous waste imports are allowed in a recycling scenario.

Table 15 Cross-comparison of destruction scenarios

Parameters	Stage 1A	Stage 1B	Stage 2
Technical performance			
Demonstration Project status	Not executed	Completed in 2016	Completed in 2017
Project location	Ohio and Texas, USA.	Monterrey, Mexico.	Colima, Mexico
Technology	Ohio: Argon plasma arc Texas: Rotary kiln incinerator	Argon plasma arc	Cement kiln
Technology status	Both commercial	Commercial.	Commercial.
Availability of facilities	There are currently seven commercial available ODS destruction facilities referenced by EPA, while many others are authorized to destroy hazardous waste	1 Argon plasma arc facility	34 cement facilities, only one currently authorized for ODS destruction [a]
Environmental performance			
ODS destruction performance	>99.99%	>99.99%	>99.99%
ODS actually destroyed in Demonstration Project (tonnes)	0	74	39
CO_2 emission reduction from ODS destruction (Thousand tCO_2e)	0	351	153
Emissions to the atmosphere	NA	CO	Dust and particles
Economic performance [b]			
Total implementation cost (USD/kg ODS)	11.0 (proposed but not implemented cost)	9.2	8.0
Destruction-only cost (USD/kg ODS)	NA	7.5	6.0
Cost-effectiveness (USD/tCO_2e) – Total costs	NA	1.9	2.0
Cost-effectiveness	NA	1.6	1.5

Parameters	Stage 1A	Stage 1B	Stage 2
Technical performance			
(USD/tCO_2e) – Destruction-only costs			
Current market	Large, including imports	Currently reduced	Currently reduced for ODS but large for other waste
Legal considerations			
License availability	There are currently seven commercial available ODS destruction facilities referenced by EPA, while many others are authorized to destroy hazardous waste	1 facility currently licensed to destroy unwanted ODS (Quimobásicos)	1 facility currently licensed to co-process unwanted ODS (Holcim Mexico)
ODS import destruction feasibility		Not possible in Mexico as hazardous waste imports are not allowed in case of incineration without thermal recovery	Possible in Mexico as hazardous waste imports are allowed in case of recycling or co-processing

[a] Cement manufacturing facilities in Mexico. A detailed assessment is needed to determine feasibility of ODS destruction in each plant.

[b] Cost-effectiveness depends not only of the amount of ODS destroyed but its actual types and concentrations. Each CFC, HCFC and HFC features different GWP values, which in turn determines the climate impact of the achieved reductions.

5 Dissemination Activities

Considering the Demonstration Project was a first-of-its-kind in Mexico and one of the first unwanted ODS disposal projects supported by MLF, it was very relevant to produce outreach materials that demonstrated the impact and benefits achieved.

To start communication activities, at the beginning of 2016, SEMARNAT and UNIDO arranged a closing event of the first stage of the project which took place at Quimobásicos plant located in Monterrey, Nuevo Leon. The purpose of the event was to disseminate the results of the project and announce that Mexico had developed national capacities to handle and destroy ODS in an environmentally responsible manner.

Figure 16 Representatives of France, Mexico, Ozone Secretariat, UNIDO and Quimobásicos during closure event



Source: SEMARNAT.

Regarding the second stage of the project, Holcim Mexico promoted its corresponding outcomes at national and international level. Consequently, in 2017 the company and its subsidiary Geocycle, were both recognized with the Environmental Excellence Award for the mitigation actions carried out in the context of this project.

Figure 17 Representatives of Holcim Mexico and Geocycle during award ceremony



Source: PROFEPA.

In addition to the dissemination activities previously mentioned, in order to share with other countries the project outcomes, transfer results, challenges and lesson learned, in August 2017, one study tour to the Holcim facilities was arranged by SEMARNAT and UNEP. Representatives of LAC region such as Guatemala, El Salvador, Chile, Colombia, Honduras, Panama, Costa Rica, Dominican Republic, Peru, Ecuador and Uruguay attended the visit.

Figure 18 Ozone and Customs officers of LAC during Holcim visit



Source: SEMARNAT.

Finally, three videos on the following topics were produced and published:

- Unwanted ODS handling and destruction in Mexico
- Destruction in Argon plasma arc at Quimobásicos
- Destruction in cement kiln at Holcim Mexico

Videos are available on Youtube Channels of UNIDO and SEMARNAT.

Given the limited funds of the projects for this component, it is important to highlight that activities associated with the videos were financed through Institutional Strengthening Project.

6 Conclusions

Project implementation

- Mexico´s Demonstration Project has proved, for the first time among high-volume-consume Article 5 countries, the destruction of unwanted ODS banks in a MLF-supported project. However, original destruction targets were not achieved due to underestimation of the collection, training, handling, and transportation costs.
- Project implementation timeline increased two years due to unexpected barriers, mainly related to higher implementation costs of the preparatory activities, time-lag derived from licensing and permit authorizations, effectiveness at consolidating unwanted ODS banks, and lack of awareness on project benefits among stakeholders.
- As it was seen from unfinished Stage 1A implementation, intended exportation of unwanted ODS stockpiles, turned out more expensive than originally estimated. It is therefore recommended to destroy unwanted ODS at local facilities whenever sufficient legal framework, destruction facilities that comply with environmental criteria are available. ODS destruction via export to Mexico is an option in cases in which these conditions cannot be guaranteed.

Technical-related aspects

- Unwanted ODS are classified as hazardous waste in Mexico. Infrastructure built along the country for handling and transportation of ODS stockpiles was a key element of the project execution. In spite of the efforts made previously by the national authorities on this topic, it was acknowledged that further training and infrastructure strengthening to recover unwanted ODS was required in order to implement a project of such a scale.
- Argon plasma arc is a cutting-edge destruction technology. Currently its application market is reduced in Mexico and related costs are also higher than other approved technologies. However, it is no-doubt the cleanest technology of the two tested and implemented during the Demonstration Project, with close to zero waste by-products. For its performance, this technology can be used to destroy other hazardous waste such as PCBs.
- Cement kiln proved to be the most cost-effective ODS destruction technology in Mexico´s Demonstration Project. Moreover, several cement manufacturing facilities are available through, in general, they exhibit state-of-the-art kilns and emissions control and monitoring devices. This industry has long experience in handling hazardous waste, other than unwanted ODS. Certain provisions must be taken for monitoring of emissions as not all of cement facilities feature Continuous Emissions Monitoring Systems (CEMS). Furthermore, cement kiln technology allows for recycling and co-processing of hazardous waste in a sustainable sound manner.
- The Project stimulated the first facilities in LAC region to obtain license authorizations to incinerate and co-process unwanted ODS, while proving the feasibility of ODS destruction using two different technologies available in Mexico: Argon plasma arc and Cement kiln.

Policy and regulatory issues

- Existing policies and regulations in Mexico were robust and sufficient for the implementation of an unwanted ODS disposal project, whether ODS are destroyed at local facilities or exported to a foreign location. Nevertheless, in order to smoothly implement the legal framework, it is necessary to raise awareness among authorities as ODS destruction had not taken place before in the country.
- Transboundary movements of unwanted ODS for their disposal is an alternative for countries where no destruction facilities are available, or when policy frameworks and environmental criteria are uncertain. As proved in Stage 1A of Mexico's Demonstration Project, cost-effectiveness of waste exportation can become a barrier, particularly if there is no access to carbon credits. Legal requirements are also relevant, as in the Mexican, no importation of waste is admitted, unless it is intended for recycling or co-processing, which is applicable to cement kiln destruction but no to Argon Plasma Arc.

Economic and Environment performance

- Second stage destructions costs were lower than first one, while proposed costs for unfinished Stage 1A proved that exportation of unwanted ODS is not the most economically feasible alternative. It was further acknowledged that the existence of more than one destruction technology and facility increases competitiveness and creates market incentives, while decreasing overall implementation costs.
- Project´s second stage revealed that co-financing of stockpiles transportation is feasible and improves its cost effectiveness. Material scrapping and recycling activities, as performed by R&R Centers in Mexico, are key to support financial balance of these companies. Furthermore, such a scheme increases overall environmental benefits of the project.
- Being a first-of-its-kind project in Mexico, its implementation path involved the testing of two destruction technologies from two different implementers, which certified that clean and safe disposal of ODS banks was feasible and, under adequate policies, cost-efficient within the region. Among most relevant outcomes, the Demonstration Project proved the necessity to strengthen regulatory framework on ODS waste management in order to encourage recycling centers to use a portion of the revenues from scrap sales to finance ODS waste destruction.
- Mexico´s pilot project will facilitate the development of better financing schemes for future projects within the LAC region. As it was witnessed here, encouraging the availability of technological alternatives can lead into relevant cost reductions. This project further allowed to try co-financing schemes with ODS stockpiles generators which, for instance, enabled significant costs drops on handling and transportation.
- Environmental impacts of the project are very significant. The co-benefits generated through its implementation contribute to harmonize the efforts made in the Montreal Protocol, with the commitments established by Mexico in terms of climate change, while promoting the use of energy efficient programs encouraging the pursue of sustainable development goals.

7 Lessons learned

- The implementation of the Demonstration Project deferred from the originally proposal after the decision of the Executive Committee to restrict the possibility of carbon credit yield, which in turn modified the original scope and objectives of the project which were more ambitious; nevertheless, the core aim of the project was sustained as legal and technical feasibility was proven, capacity building was created and financial schemes were tested. These outcomes are likely to be translated into future ODS destruction activities either which could be financed via national carbon markets or legislation strengthening.
- The substances being destroyed, and their respective compositions and amounts, were only exactly known at the moment of their final disposal at the destruction facilities, not during the collection chain.
- Unwanted ODS banks stockpiled could contain important quantities of CFC blended with HCFC and HFC, therefore training on identification and handling of unwanted ODS generators is essential to consolidate ODS banks properly. Consequently, in the future, whenever a destruction activity aims at destroying a specific substance, it is recommended taking into account that waste-refrigerants are in from of multiple blended with ODSs and HFC and other substances that cannot be separated prior destruction.
- Capacity building formed in the context of NPP and HPMP in terms of technicians training, recycling centers and customs training, is essential to facilitate project implementation.
- Preparatory activities focused on technical and legal aspects are crucial to guarantee the correct project implementation, timeline should consider activities such as training, equipment, legal diagnostics, handling and transportation issues, pilot tests and licensing, MRV, as well as socialization.
- Awareness of government areas involved in the management of unwanted ODS should be highlighted in order to familiarize them with such kind of projects. First project certifications will most likely take longer.
- It is better to destroy ODS at local facilities. However ODS destruction via export is still an option for countries where no ODS destruction facilities are available, or when performance and environmental criteria are not guaranteed.
- It is recommended to create incentives so that more than one facility could destroy ODS. This will potentially lead to reduce destruction associated costs.
- Both ODS destruction technologies proven outstanding technical performance and environmental compliance.
- Cement kiln is the most cost-effective ODS destruction technology. Such facilities in Mexico also have long experience in handling other type of hazardous waste. However, provisions must be taken for optimum monitoring of air emissions. In Mexico not all of cement facilities have CEMS installed.
- Argon plasma arc is a cutting-edge technology. Currently its application market is reduced in Mexico. Its related costs are also higher than cement kiln destruction. However, it is the cleanest technology of the two tested in this project.
- Imports of ODS for destruction are only feasible at cement facilities and not at Argon plasma arc facility, as hazardous waste imports are only allowed for recycling.

- Adequate funding for demonstration ODS destruction projects should consider costs associated with handling, transportation and dissemination activities.
- HFC phase-out Plans should consider one specific component for ODS disposal.
- Project outcomes will contribute to develop cost-effective financing schemes that enable the destruction of additional amounts of Unwanted ODS, whilst the lessons accumulated during its implementation will help relieve associated barriers to implement future unwanted HFC disposal projects in Article 5 countries.
- It was moreover identified additional market incentives such as carbon markets and tax incentives can encourage ODS destruction in the future, it is expected that once Mexico´s carbon trading program enters in operation, ODS destruction projects will get further stimulated.

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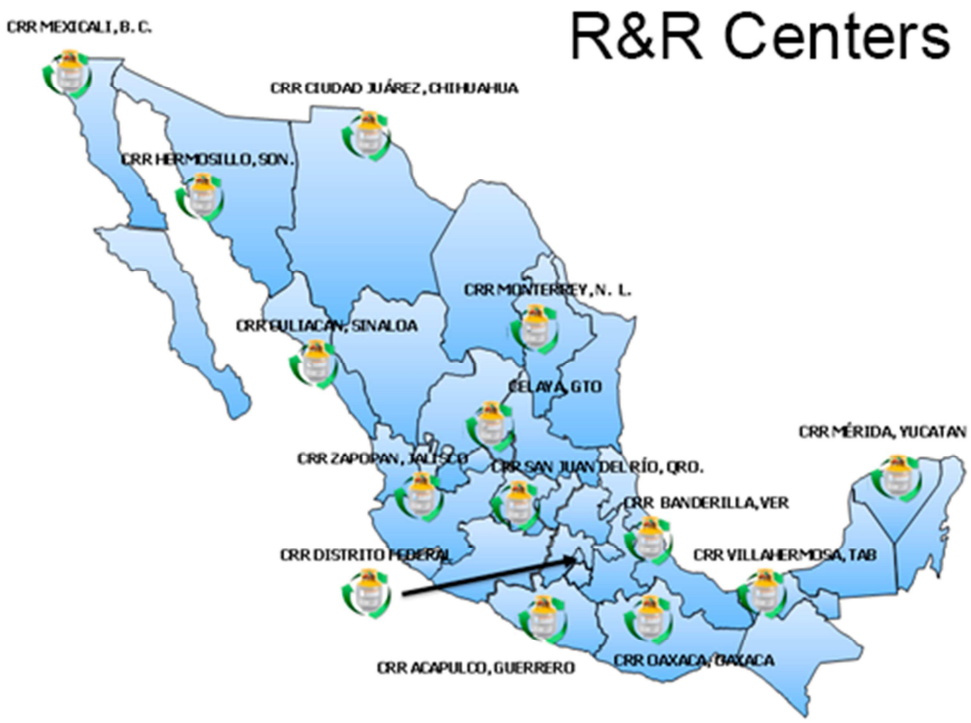
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Annexes

Annex I. Description of R&R Centers in Mexico

The 14 R&R centers in Mexico that were created by the NPP and operated as part of the ODS destruction project are geographically depicted in Figure 18, while a brief description of each is presented below.

Figure 18 Location of Recovery and Recycling Centers



Source: SEMARNAT.

1. **Recycling Center Celaya, Guanajuato. Ecofrigo.** Ecofrigo Company is dedicated to fridges scrapping and refrigerant gas center, it has installed an efficient system to increase the performance in the refrigerant gas recovery up to 150 g per equipment.
2. **Recycling Center Mexico City. Control Ambiental Profesional del Norte, S.A. de C.V.** The company operated a recycling center and it had a center for collection and destruction of refrigerators.
3. **Recycling Center Mexicali, Baja California. ING Servicios Profesionales, S.A. de C.V.** Since the installation of the recycling center in 2007, the company has been collecting and storing gases for destruction, currently is working in close coordination with others two centers (Veracruz and Tabasco) in order to get carbon credits. The company operated a recycling and FIDE centers within Baja California, it mainly dedicates to sell air conditioning equipment such as minisplits, cassette units and window units.

4. **Recycling Center Villahermosa, Tabasco. Martín Alejandro Ramón.** From the beginning of the operations, the recycling center has been collecting and storing ODS contaminated for destruction from 7 FIDE Centers.
5. **Recycling Center Xalapa, Veracruz. Ingeniería en Construcción y Soluciones Ambientales, S.A. de C.V**. The company was founded in Veracruz in 2004; its main services included the collection of gases from the equipment replacement at the FIDE centers. The company operated a recycling center and 5 FIDE centers within Veracruz. According to the SISSAO and FIDE, after Ecofrigo, this center had the highest recovery rates in the program.
6. **Recycling Center Acapulco, Guerrero. Trade Supply Integral S.A de C.V.** A company based in the south of the country. During the last 15 years the company has been involved in the commercial air conditioning business and recovery and recycling market of HCFC-22 covering part of Guerrero, Morelos, Chiapas, Campeche and Mexico City.
7. **Recycling Center Ciudad Juárez, Chihuahua. Radiorefrigeración.** It is the second center located in the north of the country, near of the border with the United States, it is mainly dedicated to the sale of commercial refrigeration machines and distribution of refrigerant gas.
8. **Recycling Center Zapopan, Jalisco. Jorge Medina Álvarez.** Previously operated by Importaciones Cortez Company (from 2007 to 2011), the recycling center of Jalisco began operations in April 2011. Based in the metropolitan area of Guadalajara, Jorge Medina Company has 20 years of experience in the field of handling, sale and distribution of refrigerant gases.
9. **Recycling Center Hermosillo, Sonora. Refriequipos de Sonora**. It was founded over 20 years ago in the north of the country, it was the second recycling center near of the border with the United States, the company was involved in buying and selling parts, accessories, conditioning air equipment and distribution of refrigerant gases covering Sonora and Baja California. In the recovery and recycling concerns, the center worked significantly in the HCFC-22 market for air conditioners.
10. **Recycling Center Monterrey, Nuevo León. Instalaciones y servicios de refrigeración, S.A de C.V.** A Mexican company founded 20 years ago, it was based in the north of the country, the third center installed near of the border with the United States, and the company was involved on vending machines sales and distribution of refrigerant gas.
11. **Recycling Center San Juan del Río, Querétaro. Refrigerantes del Bajío.** A Mexican company founded 10 years ago, it is located in the center of the country and has with 10 branches. They are involved in de commercial and air conditioning business as well the center offers maintenance service in all sectors. The company operated a recycling center and it had a center for collection and destruction of refrigerators (FIDE).
12. **Recycling Center Oaxaca. Refri-Hogar.** It was a company founded 35 years ago, located in the southwest of Mexico, involved in selling parts and accessories for refrigeration equipment, fridges, and minisplits and as a part of the integral service it provided maintenance for refrigeration and conditioning air equipment. The company operated a recycling center and it had a center for collection and destruction of refrigerators (FIDE). This center had one of the highest recovery rates in the FIDE centers, in average 50 g per appliance. From 2007 the recycling center has been collecting and storing refrigerant gases for destruction, currently the company has stockpiled already collected to be sent for destruction.

13. **Recycling Center Culiacan, Sinaloa. Taller el Capule, S.A. de C.V.** It was located in the northwest of the country, in the capital of Sinaloa, the company has over 30 years of experience on the sale of refrigeration and air conditioning equipment, parts and distribution of refrigerant gases as well as offering recovery services. This center received and stored gas for destruction from 8 FIDE centers of the region and other stakeholders.
14. **Recycling Center Mérida, Yucatán. Refrimart de México, S.A. DE C.V.** Refrimart de Mexico was based in the southeast of the country, in the capital of Yucatán State, the company was involved in the sale of refrigeration and air conditioning equipment, accessories and distribution of refrigerant gases as well as offering recovery services. This center is received and stored gas for destruction from 7 FIDE centers of the region and other stakeholders.

As part of the NPPR&R training programme, each center was trained and equipped with the below items:

Table 16 R&R Centers equipment

Description	Units
Reclaiming Machine for CFC, HCFC and HFC	1
Recovery machine	1
Vacuum pumps	1
Refrigerant Identifying Kit	1
Liquid refrigerant transfer kit	1
Programmable Electronic Charging Scale	1
Service two way manifold for R-12, R-22 and R-502 with hoses	1
Service two way manifold for R-134a, R-404A and R-407C with hoses	1
Recovery cylinders (50 pound)	20
Recovery Tanks (1,000 pounds)	3
Dehydrator Filter	10
Valve core set (piercing valves) in box	2
Digital balances	1
Portable electronic leak detector	1
Contamination detector Kit	1
Stock of spare parts to operate for one year	1

Source: SEMARNAT.

Annex II. Intended ODS destruction costs in the USA

Though not fully implemented[33] due to underestimation of the implementation costs, the indented economic costs for Stage 1A ODS destruction at two facilities in the USA are summarized in Table 17.

Table 17 Proposed cost structure of ODS destruction project in the USA

Project component	Cost (USD)
Staff and travel expenses	30,000
Transportation within Mexico	42,000
Aggregation and centralization	58,000
International transportation (2 facilities)	60,000
Documentation and permits	20,000
ODS Destruction (2 facilities)	428,064
MRV	62,500
Project management	21,403
Technical workshop	55,000
Total Destruction Project Implementation	**776,967**
ODS banks to be destroyed (kg)	**74,000**
Unit costs (USD/kg)	**10.5**

Source: UNIDO.

[33] Only Transportation within Mexico, Aggregation and Centralization were implemented.

Annex III. ODS destruction pilot test results in Argon plasma arc

ODS destruction pilot test at Quimobásicos Argon plasma arc took place from August 27th to 30th, 2013. As per the test protocol approved by SEMARNAT, 480 kg of ODS were supplied in four test cycles as seen in Table 18.

Table 18 ODS composition of samples used during pilot test in Argon Plasma Arc

Test cycle	ODS tested	Composition	Quantity (kg)
1	HFC-134a	100%	120
2	HFC-134a	100%	120
3	HFC-134a /HCFC-22	85%/15%	120
4	HFC-134a /HCFC-22	85%/15%	120
Total			**480**

Source: Quimobásicos.

The results of the destruction tests showed that average destruction efficiency was 99.9994%. Five samples were tested, as one of the cycles (August 28th) was interrupted due to issues in one of the equipment components. ODS destruction efficiency was analyzed by a certified laboratory from the US.

Table 19 ODS destruction efficiency results during pilot test in Argon Plasma Arc

Date	Operation time (h)	ODS tested	Destruction Efficiency
August 27th	4.09	100% HFC-134a	99.9994%
August 28th	4.45	100% HFC-134a	99.9994%
August 29th	4.05	85% HFC-134a / 15% HCFC-22	99.9998%
August 29th	4.02	85% HFC-134a / 15% HCFC-22	99.9983%
August 30th	4.03	100% HFC-134a	99.9999%
Mean value			**99.9994%**

Source: Quimobásicos.

Annex IV. ODS destruction pilot test results in cement kiln

ODS destruction pilot test at Holcim Mexico facilities took place on May 19 and 20th, 2015 in the cement kiln 1 of Tecomán plant. 2,050 kg of recovered unwanted ODS contained in three cylinders of varying compositions of HFC-134a, CFC-12 and HCFC-22 were supplied through SEMARNAT (Table 20). A dedicated feeding pipe with instrumentation was installed in order to supply the ODS into the main burner´s primary air inlet. ODS handling was performed by Geocycle (formerly Ecoltec), while Holcim staff supervised the flow of gases supplied into the cement kiln.

Table 20 ODS composition of samples used during pilot test in cement kiln

	Cylinder 1	Cylinder 2	Cylinder 3
HFC-134a (%)	35.6	23.8	30.5
CFC-12 (%)	52.6	53.2	10.2
HCFC-22 (%)	10.8	23.0	59.4
Gross weight (kg)	1320	1290	550
ODS net weight (kg)	**840**	**810**	**150**

Source: Holcim Mexico/Geocycle.

In each test, samples of fuels supplied in the cement kiln were analyzed (Table 22). Results are shown in Table 21. It is relevant to mention that between 12 and 21% of alternative fuels were supplied in the kiln, including tire and sludge residues.

Table 21 Results of analysis performed to fuels supplied during the pilot test in cement kiln

Parameter	Units	Solids	Tires	Liquids	Sludge
Moisture	%	17.30	2.36	93.6	89.90
Chlorine	%	0.31	≤ 0.03	0.15	0.18
Caloric value	MJ/kg	25.8	30	0	6.0
Sulfur	%	0.42	1.6	1.2	0.48
Na_2O	%	0.30	0.02	1.88	0.18
K_2O	%	0.18	0.05	0.02	0.05
pH	%	7.90	8.1	4.05	4.67
Ashes	%	17.90	NA	1.09	6.97

Source: Holcim Mexico/Geocycle.

Table 22 Amount and type of fuels supplied into the cement kiln during the pilot test

Test date	Tire chips (tonnes)	Solids (tonnes)	Liquids (tonnes)	Sludge (tonnes)	% Alternative fuels
May 20th	21.7	16.3	6.5	13.8	12.2
May 21st	38.6	26	0	24.8	20.7

Source: Holcim Mexico/Geocycle.

Combustion gases were analyzed through the CEMS installed in the stack of line number one, which consists of a dust analyzer and a gas analyzer, according to NOM-040-SEMARNAT-2002

requirements. CEMS allow the measurement of NO_x, SO2, HCl, CO, Particles and Hydrocarbons. Other parameters, including Dioxins and Furans, heavy metals and ODS, were point measured by third party laboratories.

Operating conditions of the pilot tests are summarized in the Table 23.

Table 23 Cement kiln pilot test operating conditions in 2015

Test date	Average gas flow (kg/h)	Maximum gas flow (kg/h)	Gas feed period (h)	Gas fed (kg)
May 20	43	52	23	980
May 21	153	277	7	1070

Source: Holcim Mexico/Geocycle.

The results of the emission parameters measured through the CEMS are shown in Table 24. It must be noticed that CO emissions are expected be high as alternative fuels, such as tires and sludge, were supplied to the kilns. Nevertheless, these emissions are kept well below NOM-040-SEMARNAT-2002 specifications as seen below.

Table 24 Continuous monitoring results of emission parameters regulated by NOM-040-SEMARNAT-2002

Parameter	Emission limits [a]	Units	Test date	
			May 20th	May 21st
CO	4,000	mg/m^3	340.71	585.93
SO_2	1,200	mg/m^3	0.88	0.08
NO_x	1,200	mg/m^3	480.81	454.67
THC	70	mg/m^3	24.08	28.47
HCl	70	mg/m^3	10.34	5.92

[a] Emission limits set as per NOM-040-SEMARNAT-2002

Source: Holcim Mexico/Geocycle.

Moreover, the results of point measurements to regulated emission parameters is depicted in Table 25.

Table 25 Point measurement results of emission parameters regulated by NOM-040-SEMARNAT-2002 and TEAP

Parameter	Emission limits [a]	Test date	
		May 20th	May 21st
Sb, As, Se, Ni, Mn	0.70 mg/m^3	< 0,0770	< 0,073 2
Cd	0.07 mg/m^3	0,0015	~ 0,000 6
Hg	0.07 mg/m^3	< 0,0023	~ 0,003 5
Pb, Cr, Zn	0.70 mg/m^3	~ 0,0463	~ 0,039 8
Dioxins and Furans	0.2 (ng ITEQ/m^3)	0,0010	0,001 4
Particles (TSP)	26.7 kg/h	0,1910	0,242

[a] Emission limits set as per NOM-040-SEMARNAT-2002, except for Dioxins and Furans, which are set according to UNEP/TEAP (2002).

Source: Holcim Mexico/Geocycle.

Finally, the results of analysis performed to combustion gases on ODS composition is summarized in Table 26.

Table 26 ODS concentration in combustion gases during pilot tests

ODS	May 20th			May 21st		
	Sampling time	Gas flow (kg/h)	Concentration (mg/m^3)	Sampling time	Gas flow (kg/h)	Concentration (mg/m^3)
CFC-12	13:35-14:06	50	< 0.0243	10:05-10:54	200	< 0.0240
	14:07-14:21	50	< 0.0265	11:00-11:30	240	< 0.0253
	14:22-14:46	50	< 0.0249	11:48-12:40	277	< 0.0251
HCFC-22	13:35-14:06	50	~ 0.0577	10:05-10:54	200	< 0.0142
	14:07-14:21	50	< 0.0157	11:00-11:30	240	< 0.0150
	14:22-14:46	50	< 0.0148	11:48-12:40	277	< 0.0149
HFC-134a	13:35-14:06	50	< 0.0193	10:05-10:54	200	< 0.0191
	14:07-14:21	50	< 0.0148	11:00-11:30	240	< 0.0200
	14:22-14:46	50	< 0.0198	11:48-12:40	277	< 0.0199

~ Results are between detection limit (DL) and quantification limit (QL).
< Results are below the detection limit (DL).

Source: Holcim Mexico/Geocycle.

According to pilot test performance results it was concluded that ODS destruction is feasible without increasing toxic and regulated emissions, and without impacting the quality of the clinker produced.

A maximum gas feed flow of 277 kg/h was achieved in 7 hours of test during the second day. This feed flow was attained by supplying the gases through the primary airline of the main burner. The destruction efficiency reached was 99.99865%.

All the measured parameters complied with the regulations established in NOM-040-SEMARNAT-2002 and the UNEP/TEAP (2002). It was further noticed that during the tests a reduction of 16% of NO_x was accomplished in comparison to 2014 average value.

The applied operation and safety measures allowed to ensure that unwanted ODS destruction:

1. Safety of workers and community is not put at risk

2. Emissions limits set by NOM-040-SEMARNAT-2002 and TEAP are not exceeded.

3. No disturbances are introduced into the process or quality of cement produced.

4. Destruction of unwanted ODS is compatible with clinker manufacturing.

Final Report

Demonstration of a Regional Strategy for ODS Waste Management and Disposal in the ECA Region

EUR/DES/69/DEM/13 - UN Environment
EUR/DES/69/DEM/14 - UNIDO

PRESENTED TO THE
80TH MEETING OF THE EXECUTIVE COMMITTEE
OF THE MULTILATERAL FUND FOR THE IMPLEMENTATION
OF THE MONTREAL PROTOCOL

September 2017

Executive summary

The project "Demonstration of a Regional Strategy for ODS Waste Management and Disposal in the ECA Region" was submitted jointly by UN Environment and UNIDO on behalf of the Governments of Bosnia and Herzegovina, Croatia and Montenegro. It was approved in April 2013 under a funding window for ODS destruction for LVC countries, at the funding level of USD 274,480 for UNIDO and USD 75,000 for UN Environment (excluding PSC). Preliminary project expenditures are USD 229,782 related to UNIDO's components and USD 32,840 to UN Environment's components. Thus, the overall expenditure of the project is USD 262,622.

The objective of the project was to evaluate a regional approach for ODS waste disposal in terms of cost-effectiveness and sustainability, particularly in LVC countries that do not have ODS destruction facilities. The project activities were divided into four components:

- Component 1: Aggregation of ODS waste at national level
- Component 2: Transportation of ODS waste and destruction
- Component 3: Establishment of a regional cooperation forum on ODS waste disposal
- Component 4: Awareness raising, training and project monitoring.

The project proposal aimed at environmentally sound destruction of 29.07 MT of ODS waste from the participating countries. The waste collected within the project included mainly ozone depleting CFCs and HCFCs as well as some amounts of hydrofluorocarbons (HFCs). For the purpose of destruction, it was not feasible to separate ODS waste from non-ODS waste, and therefore all collected quantities were destroyed under the project. Cost effectiveness for the project, however, was calculated based on the portion of ODS waste destroyed only.

In total, 41.37 metric tonnes (MT) of waste were destroyed, including 32.79 MT of ODS waste. Quantities of ODS and non-ODS waste collected and destroyed in each batch are presented in the following table:

Batch number	Country of destruction	Quantity of collected waste (MT)	Quantity of ODS waste (MT)	Quantity of non-ODS waste (MT)
Batch 1	Germany	7.38	7.38	0
Batch 2	Poland	25.64	19.12	6.52
Batch 3	Poland	8.35	6.29	2.06
Total:		**41.37**	**32.79**	**8.58**

The overall cost effectiveness for the project is 8.01 USD/kg taking into account all activities related to the project components 1-4. This exceeds the initially expected cost effectiveness of 12.02 USD/kg.

Aggregation of the ODS waste on the regional level, synchronization of the shipments from different countries, as well as finding synergies with POPs destruction were not possible, due to obstacles in both legislation and institutional arrangements of the beneficiary countries.

The Regional Cooperation Forum (RCF) was established as a communication platform that promotes the information exchange on success stories and lessons learned related to ODS destruction activities in the Europe and Central Asia (ECA) region. It was initiated during the

project start-up meeting in Vienna in October 2013 followed by a series of meetings at national and sub-regional level. The final meeting of the RCF was held during the thematic meeting of the ECA network in Bucharest in 2015, where the beneficiary countries shared lessons learned and their experience with the regional approach with other meeting participants from the region, namely representatives of Albania, Macedonia FYR, Serbia and Turkey.

Important outputs of the activities of the forum include: list of equipment and tools that are necessary for proper aggregation of waste; check list for laboratory analysis of ODS waste; list of eligible destruction facilities in the EU and recommendations and lessons learned.

Background information

The project "Demonstration of a Regional Strategy for ODS Waste Management and Disposal in the ECA Region" was submitted jointly by UN Environment and UNIDO on behalf of the Governments of Bosnia and Herzegovina, Croatia and Montenegro. It was approved at the 69th meeting the Executive Committee of the Multilateral Fund in April 2013 (UNEP/OzL.Pro/ExCom/69/40, Decision 69/18) under a funding window established by the Executive Committee's decision 63/4(c) for the destruction of ozone-depleting substances (ODS) for LVC countries, pursuant to decision XXI/2 of the 21st meeting of the Parties.

UNIDO's component (EUR/DES/69/DEM/14) was approved at USD 274,480 plus PSC and focused mainly on the aggregation of ODS waste at national level, storage, analysis of the composition, transportation and destruction of the ODS waste.

UN Environment's component (EUR/DES/69/DEM/13) was approved at USD 75,000 plus PSC and focused mainly on the establishment of a regional cooperation forum on ODS waste disposal, providing institutional support, awareness raising, training and project monitoring.

The objective of the project was to evaluate a regional approach for ODS waste disposal in terms of cost-effectiveness and sustainability, particularly in low-volume-consuming (LVC) countries that do not have ODS destruction facilities. In these countries, the amounts of collected ODS waste usually do not justify the establishment of local disposal facilities, and thus the ODS waste is exported for destruction at high management and overhead costs. The expected amount of ODS waste to be destroyed under the project was 29.07 MT and the break-down by country is presented in Table 1:

Country of origin	**Expected amount of ODS waste / MT**			
	CFC-11	**CFC-12**	**Mixtures**	**Total**
Bosnia and Herzegovina	0.400	0.095		0.495
Croatia		5.772	22.249	28.021
Montenegro	0.440	0.110		0.55
Total	**0.840**	**5.977**	**22.249**	**29.066**

Table 1: Expected amount of ODS waste to be destroyed under the project.

Thus the initially expected cost effectiveness of the project is 12.02 USD/kg.

Part of the project was the establishment of a regional cooperation forum on ODS waste disposal for the participating countries, in order to coordinate the disposal of ODS waste and to explore possibilities of expanding the concept to other types of hazardous wastes at a later stage. Last, but not least, the project aimed at developing and delivering an awareness and training programme for relevant stakeholders in order to enhance their commitment towards ODS recovery, recycling, reclaim, collection, storage, transport and disposal.

The project activities were divided into four components:

Component 1: Aggregation of ODS waste at national level, including identification and selection of facilities to collect and store national ODS waste stocks, provision of storage equipment (ISO cylinders), technical assistance for the analysis of the composition of the ODS waste stocks, and preparation of required documentation.

Component 2: Transportation of ODS waste and destruction, including the assessment of the optimal means for transport of the ODS waste to a facility within the European Union (EU) as none of participating countries has ODS destruction facilities, for each of the shipments, taking into account requirements of the Basel Convention.

Component 3: Establishment of a regional cooperation forum on ODS waste disposal, to share experiences, provide training and know-how, and organize common disposal operations among the three countries. The project provided institutional support and developed the appropriate technical and human resource capacity for ODS waste management, including aggregation, storage and destruction.

Component 4: Awareness raising, training and project monitoring. In order to ensure that the ODS waste collected and disposed of is properly accounted for, the process was closely monitored and data were recorded.

The last batch of ODS waste has been destroyed in April 2017 and with the submission of the final report, the project can be considered completed in September 2017. The results achieved in each of the project components are described in the following sections.

Component 1: Preparatory step (aggregation, quantitative analysis of the waste mixture, obtaining all relevant permits)

Collection and aggregation

Collection and aggregation of ODS waste was performed on the national level. Each of the participating countries undertook related activities that are described in this chapter.

In Croatia, the first step was to contact the recovery, recycling and reclaim (RRR) centres and main stakeholders and to collect information about the quantities of ODS waste that had been collected in the country. The RRR centre CIAK Zabok was responsible for coordinating these activities and collecting ODS waste from the two other RRR centers (RRR Center Split and Kemis company). One challenge was the storage of large quantities of ODS waste prior to export and destruction. The National Ozone Officer and the project management team decided to supply the RRR centres with additional ten pressure cylinders of 950 l to resolve the issue.

Croatia has an Environment Fund which might finance the collection, transport and destruction of refrigerant waste (ODS and F-gases) in future thus sustaining the disposal operations. National legislation prescribes import fees for ODS and F-gases, which feed into the Environment Fund. Importers pay 3 Croatian Kuna (HRK) (about USD 0.47) per kg of imported ODS or F-gases.

In order to collect data on quantities of collected ODS waste in Montenegro, the Ozone Officer consulted service technicians and the manager of the recovery and recycling (RR) centre. A relatively small amount of 80 kg of CFC-11 could be identified for destruction. This is partly due to the late implementation of the Terminal Phase-out Management Plan (TPMP) and RR scheme, and partly due to the fact that legislation did not prescribe a decommissioning date for end-of-life ODS equipment. Montenegro became a party to the Montreal Protocol in 2006, and the Country Programme and TPMP were approved end of 2007. The first RR equipment was delivered to the service technicians end of 2009. Only the company Hemosan doo in Bar is authorized to collect and to transport ODS waste.

In Montenegro, legislation covers recovery and recycling of ODS and alternative substances (F- gases), as well as managing ODS and F-gases waste in accordance with the regulations on waste disposal.

Bosnia and Herzegovina had identified some quantities of ODS waste during the project preparation stage. However, they were not anymore available during the implementation phase. No new ODS waste could be identified.

The collected waste included mainly ozone depleting CFCs and HCFCs as well as some amounts of hydrofluorocarbons (HFCs). The latter do not contribute to ozone depletion but are potent global warming gases. For the purposes of destruction, it was not feasible to separate ODS waste from non-ODS waste, and therefore all collected quantities were destroyed under the project. Cost effectiveness for the project, however, was calculated based on the portion of ODS waste destroyed only.

Table 2 presents quantities of ODS waste and non-ODS waste collected, taking into account the results of the chemical analysis of the waste mixtures from Croatia.

Batch number	Country of destruction	Quantity of collected waste (MT)	Quantity of ODS waste (MT)	Quantity of non-ODS waste (MT)
Batch 1	Germany	7.38	7.38	0
Batch 2	Poland	25.64	19.12	6.52
Batch 3	Poland	8.35	6.29	2.06
Total:		**41.37**	**32.79**	**8.58**

Table 2: Quantities of ODS and non-ODS waste collected for each batch.

Supply of the cylinders and tools

This activity was implemented in cooperation with selected RRR centres from each of the participating countries:

- Bosnia & Herzegovina: Kemis BH d.o.o. in Lukavac
- Croatia: C.I.A.K. d.o.o. in Zabok
  Frigomotors d.o.o. in Dugopolje
  Kemis Termoclean in Zagreb
- Montenegro: Hemosan d.o.o in Bar.

The RRR centres were equipped with equipment and tools necessary for proper aggregation at the national level. Following the need assessment, agreement on the equipment specification, and completion of the bidding procedure, the equipment was delivered to the RRR centres in October 2014.

Prior to the use, the cylinders were inspected and certified in each of the countries i.e. in Croatia by the TUV Croatia. The equipment and tools supplied to the recycling centers included refrigerant identifiers, service manifolds, charging hoses, adapters, gauges, system analyzers, scales, leak detectors, vacuum pumps, thermometers, refrigerant charts, piercing tools, pinch-off pliers, contamination detector kits, safety gloves and goggles, cylinder warming blankets and recovery cylinders. The list of equipment provided to the RRR centers is presented in Annex 1.





Photos 1-3: Example of equipment, tools and cylinders provided.

The following Table 3 provides an overview of the quantities of ODS waste from each of the RRR centers and how they were grouped into the three batches:

Batch number	RRR centre / country	Quantity of collected waste (MT)	Quantity of ODS waste (MT)	Quantity of non-ODS waste (MT)
Batch 1	CIAK / Croatia	7.38	7.38	0.00
Batch 2	CIAK / Croatia	17.02	13.43	3.59
	Frigomotors / Croatia	5.11	3.29	1.82
	Kemis / Croatia	3.51	2.40	1.11
Batch 3	CIAK / Croatia	8.27	6.21	2.06
	Hemosan / Montenegro	0.08	0.08	0.00
Total:		**41.37**	**32.79**	**8.58**

Table 3: Quantities of ODS and non-ODS waste collected by each RRR centre.

Chemical analysis

Chemical analysis of waste mixtures is an important step in the preparatory phase and is needed for two reasons:

- Firstly, to determine the quantity of ODS waste that will be destroyed under the project
- Secondly, to reduce the destruction costs. Cost estimates provided by eligible destruction facilities indicated 25-30% higher costs for destruction of waste mixtures without chemical analysis of their composition.

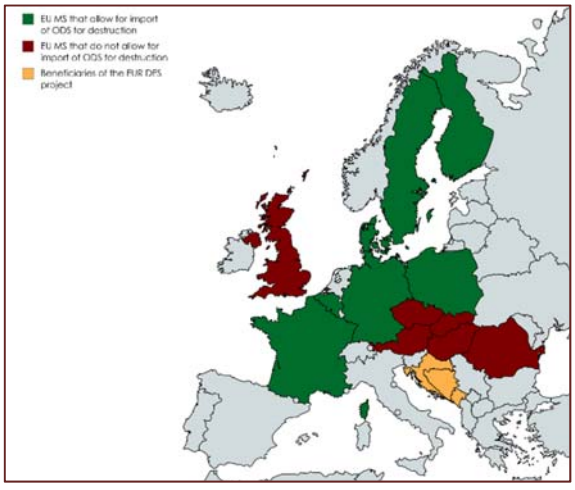
The Public Health Institute was selected to analyze the composition of waste mixtures collected in Croatia. It was using gas chromatography and aware of the analytical methods and standards to perform this type of analysis. The procedure to analyze chemical composition of the waste mixture collected in Croatia is described in Annex 2. The report of the chemical analysis is presented in Annex 3.

Selection of destruction facility

There are no destruction facilities in the beneficiary countries. For that reason, appropriate destruction facilities had to be identified abroad. European Union (EU) countries were considered due to their geographical proximity but also because of type of destruction technologies, the level of emission control and the sustainability of the scheme in the future, when the countries in the region might become EU member states.

The criteria for selecting eligible destruction facilities were defined based on the list of approved destruction technologies as prepared by the Technical and Economic Assessment Panel (TEAP) and the list of approved destruction technologies in the EU (Annex VII of EC/1005/2009[1] on Substances that Deplete the Ozone Layer).

Twenty-eight licensed facilities in 13 EU countries were identified that met the defined criteria. However, during the bidding procedure it was realized that the legislation in some of the countries did not allow import of ODS waste for destruction.



Graphic 1: Map of EU countries allowing (green) and not allowing (red) the import of waste ODS for destruction.

[1] Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on Substances that Deplete the Ozone Layer

The list of destruction facilities in EU countries that allow import of ODS waste for destruction is contained in Annex 4. The location of the destruction facilities that were invited to submit bids is shown on the following graphic:



Graphic 2: Location of the destruction facilities that were invited to submit bids.

Separate bidding procedures were organized for each batch. The analysis of offers from interested bidders showed that:

- Destruction costs ranged from 1.64 to 2.15 Euros/kg and the price differences were not caused by different types of technology since all interested bidders used rotary kiln incineration
- Transportation costs ranged from 0.36 to 0.66 Euros/kg and the price differences were not related to the transport distance
- The mode of storage of the ODS waste i.e. in several pressure cylinders at the point of origin has an impact on the transport costs. They can be up to 30% higher compared with the ideal scenario of transporting a single container in a single trip.

For the first batch, the German destruction facility “GSB Sonderabfall-Entsorgung Bayern GmbH” was selected to incinerate 7.38 MT of waste. The Polish destruction facility “SARPI Dąbrowa Gornicza” was selected for the second batch of 25.64 MT and the third batch of 8.35 MT of waste. These amounts include both ODS waste and non-ODS waste.

Component 2: Transportation and destruction, obtaining of the permits

Transport of the collected waste

The following approaches to transport collected waste to the destruction facilities were explored:

- Identifying local owners of other types of hazardous wastes, such as persistent organic pollutants (POPs) that would be willing to co-transport their wastes with the aggregated waste from the project
- Combining the waste quantities of the three countries before the transport to the destruction facility and transporting them in the same vehicle
- Transporting the waste quantities of each country separately to the destruction facility.

All participating countries are parties to the Basel Convention. Croatia is an EU member state, and the other two have the status of candidate countries. Therefore, EU regulations are directly applied in Croatia whereas Bosnia and Herzegovina and Montenegro are in the process of aligning their national legislation with the EU requirements. For that reason, in all three countries, waste CFCs, HCFCs and HFCs are classified as hazardous waste, in line with Commission Decision on the European List of Waste (COM 2000/532/EC) and Annex V to EU regulation 1013/2006[2].

Possible synergies with other chemical initiatives especially in the Persistent Organic Pollutants (POPs) focal area were explored. The national POPs teams were consulted to identify areas where joint efforts could save resources and reduce costs, including waste inventories, data collection and maintenance as well as handling, transportation, storage and disposal of waste. In Croatia, the Law on Waste Management does not allow combining ODS waste and POPs waste for destruction. The same applies to the other countries. Therefore, combining hazardous waste streams for destruction was not feasible.

Croatia had aggregated the largest quantities of waste and had been considered as the aggregation point for the waste quantities from the other countries. Croatian legislation allows the import of hazardous waste only for disposal in an environmentally sound manner but not for the purpose of aggregation and re-export. As Croatia lacks appropriate licensed facilities for recovery or disposal of ODS waste, the import of such waste is prohibited. Therefore, the option of combining the waste quantities of the three countries before transporting to the destruction facility was not feasible.

Accordingly, collected waste from each country was transported separately to the respective destruction facilities.

Destruction of the collected waste

In total, 41.37 metric tonnes (MT) of waste were destroyed including 32.79 MT of ODS waste. This exceeds the initially estimated amount of 29.07 MT.

For the purpose of bidding and contracting the destruction facility, collected waste was grouped into three batches as described in Tables 4-6.

[2] Regulation (EC) No 1013/2006 on shipments of waste

The first batch from Croatia was the waste previously collected and stored at CIAK. So it came from one RRR center and there was only one shipment. The second and third batches included additional waste collected during the project implementation.

The first batch consisted of 7.38 MT of ODS waste that were previously collected and stored in the Croatian RRR centre CIAK d.o.o. in Zabok. The waste was exported and destroyed at the German facility on the following date:

First batch	Quantity (MT)	Shipment date	Destruction date
Shipment 1	7.38	28 May 2013	11 July 2013
Total:	**7.38**		

Table 4: Quantity of waste and dates of shipment and destruction for the first batch.

The second batch of 25.64 MT of waste from Croatia included 19.12 MT of ODS waste. The waste was exported in three separate shipments and destroyed at the Polish facility on the following dates:

Second batch	Quantity (MT)	Shipment date	Destruction date
Shipment 1	10.143	18 December 2014	30 December 2014
Shipment 2	10.883	20 March 2015	20 April 2015
Shipment 3	4.614	22 May 2015	12 June 2015
Total:	**25.64**		

Table 5: Quantity of waste and dates of shipment and destruction for the second batch.

The third batch of 8.35 MT of waste included 6.21 MT of ODS waste and 2.06 MT of non-ODS waste from Croatia as well as 0.08 MT of ODS waste from Montenegro. The waste was separately exported from Croatia and from Montenegro and destroyed at the Polish facility on the following dates:

Third batch	Quantity (MT)	Shipment date	Destruction date
Shipment 1	8.27	17 November 2016	18 December 2016
Shipment 2	0.08	12 April 2017	25 April 2017
Total:	**8.35**		

Table 6: Quantity of waste and dates of shipment and destruction for the third batch.

The ODS waste from Montenegro was supposed to be destroyed together with the waste from Croatia, but this was not possible since the licensing procedure in Montenegro took longer and since the transport licenses for the waste from Croatia were already issued and about to expire. Therefore, the ODS waste from Montenegro was shipped at a later stage and the destruction combined with that of ODS waste from Turkey, where UNIDO was implementing a similar project funded by the Multilateral Fund.

For all shipments, movement documents confirming the amount of ODS waste destroyed were issued. Annex 5 shows an example of such movement document.

The project proposal aimed at environmentally sound destruction of 29.07 MT of ODS waste from the participating countries. The actual amount of ODS waste destroyed is 32.79 MT as shown in Table 7.

Country of origin	Expected amount of ODS waste to be destroyed / MT	Actual amount of ODS waste destroyed / MT
Bosnia and Herzegovina	0.495	0.00
Croatia	28.021	32.71
Montenegro	0.55	0.08
Total	**29.066**	**32.79**

Table 7: Expected and actual amounts of ODS waste destroyed under the project.

Obtaining necessary permits

All shipments were subject to rules and permitting requirements stipulated in the Basel Convention. The permits were obtained by the beneficiary RRR centres. It took about 10-15 days to obtain the necessary permits in Croatia but several months in Montenegro. Therefore, it was not possible to synchronize the shipments. In addition, export / transit / import permits had to be obtained:

- For the shipments to the destruction facility in Germany for Croatia, Slovenia, Austria and Germany
- For the shipments to the destruction facility in Poland for Croatia, Slovenia, Austria, Czech Republic and Poland.

There are also costs related to obtaining of all necessary permits – export permits from the country of origin, transit permit from each transit country, import permits from the destination country in which the destruction facility is located. There are also costs associated with translation of some of the required paperwork.

Component 3: Regional cooperation forum on ODS waste disposal

The Regional Cooperation Forum (RCF) is a communication platform that promotes the information exchange on success stories and lessons learned related to ODS destruction activities in the Europe and Central Asia (ECA) region. It was initiated during the project start-up meeting in Vienna in October 2013 followed by a series of meetings at national and sub-regional level. The forum built on existing infrastructures and human resources, with the national ozone officers being the focal points. Croatia's ozone officer was selected as the first chair of the forum.



Photo 4: Kick-off meeting of the project and the first forum meeting
in Vienna, Austria, in October 2013

The second workshop of the forum was held in Zagreb, Croatia in December 2014, after the first batch of collected waste had been destroyed. At this meeting, stakeholders discussed the experiences of the first aggregation, transportation and disposal activity within the project. A plan of action for the other two batches was elaborated and agreed upon. One of the conclusions from this meeting was that the other countries from the region, like Macedonia FYR and Serbia should be invited to the concluding workshop, to benefit from the experience gained in the context of ODS waste management and disposal.



Photo 5: Second meeting of the regional cooperation forum
in Zagreb, Croatia, in December 2014

For that reason, the third workshop of the forum was incorporated into the agenda of the ECA thematic meeting on implementation of HCFC phase-out management plans (HPMPs) in Bucharest, Romania, in October 2015. Final presentations by the countries and implementing agencies on the project activities took place at that meeting. Lessons learned and experience with the regional approach were summarized and shared with other participating countries from the region, namely Albania, Macedonia FYR, Serbia and Turkey. In addition, lessons

learned from the destruction projects in Georgia (UNDP) and Turkey (UNIDO) were presented.



Photo 6: Final meeting of the regional cooperation forum as part of the ECA thematic meeting in Bucharest, Romania, in October 2015.

The regional cooperation forum helped countries and implementing agencies to hold discussions on practical aspects of project implementation, to organize common disposal operations, such as coordination for national aggregation, launching of bidding tenders, evaluation of offers, etc. Important outputs of the activities of the forum include :

- List of equipment and tools that are necessary for proper aggregation of waste
- Check list for laboratory analysis of ODS waste
- List of eligible destruction facilities in the EU
- Recommendations and lessons learned.

Component 4: Awareness raising, training and project monitoring

National training workshops to share the experiences and lessons learned from the Croatian RRR system in Bosnia and Herzegovina and Montenegro

Two national training workshops on aggregation of ODS stocks for destruction and improvements in the RRR system were organized in Sarajevo, Bosnia and Herzegovina and in Podgorica, Montenegro, both in October 2014. The main objective of the meetings was to disseminate experiences with the operational collection and aggregation system in Croatia, and to assist both countries to enhance the collection of ODS waste during the project life and beyond. The main topics discussed during the meetings were:

- Review of Croatia's ODS and F-gas legislation with respect to RRR the disposal of ODS
- Analysis of how regulatory measures in Bosnia and Herzegovina/Montenegro could strengthen the sustainable management of refrigerants and ODS waste
- Analysis of how regulatory measures could enhance the operation of national RRR schemes in line with Montreal Protocol provisions

- Sharing Croatia's experience in planning, establishing and operating RRR systems for ODS and F-gases
- Explaining the key steps for implementation of disposal activities in Croatia including data survey, laboratory analysis, training activities, aggregation, transportation, verification, destruction and monitoring
- Importance of RRR systems and incentive schemes for retrofitting / replacement of end-user equipment and its contribution to the success of disposal actions at the national level.



Photo 7: National training workshop in Sarajevo, Bosnia & Herzegovina, in October 2014

The main conclusions from the training workshops in Bosnia and Herzegovina and Montenegro are:

- Servicing sector representatives expressed the need to introduce an obligatory licensing system for servicing companies as a condition for purchasing refrigerants.
- Servicing sector companies are committed to follow the good refrigeration practices but for them it is sometimes difficult to stay up to date with the requirements. The newly established RAC associations might facilitate this process and should be strengthened.
- There is a need for awareness raising and dissemination of information among owners of refrigeration equipment on their obligations to engage certified servicing company and personnel for installation, commissioning, decommissioning and servicing of RAC and MAC equipment.
- Mandatory record keeping of servicing companies, RRR centres and operators of RAC and firefighting equipment will provide with the necessary information about installed equipment, capacities, refrigerant type and leakage rates.
- It is important to recover refrigerants from end-of-life domestic refrigerators.
- The Croatian experts recommended the introduction of a licensing system for companies in the refrigeration servicing sector. Licensed companies would need to employ certified personnel and have equipment for the recovery of refrigerants.
- Montenegro is collecting environmental fees of about 1 Euros per kilo on imported ODS. Part of the collected funds should be spent on the environmentally sound disposal of ODS and promoting the RRR scheme.

- Bosnia and Herzegovina did not yet introduce environmental fees for the import of ODS or F-gases. If such fee was introduced, the collected funding could finance future disposal activities, the replacement of HCFC equipment and promote the RRR scheme.



Photo 8: National training workshop in Podgorica, Montenegro, in October 2014

National training workshop on ODS waste management in Croatia

The national training workshop on ODSs waste management was organized in Zagreb, Croatia in December of 2014. The main goal was to build the capacity of major stakeholders involved in ODS waste management and to discuss the key steps to implement disposal activities in Croatia including the data survey, laboratory analysis, training activities, aggregation, transportation, verification, destruction, and monitoring. The workshop was attended by 30 participants, including government representatives, national experts on ODS management, representatives of both RRR centres and the Environmental Fund, end-users and other relevant stakeholders. Representatives of Bosnia and Herzegovina and Montenegro also participated.

National training workshop for environmental inspectors in Croatia

The national training workshop on targeted inspections to comply with the RRR scheme for environmental inspectors was organized in Zagreb, Croatia, in November 2014. In total, 70 environmental inspectors were trained by three international experts from Slovenia (2) and Austria (1). The workshop was financed under Croatia's HCFC phase-out management plan (HPMP) and contributed to the objectives of the ECA destruction project. It focused on the comparison of the Croatian with the EU legislation, Slovenia's and Austria's experience related to the inspection of ODS installations, inspection of different types of RAC equipment, servicing and leakage checking of equipment and provided specific information on commonly used refrigerants. An important result of the workshop was the inclusion of 400 targeted inspections of ODS installations and RRR systems in the annual work plan. In 2015, about 50 halon related inspections took place in Croatia since that sector was prioritized in the annual work plan for 2015.

National training workshop for environmental inspectors in Montenegro

Training for environmental inspectors was organized in Podgorica, Montenegro, in 2013 under the HPMP. Montenegro has seven environmental inspectors but only one of them is responsible for ODS and F-gases. Representatives of the Hemosan company also participated in the training. The low staffing level of the inspection unit has a negative impact on enforcing ODS and F-gas related legislation.

Cost considerations

The demonstration project was approved at a funding level of USD 274,480 plus PSC for UNIDO and USD 75,000 plus PSC for UN Environment – in total USD 349,480. Upon project completion, the estimated project expenditures are USD 229,782 related to UNIDO's components and USD 32,840 to UN Environment's components. Thus, the overall cost estimate of the project is USD 262,622. Any balances will be returned to the Multilateral Fund after financial completion.

The project proposal aimed at the environmentally sound destruction of 29.07 MT of ODS waste from the participating countries. The actual amount of ODS waste destroyed is 32.79 MT. Thus, the overall cost effectiveness is 8.01 USD/kg taking into account all activities related to the project components 1-4. This exceed the initially expected cost effectiveness of 12.02 USD/kg.

Lessons learned

The following lessons can be drawn from the implementation of the ECA destruction project:

- The legislation in the EU and candidate countries does not allow the aggregation of ODS waste at regional level, because ODS waste is classified as hazardous waste, and the import / export of hazardous waste is generally banned. Some EU countries have an exemption in place and allow the import of ODS waste for disposal in an environmentally sound manner. However, since none of the beneficiary countries had such destruction facilities, the import for aggregation and re-export was not allowed.
- Operational and well established RRR schemes are crucial for the successful implementation of disposal activities. RRR centres, that handle electrical and electronic equipment (EEE) waste usually have relevant permits and are main stakeholders. Waste refrigerant mixtures are usually mixtures of CFC, HCFC and HFC components, and as such, it is not economically feasible to separate ODS from non-ODS waste prior to destruction.
- RRR centres need to be well equipped (including ISO cylinders) to allow proper aggregation at the national level.
- No synergies with the POPs destruction could be identified because of the national legislation not allowing the combination of ODS and POPs waste, the institutional set-up such as different departments / institutions dealing with each waste stream, and the fact that RRR centres specialized on ODS usually do not deal with other chemical waste.
- Obtaining of the permits for export / transit / import is essential for the time planning, because can take 15-60 days from the submission a complete application to actually obtaining the permit, which makes it difficult to synchronize shipments and destruction of waste from different countries.

- Chemical analysis of waste mixtures is important to determine the amount of ODS waste in the waste mixture, but also because the destruction costs of an unknown waste mixture can be 25-30% higher. Participating countries faced difficulties to identify laboratories that have ~~the~~ necessary equipment, analytical methods and corresponding standards in place to analyze waste mixtures containing ODS. National legislation might require accreditation of the analytical methods, but it is the laboratory to decide whether or not to include them in the accreditation. This decision is often based on the annual number of analysis required. Developing analytical procedures and maintaining accreditation for the analysis of waste mixtures might often be considered unprofitable.
- Destruction facilities should be selected based on geographical and technical criteria. The first one is to minimize transportation costs, and the latter is to ensure that the destruction will be performed in an environmentally sound manner. The destruction facilities were selected based on the list of approved technologies prepared by TEAP, but also list of approved technologies set by Annex VII of EC/1005/2009[3].
- In addition, national legislation of the country in which the destruction is supposed to take place should allow the import of waste mixtures containing ODS for destruction. The list of destruction facilities in EU countries that can accept waste mixtures containing ODS for destruction will be useful to other countries in the ECA region.
- An environmental fund, like the one in Croatia, can be an efficient mechanism to finance the collection, transport, aggregation and destruction of waste mixtures containing ODS as well as other refrigerants. The environmental fund in Croatia also provides an incentive to recover ODS waste by subsidizing the fee that the waste management facility pays to private persons who bring equipment and appliances for disposal. It also ensures sustainability of the collection system and destruction operations.
- Certification of servicing companies and technicians is important to ensure proper handling and collection of waste refrigerants. Some servicing sector representatives expressed the need to introduce obligatory licensing systems for servicing companies as a precondition to purchase refrigerants. That might prevent un-loyal competition from companies operating in the informal servicing sector which might use non-qualified personal and lack appropriate servicing and recovery equipment.
- Servicing sector companies are committed to follow the good refrigeration practices but for them it is sometimes difficult to stay up to date with the requirements. The newly established RAC associations might facilitate this process and should be strengthened.
- There is a need for awareness raising and dissemination of information among owners of refrigeration equipment on their obligations to engage certified servicing company and personnel for installation, commissioning, decommissioning and servicing of RAC and MAC equipment.
- Mandatory record keeping of servicing companies, RRR centres and operators of RAC and firefighting equipment will provide the necessary information on installed equipment, capacities, refrigerant type and leakage rates.
- It is important to recover refrigerants from end-of-life domestic refrigerators.
- Targeted inspections for complying with the RRR scheme are crucial for the collection of ODS waste. Environment inspectors should also be trained to inspect different types of RAC equipment, to review equipment log-books and be aware of commonly used refrigerants and related safety precautions. It would be useful to include scheduled inspections in the annual work plan and to prepare an inspection check-list.

[3] Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009 on Substances that Deplete the Ozone Layer

- Environmental taxes on refrigerants contributing to ozone layer depletion and climate change (ODS and F-gases) might feed into environmental funds to finance the environmentally sound disposal of refrigerant waste in the long term.

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Annex 1: List of equipment provided to the RRR centers

Item	Equipment	Kemis-BH d.o.o. in Lucavac	C.I.A.K. d.o.o. in Zabok	Frigomotors in Dugopolje	Hemosan d.o.o. in Bar	Total
1	**Advanced portable refrigerant identifier**	1	0	1	1	**3**
2	**Service manifold with hoses**	1	0	2	1	**4**
3	**Service manifold with hoses**	1	0	2	1	**4**
4	**1/4" Charging hoses with ball valve**	1	3	10	2	**16**
5	**Charging and intake adapters for liquid**	1	0	4	0	**5**
6	**High precision gauge class 1.0 100 mm. diameter**	1	1	2	1	**5**
7	**Digital vacuum gauge**	1	0	2	1	**4**
8	**Digital manifold/System analyzer**	1	0	1	1	**3**
9	**Digital scale**	1	0	1	2	**4**
10	**Portable electronic leak detector**	1	1	2	1	**5**
11	**Two-stage rotary vacuum pump**	1	1	2	1	**5**
12	**Digital thermometer**	1	0	2	1	**4**
13	**Refrigerant digital chart**	1	0	4	1	**6**
14	**Piercing tool**	1	0	2	0	**3**
15	**Set of pinch-off pliers**	1	0	2	1	**4**
16	**Contamination detector kit**	1	0	1	1	**3**
17	**Pair of safety gloves**	1	2	2	10	**15**
18	**Safety goggles**	1	2	1	10	**14**
19	**Cylinder warming blanket**	0	2	0	0	**2**
20	**Recovery cylinder 30 lbs.**	1	0	10	0	**11**
21	**Recovery cylinder 100 lbs.**	0	0	10	0	**10**
22	**Recovery cylinder 500 lbs.**	5	0	10	0	**15**
23	**Recovery cylinder 1000 lbs.**	1	0	2	0	**3**
24	**Recovery cylinder 12.5 ltr.**	1	2	5	0	**8**
25	**Recovery cylinder 27.7 ltr.**	1	2	2	2	**7**
26	**Storage cylinder 950 ltr.**	0	10	0	0	**10**
27	**Digital weighing scale**	0	0	1	0	**1**
28	**Thermal ticket printer**	0	0	1	0	**1**

Annex 2: Procedure to Determine the Chemical Composition of 25.64 MT of Refrigerant Waste Collected in Croatia

(click to open)

Annex 2 Procedure to Determine the Ch

Annex 3: A sample report on chemical analysis of the mixtures from two RRR centres in Croatia

(click to open)

Annex 3 Analysis Report- UNIDO.pdf

Annex 4: Facilities Registered for ODS Destruction in the European Union

The following is the lists of facilities registered for ODS destruction in those EU countries that allow the import of waste mixtures containing ODS for destruction:

No.	Company Name	Address	Contact details
1	Indaver Poldervlietweg	Indaver nv – registered office Poldervlietweg 5, Haven 550 BE-2030 ANTWERPEN 3 Belgium	t + 32 3 568 49 11 f + 32 3 568 49 99 info@indaver.be www.indaver.be
2	Kommunekemi A/S	Lindholmvej 3 DK-5800 Nyborg Denmark	Tel.: +45 80 31 71 00 Kenneth Simonsen Combustion Manager kenneth.simonsen@nordgroup.eu www.nordgroup.eu
3	Odense Kraftvarmevaerk	Havnegade 120, 5000 Odense Denmark	Helle L. Poulsen Tlf: (+45) 27 87 54 22 Helle.lisbet.poulsen@vattenfall.com www.vattenfall.dk/da/odense-kraftvarmevaerk.htm
4	Ekokem Oy Ab	Kuulojankatu 1 11120 Riihimäki Finland	export@ekokem.fi Taina Noopila, export manager taina.noopila@ekokem.fi Hanna Leena Luostarinen, export assistant hanna-leena.luostarinen@ekokem.fi

No.	Company Name	Address	Contact details
			www.ekokem.fi
5	CLIMALIFE	26 avenue du petit parc 94300 Vincennes France	Christophe MOROTE Activity Director Tel: +33 143 987 507 Mobile: +33 614 257 056 cmorote@climalife.dehon.com
6	VEOLIA Proprete Centre SIAP	Boulevard de l'Industrie , BP 8, 33565 Carbon Blanc France	Pascal Lefevre Tél. :05 57 77 65 50 Fax :05 57 77 65 55 plefevre@sarpindustries.fr www.sarpindustries.fr/
7	SARP Industries	427 Route du Hazay, 78520 Limay France	
8	SITA Rekem	Nouveau parc technologique, 1 rue Buster Keaton 69800 Saint-Priest France	Christelle GUYOT Tel.: +3304.72.49.28.68 christelle.guyot@teris.fr www.sita-rekem.com/
9	HIM GmbH	Waldstraße 11 D-64584 Biebesheim Germany	Telephone: +49 (0) 6258 895-0 Telefax: +49 (0) 6258 895-3333 info@him.de www.him.de/
10	GSB – Sonderabfall-Entsorgung Bayern GmbH	Äußerer Ring 50, 85107 Baar-Ebenhausen Germany	i.A. Matthias Krämer Vertrieb GSB - Sonderabfall-Entsorgung Bayern GmbH Äußerer Ring 50, 85107 Baar-Ebenhausen Telefon: +49 84 53 91 – 223 Fax: +49 84 53 91 - 230 Mobil: +49 172 8268220 Mailto: matthias.kraemer@gsb.info
11	Pfahler Müllabfuhr GmbH	Gleiwitzer Straße 1 91550 Dinkelsbühl Germany	Telefon 09851.571120 Telefax 09851.571107 entsorgung@pfahler.de www.pfahler.de
12	REMONDIS Industrieservice GmbH	Am Kanal 9, 49565 Bramsche Germany	Tel.: +49 2306 106673 Fax: +49 2306 106686 industrie-service@remondis.de www.remondis-industrie-service.de
13	REMONDIS SAVA GmbH	Fritz-Staiger-Str. 45 Brunsbüttel Germany	
14	CURRENTA GmbH & Co. OHG	LKW-Einfahrt zum CHEMPARK Autohof Tor 14 Alte Heerstraße / K 18 D-41540 Dormagen	Anita Hahn Tel.: +49 02133 / 51 3134 anita.hahn@currenta.de www.currenta.de

No.	Company Name	Address	Contact details
		Germany	
15	Solvay Fluor	Brüningstraße 50, 65929 Frankfurt am Main Germany	Tel : 069 257 586 200 Fax : 069 305 16837 info.frankfurt@solvay.com www.solvay.de
16	Thermische Rückstandsverwertung GmbH & Co. KG	Rodenkirchener Straße 50389 Wesseling Germany	Tel: +49 (0) 2236 / 94 32 4 - 0 Fax: +49 (0) 2236 / 94 32 4 - 53 Mail: TRV-KG@trv-wesseling.de www.trv-wesseling.de
17	SARPI Dąbrowa Górnicza Sp. z o.o.	42-523 Dąbrowa Górnicza ul. Koksownicza 16 Poland	Karina Szafranek - Bras Marketing and Sales Director Mobile: +48 693 466 568 Email: kbras@sarpi.pl www.sarpi.pl
18	ScanArc Plasma Technologies AB	Värnavägen 7, 813 35 Hofors Sweden	Phone: +46 290 767 800 Sven Santén sven.santen@scanarc.se Patrik Hilding patrik.hilding@scanarc.se Matej Imris matej.imris@scanarc.se Maria Swartling maria.swartling@scanarc.se www.scanarc.se/
19	TERIS	Rue Lavoisier - BP 17 - Plate-forme Chimique Le Pont de Claix France	Téléphone : +33 04 76 69 50 00 Fax: +33 04 76 69 53 87
20	TREDI	Parc Industriel de la Plaine de l'Ain BP 55 Saint-Vulbas 01152 Lagnieu. France	Téléphone : 04 74 46 22 00 Fax : 04 74 61 52 44 www.tredi.com

Annex 5: Movement document for the shipment from Montenegro

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Annex 5 TFSMontenegroCon