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THE MULTILATERAL FUND FOR THE  
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**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 79<sup>th</sup> meeting<sup>1</sup>. 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 80<sup>th</sup> meeting.<sup>2</sup>
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.

<sup>1</sup> Decision 79/6.

<sup>2</sup> 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<sup>3</sup> was presented to the 81<sup>st</sup> 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 81<sup>st</sup> meeting, and the findings of the field visits for the countries in the study.

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<sup>3</sup> 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 30<sup>th</sup> 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<sup>4</sup>. 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.

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<sup>4</sup> 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.<sup>5</sup> 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

<sup>5</sup> 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<sub>2</sub> 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<sup>6</sup> in the range of 0.91 to 4.55 per cent of the HCFC baseline, and a possible annual<sup>7</sup> 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<sup>8</sup>, and to be lower for

<sup>6</sup> This is based almost exclusively on data about stored refrigerant, which does not include the refrigerant being re-used.

<sup>7</sup> The data is only for three months of operations.

<sup>8</sup> 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<sup>9</sup>. 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<sup>10</sup> 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<sup>11</sup> 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<sup>12</sup> 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

<sup>9</sup> This could be due to attrition of equipment.

<sup>10</sup> This is the recovery fee per kg from Regener, the reclaiming centre.

<sup>11</sup> As in the case of the Migros supermarket chain in Turkey.

<sup>12</sup> 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<sup>13</sup>, 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<sup>14</sup> 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<sup>15</sup> 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.

<sup>13</sup> The subject was not mentioned in the reports.

<sup>14</sup> Co-funding was from the government for financing policy development and from independent sources for financing demonstration projects.

<sup>15</sup> 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<sup>16</sup>. 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<sup>17</sup> 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<sup>18</sup>.

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.

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<sup>16</sup> As in the case of Chile where there are several programmes to subsidise the cost of certification.

<sup>17</sup> Systems which should become part of the normal procedures within the related institutions, and not an HPMP-dependent activity.

<sup>18</sup> 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<sup>19</sup>, even though they are not always recognised as such or

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<sup>19</sup> 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 82<sup>nd</sup> 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 79<sup>th</sup> 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<sup>20</sup>, 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.

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<sup>20</sup> 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 were 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 place 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 81<sup>st</sup> 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   | <ul style="list-style-type: none"> <li>• The impact of the project on small servicing businesses and independent technicians was high, especially in rural areas;</li> <li>• Co-funding was leveraged;</li> <li>• Awareness raising campaigns are well addressed and should incorporate the new substances/technologies and the additional costs involved;</li> <li>• 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;</li> <li>• 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;</li> <li>• 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;</li> <li>• The demonstration project and HPMP activities were relevant for the adoption of transcritical CO<sub>2</sub>, incrementing confidence in the technology while removing barriers to accelerate its adoption; and</li> <li>• HPMP projects influenced technology selection and financial incentives.</li> </ul>                                                                          |
| Grenada | <ul style="list-style-type: none"> <li>• Service technicians and educational institutions have received diverse tools from the Multilateral Fund's funded projects previous to and during the HPMP;</li> <li>• 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;</li> <li>• The new standards and intensive training created a safer environment for the use of flammable refrigerants;</li> <li>• The second tranche of stage I included <i>inter alia</i>: 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</li> <li>• Establishment of three additional recovery centres, combined with and upgrading of the old centres, which included relevant tools such as new identifiers.</li> </ul> |
| India   | <p>I. As part of the implementation:</p> <ul style="list-style-type: none"> <li>• 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;</li> <li>• Support was offered to seven reclamation centres including workshop;</li> <li>• 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;</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

| Country    | Key impacts of the projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | <p>II. The enabling activities, focused on two main areas:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• 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</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Kyrgyzstan | <p>Stages I and II of the HPMP were successfully completed and <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>• Developed and implemented a licensing system for ODS refrigerant importers;</li> <li>• Provided technical workshops, four new venues for training and supplied servicing tools (e.g., recovery units and service tools);</li> <li>• Reviewed and updated the national vocational curricula and national certification programme to include HCFCs and latest alternative technologies;</li> <li>• 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;</li> <li>• Provided technical training for customs officers;</li> <li>• Updated policies and regulations; and</li> <li>• 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.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Oman       | <p>Stages I and II of the HPMP were successfully completed and <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>• Adopted new and updated existing regulations for the protection of the Ozone;</li> <li>• Banned the import of HCFC-141b and of HCFC-141b-based pre-blended polyols;</li> <li>• Established a functional National Ozone Committee and technical and legal task force to oversee the implementation;</li> <li>• Developed and implemented an e-licensing system for ODS refrigerant and equipment importers and exporters;</li> <li>• Provided technical assistance for the servicing sector, by conducting three workshops, which trained 250 technicians and one train-the-trainer activity for 30 participants;</li> <li>• Reviewed the national vocational curricula and national certification programme to include HCFCs and the latest alternative technologies;</li> <li>• 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);</li> <li>• 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;</li> <li>• 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</li> <li>• Nine training institutes have been provided with equipment (e.g., recovery unit and service tools) to facilitate training.</li> </ul> |
| Samoa      | <p>The second tranche implemented successfully, <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>• 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;</li> <li>• Carried out one HC training workshop in 2017 by an Australian expert, which trained 50 RAC technicians;</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

| Country | Key impacts of the projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
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|         | <ul style="list-style-type: none"> <li>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;</li> <li>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;</li> <li>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;</li> <li>Conducted on-site inspections of RAC sector contractors, importers as well as sellers of RAC equipment; and</li> <li>Samoa is taking part in the Pacific Islands (energy) Labelling Standards programme which take effect 1 January 2019.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Senegal | <p>I. The first tranche of stage I consisted of <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>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;</li> <li>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;</li> <li>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</li> <li>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.</li> </ul> <p>II. The second tranche consisted of <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>Training of 156 service technicians;</li> <li>Purchased recovery and recycling equipment for service workshops;</li> <li>The development of an inventory for refrigeration technicians, associations and workshops;</li> <li>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</li> <li>A total of 125 customs and enforcement officers were also trained on ODS policy and regulations.</li> </ul> |
| Turkey  | <p>The HPMP has <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>Provided 3,000 recovery machines for distribution among service technicians; and 80 trainers were trained;</li> <li>Established one additional reclaim centre and laboratory equipment to check quality of reclaimed refrigerant;</li> <li>Trained and certified 1,000 technicians and awareness workshops, training programmes for customs and law enforcement officers in monitoring, control and</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

| Country  | Key impacts of the projects                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | <p>identification of HCFCs and HCFC-based equipment, and strengthening the capacity of training schools through the provision of materials and ODS identification tool kits;</p> <ul style="list-style-type: none"> <li>• 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.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Zimbabwe | <p>I. The first tranche of stage I consisted of <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>• 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;</li> <li>• Demonstrations activities dealing with the proper procedures for AC conversions to R-290;</li> <li>• 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;</li> <li>• Developed training material such as the Code of Practice for Technician servicing and safety;</li> <li>• Initiated a HC certification scheme for RAC technicians</li> </ul> <p>II. The second and third tranches of stage I consisted of <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>• 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;</li> <li>• 18 demonstration conversions on HCFC AC systems to R-290;</li> <li>• Finalisation and enforcement of National Standards for certification of RAC technicians in HC refrigerants; and</li> <li>• Six sets of domestic appliances and small commercial display cases using R-600a being purchased for Vocational Training centers.</li> </ul> |

### 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          |
| <b>Average</b> | <b>1,503,387</b>   | <b>337,774</b> | <b>28.8</b> | <b>800,738</b> | <b>25.1</b> | <b>142,127</b>   | <b>14.8</b> | <b>61,364</b> | <b>3.1</b> |

**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/Ret rofits | %          | 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          |
| <b>Average</b> | <b>1,503,387</b>   | <b>289,099</b>   | <b>6.7</b> | <b>206,899</b> | <b>5.8</b> | <b>168,245</b> | <b>1.4</b> | <b>236,680</b> | <b>13.6</b> |

**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<br>(1) | 17 US\$<br>(2) | N/A     | N/A   | N/A        | 50 US\$<br>(4) | 10-15 US\$<br>(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.

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EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eighty-ninth Meeting  
Montreal, 7-11 March 2022  
Postponed to 16, 18 and 20 May 2022 (part I) and  
16-18 June 2022 (part II)<sup>1</sup>

**PAPER ON WAYS TO OPERATIONALIZE PARAGRAPH 16 OF DECISION XXVIII/2  
AND PARAGRAPH 2 OF DECISION XXX/5 OF THE PARTIES (DECISION 84/88)**

**Note by the Secretariat**

**Background**

1. At its 82<sup>nd</sup> meeting, the Executive Committee *inter alia* requested the Secretariat to prepare a paper for consideration by the Executive Committee at its 83<sup>rd</sup> meeting, describing ways to operationalize paragraph 16 of decision XXVIII/2, and paragraph 2 of decision XXX/5, taking into account the criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HCFC phase-out management plans (HPMPs) for low-volume-consuming (LVC) countries (decision 82/83(c)).

2. Pursuant to decision 82/83(c), the Secretariat submitted document UNEP/OzL.Pro/ExCom/83/40 to the 83<sup>rd</sup> meeting. In the document, the Secretariat noted that decision 82/83(c) made reference directly to paragraph 16 of decision XXVIII/2<sup>2</sup> and paragraph 2 of decision XXX/5,<sup>3</sup> and incorporated paragraph 1 of

<sup>1</sup> Due to coronavirus disease (COVID-19), part I of the 89<sup>th</sup> meeting will be held online while part II will be held in-person.

<sup>2</sup> To request the Executive Committee to increase in relation to the servicing sector the funding available under decision 74/50 above the amounts listed in that decision for parties with total HCFC baseline consumption up to 360 metric tonnes, when needed, for the introduction of alternatives to HCFC with low-GWP and zero-GWP alternatives to HFC and maintaining energy efficiency also in the servicing/end-user sector.

<sup>3</sup> To request the Executive Committee to consider, within the context of paragraph 16 of decision XXVIII/2, increasing the funding provided to LVC countries to assist them in implementing the activities outlined in paragraph 1 of this decision.

decision XXX/5<sup>4</sup> and paragraph(c)(xii) of decision 74/50.<sup>5</sup> Combining the text of each of these decisions would lead to the following reading of decision 82/83(c):

To request the Secretariat to prepare a paper for consideration by the Executive Committee at its 83<sup>rd</sup> meeting, describing ways to operationalize an increase in funding, in relation to the servicing sector, available under decision 74/50 for LVC countries, when needed, for: (a) the introduction of low- and zero-global warming potential (GWP) alternatives to HCFCs or HFCs and maintaining energy efficiency in the servicing/end-user sector<sup>6</sup>; (b) developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient refrigeration, air-conditioning and heat-pump (RACHP) equipment and promoting penetration of energy-efficient equipment, supported by targeted training on certification, safety and standards, awareness raising and capacity building<sup>7</sup>; and (c) taking into account the criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HPMPs.

#### Discussions at the 83<sup>rd</sup> meeting<sup>8</sup>

3. At its 83<sup>rd</sup> meeting, the Executive Committee noted that document UNEP/OzL.Pro/ExCom/83/40 was a useful basis for further discussion, both on the process to be used by LVC countries to access additional funding for servicing sector activities related to the introduction of low-GWP alternatives to HFCs, in the context of the HCFC phase-out, and the types of activities to be considered for such funding. Some members preferred to wait until more detailed information could be provided on relevant activities already being implemented, noting also that the desk study for the evaluation of energy efficiency in the servicing sector<sup>9</sup> was linked to some of the issues.

4. It was also noted that other institutions were responsible for addressing energy efficiency and assisting in developing minimum energy performance standards (MEPS), which were not related to compliance under the Montreal Protocol; and that the activities should focus on what was required for the transition to low-GWP alternatives while maintaining energy efficiency. The needs for cost-effectiveness given the high costs often associated with such activities already initiated by LVC countries; added value, as activities for facilitating the adoption of low-GWP technologies were already being implemented under HPMPs; and reporting against the performance indicators, were also highlighted.

5. The matter was further considered in the contact group that was established to address issues pertaining to the three sub-items on energy efficiency submitted to the 83<sup>rd</sup> meeting. Upon a request by the contact group, the Secretariat prepared a preliminary working document (drafted in the form of a recommendation) on which the contact group could base its discussions. In reporting back to the Executive Committee, the convener of the contact group indicated that the working document still contained text that

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<sup>4</sup> To request the Executive Committee to consider flexibility within the financial support provided through enabling activities for HFCs to enable Article 5 Parties, who wish to do so, to use part of this support for energy efficiency policy and training support as it relates to the phase-down of controlled substances, such as: developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient refrigeration, air-conditioning and heat-pump equipment; promoting access to energy-efficient technologies in these sectors; and targeted training on certification, safety and standards, awareness raising and capacity building aimed at maintaining and enhancing the energy efficiency.

<sup>5</sup> Article 5 countries with total HCFC consumption of up to 360 metric tonnes would be provided with funding consistent with the level of consumption in the servicing sector, on the understanding that project proposals would still need to demonstrate that the funding level was necessary to achieve the 2020 and 2025 phase-out targets, or if the country so decided, later reduction targets.

<sup>6</sup> Paragraph 16 of decision XXVIII/2

<sup>7</sup> Paragraph 2 of decision XXX/5

<sup>8</sup> Paragraphs 234-240 of document UNEP/OzL.Pro/ExCom/83/48

<sup>9</sup> UNEP/OzL.Pro/ExCom/83/10/Rev.1

had not been fully discussed and agreed, and proposed that the working document be used as a basis for further discussion at the 84<sup>th</sup> meeting.

6. Subsequently, the Executive Committee decided to continue discussing ways to operationalize paragraph 16 of decision XXVIII/2 and paragraph 2 of decision XXX/5 of the Parties at its 84<sup>th</sup> meeting, and to use the text contained in Annex XII to the Report of the 83<sup>rd</sup> meeting of the Executive Committee<sup>10</sup> as the basis for that discussion (decision 83/62).

#### Discussions at the 84<sup>th</sup> meeting

7. Pursuant to decision 83/62, the Executive Committee, at its 84<sup>th</sup> meeting, continued to discuss the matter on the ways to operationalize paragraph 16 of decision XXVIII/2 and paragraph 2 of decision XXX/5 in the contact group on energy efficiency using the draft recommendation contained in document UNEP/OzL.Pro/ExCom/84/67.

8. Subsequently, the convener of the contact group reported to the Executive Committee that the group had been unable to arrive at a conclusion regarding the table on additional financing. Accordingly, the Committee decided to defer and continue discussing ways to operationalize paragraph 16 of decision XXVIII/2 and paragraph 2 of decision XXX/5 of the Parties at its 85<sup>th</sup> meeting and to use the text contained in Annex XXIX to the Report of the 84<sup>th</sup> meeting of the Executive Committee<sup>11</sup> as the basis for that discussion (decision 84/88).

#### **Submission to the 89<sup>th</sup> meeting**

9. In line with decision 84/88, the Secretariat has submitted the present document to the 89<sup>th</sup> meeting.<sup>12</sup>

10. It should be noted that, at its 89<sup>th</sup> meeting, the Committee will also consider the following two documents covering various aspects of the HCFC phase-out and HFC phase-down in the refrigeration servicing sector, prepared by the Secretariat, and information contained therein are of relevance to decision 84/88:

- (a) Analysis of the level and modalities of funding for HFC phase-down in the refrigeration servicing sector, in accordance with decision 88/76;<sup>13</sup> and
- (b) Potential strategies, policy measures and commitments, as well as projects and activities that could be integrated within stage I of HFC phase-down plans taking into account parallel or integrated implementation of HCFC phase-out and HFC phase-down activities, in line with decision 88/75.<sup>14</sup>

11. The Executive Committee may wish to consider the information presented in the above-mentioned documents, while finalising its discussions on the present document on Ways to operationalize paragraph 16 of decision XXVIII/2, and paragraph 2 of decision XXX/5. For ease of reference, document UNEP/OzL.Pro/ExCom/83/40 is attached to the present document.

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<sup>10</sup> UNEP/OzL.Pro/ExCom/83/48

<sup>11</sup> UNEP/OzL.Pro/ExCom/84/75

<sup>12</sup> In light of the COVID-19 pandemic, the Executive Committee deferred consideration of the present document in accordance with the agreed procedures for conducting each Executive Committee meeting since the 85<sup>th</sup> meeting. The present document is being reissued without any modifications to that submitted to the 86<sup>th</sup>, 87<sup>th</sup> and 88<sup>th</sup> meetings, except for reference to document numbers.

<sup>13</sup> UNEP/OzL.Pro/ExCom/89/8

<sup>14</sup> UNEP/OzL.Pro/ExCom/89/7

12. In addition, the Secretariat noted that in case that additional activities would be approved for inclusion in existing and future HPMPs for LVC countries, when needed, for the introduction of low- or zero-GWP alternatives to HCFCs and for maintaining energy efficiency in the refrigeration servicing sector, relevant Article 5 countries should submit a revised Agreement with the Executive Committee. On this basis, the Secretariat suggests to amend sub-paragraph (d) of the recommendation as follows:

- [(d) To request bilateral and implementing agencies, when submitting an HPMP tranche request, to include in the tranche implementation plan, the specific actions, performance indicators and funding associated with the activities referred to in sub-paragraph (b) above; ~~as well as~~ a progress report on implementation of those activities under the previous funding tranche; **and a revised Agreement between the Government of the Article 5 country concerned and the Executive Committee.**]

### Recommendation

13. [The Executive Committee decided:

- (a) To note the paper on ways to operationalize paragraph 16 of decision XXVIII/2 and paragraph 2 of decision XXX/5 of the Parties (decision 82/83(c)), contained in document UNEP/OzL.Pro/ExCom/83/40;
- (b) To consider the following additional activities for inclusion in existing and future HCFC phase-out management plans (HPMPs) for low-volume-consuming (LVC) countries, when needed for the introduction of alternatives to HCFCs with low- or zero-global-warming potential (GWP) and for maintaining energy efficiency in the refrigeration servicing sector:
  - (i) [Pilot projects designed for and targeted towards end-users, relating primarily to energy efficient small-capacity refrigeration, air-conditioning and heat-pump (RACHP) equipment using alternative low-GWP technologies to address challenges related to market acceptance;
  - (ii) Updating of training material to strengthen components related to good practices and energy efficiency during assessment, installation, maintenance and servicing of RACHP equipment, including safety considerations when addressing refrigerants with differing operating characteristics with regard to flammability, toxicity and pressure;
  - (iii) Coordination and collaboration between the national ozone units and relevant authorities and bodies to include appropriate consideration of low-GWP refrigerants during the development of cooling and energy efficiency plans, which among others include minimum energy performance standards (MEPS), and, as appropriate, labelling and testing programmes, and standards for RACHP equipment;
  - (iv) Development and implementation of competency-based certification schemes for technicians and the strengthening of national institutions for such systems including for energy efficiency and safety; and
  - (v) Awareness and outreach programmes to promote the introduction of MEPS and labelling systems; the mandatory certification of technicians; and the introduction of energy-efficient RACHP equipment operating with low- or zero-GWP refrigerants;

- (c) To provide the following funding, when needed, for the activities identified in sub-paragraph (b) above, on the understanding that Article 5 countries would have flexibility in using the additional funding to address specific needs that might arise during project implementation relating to introduction of alternatives to HCFCs with low- or zero-GWP refrigerants and for maintaining energy efficiency in the refrigeration servicing sector:

| Consumption (mt)* | Number of countries | Additional funding (US \$)** |
|-------------------|---------------------|------------------------------|
| 0-15              | 21                  |                              |
| 15-40             | 17                  |                              |
| 40-80             | 14                  |                              |
| 80-120            | 11                  |                              |
| 120-160           | 8                   |                              |
| 160-200           | 3                   |                              |
| 200-320           | 13                  |                              |
| 320-360           | 4                   |                              |

\* Level of HCFC baseline consumption in the refrigeration servicing sector

\*\* To be determined for each level of consumption

- (d) To request bilateral and implementing agencies, when submitting an HPMP tranche request, to include in the tranche implementation plan, the specific actions, performance indicators and funding associated with the activities referred to in sub-paragraph (b) above; **as well as** a progress report on implementation of those activities under the previous funding tranche; **and a revised Agreement between the Government of the Article 5 country concerned and the Executive Committee.]**



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EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eighty-third Meeting  
Montreal, 27– 31 May 2019

**PAPER ON WAYS TO OPERATIONALIZE PARAGRAPH 16 OF DECISION XXVIII/2  
AND PARAGRAPH 2 OF DECISION XXX/5 OF THE PARTIES (DECISION 82/83(c))****Background**

1. At its 82<sup>nd</sup> meeting, the Executive Committee considered a document prepared by the Secretariat presenting a summary of the Parties' deliberations at the 40<sup>th</sup> meeting of the Open-Ended Working Group (OEWG) of the Parties and the Thirtieth Meeting of the Parties to the Montreal Protocol in relation to the report by the Technology and Economic Assessment Panel (TEAP) on issues related to energy efficiency.<sup>1</sup>
2. The document briefly presented *inter alia* the actions taken in response to decision XXIX/10,<sup>2</sup> particularly regarding the TEAP report on issues related to energy efficiency, and the workshop on energy efficiency opportunities while phasing down HFCs held in the margins of the 40<sup>th</sup> meeting of the OEWG.
3. Following the discussion, the Executive Committee *inter alia* requested the Secretariat to prepare a paper for consideration by the Executive Committee at its 83<sup>rd</sup> meeting, describing ways to operationalize paragraph 16 of decision XXVIII/2, and paragraph 2 of decision XXX/5, taking into account the criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HCFC phase-out management plans (HPMPs) for low-volume-consuming (LVC) countries (decision 82/83(c)).

<sup>1</sup> UNEP/OzL.Pro/ExCom/82/65 and Add.1

<sup>2</sup> Decision XXIX/10 requested, in relation to maintaining and/or enhancing energy efficiency in the refrigeration, air-conditioning and heat-pump (RACHP) sectors, an assessment of: technology options and requirements including challenges for their uptake, and their long-term sustainable performance and viability, their environmental benefits in terms of CO<sub>2</sub>-eq; capacity building and servicing sector requirements in the RACHP sectors; related capital and operating costs. It also requested the TEAP to provide an overview of the activities and funding provided by other relevant institutions addressing energy efficiency in the RACHP sectors in relation to maintaining and/or enhancing energy efficiency while phasing down HFCs under the Kigali Amendment. Further, it requested the Ozone Secretariat to organize a workshop on energy efficiency opportunities while phasing down HFCs at the 40<sup>th</sup> meeting of the OEWG, and, thereafter, for the TEAP to prepare an updated final report for the Thirtieth Meeting of the Parties, taking into consideration the outcome of the workshop.

### An analysis of decision 82/83(c)

4. Decision 82/83(c) refers directly to paragraph 16 of decision XXVIII/2<sup>3</sup> and paragraph 2 of decision XXX/5,<sup>4</sup> and incorporates paragraph 1 of decision XXX/5<sup>5</sup> (support for energy efficiency policy and training support as it relates to the phase-down of controlled substances), as well as paragraph(c)(xii) of decision 74/50<sup>6</sup> (funding mechanisms for servicing sector plans).

5. Incorporating the text of the relevant decisions would lead to the following reading of decision 82/83(c):

To request the Secretariat to prepare a paper for consideration by the Executive Committee at its 83<sup>rd</sup> meeting, describing ways to operationalize an increase in funding, in relation to the servicing sector, available under decision 74/50 for LVC countries, when needed, for (a) the introduction of low- and zero-global warming potential (GWP) alternatives to HCFCs or HFCs and maintaining energy efficiency in the servicing/end-user sector<sup>7</sup>; (b) developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient RACHP equipment and promoting penetration of energy-efficient equipment, supported by targeted training on certification, safety and standards, awareness raising and capacity building<sup>8</sup>; (c) taking into account the criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HCFC phase-out management plans.

6. From the above, it is noted that the focus of this decision is on increasing funding available under decision 74/50 for HPMPs for LVC countries for the introduction of low- and zero-GWP alternatives to HCFCs or HFCs and maintaining energy efficiency while addressing the HCFC consumption in the servicing sector.

7. The Secretariat prepared the present document in response to decision 82/83(c) in light of the above.

### Scope of the document

8. The document consists of the following sections addressing specific issues relating to the service sector for LVC countries<sup>9</sup>:

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<sup>3</sup> To request the Executive Committee to increase in relation to the servicing sector the funding available under decision 74/50 above the amounts listed in that decision for parties with total HCFC baseline consumption up to 360 metric tonnes, when needed, for the introduction of alternatives to HCFC with low-GWP and zero-GWP alternatives to HFC and maintaining energy efficiency also in the servicing/end-user sector.

<sup>4</sup> To request the Executive Committee to consider, within the context of paragraph 16 of decision XXVIII/2, increasing the funding provided to LVC countries to assist them in implementing the activities outlined in paragraph 1 of this decision.

<sup>5</sup> To request the Executive Committee to consider flexibility within the financial support provided through enabling activities for HFCs to enable Article 5 Parties, who wish to do so, to use part of this support for energy efficiency policy and training support as it relates to the phase-down of controlled substances, such as: developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient refrigeration, air-conditioning and heat-pump equipment; promoting access to energy-efficient technologies in these sectors; and targeted training on certification, safety and standards, awareness raising and capacity building aimed at maintaining and enhancing the energy efficiency.

<sup>6</sup> Article 5 countries with total HCFC consumption of up to 360 metric tonnes would be provided with funding consistent with the level of consumption in the servicing sector, on the understanding that project proposals would still need to demonstrate that the funding level was necessary to achieve the 2020 and 2025 phase-out targets, or if the country so decided, later reduction targets.

<sup>7</sup> Paragraph 16 of decision XXVIII/2

<sup>8</sup> Paragraph 2 of decision XXX/5

<sup>9</sup> Many of the issues discussed here are applicable to service sector for non-LVC countries also.

Introduction of low- and zero-GWP alternatives to HCFCs or HFCs: presents an overview of the refrigeration servicing sector and the regulatory framework that has been established in Article 5 countries, allowing *inter alia* implementation of controls on imports of RACHP equipment based on high-GWP controlled substances. It discusses the potential barriers for the introduction of low- and zero-GWP alternative technologies and how Article 5 countries are addressing these barriers during the implementation of their HPMPs. It also presents an overview of the adoption of standards and how they can be useful in supporting the adoption of low-GWP alternatives in the context of the HCFC phase-out.

Developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient RACHP equipment and promoting market penetration of energy-efficient equipment: presents an overview of energy efficiency policies commonly used, with an emphasis on the minimum energy performance standard (MEPS) and labelling programmes; it presents a list of 43 Article 5 countries with programmes in place for MEPS and labelling; and discusses the application of MEPS for controlling imports of “inefficient” energy efficiency RACHP equipment together with regulations favouring the introduction of low- and zero-GWP alternative refrigerants<sup>10</sup>.

Maintaining energy efficiency in the servicing sector: briefly discusses the effect of installation, maintenance and servicing practices in ensuring the efficient operation of the RACHP equipment at the highest feasible energy efficiency over the lifetime of the equipment.

Targeted training on certification, safety and standards, awareness raising and capacity building: presents an overview of the targeted training on certification, safety and standards, awareness-raising and capacity-building in support of the introduction of energy-efficient low- or zero-GWP alternative technologies currently undertaken in HPMPs, and additional activities that might be needed on these matters.

Criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HPMPs: identifies additional activities that might be required for the adoption of energy-efficient RACHP equipment operating with low- and zero-GWP refrigerants, based on the review of the regulatory framework and the phase-out plans of controlled substances, in particular those related to the refrigeration servicing sector. It proposes a set of performance indicators and a brief analysis of costs as well as funding modalities.

9. In preparing the present document, the Secretariat took into consideration information related to energy efficiency contained in the following documents previously considered by the Executive Committee or the Parties to the Montreal Protocol:<sup>11</sup>

- (a) Issues relevant to the Executive Committee arising from the Twenty-eighth Meeting of the Parties to the Montreal Protocol;<sup>12</sup>
- (b) Information relevant to the development of the cost guidelines for the phase-down of HFCs in Article 5 countries: draft criteria for funding;<sup>13</sup>

<sup>10</sup> Integrated regulations addressing MEPS and labelling and low-GWP / zero-GWP refrigerants in RACHP sectors are essential to avoid unintended growth of high-GWP refrigerant based RACHP equipment.

<sup>11</sup> To facilitate the discussion of the Executive Committee, the relevant text of the documents has been incorporated into the present document.

<sup>12</sup> UNEP/OzL.Pro/ExCom/77/70/Rev.1 (paragraphs 50 to 57).

<sup>13</sup> UNEP/OzL.Pro/ExCom/78/5 and Corr.1 (paragraphs 107 to 115 and Annex V).

- (c) Preliminary document on all aspects related to the refrigeration servicing sector that support the HFC phase-down (decision 80/76(c)).<sup>14</sup> The document presents a comprehensive overview of the refrigeration servicing sector in all Article 5 countries, and addresses in detail most of the elements in decision 82/83(c); and
- (d) Decision XXIX/10 Task Force report on issues related to energy efficiency while phasing down HFCs, UNEP TEAP, September 2018.

10. The Secretariat also considered:

- (a) Policies and decisions of the Multilateral Fund and the Meeting of the Parties related to energy efficiency;
- (b) The experience in the Multilateral Fund during implementation of projects that included energy efficiency performance indicators and the evaluation by the Senior Monitoring and Evaluation Officer of chiller projects;
- (c) Discussions with refrigeration servicing sector stakeholders in Article 5 countries and non-Article 5 countries, held during missions and during meetings at the Secretariat between February and April 2018;
- (d) Information presented at the workshop on safety standards relevant to the safe use of low-GWP alternatives<sup>15</sup> and at the workshop on energy efficiency opportunities while phasing down HFCs,<sup>16</sup> held in the margins of the 39<sup>th</sup> and 40<sup>th</sup> meetings of the OEWG, respectively;
- (e) Discussions with representatives from bilateral and implementing agencies on all aspects of the refrigeration servicing sector, during Inter-agency coordination meetings (IACMs) held in 2018 and 2019;<sup>17</sup> and
- (f) Documents issued by different institutions including bilateral and implementing agencies.

11. The Secretariat appreciates the insights, information and comments provided by the bilateral and implementing agencies during the discussions at the IACMs.

12. The Secretariat also sought advice from an independent expert on the technical aspects included in the present document. Relevant comments from the expert have been incorporated accordingly.

### **Introduction of low- and zero-GWP alternatives to HCFCs or HFCs**

13. Since the inception of the Multilateral Fund in 1991, the Executive Committee has considered funding activities in the refrigeration servicing sector<sup>18</sup> to be a priority, given that part or all of the controlled substances are used in this sector. The Secretariat notes that the support provided to the service sector has facilitated adoption of ODS-free alternative technologies, and has not directly resulted in the adoption of alternative technologies, as has been the case during the conversion of the manufacturing sector.

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<sup>14</sup> UNEP/OzL.Pro/ExCom/82/64 (all the information contained therein is relevant for consideration of the present document). Paragraphs 77 to 83 refer specifically to considerations on energy efficiency in the servicing sector.

<sup>15</sup> Bangkok, 10 July 2017.

<sup>16</sup> Vienna, 9-10 July 2018.

<sup>17</sup> 6-8 March 2018; 4-6 September 2018; and 5-7 March 2019.

<sup>18</sup> For the purpose of this document, the term “refrigeration servicing sector” will refer to both refrigeration and air-conditioning.

14. Initial activities in the service sector were implemented as stand-alone projects, consisting of training refrigeration technicians in good servicing practices, providing basic tools and equipment for technicians, and establishing refrigerant recovery and recycling schemes. Assistance was also provided for the development and implementation of specific legislation, policies and regulations and capacity building for customs and enforcement authorities for monitoring and controlling the controlled substances under the Montreal Protocol.

15. As the phase-out programme progressed, the stand-alone activities were subsumed into a holistic sector plan that would manage the phase-out of controlled substances used for servicing RACHP equipment,<sup>19</sup> taking into consideration the circumstances prevailing in the country concerned. The servicing sector activities resulted in better operations and maintenance practices while installing, maintaining and servicing equipment and thus, contributed to energy efficient operations of the equipment, indirectly and supported adoption of low- and zero-GWP options, mainly through technical capacity building for adopting alternative technologies.

16. In response to decision XIX/6 on adjustments to the Montreal Protocol with regard to HCFCs, the Executive Committee proposed a staged approach to allow countries to develop an overarching plan to achieve total phase-out of HCFCs while allowing for proposals to achieve the first two control measures in 2013 and 2015, and at the same time, allowing proposals for a subsequent stage, or stages if needed, to achieve complete phase-out. Since the 60<sup>th</sup> meeting (April 2010), stage I and in many cases stage II of HPMPs have been approved for all Article 5 countries, except for the Syrian Arab Republic. Decision XIX/6 requested Parties to promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate, as well as meeting other health, safety and economic considerations and requested the Executive Committee to give priority to projects and programmes, which focus on, *inter alia*, GWP and energy use; this provided for implementation of activities to facilitate adoption of low- and zero-GWP options.

17. The implementation of the refrigeration servicing sector plans supported by the regulatory framework in place contributed to continuous compliance with the Montreal Protocol provisions by all Article 5 countries,<sup>20</sup> and to reductions in consumption of controlled substances in line or in advance of the phase-out control targets established under the Protocol.<sup>21</sup> Furthermore, this has allowed several Article 5 countries to establish, or to consider establishing, controls including prohibition of manufacturing (where applicable) and/or on import of controlled-substance-based RACHP equipment, limiting their growth and reducing the size of the installed base of such equipment.

18. Despite the above efforts, progress reports on the implementation of HPMPs, and other evaluation reports indicate that high-GWP-refrigerant-based equipment (mainly R-410A in air-conditioning) have increasingly been imported into Article 5 countries over the last decade. However, the Kigali Amendment has triggered discussions and some initial actions, on controlling the use of high-GWP refrigerants in Article 5 countries. Given that equipment based on low- or zero-GWP refrigerants have different operating characteristics related to pressure, flammability and toxicity, the current legislation, regulations, and codes

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<sup>19</sup> The strategy could include *inter alia* economic incentives and disincentives targeting suppliers, service technicians and equipment owners; technician training; public awareness activities; customs controls on new CFC-based equipment; the retirement of existing CFC-based equipment; and an increase in the supply of recycled CFCs.

<sup>20</sup> Since the ratification of the Montreal Protocol, there have been a few countries that have been found to be in non-compliance with the Protocol. However, with the assistance of the Multilateral Fund, those Parties returned to compliance within a defined period.

<sup>21</sup> For example, funding has been approved in principle to phase out 62 per cent of the aggregate HCFC baseline for compliance in Article 5 countries, well ahead of the 35 per cent control measure in 2020.

of practice would need to be reviewed, updated and/or further developed, and standards<sup>22</sup> should be enforced to ensure safe operation and handling of the equipment.

19. The pace of introduction of low- or zero-GWP alternative technologies in various RACHP applications has been slower than originally expected in Article 5 countries, due to:

- (a) The availability of cost-effective, energy efficient equipment based on high-GWP alternatives;
- (b) The limited number of standards currently available related to the introduction, installation and servicing and maintenance of equipment based on flammable or toxic refrigerants;
- (c) The lack of standards for transportation of flammable or toxic refrigerants;
- (d) The slow pace of commercialization coupled with limited availability of some refrigerants or the equipment operating with low- or zero-GWP alternative;
- (e) The lack of building codes allowing the installation of RACHP equipment based on flammable refrigerants with a certain refrigerant charge; and
- (f) The availability of skilled and properly equipped refrigeration servicing technicians.

20. Article 5 countries are currently addressing several of these barriers through activities that are increasingly becoming standard components of the HPMPs. Article 5 countries have been encouraged to develop regulations and codes of practice, and to adopt standards for the safe introduction of flammable and toxic refrigerants. Article 5 countries have also been encouraged to limit the import of HCFC-based equipment mainly through regulatory interventions under HPMPs and facilitate the introduction of energy-efficient and climate-friendly alternatives; and to focus activities in the refrigeration servicing sector on training of technicians, good practices, the safe handling of refrigerants, containment, recovery and recycling, and reuse of recovered refrigerants rather than retrofitting.<sup>23</sup>

21. Training in the installation, operation, maintenance and disposal of RACHP equipment using flammable substances has been considered a priority during implementation of stages I and II of the HPMPs in countries where these refrigerants were already in the market or expected to be introduced.

22. In support to the work by national ozone units (NOUs), UNEP's Compliance Assistance Programme (CAP) developed a guide on international standards in refrigeration and air-conditioning, providing an introduction to standards and showing how they can be useful in supporting the adoption of low-GWP alternatives in the context of the HCFC phase-out. The guide also provides an overview of existing standards related to HCFCs and their alternatives; barriers to alternatives; the process for adopting international and regional standards at the national level; and barriers to the adoption of standards and how to overcome them.<sup>24</sup>

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<sup>22</sup> For substances, for equipment, for refrigerant containers, and on storage, transportation, design of systems and components, maximum refrigerant charge, installation, servicing and disposal of equipment, among others.

<sup>23</sup> Decision 72/41

<sup>24</sup> The standards covered in the guide are grouped into four main categories: (a) Safety standards for design, construction and installation of RACHP products and systems; (b) Performance standards for determining the efficiency and performance of RACHP systems and equipment, as well as for refrigerants; (c) Practice standards for identifying knowledge and guiding best practices for refrigeration technicians when handling RACHP systems and refrigerants; and (d) Quality standards covering any industry, but applicable to processes involving refrigerants such as production, accounting, certification and training.

23. While the above measures had an impact on adoption of low- and zero-GWP alternatives in RACHP equipment, market factors appear to have played a role in influencing the pace of adoption of these alternatives. Measures facilitating adoption of these alternatives as well as preventing high-GWP alternatives penetration may need to be further considered to enhance the pace of adoption of low- and zero-GWP alternatives.

**Developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient refrigeration, air-conditioning and heat-pump equipment and promoting the market penetration of energy-efficient equipment**

24. The energy efficiency of any RACHP equipment is largely independent of the refrigerant charged in the systems. The global demand for equipment using high-GWP substances, e.g., R-410A, is currently among the highest for many years, leading equipment manufacturers to continuously improve the energy efficiency of such equipment. With the adoption of the Kigali Amendment, an increase in the pace of introduction of RACHP equipment based on low- or zero-GWP refrigerants (e.g., HFC-32, R-290) is expected. However, improving the energy efficiency will require equipment manufacturers to introduce technological advances in the design and key components of these equipment (e.g., compressors, heat exchangers, controls).<sup>25</sup>

25. One of the energy efficiency policy measures used globally is the MEPS, a specification of performance requirements for an energy-using device that effectively limits the maximum amount of energy that may be consumed by a product in performing a specified task.<sup>26</sup>

26. Regulations for controlling imports of energy-efficient RACHP equipment would require enforcing MEPS for equipment used in different applications and operating under different climatic conditions, and supported by labelling programmes providing more information to consumers. Defining the MEPS efficiency levels for avoiding energy-inefficient equipment would vary depending upon national product-market characteristics, consumer cost-economics, consumer preferences for adopting energy-efficient equipment, which is influenced by *inter alia* technology availability, ease of adoption, price of electricity and usage patterns. Further, MEPS levels need to be revised upwards every few years, keeping in view the technical developments of the RACHP equipment. Moreover, MEPS are largely independent of the refrigerant used.

27. Accordingly, while enforcing MEPS for supply and sale of equipment in local markets is essential for improving energy efficiency, complementary measures must be implemented concurrently to avoid an increased uptake of high-GWP refrigerant-based RACHP equipment. In particular, MEPS and regulatory measures addressing the import and use of high-GWP refrigerant-based equipment should be implemented concurrently to avoid the import of energy-efficient RACHP equipment based on high-GWP refrigerant (e.g., R-410A).

28. Other measures that could facilitate the adoption of energy-efficient equipment include labelling programmes that help consumers choose specific products with certain levels of efficiency; financial incentives in the form of rebates, tax credits, loan financing or leasing of energy-efficient equipment; and procurement programmes that encourage the purchasing of energy-efficient products at attractive prices. In addition, aspects relating to building design to reduce heating loads, temperature controls in cooling space, and refrigeration-equipment operation to prevent loss in cooling, have an impact on the energy efficiency

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<sup>25</sup> Energy labels results in differentiation of products making most efficient products fall in the high-price category with other associated features. The effect of MEPS is to push manufacturers to incorporate the energy-efficient components and designs into lower-priced (lower profit margin) larger-market product lines sooner than they otherwise would.

<sup>26</sup> In MEPS-making processes, energy efficiency policy makers compare the increase in purchase price for higher efficiency equipment against the energy savings to the consumer, and set the level of MEPS level to “pay back” the average consumer within a specified time period.

of equipment; raising the awareness of consumers and other relevant stakeholders through service agencies could encourage energy-efficient operation of equipment. These measures, aligned with MEPS and other regulatory measures that can avoid the adoption of high-GWP refrigerants, could be implemented in a manner to encourage the introduction of high-energy-efficiency equipment based on low- or zero-GWP alternatives.

29. Although specific regulations related to controlling imports of RACHP equipment based on their energy efficiency ratings have not been included under HPMPs, a large number of Article 5 countries have such regulations, which are enacted by the relevant authorities dealing with energy efficiency, as shown in Table 1.

**Table 1. Overview of 43 Article 5 countries with programmes in place for MEPS and labels<sup>27</sup>**

| Country                                     | Comparative labels <sup>28</sup> |         | Endorsement labels <sup>29</sup> |         | MEPS         |         |
|---------------------------------------------|----------------------------------|---------|----------------------------------|---------|--------------|---------|
|                                             | Refrigerator                     | Room AC | Refrigerator                     | Room AC | Refrigerator | Room AC |
| Algeria                                     | X                                | X       |                                  |         | X            |         |
| Argentina                                   | X                                | X       |                                  |         | X            | X       |
| Bangladesh                                  |                                  | X       |                                  |         |              |         |
| Barbados                                    | X                                | X       |                                  |         |              |         |
| Bolivia (Plurinational State of)            | X                                |         |                                  |         |              |         |
| Brazil                                      | X                                | X       | X                                | X       | X            | X       |
| Chile                                       | X                                | X       |                                  |         |              |         |
| China                                       | X                                | X       | X                                | X       | X            | X       |
| Colombia                                    | X                                | X       |                                  |         | X            | X       |
| Cook Islands                                | X                                | X       |                                  |         | X            | X       |
| Costa Rica                                  | X                                | X       |                                  |         | X            | X       |
| Cuba                                        | X                                | X       |                                  |         |              |         |
| Democratic People's Republic of Korea (the) | X                                |         | X                                | X       | X            | X       |
| Dominican Republic (the)                    | X                                |         |                                  |         |              |         |
| Ecuador                                     | X                                | X       |                                  |         | X            | X       |
| Egypt                                       | X                                | X       |                                  |         | X            | X       |
| El Salvador                                 | X                                |         |                                  |         | X            |         |
| Eswatini                                    |                                  |         |                                  |         | X            | X       |
| Fiji                                        | X                                |         |                                  |         | X            |         |
| Ghana                                       | X                                | X       |                                  |         | X            | X       |
| India                                       | X                                | X       |                                  |         | X            | X       |
| Indonesia                                   | X                                | X       |                                  |         | X            | X       |
| Iran (Islamic Republic of)                  | X                                | X       |                                  |         | X            | X       |
| Jamaica                                     | X                                |         |                                  |         |              |         |
| Jordan                                      | X                                |         |                                  |         |              |         |
| Kiribati                                    | X                                | X       |                                  |         | X            | X       |
| Malaysia                                    | X                                | X       |                                  | X       | X            | X       |
| Mexico                                      | X                                | X       | X                                | X       | X            | X       |
| Nicaragua                                   | X                                |         |                                  |         |              |         |
| Pakistan                                    |                                  | X       |                                  |         |              | X       |
| Peru                                        | X                                |         |                                  |         | X            |         |

<sup>27</sup> Extracted from the TEAP Decision XXIX/10 Task Force report. The sources of information included: CLASP Policy Database (2018), <https://clasp.ngo/policies> (accessed on 15 August 2018); Kigali Cooling Efficiency Program, Africa Cooling Map, <https://www.k-cep.org/wp-content/uploads/2018/05/Africa-Cooling-map.pdf>; Braungardt S and Göthner KC, 2017. Harmonisation of MEPS and energy labelling in Latin America and the Caribbean – opportunities and challenges.

<sup>28</sup> Comparative labels allow consumers to compare similar products to each other using an energy efficiency rating on the label.

<sup>29</sup> Endorsement labels are granted if the product fulfils a set of criteria prescribed by the label.

| Country                         | Comparative labels <sup>28</sup> |         | Endorsement labels <sup>29</sup> |         | MEPS         |         |
|---------------------------------|----------------------------------|---------|----------------------------------|---------|--------------|---------|
|                                 | Refrigerator                     | Room AC | Refrigerator                     | Room AC | Refrigerator | Room AC |
| Philippines (the)               | X                                | X       |                                  |         |              | X       |
| Saint Lucia                     | X                                | X       |                                  |         |              |         |
| Saudi Arabia                    | X                                | X       |                                  |         |              | X       |
| Solomon Islands                 | X                                | X       |                                  |         | X            | X       |
| South Africa                    | X                                |         |                                  |         | X            | X       |
| Thailand                        | X                                | X       | X                                | X       | X            | X       |
| Tunisia                         | X                                | X       |                                  |         | X            | X       |
| Turkey                          | X                                | X       |                                  |         | X            | X       |
| Tuvalu                          | X                                | X       |                                  |         | X            | X       |
| Uruguay                         | X                                | X       |                                  |         |              |         |
| Venezuela (Bolivarian Republic) | X                                | X       |                                  |         |              |         |
| Viet Nam                        | X                                | X       | X                                | X       |              | X       |

30. During implementation of HCFC phase-out, the Executive Committee has sought opportunities to promote energy efficiency improvements in the RACHP sector. In particular, the Committee approved 14 demonstration projects related to the introduction of low-GWP alternatives to HCFCs in different sectors. The promotion of energy efficiency improvements, and reports on the achieved energy efficiency performance were among the criteria used to select projects for funding.

31. Energy efficiency considerations influenced the approval of the conversion of the air-conditioning manufacturing sector in two countries. The HPMP for Jordan included a requirement that the air-conditioning sector plan would incorporate policy and technical approaches to improve the energy efficiency of residential air-conditioning equipment to offset the climate impact associated with the introduction of R-410A technology. The HPMP for Thailand included technical assistance to support promoting the adoption of energy-efficient products beyond those that were part of the conversion, and to support assisting energy-efficiency initiatives in buildings.

32. Even though energy efficiency policies are not within the responsibilities of NOUs, at its 82<sup>nd</sup> meeting (December 2018), the Executive Committee provided flexibility for Article 5 Parties engaged in enabling activities<sup>30</sup> to undertake the following activities using the funding already approved:<sup>31</sup>

- (a) Development and enforcement of policies and regulations to avoid market penetration of energy-inefficient RACHP equipment;
- (b) Promotion of access to energy-efficient technologies in those sectors; and
- (c) Targeted training on certification, safety and standards, awareness raising and capacity building aimed at maintaining and enhancing energy efficiency.

33. As mentioned in the TEAP Decision XXIX/10 Task Force report, it is important for national ozone officers (NOOs) to be aware of energy efficiency policies and targets in their countries that may affect their RACHP equipment and key trading partners, especially those countries that manufacture equipment or components. Cooperation among NOOs and the authorities responsible for energy efficiency, who have

<sup>30</sup> At its 79<sup>th</sup> meeting (July 2017), the Committee agreed to funding enabling activities to *inter alia* support: the phase-down of HFCs; the early ratification of the Kigali Amendment aimed at initiating supporting institutional arrangements; the review of licensing systems; HFC data reporting; demonstration of non-investment activities; and national strategies (decision 79/46). As of the 82<sup>nd</sup> meeting, 130 Article 5 countries had received funding for the implementation of enabling activities. Funding approved under enabling activities ranged from US \$50,000 for countries with HCFC baseline consumption of up to 0.8 ODP tonnes to US \$150,000 for countries with HCFC baseline consumption of 17.6 to 19.8 ODP tonnes.

<sup>31</sup> The impact of energy efficiency initiatives under enabling activities is not known and expected to be limited.

limited experience and a limited role in the adoption of low- or zero-GWP-based technologies, might result in reduced costs to manufacturers and might offer coordinated policy direction to meet national targets.

### **Maintaining energy efficiency in the servicing sector**

34. The normal wear-and-tear of any refrigerator or air-conditioning equipment during its lifetime affects the operation of the equipment, reduces its energy efficiency and increases energy consumption. Proper installation, maintenance and servicing practices play a critical role in minimizing wear-and-tear and ensuring the efficient operation of the equipment at the highest feasible energy efficiency over the life of the equipment. Servicing sector training activities could change operating practices of technicians, thereby ensuring energy efficient operation of equipment.

35. The TEAP Decision XXIX/10 Task Force report indicates that energy-efficient performance of RACHP equipment could be achieved, at low-to-medium cost levels, through the implementation of good servicing practices such as appropriate refrigerant and oil charge; good air circulation through the condenser; maintaining proper air flow through the evaporator; proper setting of the temperature sensor and of the thermostatic expansion valve; and proper setting of the condenser pressure control.

36. The performance of RACHP equipment associated with servicing and maintenance practices has been measured and published. Studies conducted by the United Kingdom of Great Britain and Northern Ireland, Australia and the European Partnership for Energy and the Environment report energy savings ranging from 8 per cent to 40 per cent or more, depending on the improvements or servicing practices involved, as shown below:<sup>32</sup>

- (a) A study by the Department of Environment, Food, and Rural Affairs of the United Kingdom of Great Britain and Northern Ireland, reported that cleaning a dirty condenser delivers an 8 per cent energy saving, and resetting the temperature set point to the design temperature yields an additional 11 per cent energy saving (Swain, 2009);
- (b) A study by the Government of Victoria in Australia found that improvements to technical elements of refrigeration and air-conditioning systems have the potential to reduce energy consumption by 15 to 40 percent; improving operational practices with minimal expense can often reduce energy costs by 15 per cent or more (Sustainability Victoria 2009);
- (c) The Chartered Institute of Building Services Engineers of the United Kingdom of Great Britain and Northern Ireland estimates that savings of around 15 per cent are achievable for residential buildings built according to standards and code; additionally, over 20 per cent of savings are achievable by following good practice guidelines; and
- (d) Examples of RACHP efficiency opportunities through improved operation and maintenance from the European Partnership for Energy and the Environment are presented in Table 2:

**Table 2. Examples of RACHP efficiency opportunities through improved operation and maintenance<sup>33</sup>**

| <b>Action</b>        | <b>Explanation</b>                                                                                                                  | <b>Impact</b>                   |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| No refrigerant leaks | Too low refrigerant charge increases compressor running time and eventual loss of capacity. Motor/compressors could eventually fail | +30 per cent energy consumption |

<sup>32</sup> The TEAP Decision XXIX/10 Task Force report

<sup>33</sup> Presentation by Stefan Thie, EPEE Technical Expert, at the workshop on energy efficiency opportunities while phasing down HFCs.

| Action                                      | Explanation                                                                                                                                                                                                                                                 | Impact                                       |
|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| Clean condensor and evaporator coils        | Every 1K <sup>34</sup> rise in condensing temperature may reduce evaporator capacity by 1.35 per cent and increase power consumption<br>A dirty evaporator coil would result in reduced system duty without a reduction in motor/compressor running current | +8 per cent energy consumption               |
| Clean or replace filters regularly          | Dirty filters would result in reduced system duty (2 - 4 per cent for every 1K reduction in evaporating temperature) without a reduction of compressor running current<br>Filters with a too low filtration rate result in dirty cooling coils and fans     | Average savings of 25 per cent               |
| Check operations and settings of controller | Ensure that appropriate mode is being used, the temperature is set correctly (generally between 19 and 23 °C), a suitable fan speed is selected, the time schedule is correct and that each function operates correctly                                     | Average savings of 97 per cent <sup>35</sup> |
| Check condensor pressure controls           | Condenser fan cycling/speed controllers and dampers not set correctly could cause over- or under-condensing, resulting in poor efficiency and longer compressor running time<br>Under-condensing would result in higher running currents                    | Average savings 4 per cent                   |

37. The Multilateral Fund has supported training in good servicing practices for service technicians since the inception of the Fund; impact of the implementation of good servicing practices has not only reduced consumption of refrigerant, but also contributed to efficient operation of the RACHP equipment and maintained energy efficient performance of equipment. Training was initially provided as stand-alone training and has evolved to become an integral component of sector and/or national phase-out plans. In this process, NOUs have increased the involvement of national vocational/training centres in the implementation of training, and have ensured that the relevant subjects were included in the centres' curricula.

38. With the accelerated phase-out of HCFCs and the adoption of the Kigali Amendment, the number and variety of refrigeration and air-conditioning systems operating with low- or zero-GWP refrigerants has been increasing slowly. In this context, during the implementation of their HPMPs, several Article 5 countries have started strengthening the local institutions and bodies involved in technician training and certification; expanding the code of good practices and the training of technicians to include the proper handling and management of flammable and toxic refrigerants; and facilitating the introduction of low- or zero-GWP technologies in the RACHP sector.

### **Targeted training on certification, safety and standards, awareness raising and capacity building**

39. The level of funding for the implementation of HCFC phase-out plans in the refrigeration servicing sector for all Article 5 countries was established under decision 74/50. For LVC countries, the maximum funding levels were dependent on the HCFC baseline for compliance in the refrigeration servicing sector, and varied from US \$587,500 for countries with a consumption below 15 mt, to US \$1,800,000 for countries with a consumption above 320 mt. For non-LVC countries (with a consumption above 360 mt) funding was approved at US \$4.80/kg of HCFC used in the servicing sector.

40. With the funding provided, the activities covered under stages I and II of the HPMPs include, *inter alia*, support for the development of policy and regulations to facilitate the phase-out of controlled substances; training of customs and enforcement officers, including capacity building of these institutions

<sup>34</sup> Zero on the Celsius scale (0°C) is equivalent to 273.15K (°Kelvin), with a temperature difference of 1°C equivalent to a difference of 1K i.e., 100°C, defined as the boiling point of water, is equivalent to 373.15K. Every 1K temperature difference could result in higher power consumption impact during equipment operations.

<sup>35</sup> This value appears to be high. TEAP report indicates that controller settings adjustments would result in about 10 per cent savings.

for refrigerant identification; training of technicians in good service practices that often include safe adoption of flammable and toxic refrigerants; basic equipment and tools to support technicians and technical institutions in the adoption of good servicing practices; programmes for the recovery, reuse and reclamation of refrigerants; incentives for replacement or retrofit with alternative refrigerants; and information outreach and awareness activities.

41. Throughout the implementation of their HPMPs, Article 5 countries have the flexibility to select phase-out activities that are most suitable for the circumstances prevailing in their local markets and that best enable them to meet their compliance obligations. Several Article 5 countries have included schemes for the certification of servicing technicians, with most of them strengthening the training infrastructure to support the introduction of low- or zero-GWP refrigerants, with their intrinsic flammability and toxicity characteristics. A few Article 5 countries have also supported end-users, mainly through customized training programmes for technicians keeping in mind the market structure (e.g., large supermarkets planning to convert to low-GWP technologies have in-house capacity to maintain and train technicians), and through financial incentives for retrofitting and/or replacing the baseline equipment to low- or zero-GWP alternatives.

#### Certification of technicians

42. During the implementation of HPMPs, several Article 5 countries have considered it relevant to ensure the long-term sustainability of servicing sector activities by including systems for certifying the competency of technicians in good installation and servicing practices tailored to the specific circumstances of each country. Many countries have moved toward establishing voluntary certification schemes supported by regulations. An alternative approach considered in some countries is the issuing of environmental licenses, which would be under the purview of the Ministries of Environment. Some countries are strengthening the refrigeration associations and involving them more closely in implementing the certification system for technicians. In some regions (e.g., Pacific Island countries), there is a preference for using regional organizations for the certification of technicians as this could result in harmonised and cost-effective implementation of certification of technicians.

43. Establishing mandatory certification of technicians is more challenging, as such a decision would often go beyond the NOU's purview and would require additional institutional work. The extent to which certification mechanisms serve as a "pre-condition" for technicians varies when it comes to following procedures for good servicing of RACHP equipment, the procurement and use of different types of refrigerants, the recovery and reuse of refrigerants and the safe/effective disposal of equipment. In some countries, there are specific bodies in charge of developing technical norms and certification processes; technicians obtain a competency-based certification issued by the relevant education or other relevant regulatory body (e.g., labour ministry, technical education department) within the Government.

44. To ensure long-term sustainability of the certification of technicians, certification systems need to be further developed and/or strengthened with necessary regulatory measures at national level. The training curricula of institutions and vocational schools should be periodically updated to incorporate changes, technology upgrades of RACHP systems and the introduction of alternative refrigerants. Consideration should be given to: extending certification to enterprises involved in the installation, servicing, maintenance and decommissioning of RACHP equipment; linking technician certification to regulatory norms or standards adopted by the country; determining the number and levels of technician certification according to the specific needs of the country; and strengthening and involving refrigeration associations in the promotion or implementation of technician certification. The certification programme should include regulations to prevent uncertified technicians from working on and/or servicing RACHP equipment with certain technologies, and purchasing and handling refrigerants, and should be supported by information outreach and awareness to ensure its sustained adoption.

## Safety and standards

45. As more low- or zero-GWP alternative refrigerants enter the markets in Article 5 countries, the training infrastructure currently used for phasing out HCFCs should be assessed to determine whether it would need to be further strengthened or updated. Similarly, the current training programmes must be reviewed in order to extend the good servicing and maintenance practices to cover the new technologies being introduced. They should be structured based on national priorities relating to the servicing sector's capacity and the technologies that are expected to be introduced while phasing out HCFCs.

46. Adapting internationally approved standards<sup>36</sup> to suit national requirements could be a cost-effective way of adopting standards. In the context of LVC countries, equipment standards would typically be adopted from the prevailing international standards and adapted to the extent required to suit local conditions. Servicing standards, however, need to be developed and integrated with the certification system to ensure sustainable adoption of equipment using low-GWP alternatives.

## Awareness raising and capacity building

47. Awareness-raising activities are carried out in LVC countries under HPMPs and as part of the institutional strengthening project, mainly to support the phase-out of controlled substances in line with the compliance targets of the Montreal Protocol. Energy efficiency-related awareness activities are not separately covered under HPMPs, though they at times are covered under training activities for the servicing sector.

48. Capacity building for implementation of the Montreal Protocol has been funded since the inception of the Multilateral Fund directly to each Article 5 country, to UNEP CAP through its clearinghouse function, and at the regional and global levels, mainly through regional network meetings. The list of tools developed by UNEP CAP<sup>37</sup> and other relevant tools developed by different implementing agencies can be used to develop certification programmes in a cost-effective manner, tailored to country-specific technical needs.

49. Capacity building activities relating to regulations, training and institutional coordination with energy efficiency authorities are essential for facilitating the adoption of low- and zero-GWP refrigerants. These activities need to be customized based on national needs and priorities. Integrating energy efficiency-related aspects into outreach programmes can effectively disseminate information on energy issues to various stakeholders.

## **Criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HPMPs**

50. The Secretariat's review of the regulatory framework and the phase-out plans for controlled substances, in particular those related to the refrigeration servicing sector, in light of decision 82/83(c) has led to the understanding that introducing low- or zero-GWP technologies and maintaining the energy efficiency of RACHP equipment in the refrigeration servicing sector would necessitate the following:

- (a) Strengthening existing policies and regulations, and developing new ones for the staged reduction of imports of HCFC-based RACHP equipment, and for the adoption of

<sup>36</sup> The international bodies responsible for RACHP standards are the International Organisation for Standardisation (ISO) and the International Electrotechnical Commission (IEC). In addition, there are national and regional level standard bodies.

<sup>37</sup> The tools, products and services provided by UNEP CAP are described in Annex III of document UNEP/OzL.Pro/ExCom/82/64.

energy-efficient equipment based on low- or zero-GWP refrigerants while phasing out HCFCs;

- (b) Coordination with energy efficiency policy makers in setting up and/or operationalizing MEPS, labelling systems and other mechanisms for the introduction of energy-efficient RACHP equipment (preventing the introduction of energy-inefficient low- and zero-GWP refrigerant-based RACHP equipment) into local markets;
- (c) Continued implementation of standards for safety and for the effective use of low- or zero-GWP refrigerants, and the development and implementation of regulations to ensure that only certified technicians service and maintain RACHP equipment and handle all types of refrigerants;
- (d) Continued training and certification of technicians in the installation, maintenance and servicing of RACHP equipment to ensure efficient and safe operation of the equipment throughout its lifetime, and demonstration of new low- and zero-GWP refrigerant-based technologies; and
- (e) Awareness and information outreach on the adoption of low- or zero-GWP energy-efficient technologies, and on the certification of technicians.

51. Given that most of the above-mentioned activities for facilitating the adoption of low- or zero-GWP technologies while phasing out HCFCs are currently being implemented under stages I and II of the HPMPs, operationalizing paragraph 16 of decision XXVIII/2 would involve identifying activities in addition to the existing activities under HPMPs. Activities relating to the introduction of energy-efficient RACHP equipment are being implemented as part of the enabling activities, albeit to a limited extent. The results of the outcomes of these activities have yet to be reported.

52. Based on the above considerations, the extent to which additional funds are required would depend upon the levels of additional activities to be implemented under existing stages or future stages of HPMPs. These could include the following, for countries not already implemented such activities:

- (a) Pilot projects strategically designed and targeted to end-users, primarily for small capacity RACHP equipment, for adoption of energy-efficient equipment operating with low- or zero-GWP refrigerants for which manufacturing conversion projects have been funded under the HPMP and challenges are experienced in market acceptance;
- (b) Updating training material to strengthen components relating to good practices for installation, maintenance and servicing of RACHP equipment based on refrigerants with different operating characteristics in regard to flammability, toxicity and pressure;
- (c) Coordination and collaboration between the NOU and the energy efficiency authorities to support the development and enforcement of MEPS, labelling programme and standards for the introduction of energy-efficient RACHP equipment based on low- and zero-GWP refrigerant technologies;
- (d) Development and enforcement of certification schemes for technicians and strengthening infrastructure of national institutions on implementing certification systems. In particular, this is required due to the flammable or toxic characteristics of the low and zero-GWP refrigerants; and

- (e) Awareness and outreach programmes to promote the introduction of MEPS and labelling systems; mandatory certification of technicians; and introduction of energy efficiency RACHP equipment operating with low- and zero-GWP refrigerants.

53. Currently, HPMP activities in LVC countries are funded in line with decision 74/50(c)(xii), as shown in Table 3.

**Table 3. Total funding approved for HPMP and enabling activities in LVC countries (US \$)**

| Consumption (mt) | Up to 2020 | Up to 2025 | Total phase-out |
|------------------|------------|------------|-----------------|
| 0-15             | 205,625    | 396,500    | 587,500         |
| 15-40            | 262,500    | 506,250    | 750,000         |
| 40-80            | 280,000    | 540,000    | 800,000         |
| 80-120           | 315,000    | 607,500    | 900,000         |
| 120-160          | 332,500    | 641,250    | 950,000         |
| 160-200          | 350,000    | 675,000    | 1,000,000       |
| 200-320          | 560,000    | 1,080,000  | 1,600,000       |
| 320-360          | 630,000    | 1,215,000  | 1,800,000       |

54. Additional funding needs for achieving the objectives of decision 82/83(c), would depend upon the design of stage II of the HPMPs in terms of activities that would facilitate adoption of low- and zero-GWP alternatives and maintaining energy efficiency. With the existing levels of funding under decision 74/50 and with suitable realignment of activities, technician training and awareness outreach activities could also be undertaken for adoption of low- and zero-GWP alternatives.<sup>38</sup>

55. The need for incremental activities would mainly arise to address coordination of NOU with institutions/authorities handling energy efficiency matters to ensure energy efficiency regulations are integrated with establishment of national standards for adoption low- and zero-GWP technologies; and strengthening certification infrastructure for safe adoption of low- and zero-GWP technologies. These incremental activities will facilitate achievement of HCFC phase-out in a sustainable manner and would build a platform for HFC phase-down activities.

56. For new HPMPs or new stage of HPMPs, the countries could submit additional funding requests based on incremental levels of funding to be agreed along with associated conditions for the above-mentioned activities. For already approved stage II of HPMPs, the additional funding and associated conditions, would be considered based on the revised plans while submitting the next funding tranche.

57. Performance indicators are linked to specific actions that are considered for implementation. The following performance indicators, with suitable additions/modifications, could be adopted to measure the implementation of specific policies:

- (a) Number of policies and regulations developed and enforced for reducing and prohibiting import of HCFC-based RACHP equipment, and favouring the introduction of equipment based on low- and zero-GWP refrigerants;
- (b) Number of policies and regulations, such as MEPS and labelling systems, favouring the introduction of energy-efficient RACHP equipment;
- (c) Status of implementation of standards and labelling programmes for RACHP equipment based on low- and zero-GWP technologies;

<sup>38</sup> Pilot end-user incentive programmes and their impact would be analysed and presented in a separate paper to the 84<sup>th</sup> meeting.

- (d) Number of training institutions with infrastructure to train and certify technicians in good practices during installation, servicing and maintenance covering all types of RACHP equipment available in the country;
- (e) Number of training programmes conducted that include installation, servicing and maintenance of low and zero-GWP refrigerants, and number of technicians trained and integrated into training programs in the training institutions;
- (f) Status of enforcement of certification systems for servicing technicians;
- (g) Funds approved and disbursed for pilot end-user incentive programme and the ODS phase-out impact while adopting the technology;
- (h) Number of awareness and outreach programmes conducted favouring the introduction of MEPS and labelling systems; mandatory certification of technicians; and introduction of energy-efficient RACHP equipment operating with low- and zero-GWP refrigerants; and
- (i) Results of reports on monitoring, and reporting of activities undertaken and feedback received from NOUs and other national stakeholders on the impact of these programmes.

### **Recommendation**

58. The Executive Committee may wish to note the paper on ways to operationalize paragraph 16 of decision XXVIII/2, and paragraph 2 of decision XXX/5 of the Parties, taking into account the criteria, performance indicators, and associated funding mechanisms of servicing sector plans in existing or new HCFC phase-out management plans for low-volume-consuming countries, contained in document UNEP/OzL.Pro/ExCom/83/40.

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