UNITED
NATIONS

EP

United Nations
Environment
Programme

Distr.
GENERAL

UNEP/OzL.Pro/ExCom/82/11
16 November 2018

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Eighty-second Meeting
Montreal, 3-7 December 2018

FINAL REPORT OF THE EVALUATION OF THE REFRIGERATION SERVICING SECTOR

INTRODUCTION

Background and objectives

1. The Executive Committee approved the terms of reference for the evaluation of the refrigeration servicing sector at its 79th meeting[1]. The evaluation comprised two stages: stage one, a desk study; and stage two country-based evaluations. A synthesis reports summarizes the findings of these two stages.

2. The objective of the desk study was to analyse the progress made in the phase-out of HCFCs in the refrigeration servicing projects funded by the Multilateral Fund (MLF). It concentrated on the contribution of specific activities within servicing sector plans to reduce HCFC consumption, the impact on servicing arising from the introduction of low-global warming potential (GWP) alternatives when relevant, and challenges encountered during project implementation. The evaluation drew lessons from these projects to help future similar activities in the sector and also attempted to identify potential issues that could be related to the phasing-down of HFCs. The desk study report was presented to the 80th meeting.[2]

3. The second stage of the evaluation had the following objectives: (a) to provide an analysis of the project implementation in the refrigeration servicing sector in a sample of countries; (b) to formulate lessons learned for improving future similar projects; and (c) to further assess potential issues that could be related to the phasing-down of HFCs in the servicing sector, while taking into account the issues identified in the desk study. Furthermore, the evaluation strived to provide quantitative data on the impacts and the costs of the activities in the servicing sector to the extent possible. The terms of reference for the second stage of the evaluation are contained in Annex I to the present document.

[1] Decision 79/6.
[2] UNEP/OzL.Pro/ExCom/80/10 and Corr.1

4. The following countries were visited by the evaluation teams, based on geographical area, bilateral and implementing agencies (IAs), and/or specificity of projects:

(a) Chile (Latin American country with servicing in supermarkets)(UNDP, UNIDO and UNEP);

(b) Grenada (Caribbean country with 20 recycling and recovery (R&R) centres and awareness raising to promote alternative technologies)(UNEP and UNIDO);

(c) India (Asian country with the use of R-290) (UNDP, UNEP, and Germany);

(d) Kyrgyzstan (Europe and Central Asian (ECA) region with an innovative approach and a complete phase-out planned for 2020)(UNDP and UNEP);

(e) Oman (Middle Eastern country with activities in recovery of refrigerant)(UNEP and UNIDO);

(f) Samoa (Pacific Island Country (PIC)(UNEP);

(g) Senegal (Western Africa)(UNEP and UNIDO);

(h) Turkey (ECA region, demonstration project)(UNEP and UNIDO); and

(i) Zimbabwe (Eastern Africa)(Germany).

5. A preliminary report[3] was presented to the 81st meeting which included evaluation of the following countries: Chile, Grenada, India, Oman and Samoa. The present document is the final report, which includes the analysis of the field visits to the remaining countries, namely, Kyrgyzstan, Senegal, Turkey and Zimbabwe. All reports are available on the Secretariat's website in the evaluation library, with a restricted access, which can be provided upon request. This report also includes the following annexes:

Annex I: Terms of reference for the second phase of the evaluation of the refrigeration servicing sector

Annex II: Sample of key impacts of the projects evaluated

Annex III: Additional HCFC reduction and "cascade effect"

Annex IV: Fund allocation for activities for the servicing sector

Annex V: Detailed results of RRR operations in countries visited

Annex VI: Overall results of RRR operations in countries visited

CONCLUSIONS AND LESSONS LEARNED

6. The conclusions and lessons learned take into account those from the desk study, the preliminary report submitted at the 81st meeting, and the findings of the field visits for the countries in the study.

[3] UNEP/OzL.Pro/ExCom/81/7.

Most important questions raised by the preliminary report

Most and least effective activities across all countries

7. The ultimate indicator of the success of any activity within the HPMP is the reduction in HCFC consumption. While it is difficult to ascertain the reduction specifically attributable to each activity for the servicing sector, the training of refrigeration and air-conditioning (RAC) technicians has had the highest impact across all countries (if only because of the important) high percentage of agents of change (trained and certified RAC technicians) reaching up to 90 per cent in some countries. Similarly, the establishment of policy and regulatory frameworks has proved to be a powerful tool for compliance with the Montreal Protocol obligations in the RAC servicing sector across all countries, as clearly exemplified by the case of Turkey, where almost complete HCFC phase-out in the sector has been supported through the policy and regulatory framework. On the other hand, the establishment of refrigerant R&R networks still needs to provide consistent measurable results and seems to be lacking a sustainable economic model adapted to local condition. It must, however, be kept in mind that each of the activities within the HPMP is part of an overall strategy where each element supports or reinforces the others.

Integration of HFC phase-down

8. The integration of HFC phase down into the process of HCFC phase-out is already occurring since quite some time through: (a) the inclusion within the training for RAC technicians of good practices related to HFCs and information on the effects of HFCs and other high-GWP refrigerants on the environment, and their imminent control; (b) the inclusion in the R&R projects of recovery machines that can handle multiple refrigerants including HFCs; (c) the design of norms and standards for refrigerants and energy efficiency that favours the introduction of low-GWP technologies in the RAC sector, thus reducing the possibilities of introducing HFC-based equipment; and (d) the approval of demonstration projects that promote the adoption of low-GWP refrigerants instead of HFCs as alternatives to HCFCs. All these efforts can continue and can be stepped up in the immediate future, but the most important action may be to prevent the further influx of HFC-based (and even HCFC-based) equipment into the countries. A high-tax policy on these products coupled with fiscal incentives on the desired alternatives might be one key element of any set of policies oriented to this effect.

Low-GWP alternatives

9. Efforts are still required concerning the introduction of low-GWP-based equipment in the local markets, as well as the adequacy of norms and standards for the safe operation and maintenance of such equipment. In this sense it would be worth considering the adoption of fiscal incentives for the import of low-GWP-based equipment and providing more focused technical assistance for the adoption of national norms and standards for the safe operation and maintenance of low-GWP-based RAC equipment.

Project implementation

10. The HPMP implementation has had positive results:

(a) The rate of non-compliance with the HCFC consumption control measures was only 2.8 per cent of the 35 countries included in stage I of the study; nevertheless, all Article 5 countries are presently in compliance (as per the 30th Meeting of the Parties).

(b) It has leveraged Multilateral Fund resources by building on the institutional, policy/regulatory, and physical infrastructure as well as the human resources started with the phase-out of CFCs and followed with the phase-out of HCFCs; and

(c) It will in turn reinforce the process of the HFCs phase-down by continuing to support the same institutional, policy/regulatory and physical infrastructure as well as the human resources.

11. Some activities for the servicing sector being implemented within the HPMPs are similar in nature to those implemented within the different CFC phase-out plans, namely: (a) reducing ODS demand, through training and certification programmes for technicians, and other related initiatives; (b) reducing ODS supply with import/export licensing and quota systems and customs training, among others; and (c) assisting both efforts through supporting measures such as additional legislative and regulatory measures and public awareness. However, the major difference in the HCFC phase-out is the introduction of flammable low-GWP alternatives, requiring additional activities.

12. The analysis of how the funds for the servicing sector have been allocated among the different activities, for the nine countries included in the second stage of this study, shows that training of RAC technicians is, by far, the activity where most funds have been allocated at an average of 29 per cent followed by R&R networks (25 per cent); then customs training (an average 15 per cent), and monitoring (14 per cent) while the activity with the least funds allocated is the establishment of a policy and regulatory framework (three per cent). Annex IV of this document provides further details and analysis.

13. The most important local strategic partners for HPMP implementation have proven to be the RAC technician's associations and technical RAC training schools which have played relevant roles in the identification, contacting, training, certification and awareness-raising of RAC technicians and other RAC sector players, and even in special monitoring functions. Such has been the case in all the countries in this study except in Oman, where there is a recommendation from the consultant, in the country report, to sponsor the creation of a RAC technician's association.

14. HPMP implementation will have an important effect on HFC phase-down which will be leveraged by all the groundwork previously realised during CFC and HCFC phase-out efforts, namely:

(a) A fully operational institutional framework formed by related government institutions, private industry and trade associations, technical training institutions and non-governmental organizations (NGOs), among others;

(b) A comprehensive policy and legal framework that constitutes the basis for HFC phase-down related measures; and

(c) Human resources within the concerned government institutions and the RAC servicing sector, conversant with Montreal Protocol related subjects as well as good practices for servicing and maintenance of RAC equipment.

15. The reporting records from the countries point to the need for a more focused assistance for very low-volume consuming (LVC) countries concerning HCFC consumption monitoring and reporting, which is an issue that may affect future endeavours. The analysis of reports also suggests that there may be an excess of data not necessarily well organised and/or useful[4]. One solution is to streamline the regular reporting requirements and undertake specific data collecting efforts in a database that would allow online consultation. This approach would require a more advanced planning of the information needs in order to produce timely results, but it would certainly constitute the foundation of a more comprehensive and cost-effective reporting system for the future.

[4] At present, an enormous amount of data is scattered across numerous reports for each country, and any analysis requires the massive reprocessing (e.g., re-typing, re-formatting and consolidating) of the disseminated data with the consequent issues such as waste of time, duplication of efforts and possibility of errors.

16. The main causes for delays in HPMP implementation reported by the countries originate in the IAs' administrative processes (Chile, Grenada, Samoa and Senegal), as well as from governments' administrative processes (Chile, Grenada and Turkey). Additionally, Chile identifies other reasons related to demonstration or investment projects; Oman identifies the lack of cooperation among key stakeholders; and Zimbabwe reports banking problems in the country.

17. The reported causes for delays seem to suggest that HPMP implementation would benefit from: (a) further streamlining of project administration processes within the IAs, (b) a more independent and stable structure of the national ozone units (NOUs)/project management units (PMUs) from their central governments in order to expedite administrative processes, and (c) a more focused assistance to NOUs/PMUs on administrative and operational requirements of projects funded under the MLF.

Policy, legal and regulatory frameworks

18. In the countries evaluated, the process from design to enactment of any new regulation at the national level takes anywhere between two and a half to four years. One example is Grenada where the establishment of a new standard takes approximately two and a half years.[5] This is particularly important given the even longer time necessary for the establishment of policy, legal and regulatory frameworks at the level of regional agreements as in the case of Senegal. To prevent setbacks in any implementation schedule there must be a realistic lapse of time allowed for the legislation process. This should be coupled with a more advanced planning of regulations. It is also worth considering the value of awareness-raising to promote the political relevance of the regulations under development and thus prioritise the enactment process.

19. Once the necessary standards are established, the wider accessibility to those standard certification, which is necessary for the functioning of the servicing sector, could be a problem for some countries such as Chile, where the certification have a high cost which is unaffordable for most service technicians. This is not the case for other countries such as Grenada where the cost is accessible to anyone. The cost seems to be related to the way the certification process is structured, where more formal processes in the hands of independent and unique organizations seem to be harder to access, as discussed in more detail under the section on training.

20. Multilateral Fund funding is only provided to countries with an operational and enforced licensing and quota system. Detection of illegal HCFC imports has only been reported in Chile (in two instances), Turkey and Senegal. Three countries have undertaken no other monitoring activities outside of those carried out under normal procedures of the customs departments or those funded under the HPMP. Samoa and Senegal have formed special teams to evaluate compliance with the code of practice, technician licensing and import/export regulations. Additionally, India reports an extensive ad-hoc monitoring of training effectiveness discussed in detail under the monitoring section. These initiatives, though, do not seem to be part of any permanent regulatory framework.

21. The main barriers identified to policy, legal and regulatory measures are: (a) the lack of a wider regulatory framework; (b) lack of attributions or direct responsibilities of authorities most concerned with such regulations; (c) the high costs of implementation and administration; (d) difficulty and cost of enforcement; and (e) difficulty and cost of compliance for small enterprises.

Technology-related issues

22. The main barriers identified for the adoption of low-GWP alternative technologies to HCFCs are: (a) the higher costs involved; (b) lack of confidence in the new technology; (c) lack of local expertise; and

[5] UNEP's Guide "International standards in refrigeration and air-conditioning", published in 2014 mentioned (page. 25) that: "The process from acceptance of a standard proposal to its publication can take, on average, two to four years, although in some cases this can be considerably longer."

(d) unavailability of equipment and servicing tools in the local market. The same barriers that prevent the adoption of HCFC alternative technologies also affect the servicing and maintenance of such equipment. Additionally, as mentioned by all countries, the global market is the main influencer of technology choices since it determines the availability of certain technologies in the local markets and hence facilitates or not their choice. In this respect, Grenada suggests that awareness and information campaigns should be targeted at refrigerant and equipment importers in order to influence their choice of technology. India also mentions that awareness and information campaigns should be targeted at tools manufacturers to encourage their accession to the local market. In this respect, the transition to low-GWP alternatives is being and will be favoured by initiatives such as:

(a) Conversion and demonstration projects for high consuming sectors such as supermarkets (e.g., Chile);

(b) Training activities for technicians (all countries);

(c) Training and awareness for importers of technology since they are the most important decision makers for technology selection (e.g., Grenada and India); and

(d) Establishment of policies oriented to promote the influx of the desired technologies while discouraging others, such as, *inter alia*, tax exemptions and environmental taxes.

23. HPMP projects as well as projects from other funds were key for the adoption of trans-critical CO_2 in the supermarket sector in Chile, by increasing confidence in the technology and trying to remove barriers to accelerate its adoption. This was also mentioned by Grenada concerning demonstration projects and training. In India, the refrigeration servicing sector needs training and specialised tools for adopting new technologies introduced by the manufacturers.

24. The influence of multinational enterprises on the adoption of new technologies varies. On the one hand, the choice of new RAC technology by multinational end-user enterprises operating in Article 5 countries can influence the choice of local companies (e.g., as in Samoa with the Coca Cola plant). On the other hand, these technologies may not be widely available in Article 5 countries because the enterprises that manufacture and commercialise the technology are not interested in smaller markets (at first), as indicated by Chile and Grenada.

Retrofitting HCFC-based equipment with flammable alternatives

25. Retrofitting HCFC-based equipment with flammable alternatives is not a common practice in any of the countries visited, except Grenada. In fact, none of the countries in the study (including Grenada where the practice is common) encourages such practice due to the risks involved for the lack of local conditions for using flammable alternatives. It is generally perceived by all the stakeholders, though, that the measures being taken towards the adoption of HC-based technologies will be valid for any retrofitting to these technologies as well, since the overriding concern is the safety in installation, maintenance and operation of such equipment. As a matter of fact, all the countries in the study are taking initiatives to create the necessary conditions for safely working with HC refrigerants and the establishment of the appropriate norms and standards.

26. All the stakeholders in all the countries in the study consider that training on alternative flammable or toxic refrigerants, together with the establishment and wide dissemination of the corresponding norms, standards and codes of good practices, will create the necessary conditions for safe servicing practices using those refrigerants and to promote the HFC phase-down.

Demonstration projects for the servicing sector

27. Only four countries in the sample have demonstration projects under the HPMP: Turkey and Zimbabwe, where the projects are still ongoing, and Chile and Grenada, where both countries have at the same time other independent demonstration projects (one in Chile and two in Grenada) funded outside the MLF. These last two examples further discussed in the section on co-funding, constitute interesting cases of co-funding obtained separately from the projects in question, which complements well their objectives.

28. Completed demonstration projects in all cases have proven key in eliminating barriers for the adoption of HCFC alternative technologies by ascertaining the feasibility of these technologies under local conditions, and overcoming barriers for the adoption of the new technology, such as the higher costs involved, the lack of local expertise, or the lack of local availability of equipment, parts or refrigerant. However, there are so far, no accounts of other actual projects replicating the demonstration projects as a direct consequence of them, and there is no guarantee that some barriers will not be there for other similar projects such as higher costs (which will not be covered by a sponsoring institution) or the lack of local availability of equipment or parts.

29. Demonstration projects can take a long time to produce results, and dissemination of results can happen only at the time of project completion. This calls for a more advanced planning and approval of this type of projects and a well-orchestrated effort for dissemination of the results.

Energy efficiency

30. In every country in the sample of this study there are specialised agencies in charge of promoting energy efficiency mainly through the establishment of energy efficiency standards for locally manufactured as well as imported equipment, labelling requirements, and awareness raising. Some NOUs been involved in these efforts in order to promote HCFC alternative refrigerants. For instance, in Chile there are two separate energy efficiency programmes spearheaded by the Cleaner Production Programme and the Ministry of Energy respectively, oriented towards the improvement in energy efficiency in different commercial sectors, in which the NOU has become involved.

31. Local efforts to measure changes in energy efficiency outside of demonstration projects have not been carried out because of lack of specific programmes to do so, lack of local expertise on the subject, and lack of appropriate equipment or tools. Those projects that include energy efficiency measurements have not yet been completed, (i.e., Chile or Grenada). It has also been pointed out, as in the case of high ambient temperature countries like Oman, or tropical like Samoa and Zimbabwe the design parameters of RAC equipment are often not achieved due to extreme operating conditions or improper installation, maintenance, or servicing, or all of those reasons together. India, on the other hand, mentions that information on energy efficiency is given during the technicians' training where it is stressed that good refrigerant management practices and proper servicing and maintenance may restore the equipment's energy efficiency.

Refrigerant containment (recovery, recycling and reclamation)

32. Only six countries out of the nine included in the study, have provided data concerning the actual results of the operation of the RRR networks. Data analysis allows estimating an approximate annual recovery rate[6] in the range of 0.91 to 4.55 per cent of the HCFC baseline, and a possible annual[7] reclaiming rate of 2.6 per cent of the HCFC baseline for Chile and 26.8 per cent for Kyrgyzstan. The recovery rate presents a slight trend to be bigger in countries with lower HCFC consumption[8], and to be lower for

[6] This is based almost exclusively on data about stored refrigerant, which does not include the refrigerant being re-used.
[7] The data is only for three months of operations.
[8] This might be due to a greater coverage of the RAC sector by the training programmes, as discussed under the training section.

networks with more years of operation[9]. Additionally, Grenada also reports a refrigerant re-use rate between 80 to 85 per cent and Zimbabwe reported to have re-used "most of it". These figures relate to recovered refrigerant stored within the recovery networks established under the ODS phase-out efforts but do not include the recovery carried out by enterprises with their own equipment which are estimated by some NOUs to represent between 5 to 90 per cent of all the companies in the country. These figures confirm the important benefit for the country of the recovery operation both in the economic and environmental sense. Additional information is contained in Annex V of this document.

33. As per the data from Chile, the cost of recovered[10] refrigerant (if it can be re-used) is much lower than the cost of virgin refrigerant (US $3/kg vs US $10/kg). The price of reclaimed refrigerant is twice as costly as virgin refrigerant (US $20 against US $10), which evidences the lack of individual economic interest of the reclaiming operation, at least in this case.

34. Another aspect of refrigerant containment is leak control, which can represent as much as almost 40 per cent[11] of savings in refrigerant expenditures and consequent damage to the environment, but where there has been no evidence during the field visits of much attention being paid to this issue, except in the case of Turkey, probably due to an ODS regulation which is up to the European Union standards.

35. The cost-effective management of unwanted refrigerants is also an unsolved challenge for the countries in the study[12] due to similar but higher barriers to those for RRR systems, namely: (a) logistic costs (transport to stockpiling centres and eventually to destruction facilities); (b) labour costs (recovery is time consuming); (c) the lack of local availability of ancillary equipment and parts; (d) the cost of the destruction process; and (e) the added challenge for the majority of countries with no local destruction facilities and increased transport costs. In addition, Kyrgyzstan and Zimbabwe have mentioned problems with the shipment of ODS waste through neighbouring countries. According to data provided by the countries, destruction fees range from US $10 to up to US $50, without including recovery costs and cost of transportation to the destruction site, usually located abroad. This adds up to more than the cost of virgin refrigerant. Additional information is contained in Annex VI of this document.

36. Devising the economic benefits and the sustainability of RRR systems is challenging because of logistic costs (transport costs to recovery or reclaiming centres); labour costs (recovery from large installations is time consuming); the lack of local availability of ancillary equipment and parts (such as refillable cylinders); and the lack of economic incentives due to the low price of the virgin refrigerants (when no extra taxes are applied to Montreal Protocol regulated substances). In this sense, finding a sustainable business model for RRR systems that is attractive for the RAC sector is still an ongoing effort, as experienced by Chile, India, Kyrgyzstan and Oman.

37. Supporting measures such as prohibition of venting, mandatory recovery and use of mandatory refillable cylinders have their own barriers such as the difficulty of and cost of enforcement.

Training and sustainability of training results

38. The coverage of HPMP training programmes has ranged anywhere from 5.4 per cent of the estimated total of RAC technicians in Oman, 5.5 per cent in India, 10 per cent in Zimbabwe, 33 per cent in Chile, 50 per cent in Grenada to 90 per cent in Samoa. All countries in the sample have incorporated Montreal Protocol and ODS related information into the curricula of technical training schools to different degrees of detail depending on the priority of the countries, thus ensuring the sustainability of the training efforts. The continuous updating of the curricula and trainers for the future since this requires resources not

[9] This could be due to attrition of equipment.
[10] This is the recovery fee per kg from Regener, the reclaiming centre.
[11] As in the case of the Migros supermarket chain in Turkey.
[12] This is in line with the findings of the desk study on the evaluation of the pilot demonstration projects on ODS disposal and destruction (UNEP/OzL.Pro/ExCom/75/10).

usually available to Article 5 countries. It is foreseen that, for the HFC phase-down, formal training on energy efficiency, including methods for its improvement, its relation with good maintenance practices, and methods and tools for measurement, will be required.

39. The sustainability of the training programmes can be ensured through the establishment of standards and codes of good practice for installation, servicing and maintenance of RAC equipment and a certification system coupled with the corresponding monitoring and enforcement scheme to ensure compliance. Once the standards and codes of good practice have been established, the monitoring and enforcement is an ongoing task that requires resources not usually available to Article 5 countries. India faces a challenge with the small coverage of a very large territory, which makes sustainability of the training efforts and training effectiveness hard.

40. The training of the informal RAC servicing sector presents challenges of its own, which are made more difficult by the fact that the informal RAC servicing sector is usually bigger than the formal one in many countries. As reported by Senegal, the main challenges are that: (a) trainees lack, most of the times, even basic schooling; (b) the technicians do not have the resources to purchase the appropriate equipment and tools; and (c) the technicians work on their own and cannot afford to lose one day's worth of work. On the other hand, the technicians show a strong motivation since the training usually offers them an opportunity for financial, technical and social advancement, and the trainers and the institutions backing the training are well known and respected.

41. The certification of technicians has been adopted in Chile and Grenada, with a certification rate that ranges from 53 per cent of the technicians trained in Chile, to 73 per cent in Grenada. A licensing system was implemented in Samoa. Certification processes present various characteristics that depend on local conditions, with a formal implementation in Chile where only one independent organization is authorised to certify RAC technicians at a fee of US $300, to a more flexible and accessible certification scheme in Grenada with four different ways to obtain certification at an accessible cost that allows technicians to have several certifications at once.

Awareness-raising and dissemination of information

42. All countries (except Oman and Zimbabwe) report the use of various channels for awareness raising and dissemination of information while focusing on specific audiences such as RAC technicians, RAC refrigerant and equipment importer and vendor enterprises, national customs departments and the general public The channels of communication used are, *inter alia*: technical workshops, technical magazines, trade shows, posters, TV ads, smart phone applications, and information provided by refrigerant/technology vendors.

43. Oman has only relied on workshops and direct meetings with the RAC sector contractors, since the absence of a local trade association has made communications dependent on word of mouth. Zimbabwe has relied on the same means of communication as Oman and reports that mandatory HC certification for refrigerant purchase is not functional because of the lack of communication between government entities and the private sector. In contrast, India has mentioned innovative means for awareness raising and communication, such as an application for smart phones for the distribution of a RAC newsletter.

Funding

44. All countries in the study (except Kyrgyzstan, Oman, Turkey and Zimbabwe) have reported that the funds approved under the HPMP were less than expected and insufficient for the completion of all the activities planned. India has mentioned that the funding threshold for servicing activities should be increased and the flexibility clause expanded. Some flexibility in funds allocations was exerted to complement the activities that were deemed essential, (e.g., public awareness activities). Additional funding under decision 74/50 will be used in all cases to cover equipment and tools needed for working with HCs.

45. In all cases except India and Oman[13], co-funding provided by the government and the private sector was substantial though not always quantified, and the co-funding afforded by the beneficiary companies was, in most cases, the bulk of the cost of the project. However, independent sources of co-funding for one specific project seem to be more difficult to obtain. There are indications that co-funding obtained through separate independent projects with different but related objectives may be viable; such as in the case of one project in Chile; or Grenada with two projects. These projects are discussed in more detail in the section on demonstration projects.

46. With respect to the quantification of co-funding, only three out of the nine countries have included it:

(a) Chile, with total approved funds for the servicing sector under stage I of the HPMP of US $2 million, secured a total co-funding[14] of US $1,669,222, or 82 per cent of the total funds approved under the MLF;

(b) Grenada, with total funds approved of US $210,000, secured co-funding greater than 100 per cent of that amount[15] through two demonstration projects financed from independent sources; and

(c) Turkey with total approved funds of US $5.3 million only executed approximately 5 per cent of that amount and exceeded its obligations under the Agreement with the Executive Committee, thus achieving a level of co-funding equal to 95 per cent of the funds approved but not spent.

Monitoring

47. Most countries carry out monitoring of the implementation of the initiatives within the HPMP through independent consultants, in particular those initiatives that involve a large number of beneficiaries and activities, such as training programmes and establishment of R&R systems. Nevertheless, no actual results or their indicators are being monitored systematically, not even refrigerant recovery rates, leak rates or the adherence to lines of conduct dictated by training, codes of good practice, awareness programmes; or even regulations. Only in Samoa and Senegal a multi-sectorial government inspection team conducted site visits to ensure compliance with the code of good practices, technician licensing and import/export regulations. However, no indicators are being monitored either.

48. India has reported an “impact monitoring” tool to evaluate the effectiveness of training with the following main results: (a) the number of equipment installed and serviced by trained technicians increased in most of the states; (b) there has been a growth in practice of recovering HCFC-22 during servicing of room air-conditioning (AC); (c) technicians surveyed in most of the states use vacuum pumps for evacuation of the system and in a few states 100 per cent use (post training) have been reported; (d) technicians, in a few states, which were not using recovery units have been using it selectively after training; and (e) by adopting good servicing practices most of the technicians have reported saving on refrigerant during servicing. No specific figures were included in the report.

49. In Turkey, where as part of the efforts for joining the European Union, the current system of checking servicing documentation and HCFC and HFC emissions and leakage records by the Environmental Inspectorate will be replaced by establishing a central database, electronically connected directly to servicing facilities, and even to end-user equipment containing HCFCs and F-gases.

[13] The subject was not mentioned in the reports.
[14] Co-funding was from the government for financing policy development and from independent sources for financing demonstration projects.
[15] The exact amount was not provided.

Gender–related issues

50. While servicing in refrigeration related professions are male dominated, the field visits encountered cases where women are present and active in the sector. Based on various interviews this could be part of an evolving trend: Women are co-owners of servicing companies, as in the case of Kirgizstan, are managers of companies, as it was observed in India, and are technical consultants, as in Senegal. Training centres in Senegal have women among the trainees and an association for women in refrigeration was created in this country to help young graduates get jobs and start a career.

RECOMMENDATIONS

Project implementation

51. The success in HPMP implementation suggests that efforts should be increased in strengthening the strategic approach being used as well as the institutional, policy/regulatory and infrastructure together with the of human resources, since they will continue supporting the HCFC phase-out and the phase-down of HFCs.

52. The continued strengthening and support of strategic partners for HPMP implementation such as the RAC associations and technical RAC training schools, both with training and infrastructure or equipment, will result in additional support for the success of HCFC phase-out and the eventual phase-down of HFCs. This will be particularly important for countries such as Oman, where a RAC trade association does not exist, or India, where more regional chapters of such association would need to be opened for increased coverage.

53. The promotion of low-GWP alternatives within the HPMP (e.g., demonstration and investment projects, training activities, awareness raising efforts) should continue to be strengthened, as it is proving effective.

54. HPMP implementation and preparation of HFC phase-down would be improved by streamlining the regular reporting requirements and undertaking a continuous country-specific data collecting effort in a database that would allow online consultation and reporting. This approach would require an initial substantive effort, but it would certainly constitute the foundation of a more comprehensive and cost-effective information and decision-making system for the future.

55. Future implementation delays could be avoided through the streamlining of administrative and contractual procedures both in IAs and local governments, coupled with additional technical assistance to countries concerning the administrative and operational requirements for project implementation under the MLF.

Policy, legal and regulatory frameworks

56. The update of comprehensive policy, legal and regulatory frameworks for HFC phase-down must be undertaken as early as possible since it is usually a time-consuming process. Some of the common barriers for early action could be overcome through sensitization activities regarding the need for legislation updates at the highest levels of government in order to expedite the approval process, and provision of adequate financial and technical support. Considering that many low-GWP alternatives are flammable, this becomes particularly relevant for countries where the policy, legal and regulatory framework for working with these refrigerants is lagging behind.

57. There are indications that providing technical and/or financial assistance for improving the accessibility of the RAC community to approved standards and codes of practice could help increase the

adherence to such standards and consequently, the certification process[16]. This, in turn, would ensure a wider adherence to good servicing practices and therefore a more cost-efficient and environmentally-conscious use of refrigerants.

58. There are indications that supporting and encouraging the establishment of cost-effective legal and permanent monitoring and enforcement systems[17] might benefit the adoption and adherence to policy, legal and regulatory frameworks.

Technology-related issues

59. The adoption of new alternative technologies can be expedited through increased training on such technologies, coupled with the adoption of related standards and codes of good practices and the corresponding awareness campaigns and dissemination of information, in particular for low-GWP, and flammable and toxic alternatives. As the manufacturers of RAC technology have already been funded, an important target of related information campaigns should be the importers of RAC technology since they are recognised as important factors of change. These measures can help overcome the most common barriers identified for the adoption of such technologies.

60. Demonstration projects can also serve the purpose of expediting the adoption of new alternative technologies when targeted to specific sectors and their results are widely disseminated, as concluded during the first stage of this study.

61. Other long range measures, might be the establishment of policies and related fiscal measures oriented to the promotion of equipment using low-GWP technologies and to the discouragement equipment based on HCFC and HFC.

Retrofitting HCFC-based equipment with flammable alternatives

62. Even though the practice of retrofitting HCFC-based equipment with flammable alternatives seems not to be common in the majority of countries (eight out of nine in this study), those countries where the practice is common should increase their efforts to avoid it, and if not possible to accelerate the initiatives related to training and the establishment of related standards to work safely with HCs, coupled with awareness campaigns, in order to regulate and increase the safety of the practice, while taking into account the related decisions by the Executive Committee[18].

63. Adequate technical and financial support should be continued for related training and for the establishment of norms and standards for working with flammable alternatives even for countries where their use is not common, since this will facilitate their adoption as low-GWP alternatives to HCFCs.

[16] As in the case of Chile where there are several programmes to subsidise the cost of certification.

[17] Systems which should become part of the normal procedures within the related institutions, and not an HPMP-dependent activity.

[18] Decision 72/17: The Committee decided to include in the approval of HCFC phase out management plans, tranches, projects or activities that proposed the retrofit of HCFC based refrigeration and air conditioning equipment to flammable or toxic refrigerants that the Executive Committee notes that, if the country engages in retrofitting HCFC-based refrigeration and air-conditioning equipment to flammable or toxic refrigerants and associated servicing, it does so on the understanding that they assume all associated responsibilities and risks and decision 73/34 para.117: "The Seventy-third Meeting of the Executive Committee decided that, if a country were to decide, after taking into account decision 72/17, to proceed with retrofits that used flammable substances in equipment originally designed for non-flammable substances, it should be done only in accordance with the relevant standards and protocols".

Energy efficiency

64. Consistent measurement of changes in energy efficiency at the country level can only be obtained if specific programmes including related training are included within the HPMP initiatives due to the obstacles that prevent such consistent measurements, such as the lack of specific programmes to measure energy efficiency changes, the lack of local expertise on the subject, and the lack of appropriate equipment or tools.

Refrigerant containment (recovery, recycling and reclamation)

65. Based on the feedback from the countries, additional efforts should be undertaken to design viable and sustainable business models adapted to local market conditions for RRR systems.

66. Efforts to promote RRR systems should be sustained given the environmental and economic benefits for the countries, and for the individuals, and more emphasis should be put into informing about the individual economic benefits at the local level.

67. International efforts should be increased concerning the design of a viable, cost-effective and sustainable economic model for ODS destruction, and appropriate technical and financial assistance should be provided to countries for the proper and safe storage of unwanted refrigerants.

Training and sustainability of training results

68. Even though the sustainability of the training efforts seems to be ensured through the incorporation of good practices into the curricula of technical training schools, the necessary continuous updating of training installations, curricula and trainers may require additional support from the MLF.

69. The same could be said concerning the sustainability of the training effectiveness, which must be ensured through the adoption of standards and codes of good practice for installation, servicing and maintenance of RAC equipment, but whose monitoring and enforcement may require additional assistance from the MLF, at least in the initial stages.

70. It is necessary to undertake a more focused approach for the informal RAC servicing sector, starting with a detailed study for a better categorisation; since the imminent advent of flammable and toxic alternatives to HCFCs and HFCs into the markets will make the activities of this sector a matter of public safety.

Awareness-raising and dissemination of information

71. One channel for awareness raising efforts of a more technical nature is the national trade associations, and in the exceptional cases where it does not exist, such as in Oman, awareness and in general, plain information, does not flow regularly and effectively to the RAC sector, which is a situation that must be addressed for the benefit of HPMP implementation.

72. Refrigerant and equipment importers and distributors should become specific targets of awareness and information activities as they are important agents of change in the efforts to phase-out HCFCs and phase-down of HFCs.

Funding

73. The co-funding provided by the governments, the beneficiary enterprises and other international initiatives have been more than substantial[19], even though they are not always recognised as such or

[19] Co-funding has amounted to between 82 to 1,900 per cent in the few cases where it has been quantified.

quantified. On the other hand, co-funding from other sources for specific projects have been more difficult to obtain for different reasons, while co-funding obtained through separate projects with different but related objectives (i.e., climate change and energy efficiency) seems to be a line of action worth exploring and promoting.

Monitoring

74. There seems to be a satisfactory level of monitoring of the implementation of the initiatives within the HPMP, but the same is not true concerning their effectiveness once the initiatives have been implemented, such as *inter alia*: the adherence to good practices in RAC servicing, leakage rates ante and post training activities, refrigerant recovery, re-use, and reclaiming rates. In this respect, and in order to obtain the indicators that would be needed for an improved decision making process, it is recommended to redefine either the monitoring functions or the HPMP activities themselves (or both), by including the mandatory measurement of the appropriate indicators.

75. In relation to this, the monitoring of the observance of lines of conduct dictated by training, codes of good practice, awareness programmes, or even regulations would need additional resources. In this respect, the experience with "impact monitoring" carried out in India is worth exploring, with special attention to ante and post-facto measurements.

76. An improved and more cost-effective monitoring should be coupled with an improved and more cost-effective information system. A centralised database could contain all the implementation data that is now located in many different reports for each country and provide updated analysis upon demand.

Recommendation

77. The Executive Committee may wish:

(a) To note the final report of the evaluation of the refrigeration servicing sector contained in document UNEP/OzL.Pro/ExCom/82/11; 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 refrigeration servicing sector; and

(c) To take into account the final report of the evaluation of the refrigeration servicing sector during the discussion on agenda item 11(d) of the 82nd meeting on the Development of the cost guidelines for the phase-down of HFCs in Article 5 countries.

Annex I

TERMS OF REFERENCE FOR THE SECOND PHASE OF THE EVALUATION OF THE REFRIGERATION SERVICING SECTOR

Background

1. At its 79th meeting, the Executive Committee approved the terms of reference for the evaluation of the refrigeration servicing sector. The importance of the servicing sector as one of the largest consumers of ODS as well as one that will significantly be affected by the HFC phase-down, called attention on the opportunity of such evaluation. The evaluation was planned in two stages: stage one consisted of a desk study, and stage two country evaluations reports following the field visits, which would be based on the findings and recommendations of the desk study.

2. The desk study examined selected projects in the refrigeration servicing sector in both low-volume consuming (LVC) and non-LVC countries[20], in various geographical regions and implemented by various bilateral and implementing agencies (IAs). It concluded that the HCFC phase-out management plans (HPMPs) were in majority successfully implemented, with only 2.8 per cent of cases of non-compliance with the Montreal Protocol and levels of consumption well below the control targets of the Montreal Protocol. Smaller ODS consuming countries may need a more focused assistance concerning HCFC consumption monitoring and reporting. The desk study also tackles the causes of delays in project implementation; the institutional strength in the legislative area; the attitude towards safety issues concerning technology based on flammable refrigerants; the impact of demonstration projects and the need for disseminating results; issues related to refrigerant containment in terms of recovery, recycling and reclamation; and energy efficiency.

3. The field visits will focus on key issues stressed in the desk study and will collect updated information about the project implementation, based on direct observation and discussions with various stakeholders.

Objective of the evaluation

4. The objective of the second stage of the evaluation is taking into account the issues identified in the desk study: (a) to provide a thorough analysis of the project implementation in the refrigeration servicing sector in a sample of countries; (b) to formulate lessons learned for improving future similar projects; and (c) to further assess potential issues that could be related to the phasing-down of HFCs in the servicing sector. Furthermore, the evaluation will strive to provide quantitative data on the impacts and the costs of the activities in the servicing sector to the extent possible.

5. The evaluation will address the following issues:

Project implementation

6. It will analyse the main activities in the servicing sector under the HPMPs as well as their impact on HCFC phase-out and energy efficiency improvements to the extent possible.

[20] The countries included in the study are: Burkina Faso, Djibouti, Ghana, Nigeria and Senegal in the African region; Bahrain, Kuwait and Saudi Arabia from the Middle East region; Cambodia, China, Fiji, the Islamic Republic of Iran and Maldives from the Asia and Asia-Pacific region; Armenia, Bosnia and Herzegovina and the Former Yugoslav Republic of Macedonia from the Eastern European region; Argentina, Brazil, Chile, Grenada, Mexico, Peru and Uruguay from the Latin American and Caribbean region; and the Cook Islands, Kiribati, the Marshall Islands, the Federated States of Micronesia, Nauru, Niue, Palau, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu all englobed under one single project for the so called Pacific Island Countries (PICs).

7. How did they contribute to the transition to low-global warming potential (GWP) alternatives and what were the key barriers or success factors? How can HFC phase-down activities in the servicing sector build on this experience? Were technical assistance and capacity building taken into consideration to address safety issues associated with low-GWP and zero-GWP alternatives and if so, what kind of activities were undertaken and to what extent where they effective?

8. How, if at all, did activities address the risks associated with retrofitting HCFC-based equipment with flammable alternatives?

9. What were the issues related to availability and affordability of spare parts and refrigerants and how have they been addressed?

10. What were the main issues encountered in the project implementation in LVC countries as compared to non-LVC countries?

11. All the countries covered by the desk study presented delays with various causes, such as the reorganization of the government institutions, complexity of activities, communication with the stakeholders. The field visits will gather more in-depth information about these delays, their causes and how to avoid them in the future.

12. According to the desk study, the refrigeration associations have been key in the design and implementation of all the activities directed to the refrigeration servicing sector. What have been the roles of local refrigeration associations in implementing phase-out activities? How did the major stakeholders coordinate and communicate? What can be learned relevant to the phase-down of the HFCs?

13. Was reporting on the implementation of activities regularly done? Is the reporting providing relevant information on challenges encountered and lessons learned?

14. How have the tools developed by UNEP CAP for the refrigeration servicing sector been used? Have they proved useful and adaptable locally? What can be learned relevant to the phase-down of HFCs?

15. To what extent activities being implemented have contributed or could potentially contribute to HFC phase-down in applications not covered in the HPMPs (e.g., domestic refrigeration, commercial refrigeration based on R-404A and R-407C, and mobile AC)? What could be modified in the project design and implementation to facilitate this?

Policy, legal and regulatory frameworks

16. Countries have adopted various legislative and regulatory measures to control HCFC supply through imports including licensing and quota system for HCFC-based equipment. Several countries have also banned imports of all used HCFC-based equipment, among others. Was there a delay in adopting this legislation and why? Can the enforcement procedures and monitoring tools developed be applied to HFC use and HFC-based equipment?

17. What have been the most common regulatory measures adopted by the countries in relation to the refrigeration servicing sector?

18. To what extent the following measures related to the refrigeration servicing sector have been established and implemented in Article 5 countries as part of the HPMPs: mandatory reporting by refrigerant importers and exporters; bans on “non-refillable” (disposable) refrigerant containers; extension of import/export licensing system to all refrigerants; HCFC emissions control measures (e.g., compulsory recovery); ban on the use of HCFC-141b for flushing systems during servicing; ban on imports of second-hand HCFC based equipment; and, predetermined schedules for leakage check by certified

personnel for systems with charges above certain limit; and large systems record-keeping (e.g., HCFC logbooks and HCFC-based equipment log books)? Which have been the main barriers to introduce these measures?

19. What measures have been taken to enable the safe introduction of low-GWP, flammable or toxic refrigerants and which were the main barriers in introducing them? What were the impacts? Were there interactions with national, regional or international standards setting bodies related to the safe use of flammable or toxic alternatives?

20. Have activities been undertaken to support inspections and certifications, standardised technical testing, and enforceable technical standards for alternative technologies and if so, what was their impact? To what extent can activities for the phase-down of HFCs build on these activities?

21. How is the country addressing illegal trade of refrigerants and what can be learned relevant to the phase-down of HFCs?

22. Were there new enforcement procedures and monitoring tools developed to control HCFC use in the sector as well as HCFC-based equipment imports? If so, can they be applied to HFC use and HFC-based equipment?

Technology-related issues

23. In each country the evaluation team will inquire about what technology is being implemented and what challenges were encountered to service equipment with alternative technologies? Were alternatives technologies as well as related equipment and tools available in the local markets? Have alternatives to HCFCs that sustain the operation of HCFC-based equipment until the end of life been promoted? If so, which alternatives have been used and what were the results**,** including on energy efficiency and refrigerant use?

24. Did these projects influence technology selection during the assembly, installation, initial charging and commissioning of new refrigeration equipment by servicing enterprises and technicians? What were the main factors influencing the choice of technology? What can be learned relevant to the project design?

25. What was the role of international companies in introducing alternative technologies and to what extent has this influenced the refrigeration servicing sector, HCFC phase-out and introduction of low-GWP alternatives?

26. How does reducing the refrigerant charge size in the design of systems impact the amounts of refrigerants emitted and how does it impact energy efficiency?

Retrofitting HCFC-based equipment with flammable alternatives

27. The desk study implied that for the general public, and even some of the refrigeration servicing sector, the risk of using and servicing equipment containing flammable substances was assumed to be negligible. To what extent is information made available to the end users and relevant stakeholders in the servicing sector on how to manage the risks associated with flammable or toxic substances accessible to the users?

28. How, if at all, did servicing activities address the risks associated with retrofitting HCFC-based equipment with flammable alternatives?

Demonstration projects for the servicing sector

29. How did demonstration projects contribute to the servicing sector? Did they serve as proof of the feasibility of technology solutions under local conditions? What were the lessons learned from demonstration projects?

Energy efficiency

30. What are the initiatives related to obtaining better energy efficiency? Were there improvements of energy efficiency through servicing activities? What were the key factors relevant to achieving these energy efficiency improvements and how were they sustained?

Refrigerant containment (recovery, recycling, reclamation)

31. What activities have been undertaken to promote the recovery of refrigerants and what was their impact? What strategies were developed to enhance recovery, recycling and reclamation? What measures have been taken to sustain these activities in a cost-effective manner? Can recovery and reclamation tools and techniques for HCFCs be transferred to the HFC phase-down?

32. Which institutions are responsible for the management of refrigerant containment practice and how were they involved in the activities?

33. Were there refrigerant reclaiming facilities established? Were stockpiles of used or unwanted controlled substances managed cost-effectively?

34. What measures are in place to prevent leakage and are they successful? Can this be emulated to other subsectors?

35. What measures were taken to manage waste recuperation (e.g., empty refrigerant cylinders)? Is it mandatory to use reusable cylinders? If not, what is the percentage of one-time cylinders use?

36. What is the rate of recycling or reclamation? What is the percentage of new refrigerants substituted?

Training and sustainability of training results

37. The evaluation will further inquire on how training programmes for refrigeration technicians have managed to build their own sustainability by ensuring that the curricula of technical training institutions are appropriately modified with such training.

38. How did the Multilateral Fund resources help in enhancing the capacity of national vocational/training centres and other local institutes involved in training of refrigeration technicians?

39. How many technicians were trained since the beginning of the project and what percentage of the total pool of technicians does it represent? To what frequency must the training be renewed, to be effectively up-to-date?

40. Have the curricula of the training programmes been updated regularly? Do they integrate information on safe handling of flammable refrigerants and an understanding of related regulations and standards? Do they address issues related to the consequences of poor installation and servicing of equipment that uses flammable refrigerants? Do training programmes include a module on good practices and standards in refrigeration services? To what extent are they relevant to the phase-down of HFCs**?**

41. Is the importance of low-GWP alternatives emphasised in the training programmes for refrigeration technicians?

42. What types of certification schemes have been established in different Article 5 countries and how effective are they to ensure good practices in refrigeration? Are these made mandatory through regulations? Was there any obstacle in making the certifications mandatory? Is there widespread adoption of formal codes of practices? Were good practices included in the curricula of technical training schools? Are the curricula adapted to address, among other: good practices, proper handling/management of refrigerant including flammable alternatives and low-GWP and zero-GWP alternatives, and mandatory training for technicians?

43. What lessons in training in good practices can be applied for long-term strategies to be implemented?

Awareness-raising and dissemination of information

44. What are the main channels to disseminate updated information on technically and economically feasible alternative technologies to be applied by local refrigeration and air-conditioning (AC) manufacturers?

45. How did technical assistance projects address awareness-related challenges? What awareness-raising strategy was used and what were the results?

46. Are there awareness campaign tailored to a specific target audience? How did the servicing community change following these activities?

47. Was there any collaboration with the customs departments in raising awareness on the handling of the new refrigerants?

Funding

48. What was the level of co-funding leveraged by the MLF activities?

49. How did countries identify sources of co-financing? What were the obstacles, opportunities and challenges to identify such sources of co-financing and what lessons can be learned from there? Were there delays due to obtaining co-funding?

50. Related to the adequacy of funding, the evaluation will look into the issue raised by the desk study that some funding was inadequate or excessive.

51. How the flexibility, granted to Article 5 countries through their Agreements with the Executive Committee, was used to optimize the allocation upon implementation of the HPMP?

52. How will the increase in the funding available for the servicing sector under decision 74/50, affect the ongoing projects and acceptance of alternatives to HCFCs and HFCs with low-GWP and zero-GWP?

Other sustainability-related issues

53. The field study will assess the sustainability of activities in the servicing sector, taking into account the findings of the desk-study, and identify the key factors relevant to sustaining the activities' impacts.

54. What activities could be implemented to reduce emissions during the operation of equipment, while maintaining energy efficiency?

55. What was the impact of the project on small servicing businesses?

56. How will the servicing sector be affected by the phase-down of HFCs?

57. How did IS, CAP and HPMP activities impact on the HCFC phase-out in the servicing sector, and what are the possibilities to increase synergies to effectively address the servicing sector?

58. Have servicing activities contributed to improving the energy efficiency of the equipment? If so, were such improvements in energy efficiency monitored or assessed?

Monitoring

59. What indicators are monitored? What is the leakage rate and reuse of refrigerants? What structures are in pace for continued monitoring?

Methodology

60. A team of consultants will be recruited based on their experience and knowledge of the subject matter and of the functioning of the Montreal Protocol and the Multilateral Fund. The team will analyse the existing documents as well as the conclusions and recommendations of the desk study and collect additional information from field visits. As much as possible, reliable quantitative information will be collected together with qualitative information. Discussions with the Secretariat staff, the NOU (NOU) and the bilateral and IAs will be organised as needed.

61. Each field visit will yield a country evaluation report which will be shared with the Secretariat, the bilateral and IAs and the NOU for comments. At the 81st meeting, a short report with key findings from countries visited until this period will be presented. A synthesis report will summarize the findings from the country evaluation reports and formulate lessons learned and recommendations for consideration by the Executive Committee at the last meeting in 2018.

Sample of countries

62. The following countries are proposed to be part of the sample of countries to be visited by the evaluation team, based on geographical area, IAs, and specificity of projects:

(a) Chile (Latin American country with servicing in supermarkets; UNDP, UNIDO and UNEP)

(b) Grenada (Caribbean country with 20 recycling and recovery centres and awareness-raising to promote alternative technologies; UNEP and UNIDO);

(c) India (Asian country with the use of R-290; UNDP; UNEP, and Germany);

(d) Kyrgyzstan (Europe and Central Asian (ECA) region with an innovative approach and a phase-out planned for 2020; UNDP and UNEP);

(e) Oman (Middle Eastern country with activities in recovery of refrigerant; UNEP and UNIDO);

(f) Samoa (PIC; UNEP);

(g) Senegal (Western Africa; UNEP and UNIDO);

(h) Turkey (ECA region, demonstration project; UNEP and UNIDO); and

(i) Zimbabwe (Eastern Africa; Germany).

Annex II

SAMPLE OF KEY IMPACTS FROM THE PROJECTS EVALUATED

Country	Key impacts of the projects
Chile	• The impact of the project on small servicing businesses and independent technicians was high, especially in rural areas; • Co-funding was leveraged; • Awareness raising campaigns are well addressed and should incorporate the new substances/technologies and the additional costs involved; • 1,836 technicians were trained and the training programme is revised and updated if necessary in a yearly base. Train-the-trainers and good practices trainings are also offered by the NOU and will continue in stage II; • Certification for technicians is not mandatory but it is offered by the NOU (with access to possible subsidies) and an evaluation process for certification is being created which evaluated 978 technicians; • The reclaiming programme suffered delays and started in January 2018 at a rate of half a tonne a day. Three regional refrigerant recovery, recycling, reclaiming centres will be installed as part of stage II; • The demonstration project and HPMP activities were relevant for the adoption of transcritical CO_2, incrementing confidence in the technology while removing barriers to accelerate its adoption; and • HPMP projects influenced technology selection and financial incentives.
Grenada	• Service technicians and educational institutions have received diverse tools from the Multilateral Fund's funded projects previous to and during the HPMP; • An effective awareness campaign was developed by the NOU and certification of technicians is appreciated in the RAC market, the servicing enterprises and with independent technicians. 120 technicians have been trained and obtained a certification, plus an additional nine technicians were trained in Germany; • The new standards and intensive training created a safer environment for the use of flammable refrigerants; • The second tranche of stage I included *inter alia*: an upgrade of ODS legislation to prohibit the import of small-sized HCFC-based equipment; the development of tax incentives to promote alternatives and standards for flammable and toxic refrigerants; the implementation importers' certification and mandatory reporting programme; and a demonstration project for the replacement of existing HCFC-based equipment (i.e., the installation of three different split AC system (R-22, R410A and R-290) on three mobile bases with an energy metering device for each system); and • Establishment of three additional recovery centres, combined with and upgrading of the old centres, which included relevant tools such as new identifiers.
India	I. As part of the implementation: • 11,276 technicians and 102 trainers from the Government's Industrial Technical Institute to support the training institutes, were trained. Training programmes on good servicing practices, recovery and recycling and use of alternatives were held. 484 technicians were trained in installation and good servicing practices for room air-conditioners; • Support was offered to seven reclamation centres including workshop; • Monitoring and evaluation of the activities in the refrigeration servicing sector (mid-term monitoring of a sample of 500 trained technicians, and regular monitoring of ongoing training programmes) was carried;

Country	Key impacts of the projects
	II. The enabling activities, focused on two main areas: • Enforcement of capacity-building through timely implementation of new regulations for HCFC control, more vigorous and targeted measures to combat illegal ODS trade, and assistance to neighbouring countries to comply with their commitments. Training will be provided to customs officers on control of cross-border trade in HCFCs and illegal trade; and • Awareness activities related to HCFC phase-out for relevant stakeholders (i.e., industry associations, manufacturers, dealers and vendors), including the informal and the small and medium-sized enterprises
Kyrgyzstan	Stages I and II of the HPMP were successfully completed and *inter alia*: • Developed and implemented a licensing system for ODS refrigerant importers; • Provided technical workshops, four new venues for training and supplied servicing tools (e.g., recovery units and service tools); • Reviewed and updated the national vocational curricula and national certification programme to include HCFCs and latest alternative technologies; • Developed a national code of good practice for RAC technicians and implemented a mandatory certification programme and service log. Strict monitoring activities and inspections are in place to ensure compliance; • Provided technical training for customs officers; • Updated policies and regulations; and • Controlled the import of equipment, restricted the amounts of HCFC containers, implemented refrigerant management rules and introduced a ban on import or use of HCFC-141b and HCFC-142b.
Oman	Stages I and II of the HPMP were successfully completed and *inter alia*: • Adopted new and updated existing regulations for the protection of the Ozone; • Banned the import of HCFC-141b and of HCFC-141b-based pre-blended polyols; • Established a functional National Ozone Committee and technical and legal task force to oversee the implementation; • Developed and implemented an e-licensing system for ODS refrigerant and equipment importers and exporters; • Provided technical assistance for the servicing sector, by conducting three workshops, which trained 250 technicians and one train-the-trainer activity for 30 participants; • Reviewed the national vocational curricula and national certification programme to include HCFCs and the latest alternative technologies; • Developed a national code of good practices for different RAC servicing professions and finished the final proposal for an associated certification programme (in the process of approval); • Provided technical assistance including consultancy, exposure and training on availability of alternatives for different RAC applications in the fisheries industry. Two workshops trained 20 officers; • Developed national guidelines to promote the establishment of a refrigerant reclamation centre; acquired the necessary equipment for the establishment of the two refrigerant recycling centres; implemented one national HCFC reclamation centre (part of the demonstration project), but is however not currently operational; and • Nine training institutes have been provided with equipment (e.g., recovery unit and service tools) to facilitate training.
Samoa	The second tranche implemented successfully, *inter alia*: • Two training workshops for 35 customs officers and 10 brokers, one for fishery department officials, one for 30 RAC technicians and 12 students from the local technical college; • Carried out one HC training workshop in 2017 by an Australian expert, which trained 50 RAC technicians;

Country	Key impacts of the projects
	• Implemented a public awareness programmes, directed at elementary schools and colleges, on ozone depletion and global warming issues, and Trade events were arranged by the NOU in conjunction with the National Trade Association (SREA) to share ideas and new technologies with the RAC sector, to which attended approximately 85 technicians; • Planned an on-going review of the National Addition of the Code of Practice in Refrigeration Manual on recommendations from the NOU in consultation with the SREA and an on-going review of national ozone regulations; • Held the first RAC industry competition involving the proper installation and start-up for RAC equipment. Further competitions are planned during the implementation of the HPMP; • Conducted on-site inspections of RAC sector contractors, importers as well as sellers of RAC equipment; and • Samoa is taking part in the Pacific Islands (energy) Labelling Standards programme which take effect 1 January 2019.
Senegal	I. The first tranche of stage I consisted of *inter alia*: • Support for co-relation of ODS legislation with the safety standards, fire protection systems, storage requirements for vessels under pressure and emissions reduction measures/improvement of the reporting system for end-users and creation of an electronic database on HCFCs; • Upgrade of 10 vocational schools' curricula and performance for the training of approximately 2,100 technicians: training of 200 trainers; Provided training equipment including refrigerant identifiers, training guides and consumables and conducted public awareness activities; • Strengthening the existing recovery and recycling network: establishment of a national refrigerant reclaim facility including one reclaim machine and analysis equipment; Developed codes of practices, training of trainers, and provided 60 portable recovery machines and 60 electronic leak detectors; and • Customs training and public awareness: training of 20 trainers, 150 customs officers and other law enforcement officers and key stakeholders/development and production of materials and guides/training equipment (identifiers and consumables)/public awareness activities. II. The second tranche consisted of *inter alia*: • Training of 156 service technicians; • Purchased recovery and recycling equipment for service workshops; • The development of an inventory for refrigeration technicians, associations and workshops; • Four identifiers were purchased and delivered to two vocational schools and training curricula was upgraded including information on good practices, and adding information on alternative technology, energy savings and the need to address HFCs; and • A total of 125 customs and enforcement officers were also trained on ODS policy and regulations.
Turkey	The HPMP has *inter alia*: • Provided 3,000 recovery machines for distribution among service technicians; and 80 trainers were trained; • Established one additional reclaim centre and laboratory equipment to check quality of reclaimed refrigerant; • Trained and certified 1,000 technicians and awareness workshops, training programmes for customs and law enforcement officers in monitoring, control and

Country	Key impacts of the projects
	identification of HCFCs and HCFC-based equipment, and strengthening the capacity of training schools through the provision of materials and ODS identification tool kits; • Banned the import of: equipment containing HCFCs on 1 January 2010; of HCFC-141b or mixtures thereof from 1 January 2013; of HCFC-22 was banned in 2015(except for the use for service and maintenance of equipment). However, importation of controlled substances was permitted after 2015 only for the production of domestic air-conditioning systems, manufactured for export to Article 5 countries; and of importation of non-refillable containers with fluorinated greenhouse gases.
Zimbabwe	I. The first tranche of stage I consisted of *inter alia*: • 65 customs officers were trained in the control of ODS blends and illegal trade in six customs workshops and 138 RAC service technicians were trained for the proper use and safety of HC refrigerants in six training workshops; • Demonstrations activities dealing with the proper procedures for AC conversions to R-290; • Purchased 20 recovery machines for RAC contractors and 8 comprehensive sets of servicing equipment (7 for National Technical Colleges, and one for the NOU), four Refrigerant Identifier kits for customs. Six Vacuum pumps complete with service gauges for RAC contractors; • Developed training material such as the Code of Practice for Technician servicing and safety; • Initiated a HC certification scheme for RAC technicians II. The second and third tranches of stage I consisted of *inter alia*: • Additional training of 200 RAC technicians in the HC workshops, 55 customs officers were trained and 250 RAC service technicians were trained in 25 workshops; • 18 demonstration conversions on HCFC AC systems to R-290; • Finalisation and enforcement of National Standards for certification of RAC technicians in HC refrigerants; and • Six sets of domestic appliances and small commercial display cases using R-600a being purchased for Vocational Training centers.

Annex III

ADDITIONAL HCFC REDUCTION AND "CASCADE EFFECT"

1. Table 1 presents the specific HCFC reductions for each of the nine countries included in the second stage of the evaluation.

Table 1. HCFC reduction per countries (ODP tonnes)

Country Name	Baseline	2013	2015	2013 MP obligation	2015 MP obligation	2013 compliance (%)	2013 additional reduction (%)	2015 compliance (%)	2015 additional reduction (%)
Chile	87.5	75.99	67.63	87.5	78.75	87	13	86	14
Grenada	0.8	0.33	0.22	0.8	0.72	41	59	31	69
India	1,608.2	975.94	992.54	1,608.2	1447.38	61	39	69	31
Kyrgyzstan	4.1	3.99	1.58	4.1	3.69	97	3	43	57
Oman	31.5	28.87	22.3	31.5	28.35	92	8	79	21
Samoa	0.3	0.11	0.07	0.3	0.27	37	63	26	74
Senegal	36.2	7.7	20.63	36.2	32.58	21	79	63	37
Turkey ***	551.47	147.02	17.95	456.1	265.5	32	68	7	93
Zimbabwe	17.8	15.76	14.16	17.8	16.02	89	11	88	12

***** Percentage of actual consumption over MP obligation
****** 100 percent minus percentage of consumption over MP obligation
******* Stage I of the HPMP for Turkey was approved for the period 2012 to 2017 to reduce HCFC consumption by 75.5 per cent [86.4 per cent if the baseline is revised by the Parties] of the established baseline.

Cascade effect

2. The "cascade effect" is the generation of results that exceed the original expectations and occurs when, for instance, technical training schools include ODS issues and good practices into their curricula, thereby increasing the number of technicians trained in and upholding these practices, thus reducing HCFC consumption further than expected. This effect also happens when a code of good practices in refrigeration is adopted as the working standard for the sector and it becomes enforced by official directives and even by peer and public pressure, with the same result. Public awareness about these activities has the clear objective to increase the "cascade effect", as do the policy and regulatory measures.

3. Likewise, one of the values of demonstration, and to some extent investment projects, resides on the expected "cascade effect" since the example set by a successful conversion may lead related end-users to undertake similar endeavours, thus increasing the expected reduction in HCFC consumption.

4. Therefore, the "cascade effect" takes place for the servicing and manufacturing sector projects alike, and the specific value of such "cascade effect" for each sector could be calculated for each country by calculating the excess reduction for each sector (servicing or manufacturing) as compared to the target reduction under the HPMP for a given year. In the case of countries with no manufacturing sector, the excess reduction in HCFC consumption is, of course, attributable only to the activities for the servicing sector since there are no activities for the manufacturing sector. In this respect, Grenada, Samoa and Senegal only have HCFC consumption in the servicing sector, and their excess reduction in HCFC consumption is attributable to the HPMP initiatives for the servicing sector, namely 59, 63 and 79 per cent of their baseline respectively in 2013, and 69, 74 and 37 per cent of their baseline respectively in 2015.

Annex IV

FUND ALLOCATION FOR ACTIVITIES FOR THE SERVICING SECTOR

1. Tables 1 and 2 below provide fund allocation, per country evaluated, under the stage I of the HPMP for the servicing sector.

Table 1 Fund allocation for activities for the servicing sector, under stage I of the HPMP - Part 1.

Countries	Total Funding US$	Ref. Training	%	R&R	%	Customs training	%	Policy	%
Chile	2,044,633	250,294	12	205,175	10	593,176	29	155,450	8
Grenada	210,000	105,000	50	N/A	0	23,000	11	N/A	0
India	3,876,000	1,570,660	41	229,800	6	150,000	4	N/A	0
Kyrgyzstan	88.000	12.500	14	52.800	60	12.500	14	5.200	6
Oman	330,000	80,000	24	155,000	47	30,000	9	25,000	8
Samoa	148,500	84,000	57	N/A	0	34,500	23	N/A	0
Senegal	1,035,216	290,000	28	306,800	30	240,000	23	65,000	6
Turkey	5,326,050	525,000	10	3,907,600	73	103,450	2	N/A	0
Zimbabwe	560,000	135,000	24	N/A	0	105,000	19	N/A	0
Average	**1,503,387**	**337,774**	**28.8**	**800,738**	**25.1**	**142,127**	**14.8**	**61,364**	**3.1**

Note: The categorisation of activities is not homogeneous across countries: in some cases, several interrelated activities were integrated into one of the categories presented in the tables, while in other cases the opposite happened. The accuracy of the categorisation was dependent on the quality of the information available.

Additional considerations

2. Training of RAC technicians: All the nine countries included in the stage II of this study included this activity, with the greatest allocation of funds being 57 per cent (Samoa) and the lowest 10 per cent (Turkey), with higher consuming countries tending to allocate a lower percentage except for India.

3. R&R networks: Lower consuming countries with a lower amount of funds for the servicing sector, tend not to invest in this activity, hence, three such countries out of the nine under study did not allocate any funds for R&R networks. The lowest percentage of funds allocated to this activity was six per cent (India) and the highest 73 per cent (Turkey), both being the highest consuming countries in the group.

4. Customs training: The allocation of funds ranged from two per cent (Turkey) up to 29 per cent (Chile).

5. Policy: Only four countries, Chile, Kyrgyzstan, Oman and Senegal, made specific allocations to this activity of between six to eight per cent.

Table 2. Fund allocation for activities for the servicing sector, under stage I of the HPMP - Part 2

Countries	Total Funding US$	Demos/Retrofits	%	Awareness	%	Others	%	Monitoring	%
Chile	2,044,633	357,297	17	210,994	10	186,489	9	85,758	4
Grenada	210,000	N/A	0	40,000	19	N/A	0	42,000	20
India	3,876,000	N/A	0	561,600	14	150,000	4	1,213,940	31
Kyrgyzstan	88.000	N/A	0	N/A	0	N/A	0	5.000	6
Oman	330,000	N/A	0	N/A	0	N/A	0	40,000	12
Samoa	148,500	N/A	0	15,000	10	N/A	0	15,000	10
Senegal	1,035,216	N/A	0	N/A	0	N/A	0	133,416	13
Turkey	5,326,050	290,000	5	N/A	0	N/A	0	500,000	9
Zimbabwe	560,000	220,000	39	N/A	0	N/A	0	100,000	18
Average	**1,503,387**	**289,099**	**6.7**	**206,899**	**5.8**	**168,245**	**1.4**	**236,680**	**13.6**

Additional considerations

6. Demonstration or retrofit projects: Only three countries of the sample allocated funds to this activity of between 5 to 39 per cent.

7. Awareness: Four countries made allocations to this activity of between 10 to 14 per cent, but it has been a common practice to also assign funds within specific projects for this activity, when it is considered essential to attain the expected results, such as in the case of demonstration or training projects.

8. Others: Only Chile and India made allocation of 9 and 4 per cent of the funds to this category respectively, which in these specific cases were a project for the elimination of HCFC-141b as a cleaning agent (Chile) and the promotion of new building codes to foster energy efficiency (India).

9. Monitoring: All countries made allocations of between four to 31 per cent of the funds to monitoring.

Annex V

DETAILED RESULTS OF RRR OPERATIONS IN COUNTRIES VISITED

Table 1. Detailed results of RRR operations in countries visited– Part 1

Country	HCFC Baseline (ODP tonnes)	HCFC Baseline (mt)	Total recovered refrigerant (mt)	Total recycled refrigerant (mt)	Total reclaimed refrigerant (mt)	Total unwanted refrigerant (mt)
Chile (1)	87.50	1,232.12	14	6	8	N/A
Grenada	0.80	15.10	2	N/A	N/A	N/A
India (2)	1608.20	22,259.40	N/A	N/A	N/A	N/A
Kyrgyzstan(3)	4,1	74,70	28	N/A	7.5	20.5
Oman (4)	31.50	569,77	N/A	N/A	N/A	N/A
Samoa	0.30	5.45	0.40	N/A	N/A	N/A
Senegal (5)	36.20	658.00	30	N/A	N/A	30
Turkey	551.47	8.007.00	N/A	N/A	N/A	N/A
Zimbabwe (6)	17.80	324.00	4	N/A	N/A	0.1

Note: N/A denote that no information was provided.
(1) Figures only for reclaiming centre.
(2) RR network since 2007, No figures provided.
(3) Unwanted refrigerant is both CFCs and HFCs –no comparison can be made
(4) RR network shutdown after one year.
(5) Years of operation are estimate.
(6) Total (annually) recovered refrigerant is only an estimation by NOU – total unwanted refrigerant is actual figure.

Table 2. Detailed results of RRR operations in countries visited – Part 2

Country	HCFC Baseline M T	Percentage of total recovered refrigerant over baseline	Years of RR operation	Percentage of recovered refrigerant per year over baseline	HFC
Chile (1)	1,232.12	1,14	0,25	4,55	Yes
Grenada	15.10	13,30	7	1,90	Yes
India (2)	22,259.40	N/A	N/A	N/A	N/A
Kyrgyzstan(3)	74,70	N/A	14	N/A	N/A
Oman (4)	569.77	N/A	1	N/A	N/A
Samoa	5.45	7,34	2	3,67	N/A
Senegal (5)	658.00	4,56	5	0,91	Yes
Turkey	8,007.00	N/A	N/A	N/A	N/A
Zimbabwe	324.00	N/A	1	1,2	N/A

Note: N/A denote that no information was provided.
(1) Figures only for reclaiming centre.
(2) RR network since 2007, No figures provided.
(3) Unwanted refrigerant is both CFCs and HFCs (indiscriminate) –no comparison can be made
(4) RR network shutdown after one year.
(5) Years of operation are estimated.

Annex VI

OVERALL RESULTS OF RRR OPERATIONS IN COUNTRIES VISITED

Table 1. Overall results of RRR operations in countries visited

	Chile	Grenada	India	Kyrgyzstan	Oman	Samoa	Senegal	Turkey	Zimbabwe
Percentage of companies with RR equipment *	5%	N/A	N/A	N/A	60%	90%	N/A	N/A	N/A
Cost of recovered refrigerant per Kg	3 US$	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cost of reclaimed refrigerant per Kg	20 US$	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cost of virgin refrigerant per Kg	10 US$	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cost of destroyed refrigerant per Kg (1)	17 US$ (2)	N/A	N/A	N/A	50 US$ (4)	10-15 US$ (3)	N/A	N/A	N/A

Note: N/A denote that no information was provided.
* NOU estimation.
(1) Without including recovery cost and transport cost to destruction site.
(2) Destruction done in Mexico.
(3) Destruction done in Australia.
(4) Destruction site not mentioned.