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FINAL REPORT ON THE EVALUATION OF THE PILOT DEMONSTRATION PROJECTS ON ODS DISPOSAL AND DESTRUCTION

Introduction

1. The importance of destroying ODS banks at the end of their useful life was acknowledged by the Parties to the Montreal Protocol at their Twentieth Meeting and is reflected in decision XX/7. This recognition came with the phase-out of CFC and the implementation of the phase-out of HCFC, thus reflecting the understanding that otherwise these ODS would be released into the atmosphere at some point in a conventional waste management process.

2. At its 57th meeting, the Executive Committee decided to look at pilot ODS disposal projects that would respond to decision XX/7 that specified that pilot projects could cover the collection, transportation, storage and destruction of ODS, with a focus on assembled stocks with high global warming potential (GWP) in a representative sample of regionally diverse Article 5 countries. The decision also postulated that ODS disposal demonstration projects should be feasible and include methods of leveraging co-funding (decision 57/6).

3. At its 58th meeting, the Executive Committee discussed the criteria and guidelines for the selection of ODS disposal projects (contained in decision 58/19). Subsequently, at its 63rd meeting, the Executive Committee decided to set a window for ODS destruction for low-volume-consuming (LVC) countries, pursuant to decision XXI/2 (decision 63/5(c)).

4. At the 75th meeting, the Senior Monitoring and Evaluation Officer (SMEO) presented the desk study for the evaluation of pilot demonstration projects on ODS disposal and destruction. Drafting the desk study was deemed opportune as it followed several reports presented to the 64th and 70th meetings,

summarizing the experience related to the implementation of ODS disposal projects such as collection, training and awareness raising, storage and destruction[1].

5. The report pointed out the need to raise awareness among waste management operators on the importance of having detailed procedures for the management and disposal of ODS waste. Logistical planning is a substantial part of the preparatory work for successful disposal of ODS waste. Synchronizing logistical details and procedures for obtaining the required permits is of utmost importance to prevent delays. Regarding the collection method of ODS, the report found that the most practical option seems to be collecting at the regional level, then transferring to a central aggregation point and sending the waste for destruction when a sufficient quantity has been accumulated.

6. At its 75th meeting, the Executive Committee postponed the second phase of the evaluation, including field work, due to the premature implementation phase of these projects, and decided to ask the SMEO, *inter alia,* to reassess the projects included in the desk study, when conducting the field study on ODS disposal in a future draft monitoring and evaluation work programme, to provide an update on the status of implementation or completion of the projects (decision 75/8(c)).

7. At the 82nd meeting, a synthesis report on the final reports of nine pilot projects on ODS disposal[2], and two studies for the establishment of a private-public financing system for disposal of ODS was considered by the Executive Committee. During the discussion, members of the Committee noted the overview and summary of these projects and requested that the challenges identified in the synthesis report be considered in this second phase of the evaluation. In the discussion of the draft work programme for monitoring and evaluation in 2019[3], it was pointed out that when considering the second phase of the evaluation of the ODS disposal demonstration projects, it was important to keep in mind the dimension of sustainability. It was therefore useful to gather further knowledge on the role of waste prevention, for example through the recycling of ODS, which was particularly important in Article 5 countries generating small quantities of waste, and the policy approaches, necessary to have an operational and well-established recovery, recycling and reclamation (RR&R) schemes, in conjunction with ODS disposal and destruction activities. In addition, the application of the concept of extended producer responsibility and how it supported the development of a sustainable business case for waste prevention and collection needed to be explored, as well as the modalities adopted for the implementation of the demonstration projects. Within the context of sustainability, the second phase of the evaluation was approved and contains a sample of five countries selected for field studies (Colombia, Georgia, Ghana, Mexico and Nigeria) and a synthesis report to be presented to the 84th meeting in accordance with decision 82/10. The terms of reference for the second phase of the evaluation are contained in Annex I to the present document.

Evaluation objective and main issues

8. Based on the findings of the desk study, on issues raised in the reports from various countries and on the synthesis report submitted at the 82nd meeting[4], the second phase of the evaluation focused on the sustainability of the results of the ODS disposal and destruction projects implemented, as well as on the contribution of RR&R activities. It also inquired whether the destruction capability demonstrated through the pilot project can move to a sustainable business model and on how this is supported by a legal and regulatory framework and by a public awareness component. It stressed the need for waste prevention mechanisms and on enhancing ownership and responsibility of the stakeholders.

[1] UNEP/OzL.Pro/ExCom/75/10
[2] UNEP/OzL.Pro/ExCom/82/21
[3] UNEP/OzL.Pro/ExCom/82/13/Rev.1
[4] UNEP/OzL.Pro/ExCom/82/21

9. The evaluation also analyzed the limitations of such a model, the reasons of these and their impact on the productivity and cost effectiveness in destroying ODS. Furthermore, it examined the reasons for delays and summarizes lessons learned from project implementation.

Evaluation scope and methodology

10. A sample of countries was selected based on the following criteria: region, implementing agency (IA), approach to destruction (local or export) and the results of the projects. The countries and projects selected are summarized in Table 1.

Table 1. Countries selected for the field missions for the evaluation of ODS disposal and destruction projects

Country/Implementing agency	Project focus	Meeting approval date	Project duration (months)
Colombia/UNDP	Domestic destruction through certification of three incineration facilities for ODS destruction	66	36
Georgia/UNDP	Co-disposal with persistent organic pollutants (POP) waste through export to develop a protocol to be implemented in other LVC countries	69	24
Ghana/UNDP	Export to a non-Article 5 country for carbon finance	62	36
Mexico/UNIDO/France	Transportation of ODS waste to a centralized facility in Mexico and to the United States of America	63	24
Nigeria/UNIDO	Transportation to a centralized facility for storage before exporting	67	24

11. A team of consultants was recruited to visit the selected countries and collect information on implementation and results of the demonstration projects. The consultants used a qualitative approach and collected information from available documents and interviews with various stakeholders as well as from direct observation at project sites. Data obtained in this way was compared for accuracy with other sources of relevant information by the method of triangulation.

12. Each visit produced a country report that was shared with the relevant national ozone units (NOUs) and the Secretariat for comments. This synthesis report summarizes the findings from the five country reports and formulates lessons learned.

Evaluation findings

Project design

13. The structure and contents of the project proposals were consistent with the criteria stipulated in the guidelines approved by the Executive Committee[5]. The evaluation missions provided additional information as follows.

14. The time needed for preparation of the projects is summarized in Table 2.

[5] UNEP/OzL.Pro/ExCom/58/19/Rev.1

Table 2. Timeline for preparation of the demonstration projects

Country	Meeting/approval date		Time (months)
	Preparatory funding	**Project submission**	
Colombia	59th /November 2009	66th /April 2012	29 months
Georgia	64th /July 2011	69th /April 2013	21 months
Ghana	57th /April 2009	62nd /December 2010	20 months
Mexico	57th /April 2009	63rd /April 2011	24 months
Nigeria	60th /April 2010	67th /July 2012	27 months

15. As shown in Table 2, the preparation of the projects took 20-29 months, (i.e., longer than the 12-month standard period for preparation of a main project). The reasons for the longer period for project preparation, were the need to conduct inventories of the already collected ODS waste and to develop synergies with other hazardous waste management and climate change initiatives.

16. The main factor that influenced the design of the projects was decision 58/19 and the specific parameters indicated therein, in particular the stipulation that no funding would be provided for the collection of unwanted ODS. Consequently, the demonstration projects were designed to address the already collected ODS and additional estimated amounts that were expected to be collected under other projects implemented in parallel and funded from other sources (e.g., the Global Environment Facility (GEF)).

17. The two projects in Colombia and Ghana, were designed for local destruction of ODS waste through the rotary kiln incineration and the plasma arc technology, respectively. The three other projects were designed with the objective to export the ODS waste to recognized high temperature incineration (HTI) facilities in non-Article 5 countries.

18. The demonstration project in Colombia had originally been designed for parallel implementation with the GEF-funded project on management of polychlorinated biphenyls (PCB) stockpiles. This suggestion was rejected as the joint destruction of the two types of waste would have a deteriorating effect on the rotary kiln due to excess of chlorine. Also, the time period required to undertake the destruction demonstration aspects of the project and then the transition to a sustainable and self-funded extended producer responsibility (EPR) system has taken longer than anticipated; hence, the project was extended until June 2019 (decision 79/18(c)(ii)).

19. In the preparatory phase of the demonstration project in Georgia, possibilities for ODS destruction were explored through a survey of existing cement plants. However, the survey results revealed that the owners of the cement kilns were not prepared to upgrade their air-pollution control equipment and introduce a complementary ODS waste feed mechanism because of fears of negative effects on the main production output and the necessary capital investments.

20. Changes had to be made in the approach of the project in Ghana as originally approved. At the preparatory phase of the project, the possibility of export for destruction was found cheaper than the proposed domestic destruction option. However, the export approach was not endorsed by the Government as it wanted to pioneer ODS destruction in the region and requested the IA to continue with the proposal using the plasma arc technology. However, this approach was not deemed feasible and the originally approved plan of the project was modified with the aim to establish a central ODS disposal centre for transport of all collected ODS waste to a HTI destruction facility abroad.

21. Further changes had to be made during implementation of the projects when discrepancies were found between the quantities of ODS estimated for destruction in the preparatory phase and the quantities

actually collected. Due to the lower amounts of collected unwanted ODS, the establishment of the ODS disposal centre was not economically feasible. In Nigeria, the estimated amounts of unwanted ODS from the appliance replacement project were never collected due to the lack of GEF-funding and unavailability of carbon credits that were to be used for additional funding for the appliance replacement project.

22. The implementation of the demonstration project in Mexico deferred from the original proposal after the decision[6] of the Executive Committee to restrict the possibility of carbon credit yield, which in consequence triggered modification of the scope and objectives of the project which were more ambitious. Nevertheless, the core aims of the project were to prove its legal and technical feasibility. The creation of capacity building and testing of possible financial schemes for ODS disposal were maintained.

Policies and regulations supporting ODS disposal

23. Two countries with the demonstration projects designed for ODS waste export to HTI (Ghana and Mexico) already had legislation in place for control of ODS wastes at the time of the projects' inception; hence no amendments of the existing legislation were necessary. The existing regulations allowed for the transportation of unwanted ODS using synergy with other projects for combining the stockpile of collected ODS with other hazardous waste (e.g., pentachlorophenol and obsolete pesticides). Since both countries are signatories to the Basel Convention, there were no legal impediments to the transport to certified HTI facilities abroad once approval was obtained from the destination countries.

24. It was necessary to modify the national hazardous waste regulations in Colombia and Nigeria in order to include ODS waste into the list of waste for the HTI treatment. Legislation was adopted on identification of the legal and technical requirements for establishment of ODS destruction facilities, including requirements for a feeding control system connected with the emission monitoring and rotary kiln operation control systems. Since adoption of the new regulations took longer than expected, the project in Colombia has actually destroyed only a small quantity of ODS during the test burns performed in one of the rotary kilns while a permit from the local environment authority to begin with a full scale destruction was still under consideration at the time of the field mission.

25. At the inception of the demonstration projects, there were no supporting legal frameworks for management and recycling of waste electrical and electronic equipment (e-waste) in any of the project countries. However, the work on such legislative measures started in Colombia, Ghana, Mexico and Nigeria in parallel with the implementation of the demonstration projects and has reached some milestones. The formulation of e-waste regulations conducive to management and disposal of unwanted ODS in the other country started later and is currently on-going.

26. Since the inception in 2013, the development of a national EPR system in Colombia has progressed to the point of transition from the voluntary pilot phase to the incremental implementation of a mandatory system. The EPR initiative is supported by relevant legislative and regulatory measures and by financial incentives related to value-added tax reductions and energy efficiency incentives applicable to equipment replacement. The NOU in Colombia coordinated the development of the EPR system within the overall regulatory and policy framework of the national initiative on integrated e-waste management.

27. The new ozone regulations in Nigeria, enacted in 2016, stipulate provisions for mandatory destruction of wastes, provide guidelines for operation of destruction facilities including emission limits

[6] Decision 63/28(c): "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 extend responsibility of end-of-life (EOL) waste equipment to producers and suppliers. Moreover, EPR regulations are now in place for the electronic/electrical sectors.

28. The common factor in all five countries was that development of national policies on ODS waste disposal and destruction closely followed relevant international policies (e.g., of European Union) and were adjusted to fit the local conditions.

Approaches in ODS waste collection

29. The sources of ODS waste included energy efficiency programmes for electrical appliances, confiscation of illicit ODS at customs, EPR programmes, as well as implementation of ODS phase-out projects (through national phase-out plans and HCFC phase-out management plans (HPMPs)). National refrigerant RR&R networks had been created under the previous MLF-funded projects in all five countries. The number of the RR&R centres ranged from two centres in Georgia to fourteen centres in Mexico. In four countries, unwanted ODS for the demonstration projects were collected through the national RR&R networks. Ghana was the only country that did not have operational RR&R centres and unwanted ODS was to be collected in two privately owned servicing and dismantling workshops. However, instead of the estimated 7 tonnes of ODS waste, the actual collected amounts were only 406 kg from the GEF project and from refrigerators confiscated by the customs.

30. Since the end of the CFC phase-out, the RR&R centres experienced a growing interest in recycling of refrigerants as a result of a rapid shift of some end-users to alternative refrigerants and a growing demand for recycled CFCs driven by the absence of virgin CFC refrigerants on the market. However, from that time the RR&R centres also started to accumulate unwanted ODS as part of the recovered refrigerants was found not suitable for recycling and/or reclamation due to excessive contamination resulting from use of aged refrigeration and air-conditioning (RAC) equipment and, in some cases, also to poor equipment maintenance practices.

31. A partially decentralized (regional) approach in storage was implemented under the project in Mexico where one of the main sources of ODS waste stockpiles was the home appliances replacement programme (HARP). Over a hundred of HARP scrapping centres were in operation and shifted their unwanted ODS to the national recovery and recycling network composed of 14 RR&R centres along the country.

32. The total amounts of collected ODS waste included in the project proposals were calculated on the basis of the inventories of unwanted ODS collected and temporarily stored in various storage facilities in the project countries. The inventories had been carried out about two years before the actual approval and start of the demonstration projects.

33. Information on the types and amounts of collected and estimated ODS waste at the inception as well as on the amounts actually destroyed in the five demonstration projects is summarized in Table 3.

Table 3. Types and planned total amounts of ODS waste addressed by the demonstration projects

Country	Type of ODS waste	Amounts planned (mt)	Amounts destroyed (mt)
Colombia	CFC-11 and CFC-12	11 collected +103 estimated	15.1 (domestic HTI)
Georgia	Various CFCs and HCFCs	2.13 collected	1.47 (export)
Ghana	CFC-12	1.8 collected + 13 estimated	1.2 + 1.0 (export)
Mexico	Various CFCs and HCFCs	119.7 collected + 47 estimated	74.1 (argon plasma arc) 39.1 (cement kiln)
Nigeria	CFC-12	66.5 collected + 17.5 estimated	1.5 (domestic rotary kiln)

34. The implementation of the projects revealed that the estimates of unwanted ODS stocks obtained through the national inventories were unreliable and sizeable discrepancies were found between the quantities of unwanted ODS reported in the pre-project inventories included in the project proposals and the amounts of ODS waste actually found available for disposal during implementation of the projects. In addition to the inaccuracy of the inventories, other reasons for the discrepancies included lack of containment tanks of sufficient size for storing unwanted ODS, deteriorated condition of available gas cylinders and mishandling of the ODS waste stockpiles that collectively caused venting of the previously collected refrigeration gases to the atmosphere.

35. The greatest divergence between the planned and actual ODS waste quantities was found in Nigeria where the amount indicated through the initial inventory was 84 mt of ODS (CFC-12) while the actual amount found was only 1.5 mt. The contradiction was attributed to mistaken reporting of 40 mt of halons as CFC-12 as well as to losses of the actually collected ODS through leakage or venting.

36. In addition, the quantities of ODS waste generated during the implementation of the projects were also lower than the initial pre-project estimates due only to modest capture of unwanted ODS from the early stages of the energy efficiency programmes and the ongoing R&R operations. The underlying assumption made initially was that the large majority of the generated ODS waste would be CFC-12 and CFC-11 both in concentrated form as extracted refrigerant or from waste foam. However, the implementation experience has shown that a major portion of refrigerants captured in the EPR systems was HFC-134a that was largely returned for reuse through refrigerant reclamation procedures.

Approach in transportation and storage of ODS waste

37. There were several approaches used for transportation and storage of ODS waste in the project countries. The simple approaches taken in Georgia and Nigeria were based on the transport of the collected ODS waste for temporary storage at large national RR&R centres before initiating the activities on final disposal. In Georgia, a local refrigeration association was contracted to implement the transportation and aggregation of unwanted ODS and prepare the ODS waste for export shipment abroad.

38. A scheme for on-going collection and storage of refrigerant gases was pursued under the refrigerator incentive/rebate scheme in Ghana, where the national ODS collection centre (NOCC) was created as a dismantling facility for collection of rebated refrigerators and degassing of the refrigerants. However, this arrangement had only a limited duration. After a forced shut down of NOCC, the project team had to establish for collection of the ODS waste a temporary ODS decanting and export centre within the national RAC centre of excellence funded by the Ghana HPMP.

39. In Mexico, unwanted ODS banks were spread along the country among the HARP centres, customs warehouses, pharmaceutical industry facilities and RR&R centres. In order to comply with the relevant regulations and provisions related to handling, transport and disposal of such materials, the ODS banks were further consolidated in large containers and in key locations and were handled by a single authorized service provider. This approach eased the logistics for transport and storage and the monitoring of the unwanted ODS destruction.

40. Transport of ODS waste from the collection points to central storage facilities, in the projects evaluated, was conducted by authorized local hazardous waste operators in line with the conditions and requirements of the national policies for movement of hazardous waste. The refrigerant gases collected and sent to the central storage in Ghana and Nigeria were in disposable refrigerant cylinders. Although a small part of the collected ODS was later decanted into reusable cylinders, the majority of the ODS waste remained in disposable cylinders. All reusable as well as disposable cylinders were transported to the

designated national destruction facility. Since all transportation of ODS waste was done within the country the Basel Convention requirements did not apply.

41. Further transport of the aggregated ODS waste from the project countries to the destruction facilities abroad was performed by international contractors selected on basis of international tenders organized by the IAs. Local hazardous waste operators were subcontracted to cooperate with the international contractors on preparation of the stored ODS waste for transboundary shipment, in particular they assisted in operations for transfer of the ODS into refillable international organization for standardization (ISO) containers and in the process of obtaining the necessary permits for the export of the waste in line with the requirements of the Basel Convention.

Approaches in final destruction of ODS

42. A detailed technical assessment was conducted in Colombia on three companies with rotary kiln facilities and one with a cement kiln. As the latter one refused to participate, the company best equipped for the rotary kiln destruction option was selected. Test burns were undertaken at the selected facility in three stages with the aim to optimize the ODS waste feed rates and calibrate emission monitoring systems.

43. The test burns proved to be a very important aspect of the Colombian project as they provided a basis for establishment of ODS destruction protocols and have supported the domestic destruction facilities in their efforts to meet international standards. The results of the test burn also served as a starting point for the development of specifications required for the modifications of the rotary kilns.

44. Apart from the projects in Colombia and Ghana designed for domestic destruction of ODS, the other three projects were designed for export to an internationally recognized destruction facility abroad. At some point in their respective projects' preparation and/or implementation, the project teams in Georgia, Mexico and Nigeria made an assessment of available options for domestic destruction, which led the latter two countries to ultimately change the original plan and selected domestic ODS destruction options.

45. There were no facilities for local ODS destruction in Mexico at the project preparatory phase. During the international tender for shipment of aggregated ODS waste to a special destruction facility in the United States of America, it was found that the budget's transport costs were underestimated. Costs of consolidation and aggregation of the collected waste at the central domestic storage as well as fees related to the environmental insurance policy and to requirements related to transboundary movements of hazardous waste had not been fully considered in the project budget either.

46. The repeated international tender resulted in a bid from a Mexican enterprise that had just acquired a permit for ODS waste incineration using a state-of-the-art plascon argon plasma arc technology. Therefore, this bid was subject to a comprehensive technical evaluation and subsequently the company was contracted to perform the destruction of the first batch of ODS waste.

47. In 2015, one cement manufacturing company in Mexico obtained authorization for co-incineration of ODS in the cement kiln at one of its production facilities. Based on another international tender, the IA contracted the company to provide ODS destruction services in the cement kiln for the second batch of ODS waste. Since the proposed total price of the service was above the available project budget, the contractor was approached with a request to reduce the unit price per kilogram ODS to be destroyed. As the company was unable to provide any discount, it was agreed to reduce the amount of ODS waste for the co-incineration.

48. As Nigeria did not have a licensed facility for ODS destruction, the original solution chosen for the disposal of ODS waste was shipment to an internationally certified destruction facility. However, due to

the discrepancy between the estimated amount of ODS waste and amount collected (much lower than planned), this approach was not cost-effective. Hence, officials from the Government and the IA inspected four hazardous waste disposal facilities in the country and invited two of them to bid for the disposal of waste ODS waste under the project.

49. The company selected to provide the ODS destruction services in Nigeria had a proven track record of hazardous waste management for multinational companies as well as specific experience in managing unwanted ODS from collection to recycling. After the company had modified their facility at their own expense, it was certified as an ODS destruction facility by the Ministry of Environment and will be seeking European Union certification as an ODS destruction facility in the near future.

50. In the preparatory stage, the project team in Georgia found that the country did not have special facilities with technical capacities and means for local disposal of unwanted ODS waste, apart from cement kilns. However, the main reasons for which the cement industries refused to participate in the disposal activities were low streams of generated ODS waste and high capital costs required to equip the cement kilns with relevant technical means for ODS waste disposal and emission control. Consequently, the export of unwanted ODS abroad remained as the only viable final destruction option and transport to a HTI facility in France was pursued on following an international tender.

51. The export for final disposal of the ODS waste from Georgia was conducted by an experienced international contractor strictly in line with the Basel Convention requirements. The accumulated ODS were re-packed into ISO containers purchased specifically for the transport. All activities (re-packaging, transport and destruction) were accompanied by the required documentation, mandatory insurance, transit permits, as well as waste acceptance and disposal certificates by the disposal facility.

52. The export of ODS from Ghana was affected by the forced shutdown of the national ODS collection centre impacting the export preparations of the accumulated ODS waste to a selected destruction facility in Poland. All waste materials, specifically CFC-12, was collected and transported to the ODS collection centre in the Accra technical training center. Some ODS was decanted into recycling cylinders however the majority remained in disposable cylinders. From there, these recycling cylinders along with disposable ones were transported to Port Tema for export. Veolia, the shipping company, accepted both the disposable and the recovery cylinders for export to their facility in Poland (it is worth noting that the Basel Convention does not specifically exclude reused disposable cylinders for transportation).

Monitoring and verification of the destruction

53. Two different approaches in monitoring and verification were observed in the demonstration projects. For the projects in Georgia and Ghana, which exported the ODS waste for destruction abroad, verification of the amounts of ODS actually destroyed was provided by means of special disposal certificates issued by the respective disposal facilities to the waste management company assisting with the waste transfer process and transferred to the national authorities and the IAs.

54. The approaches in monitoring and verification for Colombia, Mexico and Nigeria that opted for domestic waste destruction, varied in complexity. A relatively simple approach was adopted in Nigeria where the local destruction facility provided a verification report upon completion of the destruction of all the ODS waste material. In Colombia, the national regulations require inclusion of a monitoring and recording system for ODS destruction; therefore, the demonstration project incorporated features of such system to ensure tracking of ODS waste origin and verification of the destruction performed by an independent auditor.

55. The project in Mexico established a multifaceted monitoring, registry and verification (MRV) system that involved a series of activities to verify the amount of unwanted ODS destroyed and ensure fulfilment of provisions for safety and environmental protection. The MRV system integrates tracking down and detailed reporting related to 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 destruction facilities. It also allows the destruction facilities to report the detailed results of the destruction. Finally, the authority is enabled to check and validate the information and issue the destruction certificate as the final evidence of the ODS disposal.

Technical assistance and training

56. On inception of the five demonstration projects, the IAs in each country organized a capacity building and awareness workshop for representatives of all stakeholders involved in the preparation for the ODS waste destruction, including the NOU, agencies of the Government in charge of dealing with hazardous waste, the national RAC association, and enterprises. Participation in the workshop gave the attendees a good insight into the background of the project, roles of various actors and requirements for safe handling, collection, transport, aggregation and storage of ODS wastes. In Ghana, the inception workshop resulted in development of a set of three methodological guides that were printed and distributed to relevant project stakeholders.

57. During implementation of the projects, specific training and information workshops were organized in different formats for a variety of audiences including officials of the Governments, RAC technicians, workers of the hazardous waste transport companies and staff of the ODS waste collection points. This was often carried out in close synergies with parallel projects funded by other donors such as GEF and bilateral agencies (e.g., Government of Germany).

58. In Ghana, a training workshop was conducted under the project for RAC technicians on proper dismantling procedure and refrigerant recovery from domestic appliances. These technicians were sent to work at the two newly established dismantling facilities. Furthermore, seminars were provided under the GEF energy efficiency programme for over 300 salespersons of retail merchants who had been selected to partake in the refrigerator rebate scheme. The participants were trained on safe handling of appliances for delivery and what conditions applied in order to accept EOL equipment under the rebate programme.

59. In Mexico, extensive training scheme was provided for 14 technical schools on topics such as analysis and detection of ODS, recovery methods and good handling practices, and ODS environmental impact. About 360 people were trained, including technicians from the equipment collection and RR&R centres and officers involved in the national HARP. The activities of the RR&R training programme reportedly brought along a more than 100 per cent increase in the ODS recovery rates per appliance leading to the collection of additional 35 tonnes of refrigerant waste for disposal. Training was offered to more than 100 environmental inspectors and about 40 customs officers.

60. Technical and legal assistance to RR&R centres as well as destruction companies were also provided under the projects. The NOU of Colombia technically supported all processes of revision of the legislation as well as other actions referred to the management of electrical and electronic equipment. An international consultant with expertise in the destruction of refrigerants as well as management of waste electrical and electronic equipment was contracted to provide oversight of the destruction project.

61. The national refrigeration association in Georgia, as part of its assignment in the demonstration project, used the project funds for calibration of the gas chromatograph in the Georgian RR&R centre and facilitated the analyses of the accumulated ODS waste as part of the preparatory activities for the ODS re-packing and shipment.

Financial aspects

62. Apart from demonstration of practical use of best available techniques/best environmental practices (BAT/BEP) for ODS waste disposal, the other purpose of the projects was to demonstrate various financing and co-financing options. Experience from implementation of the projects provided valuable insight into feasibility and sustainability of the various business models employed.

63. The funding for the demonstration projects provided by the Multilateral Fund (MLF) appeared to be sufficient for the planned activities with the exception of the project in Mexico where the costs of consolidation and aggregation of ODS waste at central storage were not thoroughly taken into account in the project financial planning. Furthermore, fees related to the environmental insurance policy and to the requirements for transboundary movements of hazardous waste had not been considered either. Consequently, the project budget was found underestimated and could not cover the planned export of the already collected ODS waste to an accredited destruction facility in the United States of America.

64. The demonstration projects for Ghana and Mexico originally included a co-financing leverage through sales of carbon credits in the voluntary carbon markets and thus proposed to develop a system that would use carbon credits resulting from the ODS to be destroyed in order to scale up the projects. However, as mentioned in the project design sub-section, decision 63/28 made any marketing of GHG emission reductions generated by or associated with the project subject to a Committee decision, hence the original scope of the project in Mexico was modified to consider other co-financing options.

65. There was a limited use of voluntary carbon markets under the project in Ghana. After the export shipment of the bulk ODS waste that was covered by the project funds, about 1 tonne of unwanted refrigerants remained under custody of the central ODS storage facility in Ghana. Upon obtaining an import permit from the United States Environmental Protection Agency, this stock of ODS waste was exported using the voluntary carbon markets financial mechanism at no cost to the project. The pilot use of the carbon financing proved existing interest of the private sector to continue exploring the carbon financing options in the future.

66. The line ministries in all five countries provided in-kind co-financing contributions that mainly referred to preparation or modification of the legal framework necessary for the collection, aggregation and disposal of ODS waste. For the projects in Colombia, Mexico, and Nigeria, parallel financing matching the MLF funds was obtained through the respective national schemes for replacement of RAC equipment.

67. Sizeable co-financing for the project in Mexico was provided by ODS generators that paid the transportation of unwanted ODS from the source points to the destruction facility. The co-financing was achieved through collaboration among all main actors in the project, namely the Government, ODS generators and service providers, which allowed destruction of a larger batch of ODS waste to be covered by the project budget. It also proved feasibility of such co-financing as material scrapping and recycling activities performed by the RR&R centres were key to a financial support of these enterprises. Consequently, such a scheme increased the overall environmental benefits of the project.

68. Considerable co-financing was secured under the project in Colombia through cooperation with the national EPR system. The latter had been developed as part of the national initiative on integrated waste electrical and electronic equipment management and set up a formal waste collection system in addition to existing recovery and recycling actions done through the HPMP. The co-financing contributions were provided by all actors in the process of ODS waste collection, transport and destruction. ODS waste holders paid for transportation to the collection centres; licenced waste collection operators purchased additional tanks, refrigerant identifiers and recovery machines required for the collection and aggregation of ODS waste; RR&R centres contributed with the laboratory analysis on characterization of the waste refrigerant

for the test burns by gas chromatography; and the destruction facility paid for a part of the modification of the rotary kiln and contributed with the costs of labour involved in the destruction operations.

69. The demonstration project in Georgia was designed to benefit from a coordination of activities with the GEF/UNDP POP pesticides disposal project that had already started. This expectation has fully materialized and savings were achieved through cost-sharing between the two projects in several activities, namely revision of legislative frameworks related to hazardous waste management, implementation of one joint tender process for disposal of combined POPs and ODS waste, joint launching of waste export notification through the governmental departments and management and logistics costs for handling the combined wastes by a selected international waste management company.

70. Further improvements of the cost-effectiveness of the project in Georgia were achieved through the division of responsibilities between the international contractor, which assumed responsibility for securing the actual export and destruction operations on the ODS waste abroad, while the local RAC association prepared the collection of ODS waste for export.

71. Apart from the disposal of the concentrated sources of unwanted refrigerants, two projects tested also the possibilities for the disposal of diluted sources of ODS chemicals in the form of polyurethane (PU) foam, based on CFC-11 and HCFC-141b. The project in Colombia established the cost-effectiveness for destruction of CFC-11 and CFC-12 at less than half of the maximum cost-effectiveness threshold established by decision 58/19. However, the same project found the cost-effectiveness of PU foam destruction approximately four times higher than the threshold and therefore the destruction of PU foam would not be considered feasible for domestic destruction within the current EPR system framework.

72. The destruction of the PU foam waste was also deemed unfeasible for export in Ghana. The PU insulation and plastic materials collected from the dismantled refrigerators could not be included in the two shipments for destruction from Ghana to Poland and the United States of America, respectively. The accumulated volume of foam created a challenge for the dismantling of EOL RAC equipment. The country has been working on a solution for the disposal of the PU foam waste materials in an environmentally sound manner in accordance with the Montreal Protocol's requirements.

Communication and dissemination

73. Several approaches for the communication and dissemination of the achieved results were pursued under the demonstration projects. Given the limited funds for this component in the projects' budgets, some activities were financed from other sources such as the institutional strengthening projects. External communications about the projects and the achieved results were also done through presentations at the regional ozone network meetings.

74. In Colombia, the Ministry of Environment in cooperation with the Government of Germany issued a joint publication to demonstrate the steps for a good management of EOL products containing refrigerants. This publication targeted enterprises involved in the EPR programme as well as local and regional environmental authorities.

75. In Georgia, UNDP conducted awareness campaigns, prepared communication strategies and action plans, and supported creation of respective websites for the national RAC association and the NOU. The latter's web page was subsequently merged with the website of the newly established Environmental Information and Education Centre. The project also organized two workshops for the media about the project issues and achievements and an awareness raising workshop was held for the national public broadcaster on ozone layer matters that was transmitted by radio and e-media.

76. In order to share the outcomes, challenges and lessons learned with other countries, the demonstration project in Mexico, the Ministry of Environment and Natural Resources, in cooperation with UNEP, arranged a study tour to the national destruction facilities for representatives of 11 countries of the region. In addition, the project produced three videos on the topics of unwanted ODS handling and destruction. The NOU with their counterparts in Chile, explored the possibility of destroying ODS hazardous waste from Chile, in Mexico.

77. The dissemination of information about the projects in Ghana and Nigeria was conducted through workshops, directed at various government departments, and seminars for staff of retail merchants participating in the collection and aggregation of ODS waste.

Sustainability and replicability

78. The demonstration project in Colombia was undertaken within a broader policy framework consisting of an integrated approach to special and hazardous waste management, promotion of energy efficiency and the country's commitments under the Montreal Protocol. Under this framework, priority was given to the environmentally sound management of EOL ODS generated as a result of developing national policy initiatives in the RAC sector. The MLF support for demonstration of EOL ODS capture and destruction, made an important contribution to this framework, along with the national EPR programme and the bilateral financial support now in place should ensure sustainability.

79. The project in Colombia further demonstrated that efforts to secure the capture of ODS waste close to the estimated available ODS banks for destruction must be supported by an array of enabling factors and circumstances, including: strong policy commitment; supporting legislative and regulatory frameworks; established institutions; economic instruments; and public awareness. Due to an early recognition of these factors, the Government of Colombia fostered incremental evolution of these conditions in parallel with the ODS destruction project. Such enabling factors and conditions are complementary to the development and the demonstration of technological capabilities for ODS destruction.

80. Under the demonstration project in Georgia, a draft scheme was proposed for the sustainable collection and destruction of ODS waste to be accumulated in the country in the future. The scheme is based on a study that was conducted on the ODS wastes generation and accumulation rates, analysis of the existing national regulatory framework for ODS waste management, as well as the existing technological capacities for ODS waste destruction, locally and internationally. The study resulted in three alternative proposals for the financial sustainability of ODS waste collection and destruction in the country. The study was provided to the Ministry of Environment, but no action was taken by the Government to pursue any part of the proposals.

81. Experience from the demonstration project in Ghana offers another example worth following to ensure the sustainability of ODS waste destruction. The NOCC, until its forced shutdown, appeared to be a potentially sustainable establishment due the integration of the dismantling of EOL electrical equipment with ODS recovery and recycling operations, at the same facility. This arrangement provided extra revenue sources, through the sale of secondary materials, and has demonstrated what the Government and the private sector can achieve to ensure sustainability, without overreliance on external funding. Moreover, the project demonstrated a limited potential for the use of carbon financing for destruction of unwanted ODS.

82. The demonstration project in Mexico proved the importance of strengthening the national regulatory framework on ODS waste management in order to encourage the recycling centres to use a portion of the revenues from scrap material sales to finance ODS waste destruction. The project showed that increased availability of technological alternatives can lead to significant cost reductions of ODS waste

destruction and demonstrated that co-financing schemes with ODS generators enable cost reductions of in-country handling and transportation of ODS waste.

83. The ODS destruction facility, established under the project in Nigeria, has demonstrated the feasibility of the destruction of ODS waste, in an Article 5 country, by incineration in rotary kilns. By the same means, the project also paved the way towards future local destruction of ODS waste, that will not rely on export. In order to enhance the sustainability of its operations, the ODS destruction facility in Nigeria, in addition to the already obtained national certification, should seek international accreditation to be able to offer its services to the neighbouring Article 5 countries.

Gender related issues

84. Notable representation of women was found at the level of the project, in IAs (UNDP and UNIDO) and in the main ministries of the recipient countries. Traditionally, RAC servicing technicians were all male, due to the nature of the servicing operations. However, the first signs of a change were spotted in some of the projects under evaluation. In Colombia, the newly designed training programme for young technicians had 50 per cent female attendants. The RAC vocational training programme in Georgia recently recorded enrolment of the first two female trainees. In Mexico, women occupied relevant positions in laboratories and in the facilities used for ODS destruction and one of the Mexican RR&R centre is owned by a woman. In Ghana, the enterprise City waste, which owns the collection centre, is managed by a woman. The enterprise created about 500 jobs among which many are for women.

CONCLUSIONS AND LESSONS LEARNED

85. The five demonstration projects on ODS waste disposal and destruction have achieved their objectives in testing feasibility of a variety of technological and logistical options as well as co-financing scenarios for collection, aggregation, disposal and destruction of unwanted ODS.

86. As indicated in the synthesis report on the pilot ODS disposal projects[7] and confirmed by the evaluation team, the total amounts of ODS waste actually destructed, destruction methods and cost-effectiveness of the destruction are summarized in Table 4.

Table 4. Summary of results of the pilot demonstration projects on ODS waste destruction

Country	Amount destroyed (mt)	Destruction method	Cost-effectiveness (US $/kg)
Colombia	15.1[a]	Domestic – HTI (rotary kiln)	5.98-6.20[b]
Georgia	1.47	Export - HTI (France)	5.99[c]
Ghana	1.27	Export - HTI (Poland)	No cost data given[d]
	1.0	Export – HTI (the USA)	0.00[e]
Mexico	74.1	Domestic - argon plasma	9.20[f]
	39.1	Domestic - cement kiln incineration	8.00[f]
Nigeria	1.5	Domestic – rotary kiln incineration	29.82[f]

[a] Total amount of liquid and gaseous ODS refrigerants as well as PU foams destroyed during test burns of the rotary kiln.
[b] Includes only net cost of destruction of liquid CFC-11 and gaseous CFC-12.
[c] Including all inland as well as maritime export transportation cost.
[d] No costs given as the amount of ODS waste was co-disposed with 5.2 mt of methyl bromide.
[e] Destruction costs covered by carbon credits at no cost to the project.
[f] Including cost of handling and in-country transportation.

[7] UNEP/OzL.Pro/ExCom/82/21

87. Furthermore, the demonstration projects responded to the request of decision XX/7 that required the Executive Committee to commence pilot projects that may cover the collection, transport, storage and destruction of ODS, and as a matter of an initial priority to focus on assembled stocks of ODS with high net GWP.

88. Based on the analysis of the completion reports from the selected demonstration projects prepared by the project implementation teams, the projects resulted in emission reduction of 665,711 CO_2-equivalent tonnes. This amount was calculated based on the actual quantities and nature of ODS waste actually destroyed by the collective intervention of the five projects, as indicated in the synthesis report on the pilot ODS disposal projects[8] and shown in Table 5.

Table 5. Global environmental benefits of the five demonstration projects

Country	**Substance**	**GWP***	**ODS destroyed (mt)**	**GHG emission reduction (CO_2-eq.tonnes)**
Colombia	CFC-11	4,750	6.654	38,000
	CFC-12	10,900	6.00	65,400
Subtotal			**12.60**	**103,400**
Georgia	CFC-12	10,900	1.47	15,990
Subtotal			**1.47**	**15,990**
Ghana	CFC-12	10,900	2.27	24,765
Subtotal			**2.27**	**24,765**
Mexico	CFC-11	4,750	24.70	117,325
	CFC-12	10,900	25.30	275,770
	CFC-114	10,000	0.50	5,000
	HCFC-22	1,810	40.10	72,581
	HCFC-141b	725	0.20	145
	HFC-134a	1,430	21.50	30,745
	R-407	2,107	0.90	1,896
Subtotal			113.20	503,462
Nigeria	CFC-12	10,900	1.50	18,094
Subtotal			**1.50**	**18,094**
Total for 5 projects			**133.50**	**665,711**

***** Based on the IPCC 4th Assessment Report

89. Analysis of the project implementation and the evaluation field mission reports, prepared by independent international consultants, allow to draw a number of conclusions and lessons learned that are summarized below.

Project design

[8] UNEP/OzL.Pro/ExCom/82/21

90. Identification of stockpiles of unwanted ODS must be physically verified by on-site visits, thus ensuring accurate information is provided for the preparation of future activities. Information on collected ODS waste through questionnaire, surveys and other forms of remote communication are not reliable and should not be taken as an exclusive basis for the development of proposals for funding.

91. Inadequate legislation for prohibition of refrigerants venting, combined with the lack of suitable containers for safe storage of unwanted refrigerants causes sizeable losses of stockpiles of ODS waste available for destruction. Lengthy time gaps between the submission of proposals and approvals of funding for projects on ODS waste destruction could have impacts on the available quantities of ODS for destruction and thus negatively affect cost-effectiveness of the approved projects.

92. The projects designed for joint destruction of ODS waste with POPs/PCBs proved to be feasible only for export shipment of ODS waste to HTI incineration facilities. Domestic destruction of ODS waste in cement kilns, together with other types of hazardous chemicals, will require thorough optimization of conditions and possibly also additional capital investments at the destruction facilities.

Policies and regulations on ODS disposal and RR&R

93. Increasing capture of EOL ODS, for environmentally sound processing to a level that would ultimately be meaningful, in terms of global environmental benefit, will require effective enforcement of the current policy and regulatory measures, as well as establishment of supporting mechanisms such as mandatory EPR systems. Moreover, although the capture of refrigerants is relatively simple, the infrastructure available for this activity should be carefully assessed in the preparatory phase of future projects.

94. The tracking systems for ODS waste life-cycle, from waste generation to waste destruction, requires normalization. Presently, the different activities in the cycle are operated by different actors along various programmes. Establishment of ODS waste tracking will require institutional capacity building of the environmental authorities in order to strengthen their inspection, surveillance and enforcement functions.

95. Specific national policies are needed to ensure safe storage of unwanted ODS stockpiles, in particular, a ban on the reuse of disposable refrigerant cylinders is highly recommended. The reuse of such cylinders is highly dangerous and is prohibited in all non-Article 5 countries and cylinder manufacturers, and should not be allowed in Article 5 countries.

Collection of ODS waste and selection of destruction technology

96. Although the temporary use of non-refillable cylinders for collection of ODS waste could be considered relatively safe, there are certain hazards associated with their transportation and storage. Mishandling or improper usage of non-reusable cylinders can lead to liabilities, personal injuries and/or property damages. Funding for future ODS destruction operations (e.g., under HPMPs) must include the purchase of approved refillable cylinders as well as a means of supervisions and enforcement to ensure the ODS is stored and transported, in line with the approved international standards and practices.

97. The feasibility of domestic destruction of CFC refrigerants, through the technology of high-temperature rotary kiln incineration, was demonstrated by the successfully conducted test burn programme in one rotary kiln incinerator in Colombia and by the destruction of relatively small quantities of ODS waste in a similar facility in Nigeria. However, the test burns performed during the projects were conducted on waste CFC refrigerants in view of the most abundant EOL refrigerants in the unwanted ODS stockpiles. For destruction of unwanted HCFC, as well as HFC-based refrigerants, new test burns will be

necessary. Also, the productivity of the destruction process at the selected facility in Colombia was found relatively low, hence more destruction facilities would be necessary to cope with higher streams of unwanted refrigerants.

98. Since only the destruction of ODS waste was eligible for funding under the demonstration projects, it restricted the choices of the recipient countries for the management of ODS stockpiles and the selection of disposal strategies. It would be beneficial if, for future ODS destruction activities, both collection and destruction were eligible for funding. Instead of a restriction on the type of activities, a cost-effectiveness threshold could be applied to reduce the total cost borne by the donor. This would give countries a greater flexibility in designing projects that fit their national circumstances.

99. The project in Mexico proved that the incineration of ODS waste in a cement kiln is a cost-effective ODS destruction technology. However, as capital investments are required into emission control and continuous monitoring devices, the investments are justified only for higher streams of ODS waste generation.

100. Unwanted stockpiled ODS can contain sizeable quantities of CFCs blended with HCFCs and HFCs that cannot be separated prior to destruction. Availability of advanced equipment for analysis of ODS waste mixtures and training on identification refrigerants are the essential requirements for the selection of proper handling of unwanted refrigerant mixtures and the technology for its destruction.

Synergies with co-funded projects

101. Projects funded by two separate funding mechanisms (i.e., the MLF and the GEF) can collaborate only on condition that the project planning/approval cycles can be aligned to the extent possible. The demonstration project in Georgia benefitted from the GEF-POPs project. However, this synergy could be difficult to replicate considering the relatively longer time for preparation and approval of the GEF medium-and full-size projects and the fact that, on matters not required for compliance with the Montreal Protocol (i.e., ODS waste management), MLF-funding is only available once. Therefore, replicability in other countries depends on planned or ongoing GEF/POPs programmes in those countries and the possibilities for synchronisation with MLF funding options.

102. Implementation of the demonstration projects has also provided the relevant national stakeholders with information on real costs of the ODS waste collection and transportation to the destruction facilities abroad. This financial information will be important in the future, as there are plans for the construction of regional ODS destruction facilities that could be used for final disposal of ODS waste from LVC countries.

103. Apart from the evidence of practical feasibility and the rationale for the joint approach of the MLF and the GEF, the joint activities could also facilitate communication between the NOO and other hazardous waste focal areas in the government setting, as other waste management departments get first-hand involvement in the ODS-related work.

104. Collaboration with bilateral agencies could serve as complementary means for addressing issues identified in the course of implementation of the ODS destruction activities. For example, the collaboration of the demonstration project in Ghana with the project funded by the Government of Germany enabled procurement of a cross flow chopper with an integrated foam blowing agent absorption system with an active carbon storage, in order to process stockpiles of PU foams that could not be addressed by the MLF project.

Recommendation

105. The Executive Committee may wish:

(a) To note the final report on the evaluation of the pilot demonstration projects on ODS disposal and destruction contained in document UNEP/OzL.Pro/ExCom/84/11; and

(b) To invite the bilateral and implementing agencies to apply, when appropriate, the lessons learned based on the key findings of the evaluation of the pilot demonstration projects on ODS disposal and destruction.

Annex I

TERMS OF REFERENCE FOR THE SECOND PHASE OF THE EVALUATION OF THE PILOT DEMONSTRATION PROJECTS ON ODS DISPOSAL AND DESTRUCTION IN CONJUNCTION WITH RECOVERY, RECYCLING AND RECLAMATION (RR&R) ACTIVITIES

Evaluation objectives and main issues

1. Based on the findings of the desk study, on issues raised in the reports from various countries and on the synthesis report submitted at the 82nd meeting[9], the evaluation will focus on the sustainability of the results of the ODS disposal and destruction projects implemented, as well as on the contribution of RR&R activities. It will inquire whether the destruction capability demonstrated through the pilot project can move to a sustainable model and on how this is sustained by a legal and regulatory framework and by a public awareness component. It will stress the need for waste prevention mechanisms and on enhancing the spirit of ownership and responsibility of the stakeholders.

2. The evaluation will analyse what were the limitations of such a model, the reasons of these and their impact on the productivity and cost effectiveness in destroying the ODS. Furthermore, it will analyse the reasons for delays and will summarize lessons learned from project implementation.

3. More specifically, the following issues will be addressed:

Project design

(a) What were the changes made in the approach for the project as compared to its original approval, and the justification for these changes?

(b) Describe the type and amount of ODS that was destroyed, how consistent it was with the approved proposal. If there are differences, what was the cause?

(c) Was the project designed around an existing ODS destruction facility (i.e., rotary or cement kiln) in the country, or was the ODS waste proposed to be exported? What modifications were needed to make the ODS destruction facility equipped to meet the standard of 99.99 per cent DRE for ODS destruction?

(d) Describe the existing framework for waste management in the country that facilitated project implementation and how it was it improved as a result of the project?

(e) What was the impact of the existing recycling, recovery, and reclamation (RR&R), centres available in the country in the overall determination of ODS wastes in terms of the logistics for refrigerant collection? How many of these R&R centres were established under Multilateral Fund projects and how many are privately operated? What challenges exist for increasing recovery?

[9] UNEP/OzL.Pro/ExCom/82/21.

(f) Where projects were originally designed to look at synergies with similar projects and initiatives, or projects dealing with other organic pollutants destruction, how was this collaboration designed (e.g., funded by the Green Energy Fund)? For other projects, which did not include this component, were considerations made during project implementation of looking at such synergies to meeting national obligations under the Stockholm Convention on Persistent Organic Pollutants?

(g) How did the project integrate elements that ensured the quality (including type, purity, location and ownership) of the ODS waste that was to be destroyed?

(h) Was the foreseen management and financial set-up in the approved project achieved in implementation? If not, why? How was the management of end-of-life ODS integrated into the countries' overall hazardous waste and/or refrigerant management system?

Policies and regulations related to ODS disposal and destruction and RR&R

4. According to the desk study and the subsequent synthesis report, changes were required in the existing national policy and regulatory infrastructure for the implementation of the ODS waste disposal projects. This primarily concerned the revision of the legal framework related to ODS waste management.

(a) What type of changes were made the existing national policy and regulatory infrastructure to facilitate the implementation of the ODS destruction projects? Describe all changes, and the specific new regulations that resulted from the project. Likewise describe those that were required but not implemented and why. Was the project implemented as part of a larger national policy framework, which was part of an integrated approach to special and hazardous waste management?

(a) Describe the regulations that were established during project implementation that mandated ODS and other waste collection efforts and standards such as the extended producer responsibility (EPR) or the waste electrical and electronic equipment (WEEE) recycling management programme and how these facilitated the implementation of the demonstration projects

(b) In the case of exporting ODS for destruction, describe the changes required in the legal framework allowing or prohibiting such activity? What motivated the Government to decide to export waste instead of destroying it and what were the problems encountered? Was this decision in agreement with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal? Was there any exemption for ODS export?

(c) For those countries that lacked regulatory mechanisms requiring safe disposal and destruction of ODS waste at project inception, did the results from the pilot projects provide opportunities to introduce requirements for decommissioning ODS-containing refrigeration equipment, including obligations to dispose of such waste, and to put in place mandatory requirements for destroying ODS?

(d) What Ministries were involved in the project implementation? Was there a synergy or network of coordination among the Ministries involved? Was there any training of their personnel on the harmful effect of ODS and the need for destruction, recycling/reclamation or export? Were there any legal limitations for any of the Ministries involved for facilitating the project?

(e) How was the coherence among national policies on waste disposal and destruction, recovery, recycling and reclamation with existing regional regulations (e.g., European Union) and how has this facilitated the formulation of a disposal and destruction national legislation?

Approaches in collection, destruction and selection of technology

5. How was waste collected and aggregated? Was there an institutionalized collection system at the national and/or local level (collecting and dismantling end-of-life (EOL) electrical appliances including domestic and commercial refrigeration equipment, home appliance replacement and EPR programmes)? What was the role of recovery and recycling centres or of networks in collection?

6. The desk study found out that there were only two main approaches selected in the sample countries, namely domestic destruction through local facilities and export of the ODS waste abroad.

(a) How was the identification and selection of destruction technology undertaken? Were there various options for destroying ODS waste considered? What was the process of validation of the technological, economic and environmental effectiveness of these?

(b) Was there an existing technology that needed modification and if yes, which one? What were the challenges in adapting existing infrastructure (e.g., cement kilns, rotary kilns and chemical incinerators)? What was the participation of stakeholders in this process? Were there preliminary discussions with or monitoring of potential suppliers?

(c) What was the result of the technology used for destruction in terms of *inter alia* emissions and cost-effectiveness?

(d) What were the criteria for choosing the facilities included in the projects?

(e) Was recycling or reclamation of ODS considered? If so, how?

Storage and transportation of ODS waste

7. What was the procedure to identify and select ODS waste storage facilities (e.g., existing recovery/reclamation/collection centres or other)? How was the assessment process carried out? Were there bidding mechanisms put in place and what were the challenges? How were these facilities equipped? (e.g., storage cylinders to allow aggregation of waste refrigerants at the national level).

8. How was the transportation of ODS waste organized? How did it contribute to the total cost of disposal and destruction? Was there appropriate equipment (e.g., iso-tanks) available?

9. Were the requirements of the Basel Convention applied during transboundary transportation of the waste?

Monitoring and verification of the destruction

(a) How is the destruction of ODS waste properly accounted for? Were databases for data collection and storing created if yes, please describe? How were there monitoring plans devised? Were the database and monitoring process institutionalized and improved upon to sustain the subsequent ODS destruction activities?

(b) Is it possible to trace dismantled ODS equipment, if so how?

(c) When ODS were extracted from EOL equipment, did the model include recovery and recycling or disposal of residual materials? Was any cost or revenue generated from this? Is there a system of certificates provided to the enterprises from which ODS have been picked up?

Technical assistance and training

10. What were the needs in technical assistance, legal and institutional of various countries and how were these met? Was training of national experts, environmental audits of the facilities and environmental management plans provided? Where did the training take place? Who was trained and in which area? Was standard Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal documentation provided during the training?

11. How was the certification of servicing companies and technicians organized to ensure proper handling and collection of used refrigerants?

12. Were there and if yes, how were they organized, training workshops on aggregation of ODS stocks for destruction as well as for improvement of the recovery and recycling systems and what were the main challenges in identifying and attracting trainees?

Financial aspects

(a) Was funding for the demonstration projects adequate? If not, which components (e.g., storage or transportation) were not adequately funded and why?

(b) What specific opportunities were found for leveraging co-financing for a self-sustained ODS destruction system? What challenges were encountered in securing co-financing? What co-financing modalities were explored and which were successful? Are other modalities being explored, and if so, what are they?

(c) What specific opportunities were found for leveraging co-financing for a self-sustained ODS destruction system? What challenges were encountered in securing co-financing? What co-financing modalities were successful and why?

(d) What were the costs assessed in the project design? What were the costs after completion of the project, compared to those planned? If there were differences, what were the reasons

for these differences? How were costs affected relating to the implementation of policies and regulations in the country?

(e) Did the business model established for ODS disposal/destruction include the following?

(i) Type of ODS included;

(ii) Expected amounts of ODS to be collected for a successful operation; and

(iii) Funding sources mobilized and included into the model (i.e., link to carbon credits in voluntary markets; national regulation incentives; suppliers co-financing for EOL collection of equipment, cost savings through cost-sharing with similar projects)?

Communication and dissemination

13. What were the communication mechanisms (e.g., workshops and seminars) and what were the challenges encountered? What were the national or regional communication platforms on ODS waste disposal (e.g., forums and conferences) to disseminate and promote information and lessons learned from successful experiences? Were there similar activities related to RR&R?

14. How was the coordination and communication among various actors in both disposal and destruction and RR&R areas been organized?

15. What has been the political and industrial response towards such projects and what consequences with regard to project implementation were observed?

Sustainability and replicability

16. What needs to be taken into account when designing a viable and sustainable business model for ODS disposal and destruction? How can a mechanism of waste prevention be implemented, what are its main elements and what are the main challenges to its implementation?

17. What changes need to be brought to the national and/or local policy and regulations framework to encourage waste prevention and effective collection, storage, transportation and destruction of existing ODS waste?

18. What are the measures implemented or that need to be implemented to promote the idea of ownership at the institutional level as well as to increase responsibility among refrigeration suppliers and distributors (e.g., EPR or other)? How can this be monitored?

19. Some LVC countries (i.e., Georgia and Nepal) implemented the project and came out with protocols, which could be implemented in other LVCs.

(a) What is the feasibility of implementation of these models? What are the conditions needed for this protocols to be implemented in other countries and what are the potential challenges?

(b) What were the solutions of self-funding for sustainability?

(c) How did regional projects contribute to help the destruction of ODS?

Gender-related issues

20. Did training of national experts took gender issues into account in identifying potential trainees? What other gender-related issues have been observed during project implementation?

Scope, methodology and schedule of submission

21. A sample of countries was selected based on the following criteria: region, implementing agency, approach to destruction (local or export) and the results of the projects. The countries selected are:

(a) Colombia (UNDP): Domestic destruction through certification of three incineration facilities for ODS destruction;

(b) Georgia (UNDP): Co-disposal with POPs waste through export of these wastes to develop a protocol to be implemented in other LVC countries;

(a) Ghana (UNDP): Export to an Article 2 country for carbon finance;

(b) Mexico (UNIDO/France): Transportation of ODS waste to a centralized facility in Mexico and to the United States; and

(c) Nigeria (UNIDO): Transportation to a centralized facility for storage before exporting.

22. A team of consultants will be recruited to visit the countries and collect information. In addition, they will read existing documentation, especially the desk study of the evaluation as well as the synthesis report on the pilot ODS disposal projects (document UNEP/OzL.Pro/ExCom/82/21) presented at the 82nd meeting of the Executive Committee, and discuss with members of the Secretariat and the bilateral and implementing agencies, as needed.

23. Each visit will yield a country report and a synthesis report will summarize the findings and formulate lessons learned, which will be submitted to the 84th meeting. The reports will be shared with the bilateral and implementing agencies for comments.