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EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eighty-seventh Meeting  
Montreal, 28 June-2 July 2021<sup>1</sup>

**DESK STUDY FOR THE EVALUATION OF THE ENERGY EFFICIENCY IN THE  
SERVICING SECTOR****Background**

1. In the context of deliberations at its 82<sup>nd</sup> meeting on documents UNEP/OzL.Pro/ExCom/82/65 and Add.1, and responding to decision XXX/5 of the thirtieth Meeting of the Parties (MOP), the Executive Committee suggested that the request in operative paragraph 5 of the decision<sup>2</sup> was aligned with the work of the Senior Monitoring and Evaluation Officer (SMEO) and could be included in her 2019 Work Programme.<sup>3</sup> In line with this decision, at its 83<sup>rd</sup> meeting, the Executive Committee, approved the terms of reference (TOR) submitted by the SMEO for the desk study for the evaluation of the energy efficiency in the servicing sector, contained in Annex I of the present document.<sup>4</sup>

2. Taking into consideration the challenges to the desk study for the evaluation of the energy efficiency in the servicing sector and to allow enough time for the collection of information and data, the Executive Committee, when approving the TOR, decided that the desk study would be submitted to the 86<sup>th</sup> meeting and requested the SMEO to provide an update to the 84<sup>th</sup> meeting<sup>5</sup> on the status of the desk study (decision 83/9(b) and (c)). The update at the 84<sup>th</sup> meeting presented a list of documents relating to energy efficiency, including previous evaluations, project documents with energy efficiency-related activities in the servicing sector, verification reports and project completion reports to catalogue the energy efficiency activities already undertaken in the servicing sector and relevant material available from other sources.

3. At the extended intersessional approval processes established for the 86<sup>th</sup> meeting, the Executive Committee considered the desk study for the evaluation of energy efficiency in the servicing

<sup>1</sup> Online meetings and an intersessional approval process will be held in June and July 2021 due to coronavirus disease (COVID-19)

<sup>2</sup> Paragraph 5 of decision XXX/5: "To request the Executive Committee to build on its ongoing work of reviewing servicing projects to identify best practices, lessons learned and additional opportunities for maintaining energy efficiency in the servicing sector, and related costs".

<sup>3</sup> Paragraph 295 of document UNEP/OzL.Pro/ExCom/82/72

<sup>4</sup> UNEP/OzL.Pro/ExCom/83/10/Rev.1

<sup>5</sup> UNEP/OzL.Pro/ExCom/84/14

sector.<sup>6</sup> Changes were proposed to the desk study to reflect the policy that had been put in place to allow for a safer retrofitting process and the requirement to use appropriate safety standards, and therefore document UNEP/OzL.Pro/ExCom/86/13/Corr.1 was issued to address those changes. The Committee further decided to defer consideration of the desk study to the 87<sup>th</sup> meeting (decision 86/12), primarily to reflect on how this desk study could respond to the request by the Parties in decision XXX/5.

4. The present document is being issued in accordance with decision 86/12 and incorporates the modifications contained in document UNEP/OzL.Pro/ExCom/86/13/Corr.1, which are found in **bold** for ease of reference.

### **Objectives and methodology**

5. As established in the TOR, the objective of the desk study is to identify and assess, to the extent possible, best practices, lessons learned and additional opportunities for maintaining energy efficiency in the servicing sector, based on information available in the documents considered by the Executive Committee (contained in Annex II of the present document), through examination of project-related documentation such as MOP documents, project proposals and progress reports, as well as feedback received from the Fund Secretariat and Implementing Agencies (IAs). Additional information was gathered from other available documents on this topic.

6. In particular, document UNEP/OzL.Pro/ExCom/83/40<sup>7</sup> prepared by the Secretariat for the consideration by the 83<sup>rd</sup> meeting presented a systematic overview of the refrigeration servicing sector in Article 5 countries and a comprehensive analysis of a number of specific issues relating to the service sector such as: maintaining energy efficiency in the servicing sector, introduction of low- and zero-GWP alternatives to HCFCs or HFCs, targeted training on certification, safety and standards, awareness raising and capacity building, developing and enforcing policies and regulations to avoid the market penetration of energy-inefficient refrigeration, air-conditioning and heat pump (RACHP) equipment, and promoting market penetration of energy-efficient equipment. The information provided in document 83/40 is closely related to the terms of reference of the desk study. An attempt was made to enhance the analysis and findings reflected in document UNEP/OzL.Pro/ExCom/83/40 and other Secretariat documents related to the energy efficiency in the refrigeration servicing sector, by providing additional information on a number of specific issues.

### **Scope of the desk study**

7. As there are no specific programmes focused on energy efficiency, the desk study reviewed progress made in previously funded projects to identify energy efficiency related activities in the servicing sector, and their applications in policies and regulations at the country level.

8. The HPMP activities in the refrigeration and air-conditioning (RAC) servicing sector have been analysed by studying progress reports as well as planned activities presented to the Secretariat in requests for funding tranches by the governments of low-volume consuming (LVC) and non-LVC Article 5 countries. Altogether, documents presented by 40 Article 5 countries to the 73<sup>rd</sup> and 74<sup>th</sup> meetings were evaluated. These two meetings were selected to demonstrate how decision 72/41<sup>8</sup> was reflected in the activities proposed and implemented as part of activities in stage I of the HPMP, relating to the adaptation of training programmes; sustainability of training institutions; introduction of certification of servicing technicians; development of regulations and standards; and provision of tools and equipment, including those for recovery, recycling and reclamation (RRR) activities.

9. The activities analysed are related directly or indirectly to the improvement of energy efficiency

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<sup>6</sup> UNEP/OzL.Pro/ExCom/86/13

<sup>7</sup> 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)).

<sup>8</sup> Decision 72/41. Minimizing adverse climate impact of HCFC phase-out in the refrigeration servicing sector.

of serviced RAC equipment and/or reduction of the greenhouse gas (GHG) emissions. The randomly selected sample of 40 Article 5 countries is comprised of 22 LVC and 18 non-LVC countries representing eight geographical regions.

10. The progress achieved in the subsequent five years has been further assessed through the comparative evaluation of progress in the implementation of HPMP components (many of them stage II), as reported to subsequent meetings up to the 85<sup>th</sup> meeting. The sample group of 40 LVC and non-LVC countries was evaluated in terms of training, certification, development of standards, and procurement and distribution of tools and equipment, including RRR activities. The narrative information extracted from the progress reports is presented in Annex III of the present document, which makes possible to carry out a statistical analysis.

11. Annex III is organized in nine columns, covering the sample of 40 Article 5 countries, and displays the status of implementation of training programmes with traditional good servicing practices, training on handling of flammable refrigerants, adoption of certification standards and availability of certified technicians, conversion to low-GWP technology, standards on energy efficiency and the handling of flammable refrigerants, provision of toolkits to support technicians and training facilities, including RRR equipment, and remarks.

12. The desk study presents the results of analysis on specific issues related to activities and opportunities for maintaining energy efficiency and reduction of ODS and HFCs emissions in the refrigeration servicing sector, including: technical opportunities and measures in maintaining the energy efficiency in servicing RAC equipment, low-GWP alternatives and related standards and regulations, training and competency-based certification programmes and related standards and protocols, technical assistance programmes, refrigerant containment and reduction of emissions, refrigerant RRR programmes, labelling and minimum energy performance standards (MEPS), and energy performance testing. This document presents lessons learned and key conclusions at the end of each section, on which the Executive Committee may wish to decide on a way forward for a next phase of the evaluation.

13. This document contains the following six annexes:

- I Terms of reference
- II List of documents on issues relating to energy efficiency
- III Summary of HPMP stages I and II progress reports
- IV Training workshop in Bangladesh
- V The status of the certification scheme in 15 selected Article 5 countries
- VI Labelling and energy performance standards in selected Article 5 countries and additional information on specific initiatives in selected countries

### **Opportunities and measures in maintaining the energy efficiency in servicing the RAC equipment**

14. The largest potential to improve energy efficiency in RAC equipment comes from total system design and component improvements which can improve efficiency up to 70 per cent. The desk study does not cover energy efficiency related to the RAC manufacturing sector as such, however there are some issues that are linked to both the manufacturing and servicing sectors. The term “RAC servicing sector” describes only the service of existing RAC equipment. In reality, refrigeration servicing technicians are also frequently involved in activities related to assembly, installation, initial charging and commissioning of new RAC equipment, in particular when such equipment is custom-made for specific purposes (e.g., households, offices, supermarkets, refrigerated transportation). The enterprises involved in the assembly, installation, initial charging and commissioning sub-sector could offer a range of options within the available technology. These options may motivate the potential customer in making the final decision, to a certain degree. In contrast, the actual servicing of RAC equipment deals with the procured and delivered equipment designed for a specific refrigerant. In this case, there is a

very limited possibility of changing the technology used. However, in some instances servicing technicians might have an influence on the choice of technology by their end-user clients.

15. Because of the HCFC phase-out process, a need remains to service already installed RAC equipment until the end of their useful lives. In Article 5 countries, existing equipment is often repaired several times in order to extend their useful lives. Some loss of energy efficiency over the lifetime of equipment is inevitable; however, the improved design of the equipment and improved servicing, installation and maintenance can limit the energy efficiency depreciation. Apart from energy efficiency improvements related to system and component design, the proper installation, configuration, maintenance, and servicing of RAC equipment has a significant impact on the efficiency of equipment and systems over the lifetime of these systems with minimal additional cost. Appropriate maintenance and servicing practices can curtail up to a 50 per cent reduction in performance and maintain the rated performance of the equipment over its lifetime. A more detailed overview of efficiency opportunities through improved operation and maintenance of RAC equipment is presented in Table 1.<sup>9</sup>

**Table 1. Examples of RACHP efficiency opportunities through improved operation and maintenance<sup>10</sup>**

Action	Explanation	Impact
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
Clean condensor and evaporator coils	Every 1K <sup>11</sup> rise in condensing temperature may reduce evaporator capacity by 1.35 per cent and increase power consumption. 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. 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>12</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. Under-condensing would result in higher running currents.	Average savings of 4 per cent

16. Other benefits include reduced energy cost, improved safety by eliminating risks, better temperature control and improved resident comfort, and compliance with regulations.

17. In the servicing sector, the use of low-GWP refrigerants, when some of them are flammable and/or toxic, requires capacity building and additional training initiatives to address the specific issues related to installation, operation, and maintenance. The issue of minimizing the adverse climate impact of HCFC phase-out in the refrigeration servicing sector was on the agenda of the 66<sup>th</sup> and 70<sup>th</sup> meetings. Subsequently, at its 72<sup>nd</sup> meeting, the Executive Committee decided “to encourage Article 5 countries,

<sup>9</sup> Table 2 of document UNEP/OzL.Pro/ExCom/83/40.

<sup>10</sup> Presentation by Stefan Thie, EPEE Technical Expert, at the workshop on energy efficiency opportunities while phasing down HFCs.

<sup>11</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>12</sup> This value appears to be high. The TEAP report indicates that controller settings adjustments would result in about 10 per cent savings.

when implementing their HPMPs, to consider, as needed and feasible: (i) The development of regulations and codes of practice, and the adoption of standards for the safe introduction of flammable and toxic refrigerants given the potential risk of accidents and negative effects on health associated with their use; (ii) Measures to limit the import of HCFC-based equipment and to facilitate the introduction of energy efficient and climate-friendly alternatives; and (iii) Focusing 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” (decision 72/41).

18. The issue of energy efficiency in the servicing sector was discussed extensively in recent years at Meetings of the Parties and by the Executive Committee, particularly in light of the adoption of the Kigali Amendment. It was acknowledged during the deliberations and in decisions adopted that training provided to technicians should expand beyond good RAC equipment servicing practices and focus on proper containment of controlled substances through preventive maintenance, enhancing installation quality, and maintaining/improving the energy efficiency of equipment through appropriate control settings, proper cleanliness of the heat exchangers, and ease of related airflow.

19. There is also the additional risk of accidents associated with the use of several flammable low-GWP refrigerants. Therefore, appropriate standards should be developed to regulate the safe handling of flammable and toxic refrigerants, and training manuals need to be adopted to reflect these new standards. The capacity of training facilities to provide proper training of refrigeration personnel, refresher training and requalification for handling new equipment and flammable and toxic refrigerants should be enhanced to deliver this updated and additional training.

### **Training programmes**

20. The training of refrigeration technicians in good servicing practices was included in stage I and stage II of HPMPs for all 40 Article 5 countries resulting in better operations and maintenance practices, reducing demand for HCFCs in servicing RAC equipment and contributing to energy efficient operations of the equipment. The number of trained trainers and technicians has been growing steadily according to the established targets, as new funding tranches have been approved. These training programmes indirectly contribute to better cooling and energy efficient performance of equipment.

21. Several positive results have been achieved, such as establishing new training centres and an increased number of trained personnel under several HPMP training programmes. As an example, in China in 13 training centres, more than 4,100 technicians, trainers and students had been trained as of August 2018. In India, a total of 62 trainers and 11,276 technicians had been trained during stage I of the HPMP, with a target of 10,000 trainees in stage II. In Brazil, 14 training institutions were contracted and provided with educational kits (i.e. basic servicing tools and equipment components for demonstration and practical training). Sixty-five trainers and 1,238 technicians were trained in best practices for split and window-type air-conditioners, 737 technicians were trained in best practices for commercial refrigeration, and three monitoring visits to regional partner training institutions were carried out.

22. All Article 5 countries reported that the training manuals have been updated to include new and emerging technologies, including low-GWP alternatives and the handling of new flammable refrigerants was incorporated into training curricula of local training facilities through the cooperation of national ozone units (NOUs) with training and education authorities. However, some energy efficiency aspects require additional training and further awareness. These aspects have not been particularly articulated in HPMP progress reports submitted by the implementing agencies.

23. The overall energy efficiency of RAC equipment primarily depends on an appropriate system design and the selection of optimally designed components, such as heat exchangers, compressor and expansion valve. In addition, the choice of equipment with an appropriate configuration based on the heat load is important for long-term effective performance of equipment. The appropriate installation

and optimized control and operation, taking into account the required cooling load and the prevailing ambient temperature, also have a significant impact on the efficiency of RAC equipment and can be part of updated training manuals. For example, by using an electronic expansion valve in place of a thermostatic expansion valve, the head pressure control setting can be significantly reduced in cold weather resulting in possible energy savings of up to 20 per cent. The use of variable speed drives in compressors, and auxiliary pumps and fans at the part-load operations can often deliver over a 25 per cent efficiency improvement.<sup>13</sup> Other examples of optimized control may include adjustable suction pressure and defrost-on-demand control, bringing reductions in indirect GHG emission. A well-trained maintenance technician would be able to check the system's performance, when operating well below peak efficiency, to diagnose and correct the system's functions to improve its efficiency.

24. There is still a shortage of technicians with the minimum skills required to service the growing base of more technologically advanced equipment, using a wide variety of refrigerants with different operating characteristics related to pressure, flammability and toxicity. The Secretariat, in its reviews of HPMP proposals, commented on training programmes, indicating that the duration of training courses was frequently too short to absorb the volume of new material and insufficient time was dedicated to practical training. Similar concerns were expressed in the 2019 Consolidated project completion report presented to the 84<sup>th</sup> meeting.<sup>14</sup> This problem has become even more sensitive when safety aspects are included in the training course. These concerns can be better understood by looking at the content and the set-up of the training workshop held in Bangladesh (see Annex IV of the present report).<sup>15</sup> It appears that the programme of the course is demanding, while the duration is too short and the number of participants is excessive. The qualification value of participation certificates awarded to the trained technicians is also questionable.

25. There are a number of challenges, however, which need to be considered in the context of the Bangladesh RAC servicing sector. On the 2011 survey, there were about 15,000 refrigeration servicing workshops that employed about 3-4 service technicians each. The total number of technicians was around 50,000 at a conservative level, mostly from the informal sector. In 2017, there are approximately 16,160 service workshops in Bangladesh. In these circumstances, the training capacity of the country is overstretched. Additionally, due generally to their low income, technicians cannot afford more than two days without an income. Similar challenges exist in other Article 5 countries.

26. In the residential RAC sector, the guaranteed maintenance of RAC appliances, to ensure continued operational efficiency, is typically limited to several months. After this time period, the appliance owners may involve self-employed, less costly informal sector technicians who are not aware of the need for, or potentially not interested in, monitoring the energy efficient operation of the system.

27. The technical support to training facilities and the provision of servicing equipment and tools were a traditional area of the MLF assistance in the RAC servicing sector. The importance of the technical support to newly established training centres is growing with emergence of requirements to cover the handling of low-GWP technologies in their training curricula. A new broad range of equipment needs to be provided to the training facilities and training curricula should be updated to include the servicing of equipment using new refrigerants. In order to facilitate the introduction and the safe use of low-GWP refrigerants, the regional training centre in Grenada was upgraded in 2017 with equipment, tools and materials suitable for low-GWP flammable refrigerants. The list of items was established in consultation with the NOU of Grenada and other National Ozone Officers (NOOs) of the region, based on needs identified at the regional level and following the recommendations contained in the training and certification curriculum on flammable refrigerants developed as part of the project and

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<sup>13</sup> Decision XXIX Task Force Report on Issues Related to Energy Efficiency While Phasing down Hydrofluorocarbons

<sup>14</sup> Document UNEP/OzL.Pro/ExCom/84/23

<sup>15</sup> The two-day training course for 55 participants contained 17 theoretical topics, including handling and safety issues of HC refrigerants, servicing of HC-based air-conditioners and hands-on training on the evacuation of the system. At the end of the course, certificates were distributed among the participants.

the “Guidelines for the safe use of hydrocarbon refrigerants” developed by the GTZ *Proklima* in 2010. Items delivered included: manifolds with gauge for hydrocarbons (HC), electronic leak detectors for flammable refrigerants, portable charging stations for HC, propane and butane gas cylinders, and other tools and material for the use of low-GWP refrigerants in air-conditioning.

#### Lessons learned

28. The enhanced capacity of training facilities and significant growth in the number of trained servicing personnel are observed as a result of the implemented training components of stages I and II of HPMPs. The improved skills of technicians in servicing, maintenance and installation seemingly resulted, albeit not quantified, in improvement in energy efficiency of RAC equipment.

29. Installation, maintenance and servicing of high-efficiency equipment, based on the latest technology, may require new technical skills. If there is a lack of competency of the service provider and their technicians, high-efficiency equipment might not be adopted. A total of 23 Article 5 countries, from the sample of 40, considered it a priority to include training in the installation, operation and maintenance of RAC equipment using flammable refrigerants during implementation of stage I of the HPMPs, showing positive reaction to decision 72/41. Another 12 countries incorporated training on the safe handling of flammable refrigerants in their HPMP stage II or the latest tranches of stage I. Out of the 40 countries, 35 countries (87.5 per cent) have been preparing to use potentially more energy efficient low-GWP technology by removing, at least partially, the barrier related to the availability of new technical skills. The following remaining barriers still have to be addressed: financial (in part due to the higher cost of energy efficient alternative technologies), market (i.e., acceptance and the limited availability of low-GWP refrigerants, servicing equipment and parts in the local market), information and awareness-raising, and institutional and regulatory measures.

30. There are a number of examples of good cooperation between NOUs and training and education authorities. It is important to encourage and assist NOUs to work with these authorities to integrate good servicing practices and other key aspects (e.g., safety measures, RRR and safe disposal) into their national qualification frameworks through curricular updates and certification schemes. However, the energy efficiency aspects require additional training content which have not been emphasized in updated training material. The training curricula of institutions and vocational schools should be periodically updated to incorporate changes including technology upgrades of RACHP systems, the introduction of alternative refrigerants and energy efficiency aspects.

31. The circumstances prevailing in the RAC servicing sector of Article 5 countries need to be considered in determining the scope and priorities of the MLF assistance to training programmes. Servicing technicians in the informal sector, which often operates outside the scope and reach of both the government and the industry associations, need special attention to ensure their engagement in the training process, including energy efficiency aspects.

32. Introduction of low-GWP technology has been associated with the demand by new and existing training centres for new equipment to facilitate the introduction of updated training and certification curricula. Similarly, servicing technicians need new equipment and tools to meet the growing demand for servicing RAC equipment based on the emerging technologies. Article 5 countries have been actively using the opportunities granted through the MLF technical assistance. The IAs have demonstrated the capability to cope with these new demands and challenges. This assistance remains crucial to ensure the sustainability of training facilities in the future. The timely supply of the necessary equipment must be closely monitored by the Secretariat. It is recommended that training sessions for RAC technicians should include more practical sessions and additional training tools.

#### *Safety standards related to the use of flammable refrigerants*

33. Training on the safe handling of flammable and toxic refrigerants relies on strict codes and regulations which must be reflected in training curricula. The absence of trained and qualified

technicians in handling flammable and toxic refrigerants and the lack of the respective codes and regulations are considered a barrier by suppliers of new low-GWP and energy efficient technologies. This could have an adverse impact on rate of adoption of such new technologies. However, only a limited number of Article 5 countries have currently adopted standards related to the installation, servicing and maintenance of equipment based on flammable or toxic refrigerants.

34. The Indonesia National Standard agency has already adopted ISO 817/2014<sup>16</sup> as a national standard for designating refrigerants, including a safety classification for refrigerants based on toxicity and flammability, and as a means of determining the refrigerant concentration limit. In China, the National Standard for Safety and Environmental Requirements for Refrigeration Systems and Heat Pumps (GB-9237) has been completed and went into effect on 1 July 2018 to allow for the use of flammable refrigerants.

35. Several Article 5 countries are in the process of adopting national standards based on European training and safety standards. In Argentina, European REAL training standards<sup>17</sup> will apply in subsequent training and certification of technicians. The trainers will replicate the REAL training courses nationally and the NOU will audit the quality of the courses. In Armenia, the adoption of safety and environmental requirements for refrigeration systems and heat pumps (EN 378 1-4)<sup>18</sup> has been initiated jointly with the National Standardization Institute. In the Dominican Republic, 300 technicians participated in 20 short courses led by the National Refrigeration Association on recovery and recycling and the safe use and management of HC refrigerants. The work on the adoption, support and implementation of safety standards/guidelines for flammable refrigerants is still ongoing. However, during the second tranche of stage II of the HPMP, 500 RAC technicians were trained on good refrigeration practices, 620 technicians participated in workshops on the safe use of HCs as a refrigerant and 56 teachers of technical schools were trained on good refrigeration practices and the use of safety standards/guidelines for flammable refrigerants. Additionally, five regional training laboratories were equipped with 14 sets of refrigeration equipment and tools to work with flammable gases. Each set contained a recovery unit, a vacuum pump, three cylinders of different capacities and general tools.<sup>19</sup>

36. In Bangladesh, a review and update of safety standards for flammable refrigerants has been scheduled by the Bangladesh Standard and Testing Institute following the approval of stage II of the HPMP in June 2018. However, the progress report for the second tranche of stage I (approved in April 2015) indicated that 3,524 technicians were already trained on good servicing practices, safe use of alternative refrigerants and RRR of HCFCs operations. No information was provided on activities in Brazil, Fiji, Guyana, Honduras, India, Kyrgyzstan, Liberia, Nigeria, Pakistan, Panama, Paraguay and Saint Kitts and Nevis on the development and adoption of national standards regulating the use and handling of low-GWP flammable and toxic refrigerants. Nor were references made to available regional or international safety standards that could be used as a potential model for the subsequent development and adoption of safety standards adapted to the local circumstances. Yet, the progress reports provide information on ongoing training of service technicians in these countries for safe handling of flammable refrigerants. The basis for formulating safety procedures and training manuals for installation and

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<sup>16</sup> ISO 817:2014 provides an unambiguous system for assigning designations to refrigerants. It also establishes a system for assigning a safety classification to refrigerants based on toxicity and flammability data and provides a means of determining the refrigerant concentration limit.

<sup>17</sup> The Real Alternatives programme is a multi-country training initiative promoted by five EU Member States (Belgium, Germany, Italy, Poland and the United Kingdom) that will provide a firm foundation for future training activities throughout the EU. The programme has been supported by the European Commission and by UNEP Ozone Action as well as a number of RACHP companies. Training experts in the 5 participating Member States have helped to create an excellent body of training material for low-GWP alternative refrigerants, including knowledge of EN 13313 (the EU standard that defines competence of personnel working on RACHP equipment, provides an excellent framework to define training courses, including a certification scheme if needed).

<sup>18</sup> EN 378 (the EU safety standard for RACHP systems) includes references to the training that is required for personnel handling flammable refrigerants.

<sup>19</sup> UNEP/OzL.Pro/ExCom/86/46



servicing of equipment using flammable refrigerants, in the absence of the required local standards and regulations, is not clear.

37. It is noted, however, that the process of developing national standards in Article 5 countries is lengthy and involves many stakeholders. The international safety standards are evolving and are periodically reviewed and updated. The Ozone Secretariat monitors the status of the most relevant standards and regularly reports to the MOP. The role of the NOUs and the IAs in the development and adoption of standards is currently limited mainly to providing support for the review and discussion of the proposed technical standards. This role needs to be strengthened by providing additional support to ensure the sustainability of these important regulatory activities.

### Lessons learned

38. Prior to initiating practical training on handling flammable refrigerants, a number of Article 5 countries have developed national safety regulations adapting available international standards. There is a disconnect between the timeframe of the adoption of safety standards and the practical training of technicians on handling of flammable refrigerants in several Article 5 countries. Several HPMP progress reports refer to the integration of good and safe practice training on handling flammable alternative refrigerants into the technical and vocational curricula or development of national training manuals without providing the reference to the basis or the source of such as existing international and/or national safety standards (e.g., equipment safety standards related to the use of flammable refrigerants such as: IEC 60335-2-40 and ISO 5149). For Article 5 countries with limited capacity, the optimal way forward would be to develop national regulations and codes of practice by adapting international standards for the safe introduction of flammable and toxic refrigerants to their specific local conditions, prior to the practical implementation of training programmes involving flammable refrigerants. Institutional coordination for capacity building, regulations development and a monitoring mechanism are further important that should be considered to ensure the effective adoption of new low-GWP refrigerant technologies.

39. The development of national standards is essential in guiding stakeholders on the selection and use of low-GWP alternatives with higher energy efficiency products. Similarly, the willingness to develop legislation and incentives to promote the adoption of new and energy efficient technologies lies with the government. The lack of standards and codes of best practice to guide installation and servicing of RAC equipment with flammable refrigerants makes it difficult to promote energy efficient systems.

40. It is vital for all stakeholders to be updated with the latest policy measures and the best available technology and environmental practices. Stronger relationships need to be established between NOUs, national authorities and stakeholders involved in the development of national standards. These activities might be considered within the UNEP two-year “Twinning” project to jointly build the capacity of NOOs and national energy policymakers for linking energy efficiency with Montreal Protocol objectives in support of the Kigali Amendment (further discussed under “Energy Efficiency Labelling and Minimum Energy Performance Standards (MEPS)” section).

### **Certification of trained technicians**

41. High efficiency equipment commonly includes the use of the latest technology which requires new technical skills. If there is a lack of skill or competency from the service provider, high efficiency equipment might not be purchased and used. Therefore, training is an important tool to transfer knowledge to service technicians to ensure the correct installation, maintenance, repair and dismantling of RACHP equipment. However, training alone does not verify the level of comprehension, competence and skills of a participant in a training programme. A certificate of participation, often received at the end of a training course, cannot replace certification based on a comprehensive assessment of the knowledge and skills obtained during the course.

42. The analysis of the status of development of the certification schemes in the sample of

40 selected countries shows that nine countries have a certification scheme in place, certification programmes are under preparation in 16 countries, three countries are discussing the future concept, and 12 countries are planning to start the appropriate activities in the near future.

43. Certification schemes which are mandatory by legislation have the advantage of providing a strong incentive for technicians and enterprises to comply. Certification in the RAC sector can also act as an added value for technicians to prove their competence and proficiency, particularly when they change employers or seek new jobs. The Governments of Armenia and Brunei Darussalam committed to establish a mandatory technician certification system during the next funding tranche, and once a formal education system for refrigeration technicians is fully operational in Armenia. In Costa Rica and Indonesia, the draft regulation is currently under review to make RAC technician certification mandatory.

44. International and regional organizations can contribute to establishing certification schemes in Article 5 countries. The 18 Argentinean trainers were certified in Italy using the REAL alternative programme for the safe handling of flammable refrigerants. In order to promote certification, European REAL training standards will apply in subsequent training and certification of technicians in Argentina. The international institute (Italian Association of Refrigeration Technicians (ATF)) has been contracted to design a local environmental certification programme in Kuwait for refrigerant management similar to F-Gas certification in the European Union, but tailored to local conditions.

45. There are significant differences around the world in terms of the existence, modalities and levels of certification for technicians and enterprises involved in the installation and servicing of RAC equipment. Annex V of the present document contains information about the status and certification modalities in a number of selected Article 5 countries, including the nine Article 5 countries in the sample that reported on existing certification practices.

46. While there is progress in establishing certification schemes in Article 5 countries, the number of certified technicians is still disproportionately low in comparison with non-Article 5 countries. In Italy, for example, there are currently about 45,000 certified RAC service technicians and in Germany and the United Kingdom 25,000 and 32,000, respectively. In Australia the number of certified technicians is around 55,000, but this includes automotive mechanics. By contrast, in the Philippines, there are around 3,000 certified RAC service technicians.

#### Lessons learned

47. The establishment and enhancement of the certification schemes for RAC technicians developed under HPMPs and tailored to the specific needs of each country has an important role in maintaining the long-term sustainability of RAC servicing sector activities. The use of high energy efficient equipment may require the development of new skills of the servicing personnel. The establishment of certification schemes is the best way to validate the required competence needed to maintain energy efficient performance in new low-GWP systems, hence eventually encouraging investments in the new technology. However, there is still a lack of regulations that require the installation and maintenance of systems by certified and properly trained personnel.

48. A number of Article 5 countries have introduced, or are considering introducing, mandatory certification or license schemes which add additional measures to determine the category of equipment to be serviced and/or installed, and to control the purchase, use and final disposal of refrigerants.

49. The Secretariat formulated measures ensuring the sustainability of the certification of technicians in document UNEP/OzL.Pro/ExCom/83/40. 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. 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, as well as purchasing and handling refrigerants, and should be supported by information outreach and awareness to ensure its sustained adoption.

### **UNEP initiative to introduce the training and qualification programme: Refrigerant Driving License**

50. In 2015, UNEP under its Compliance Assistance Programme (CAP), in cooperation with refrigeration associations in Australia, Brazil, Colombia, the European Union, Japan, Russia, and the United States of America, which formed the Advisory Committee, launched an initiative to introduce a globally recognized qualification programme (Refrigerant Driving License (RDL)) to set minimum competencies and skills for RACHP servicing network (for individuals and enterprises).

51. The Advisory Committee adopted four initial categories of application for RDL: (A) Small Applications, (B) Commercial Refrigeration, (C) Commercial Air-Conditioning, and (D) Enterprises, and competency requirements relevant to each specific application. The comprehensive technical documentation and procedures for conducting the training was developed for category (A) including: examinations, preparatory work, qualification of trainers/assessors, setup of hands-on sessions and practical checks, evaluation and monitoring and roles of local stakeholders (i.e., NOUs and training centres) and the development of supporting tools (i.e. checklists, guidance for examinations, printing plans).

52. All of the above materials were discussed with Article 5 countries interested in piloting RDL providing detailed explanations about possible options for linking RDL to ongoing training and/or certification programmes or to use the RDL programme as alternate qualification programmes for countries that are facing difficulties in building local certification schemes. These six countries expressed interest and agreed to pilot the RDL in conjunction with ongoing training activities under HPMPs: Grenada, Maldives, Rwanda, Sri Lanka, Suriname, and Trinidad and Tobago.

53. Five international experts were identified to be the International Master Trainers for delivering train-the-trainers' sessions in the six pilot countries. Between June and August 2019, six train-the-trainers' sessions were successfully completed. Twelve to fifteen local trainers were trained and tested in each country in accordance with the RDL programme. A schedule of training was set for the six pilot countries to complete the follow-up RDL training during September and December 2019. The available feedback has been analyzed and RDL Administration are working on drafting the final operational setup and procedures to allow for offering of the RDL widely to all interested NOUs, training centres and individuals. Evaluations of the RDL pilot projects will then be used by the Air-conditioning Heating, and Refrigeration Institute and UNEP to determine the future RDL training programmes around the world.

### Lessons learned

54. The RDL training and qualification programme is conceived as an alternative programme to HPMP training and certification activities. It is too early to assess the effectiveness and compatibility of the programme with ongoing HPMP activities in the absence of the feedback from the concerned Article 5 countries.

### **HCFC and HFC refrigerant containment activities**

55. Article 5 countries have the flexibility to select phase-out activities that are the most suitable for the circumstances prevailing in their local markets and that best enable them to meet their compliance obligations in phasing out HCFCs. A few Article 5 countries have included demonstration

projects and customized training activities in their HPMPs to address the commercial refrigeration sector and, in particular, to support HCFC phase-out in supermarket end-users. The assessment of potential environmental benefits proved that reducing and eliminating the loss of refrigerant by repairing the heavily leaking systems can reduce the demand for HCFC and HFC refrigerants for servicing and curtail significantly GHG emissions.

56. Properly installed split air-conditioning systems have much lower levels of leakage than commercial refrigeration systems. Some types of larger systems (such as large supermarket systems or industrial systems) have historically had high levels of leakage and the direct refrigerant emissions can represent up to around 40 per cent of the total, although emissions from energy generation remains the largest part of the emissions.<sup>20</sup>

57. These high leakage rates and high-GWP emphasized the importance of reducing HCFC and HFC emissions and subsequently national consumption. Each kilogram of HCFC-22 not emitted due to better refrigeration practices results in the savings of approximately 1.8 CO<sub>2</sub> equivalent tonnes. It is also well recognized that the reduction in the leak rate is directly related to the improvement of energy efficiency. A number of Article 5 countries included in their activities for stages I and II of their HPMPs specialised training on reduction of leakage and other refrigerant containment measures.

58. The desk study presents two demonstration projects highlighting refrigerant containment measures implemented in Brazil and the Islamic Republic of Iran and the replacement of HCFC/HFC-based equipment with non-ODS low-GWP technology in supermarket refrigeration systems in Argentina in order to compare the impact of the two approaches. Table 2 shows the major features of these three projects.

**Table 2. Major parameters and impact of demonstration projects on conversion in Argentina and refrigerant containment in Brazil and the Islamic Republic of Iran supermarkets**

Country	Argentina	Brazil		Islamic Republic of Iran	
Project	Supermarket conversion from HCFC-22/HFC-404A to CO <sub>2</sub> /R-290 alternatives*	HCFC-22 better containment demonstration projects in supermarkets		Financial incentives for technology demonstration "Optimization refrigeration system and leak control in supermarkets" **	
	La Anonima	Supermarket 1	Supermarket 2	Refah (2 )	Shahrvand (1)
Leak rate	97% for HCFC-22 systems and 321% for HFC 404A systems	62%	130%	>100%	
Containment of	398.2 kg of HCFC-22/HFC-404A	118 kg of HCFC-22	156 kg of HCFC-22	Data on the initial refrigerant charge is not available	
Direct emission reduction	834.9t CO <sub>2</sub> eq	213,580 kg CO <sub>2</sub> eq	282,360 kg of CO <sub>2</sub> eq	Leak tight system was introduced in three supermarkets reducing drastically direct emission	
Electricity consumption reduction	27%	COP increase by 13% (plus cooling system) and 4% (minus cooling system)	COP increase by 7,4% (plus cooling system)	Electricity consumption was reduced due to installation of two new condensing units, reduced leaks of the systems and better servicing	

<sup>20</sup> UNEP Briefing Note A [http://conf.montreal-protocol.org/meeting/workshops/energy-efficiency/presentation/briefingnotes/briefingnote-a\\_importance-of-energy-efficiency-in-the-refrigeration-air-conditioning-and-heat-pump-sectors.pdf](http://conf.montreal-protocol.org/meeting/workshops/energy-efficiency/presentation/briefingnotes/briefingnote-a_importance-of-energy-efficiency-in-the-refrigeration-air-conditioning-and-heat-pump-sectors.pdf)

Country	Argentina	Brazil		Islamic Republic of Iran	
Indirect emission reduction	21.43 t CO <sub>2</sub> -eq	Not calculated	Not calculated	N/A	N/A
Annual electricity cost savings	US \$9,200	N/A	N/A	N/A	N/A
Annual refrigerant cost savings	US \$5,700	N/A	N/A	N/A	N/A
Total annual OC savings	US \$14,900	N/A	N/A	The cost of servicing and refrigerant was significantly reduced	
Total project cost	US \$508,135	US \$860,736*		US \$415,000	

\*Approved for five beneficiaries. The information on actual cost of the project is not yet available. The final report will be presented at the end of 2020.

\*\* The calculation of the impact of the project in terms of direct and indirect emissions was not envisaged in the design of the project.

59. The annual leak rates in the five supermarkets varied from 62 per cent in HCFC-22 systems to 321 per cent in R-404A self-contained freezer units (islands and upright reach-in cabinets) which are far above the average leak rates reported in industrialized country supermarkets. The typical reasons for excessive leak rates are the use of handmade flared joints, lack of recovery and recycling, bad condition of piping (i.e., brazing condition, support, vibration, insulation), lack of fixed leak detectors and monitoring systems, inadequate training of technicians, and lack of standards prescribing leak preventing measures, among others.

60. Due to high leak rates, the direct emission reduction in Argentina conversion project exceeded the indirect emission reduction. In CO<sub>2</sub>-equivalent terms, they account for 97.5 per cent and 2.5 per cent of total emission reduction accordingly. The indirect emission reduction was not reported in the Brazil and Iran containment projects, but one can expect similar direct/indirect emission ratio.

61. In terms of electricity consumption reduction, the conversion project in Argentina yielded a larger result (27 per cent) versus the containment project in Brazil (13 per cent, 7.4 per cent and 4 per cent). The annual operating cost savings reported by the Argentina project included US \$9,200 savings on the electricity bill and US \$5,700 saved on the cost of refrigerant. The higher cost in initial investment for a CO<sub>2</sub>/R-290 system, about 20 per cent higher than a new HCFC-22/R-404A system (about US \$100,000) can be offset over time by the savings from reduced electricity consumption and possible reduced refrigerant leakage during operation (US \$14,900 annually). Similar categories of savings presumably occurred in the Brazil and Islamic Republic of Iran projects but were not calculated and reported. The implementation of projects in Brazil and the Islamic Republic of Iran faced a number of challenges. The final report on the Brazil project is pending.

62. The refrigerant containment projects in Brazil and the Islamic Republic of Iran were supported by the customized training of servicing personal on leak repair and prevention. Apart from these two countries, specialized training courses on leak detection and prevention have also been conducted in Chile, Gabon, Kyrgyzstan, Lesotho and Mozambique and supported by the provision of service tools for containment of HCFC and HFC refrigerants. Oman is developing a regulation on mandatory leak detection of all controlled substances in RAC systems with initial charge greater than 3 kg. Several countries introduced a system of keeping servicing logs. This recordkeeping and data collection provide a useful source of information on refrigerant inventories, leaks, and amounts disposed. Such reporting is a complementary measure that can allow effective enforcement of other refrigerant management requirements and best practices.

### Lessons learned

63. The projects in Brazil and the Islamic Republic of Iran extended the lifetime of refrigeration equipment and resulted in lasting direct and indirect emission reduction of GHG through decreasing energy consumption and containment measures. It also provided a sustainable technological option for HCFC and HFC phase-out in supermarkets which is being replicated in these two countries and in several other countries in the region. The continuation of the MLF support to similar refrigerant containment projects for HCFC- and HFC-based equipment is sensible, subject to the thorough preliminary examination of prevailing local conditions.

### **Drop-in refrigerants, retrofitting and conversion**

64. **Some Article 5 countries, using flexibility in their HPMPs, adopted customized training programmes for technicians targeting retrofitting or conversion of their baseline equipment to low-GWP alternatives or replacing (through financial incentives) the equipment with low- or zero-GWP technologies. HCs are not recommended in systems that are not designed to use the flammable refrigerant. The Executive Committee adopted two decisions applicable to HPMP proposals<sup>21</sup> that if HCs are considered for conversion, the appropriate safety standards and codes of practice should be strictly followed and the country would assume all associated responsibilities and risks.**

65. Notwithstanding the Executive Committee decisions, there are examples where Article 5 countries in the sample implemented activities related to the adoption of HC refrigerant for conversion of air-conditioning equipment, as the examples below demonstrate:

- (a) Burundi and Cuba conducted training of their technicians on conversion to HC refrigerants;
- (b) Fiji: In the second tranche of stage I, the NOU, in consultation with the Ministry of Fisheries and relevant stakeholders, prepared the draft of a five-year plan that contained guidelines and options on retrofitting and other methods to support conversion of the refrigeration equipment in the fisheries sector, once approved. Various options were studied and non-ODS low-GWP options are still not available for fishery vessels. It was decided, in the third tranche of the HPMP, that the trial retrofit of one fishing vessel should be cancelled. However, training and technical assistance in refrigerant recovery, recycling and reuse have been planned to assist the fishery sector in the fourth tranche;
- (c) Honduras: Performed the training on the safe use of HC as refrigerants, issued a guide on the use of HC refrigerants and embarked on conversion of more than 30 pieces of air-conditioning equipment to HC-290 (implemented during the first tranche). During the second implementation period, the Government adopted a policy to avoid the drop-in conversion to HC and focused on awareness activities to sensitize technicians on the risks associated with the use of HC refrigerants;
- (d) Panama: One air-conditioning system installed in a MINSA building was converted to operate with HC refrigerant. A pilot project to convert HCFC-based air-conditioning equipment to an alternative technology (to be determined) in a public health institution will be implemented; and

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<sup>21</sup> Decision 72/17: "...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: "...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."

- (e) Paraguay: One hundred and eighty-six technicians received training on retrofitting refrigeration equipment to HC technology. Under the second tranche of the HPMP, training of 80 to 120 technicians was conducted on the conversion of HCFC-based systems to HC and management of natural refrigerants. One training workshop per year is envisaged on retrofitting HCFC-based equipment to HCs available in the national market.

66. Following decisions 72/17 and 73/34, the Secretariat, in their comments on HPMP proposals, consistently discouraged attempts of some governments and IAs to include activities related to conversion of existing HCFC-22 equipment to HC refrigerants. Several Article 5 countries have abandoned their original intention of conversion to flammable refrigerants.

#### Lessons learned

67. **The implications of the conversion of HCFC-22 systems to flammable refrigerants should be carefully deliberated. All the potential risks and benefits have to be carefully assessed. The conversion can only take place when the appropriate safety standards and codes of practices are strictly followed.**

#### **Refrigerant recovery, recycling and reclamation activities**

68. The RRR and collection and storage of unwanted refrigerants for subsequent destruction are a part of routine duties of servicing technicians and included in training curricula for most Article 5 countries. The well-established and sustainable RRR activities contribute to the reduction of HCFC and HFC consumption and decrease direct GHG emissions. However, the unchecked reuse of recovered and reclaimed refrigerants of unknown composition may have a negative effect on the efficiency of RAC equipment operation and even lead to the serious damage of the compressor.<sup>22</sup> The economic sustainability of RRR activities remains to be in the focus of the Executive Committee.

69. The conclusions of the previous evaluations of RRR activities require additional attention to MLF funding of RRR schemes, especially the refrigerant reclamation facilities. The Secretariat has been effectively monitoring requests for funding reclamation facilities. Altogether 24 countries included recovery and recycling equipment into their funding requests for HPMPs in stages I and II. A total of 13 countries requested funds for the establishment of reclamation facilities. In the case of Kuwait, the Secretariat requested additional clarifications on the project components related to reclamation facility, including the regulatory framework that will facilitate HCFC-22 recovery and reclamation in the country. A study on the technical and economic feasibility of the reclamation scheme in Kuwait is under preparation. The results of the recovery and reclamation feasibility study would be used to finalise the specifications of equipment and operational processes for the reclamation centre.

70. Exclusive reclaiming operations are not a sustainable business in Mexico and, therefore, the reclaiming enterprises also offer environmentally appropriate collection and management services for RAC equipment. Up to 70 per cent of their income is from the sales of recoverable materials (e.g., copper, iron, and plastics), and the remaining 30 per cent is from the sales of reclaimed refrigerant.

71. In Lao People's Democratic Republic, the plans to provide the refrigerant recovery and reclamation component was revised given that the current price of HCFC-22 is very low and there is no incentive for technicians to use the reclaimed refrigerant. In Nicaragua, the reclamation centre is intended to serve mainly large end-users handling a variety of refrigerants and independent technicians. The refrigerant will be stored and processed only when certain amount has been collected. The centre will charge a fee for the reclamation service in order to operate in a self-sustaining manner. In Oman, a second reclamation centre would only be established during stage II of the HPMP based on lessons learned from the operation of the first centre. In Iraq, the enforcement regime will be strengthened to

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<sup>22</sup> UNEP/OzL.Pro/ExCom/82/64

facilitate the sound operation of the three recovery and reclaiming systems during stage II of the HPMP. In Chile, the technical and economic assessment of the feasibility of establishing three more regional reclamation centres has been completed (the first was piloted during stage I). Once the selection process is established, contracts will be signed with beneficiaries to ensure their commitment to reclaim refrigerants and regular reporting of the amounts of recovered, recycled and reclaimed refrigerants.

### Lessons learned

72. The composition of recovered and reclaimed refrigerants has to be carefully monitored to ensure the efficient operation of RAC equipment. The unchecked reuse of recovered and reclaimed refrigerants of unknown composition may have a negative effect on the efficiency of RAC equipment operation and even lead to the serious damage of the compressor. The sustainability of RRR activities depends greatly on appropriate government regulations and in some cases on government subsidies.

### **Energy Efficiency Labelling and Minimum Energy Performance Standards (MEPS)**

73. The role of labelling programmes and MEPS was considered in document UNEP/OzL.Pro/ExCom/83/40 in the context of 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. The document discussed the significance of labelling and MEPS as a tool to promote energy efficient RAC product.

74. The desk study aimed at providing additional information that could enhance the understanding of labelling and MEPS potential by providing examples of application of these mechanisms in selected Article 5 countries.

75. Labelling programmes cover a wide range of energy consuming products. Energy labelling clearly displays the energy consumption of a RAC unit and its efficiency ranking. Often, it is the first step towards increasing the energy efficiency of electrical appliances. It also provides the consumer with an informed choice about the energy saving and thereby the cost saving potential of the relevant marketed RAC product. Thus, consumers might be able to make informed purchasing decisions including the running costs over the appliance's lifetime and can therefore lower energy bills. Labelling alone is, therefore, an incentive for companies to produce more energy efficient appliances increasing the market share of higher efficiency appliances.

76. The next step in energy consumption reduction is the introduction of MEPS, which regulate energy consuming products below a certain level of energy efficiency. Often this means that the lowest class or classes of the labelling scheme are banned when the application of MEPS are mandatory. Many Article 5 countries have demonstrated that labelling and MEPS for RAC products can be very effective in reducing energy consumption and carbon footprint. They lower the energy bills of consumers as well as a country's energy demand and therefore its dependency on fossil fuel imports. Sectors where private consumers make most decisions, such as domestic refrigeration and unitary air-conditioning, are the most likely to benefit from energy labelling and MEPS.

77. The labelling and MEPS programmes facilitated eliminating HCFC-22 RAC product from the market in a number of Article 5 countries because of its lower energy efficiency. A thermodynamic analysis of HFC-32 shows it has an advantage of about 5 per cent over R-410A for small building air-conditioners. It would be fair to anticipate that R-410A equipment would be replaced by HFC-32 product in the near future following a similar pattern.

78. Annex VI of the present document contains data on comparative and endorsement labelling programmes and MEPS in 50 Article 5 countries. Data specified as P (proposed), V (voluntary) and M



(mandatory) mostly refer to 2013 with some more recent updates extracted from CLASP.<sup>23</sup> Data designated with X was extracted from Table 1 of document UNEP/OzL.Pro/ExCom/83/40.

79. As seen in Annex VI, many Article 5 countries still do not have such regulation in place. The capabilities of NOUs in promoting labelling and MEPS programmes in Article 5 countries are often very limited since energy efficiency issues are under the purview of other agencies than those which handle the Montreal Protocol. UNEP is implementing a two-year “Twinning” project to jointly build the capacity of NOOs and national energy policymakers for linking energy efficiency with Montreal Protocol objectives in support of the Kigali Amendment.

80. UNEP convened the Twinning of NOOs and Energy Policymakers for Energy Efficient and Climate Friendly Cooling in February 2019, in Paris, France. This event was jointly organized by UNEP’s *OzonAction* CAP and the United for Efficiency Initiative (U4E) with the financial support of the Kigali Cooling Efficiency Programme (K-CEP). This workshop was the second round of capacity building following the initial round that occurred in 2018. UNEP invited developing countries from all regions to participate in this event to exchange experiences, develop skills, and share knowledge and ideas on more sustainable cooling solutions in support of the Kigali Amendment. The workshop built on the relationships between the ozone and energy communities that were either established or strengthened during the Twinning workshops organized in 2018, as well as to follow up on the national and regional opportunities identified by the participants.

81. In every country in the sample, 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 have been involved in these efforts in order to promote HCFC alternative refrigerants. The second part of Annex VI contains information on some initiatives undertaken in Article 5 countries in respect of labelling and MEPS.

#### Lessons learned

82. Mandatory labelling and enforced MEPS provide a high degree of certainty for delivering energy savings paired with an effective compliance regime. Timely adoption of these regulations help avoiding the dumping of appliances with low energy efficiency into a country and thereby create economic and energy savings to the economy as well as accelerate the phase-out of HCFC-22. In the current market environment, new equipment with higher energy efficiency are largely using R-410A as a refrigerant.

83. There are still many Article 5 countries that do not have labelling programmes and MEPS in place, especially in Africa. It is important to encourage the involvement of Article 5 countries NOUs and national refrigeration associations in dialog with national environment, energy and standards development authorities to promote adoption and updating of the existing MEPS and labelling programmes.

84. Incentives for energy efficient technologies need a supporting framework. Without realistic tariff structures, performance standards and mandatory labelling, energy efficient products will have no market. Governments need to pursue a strategy combining the adoption of MEPS and labelling, where MEPS are setting the targets, eliminate inefficient products from the market and stimulate manufacturers to produce more efficient appliances, while labels inform and motivate consumers buying energy efficient products and helping manufacturers of appliances to overcome investment and market barriers.

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<sup>23</sup> <https://www.clasp.ngo/policies>

**RECOMMENDATION**

85. The Executive Committee may wish to take note of the desk study for the evaluation of the energy efficiency in the servicing sector, contained in document UNEP/OzL.Pro/ExCom/87/7.

## Annex I

### TERMS OF REFERENCE FOR THE DESK STUDY FOR THE EVALUATION OF THE ENERGY EFFICIENCY IN THE SERVICING SECTOR

#### Background

1. At the 82<sup>nd</sup> meeting, the Senior Monitoring and Evaluation Officer submitted the draft monitoring and evaluation work programme for 2019,<sup>1</sup> which *inter alia* presented possible evaluation topics, and requested guidance from the Executive Committee on which of them should be included in the work programme.

2. During the discussion, one member said that it would be instructive to evaluate how recovery, recycling and reclamation projects in the refrigeration servicing sector addressed energy efficiency, given that a decision on the matter had been adopted by the Thirtieth Meeting of the Parties. Some members said that such a study could go beyond the evaluation of the projects in Chile and Grenada that included energy-efficiency measurements and look more broadly at energy-efficiency issues in the servicing sector.

3. At its 82<sup>nd</sup> meeting, the Committee also considered the final report on the evaluation of the refrigeration servicing sector,<sup>2</sup> submitted by the Senior Monitoring and Evaluation Officer. In every country in the sample evaluated, it was found that specialised agencies promoted energy efficiency mainly through the establishment of energy efficiency standards for locally manufactured as well as imported equipment, labelling requirements, and awareness raising activities. However, local efforts to measure changes in energy efficiency outside of demonstration projects have not been carried out. This was mainly due to the lack of specific programmes with activities and targets to address energy efficiency, local expertise, and lack of appropriate equipment or tools, besides other structural factors that make measurements of energy efficiency complex.

4. During the discussion, the Executive Committee considered the importance of addressing energy efficiency in the refrigeration servicing sector and deliberated on whether the evaluation should have gone more in depth on the study of energy efficiency, considering that it was not its main subject.

5. Subsequently, the Executive Committee requested the Senior Monitoring and Evaluation Officer to present to the 83<sup>rd</sup> meeting the terms of references for the desk study for the evaluation of the energy efficiency in the servicing sector, which would analyse, *inter alia*: “the design of norms and standards for refrigerants and energy efficiency that favours the introduction of low-global warming potential (GWP) technologies in the refrigeration and air-conditioning (RAC) sector; the promotion of energy efficiency in Article 5 countries; and the local efforts to measure changes in energy efficiency outside of demonstration projects”, in the context of the decision XXX/5 of the Meeting of the Parties that “requested the Executive Committee of the Multilateral Fund (MLF) to build on its ongoing work of reviewing servicing projects to identify best practices, lessons learned and additional opportunities for maintaining energy efficiency in the servicing sector”.

6. The terms of reference of the desk study for the evaluation of the energy efficiency in the servicing sector were approved as part of the monitoring and evaluation work programme for 2019 (decision 82/10).<sup>3</sup>

#### Challenges to the desk study

7. During the phase-out of CFCs and HCFCs, no funds were allocated for considering energy

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<sup>1</sup> UNEP/OzL.Pro/ExCom/82/13

<sup>2</sup> UNEP/OzL.Pro/ExCom/82/11

<sup>3</sup> UNEP/OzL.Pro/ExCom/82/13/Rev.1

efficiency in the Multilateral Fund projects in the RAC sector. However, the industry made great efforts to improve energy efficiency when transitioning from controlled substances, while at the same time achieving cost effectiveness.<sup>4</sup>

8. The interest of the Parties to the Montreal Protocol on energy efficiency related to the RAC sector increased, however, in the context of the Kigali Amendment to the Montreal Protocol. They requested the Executive Committee to “develop cost guidance associated with maintaining and/or enhancing the energy efficiency of low- and zero-GWP replacement technologies and equipment, when phasing down HFCs, while taking note of the role of other institutions addressing energy efficiency, when appropriate”<sup>5</sup> and to increase funding for low-volume consuming (LVC) countries when needed for the introduction of low- and zero-GWP alternative technologies to hydrofluorocarbons and maintaining energy efficiency in the servicing/end-user sector.<sup>6</sup>

9. Enhancing and monitoring energy efficiency has only recently become a focus of both the Parties to the Montreal Protocol and the Executive Committee; energy efficiency related activities were not considered an eligible incremental cost, and consequently, were not funded. Therefore, the desk study might be constrained by the availability of information on policies, regulations, standards, norms in place, and technical and quantifiable information on energy efficiency in project proposals. To address this constraint, the desk study will be informed by the policy documents on energy efficiency submitted to the 83<sup>rd</sup> meeting.<sup>7</sup>

### **Objectives of the desk study**

10. The objective of the desk study will be to identify and assess, to the extent possible, best practices, lessons learned and additional opportunities for maintaining energy efficiency in the servicing sector.

11. As there are no specific programmes focused on energy efficiency, the desk study will review previously funded projects to identify energy efficiency related activities in the servicing sector, and their applications in policies and regulations at the country level. Based on the information that will be gathered, the desk study will make suggestions to assist the Executive Committee in considering whether to proceed with further evaluation at the country level.

### **Scope and methodology**

12. The desk study will gather information from the available documents on this topic, including previous evaluations, project documents, progress reports, verification reports and project completion reports to catalogue the energy efficiency activities already undertaken in the servicing sector.

### **Organization of the evaluation**

13. A consultant will be recruited to prepare the desk study to be presented at the 86<sup>th</sup> meeting. Information provided to the Executive Committee will include information on where the project occurred, a brief description of the activity and type of equipment (if relevant), and any lessons learned from the project. As much as possible, reliable quantitative information will be collected together with qualitative information. Discussions with the Secretariat staff, bilateral and implementing agencies, and

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<sup>4</sup> TEAP Decision XXIX/10 Task Force report on issues related to energy efficiency while phasing down HFCs. September 2018.

<sup>5</sup> Paragraph 22 of decision XXVIII/2

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

<sup>7</sup> Summary of the report by the Technology and Economic Assessment Panel on matters related to energy efficiency with regard to the issues identified in decision 82/83(e) (decision 82/83(f)) (UNEP/OzL.Pro/ExCom/83/42) and 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)) (UNEP/OzL.Pro/ExCom/83/40)

National Ozone Units will be organized, as needed.



**Annex II**

**LIST OF DOCUMENTS ON ISSUES RELATING TO ENERGY EFFICIENCY**

<b>Document number/source</b>	<b>Title</b>
<b>Executive Committee documents</b>	
UNEP/OzL.Pro/ExCom/70/53/Rev.1	Discussion paper on minimizing adverse climate impact of HCFC phase-out in the refrigeration servicing sector (decision 68/11)
UNEP/OzL.Pro/ExCom/77/9	Final report on the evaluation of HCFC phase-out projects in the refrigeration and air-conditioning manufacturing sector
UNEP/OzL.Pro/ExCom/77/70/Rev.1	Issues relevant to the Executive Committee arising from the Twenty-eighth Meeting of the Parties to the Montreal Protocol
UNEP/OzL.Pro/ExCom/80/9	Final report on the evaluation of chiller projects with co-funding modalities
UNEP/OzL.Pro/ExCom/82/11	Final report of the evaluation of the refrigeration servicing sector
UNEP/OzL.Pro/ExCom/82/64	Preliminary document on all aspects related to the refrigeration servicing sector that support the HFC phase-down (decision 80/76(c))
UNEP/OzL.Pro/ExCom/82/65 and Add.1	Summary of the Parties' deliberations at the 40 <sup>th</sup> Meeting of the Open-Ended Working Group and the Thirtieth Meeting of the Parties to the Montreal Protocol in relation to the Technology and Economic Assessment Panel's report on issues related to energy efficiency (decision 81/67(b))
UNEP/OzL.Pro/ExCom/83/40 and UNEP/OzL.Pro/ExCom/84/49	Paper on ways to operationalize paragraph 16 of decision XXVIII/2 and paragraph 2 of decision XXX/5 of the Parties
UNEP/OzL.Pro/ExCom/83/41 and UNEP/OzL.Pro/ExCom/84/50	Paper on information on relevant funds and financial institutions mobilizing resources for energy efficiency that may be utilized when phasing down HFCs
UNEP/OzL.Pro/ExCom/83/42 and UNEP/OzL.Pro/ExCom/84/69	Summary of the report by the Technology and Economic Assessment Panel on matters related to energy efficiency with regard to the issues identified in decision 82/83(e)
UNEP/OzL.Pro/ExCom/84/63	Report on end-user incentive schemes funded under approved HCFC phase-out management plans (decision 82/54)
UNEP/OzL.Pro/ExCom/83/11	Status reports and reports on projects with specific reporting requirements
<b>Bilateral and implementing agencies</b>	
GIZ - presentation on energy efficiency at the meeting of the 41 <sup>st</sup> Open-ended working group of the Parties to the Montreal Protocol	Energy efficiency in servicing. Impacts of HPMP training and future potential (2019)
UNEP	Briefing note A: The importance of energy efficiency in the refrigeration, air-conditioning and heat-pump sectors (2018)
<b>Technology and Economic Assessment Panel reports</b>	
Report of the UNEP Technology and Economic Assessment Panel. September 2018, Volume 5	Decision XXIX/10 Task Force report on issues related to energy efficiency while phasing down hydrofluorocarbons
Report of the Technology and Economic Assessment Panel. May 2019, Volume 4	Decision XXX/5 Task Force report on cost and availability of low-GWP technologies/equipment that maintain/enhance energy efficiency





## Annex III

## SUMMARY OF PROGRESS REPORTS OF STAGES I AND II OF HPMPs

Country		GSP* Training	HFR* Training	Certif. standards	Certif.	Conversion to low-GWP	HFR; EE Standard	RRR/ T/S/E*	Remarks
Argentina	Stage I	X	X					T; S	Flushing
	Stage II	X	X	X	X		HFR	T; HFR S	REAL standards
Armenia	Stage I	X						S	
	Stage II	X	X				HFR		EN378 1-4 discussed
Bangladesh	Stage I	X	X						
	Stage II	X	X		X		HFR; EE	RRR;T;S	Pilot cert. scheme
Brazil	Stage I	X							Demo containment
	Stage II	X	X					T;S;	
Brunei Darussalam	Stage I	X						RRR	
	Stage I.4	X	X					RRR	HFR import is restricted by law
Burundi	Stage I	X	X			X			
	Stage II	X	X			*		S	*Conversion to HFR is cancelled
Chile	Stage I	X			X			RRR	
	Stage II	X	X	X	X			RRR	
China	Stage I	X		X	X		X	T	
	Stage II	X	X	X			X		
Costa Rica	Stage I.3	X		X	X		X	T	EE certification
	Stage I.5	X		X	X		X	T	HFR under prep.
Cuba	Stage I.2	X	X	X		X		RRR; T	
	Stage I.5	X	X		X			T	
Dominican Republic	Stage I	X	X	X	X			RRR; S;T	
	Stage II	X	X	X	X		X	RRR; S;T	
El Salvador	Stage I	X	X					RRR; S;T	
	Stage II	X	X					RRR;S;T	
Equatorial Guinea	Stage I.2	X	X						
	Stage I.4	X	X					S	
Fiji	Stage I.2	X	X	X	X	X		RRR	Fishery conversion
	Stage I.3	X	X		X	X	X	RRR;S	Replacement with HC; HFC-32
Gabon	Stage I.2	X	X					RRR;S	
	Stage I.4	X	X					RRR;T;S	
Guyana	Stage I	X	X					S;T	
	Stage II	X	X		X		HFR*	RRR	* Under discussion
Honduras	Stage I.2	X	X			X		RRR; S	
	Stage I.4	X	X	X	X			RRR;S	
India	Stage I	X						T	
	Stage II	X	X						
Indonesia	Stage I	X						RRR	
	Stage II	X	X	X	X		X	T;S;	
Islamic Republic of Iran	Stage I	X						T;S;	
	Stage II	X						RRR; T	
Iraq	Stage I	X		X	X			RRR;T	
	Stage I.3	X						RRR	
Kuwait	Stage I	X	X	X	X				
	Stage I.3	X	X						
Kyrgyzstan	Stage I	X						RRR; S	
	Stage II	X	X		X			RRR;S	
Lao People's Democratic Republic	Stage I	X						RRR	
	Stage I.3	X	X					T	
Lesotho	Stage I	X	X					S;T	
	Stage I.4	X	X					T;	
Liberia	Stage I	X	X		X			T;	

Country		GSP* Training	HFR* Training	Certif. standards	Certif.	Conversion to low-GWP	HFR; EE Standard	RRR/ T/S/E*	Remarks
	Stage I.3	X	X				ISO 5149 <sup>1*</sup>		* In 2020
Mexico	Stage I	X*						S	*Cleaning and flushing is a priority
	Stage II	X	X				AC EE standard	RRR;S;T	
Mozambique	Stage I	X	X					S;T;	
	Stage I.4	X	X					RRR;S;T	
Nicaragua	Stage I	X	X					T;S	
	Stage I.3	X	X	X	X		X*	RRR	*HC handling standard
Nigeria	Stage I	X	X	Follow EN 378			EN 378 & GIZ HC*	S	*National standards will be based on
	Stage II	X	X					RRR; S	
Oman	Stage I	X		X	X				
	Stage II	X		X	X		MEPS*	RRR	*EE for low-voltage RAC
Pakistan	Stage I	X						S	
	Stage II	X	X	X	X			RRR;S;T	
Panama	Stage I	X	X	X	X			S;T	
	Stage II	X	X	X	X			RRR;S;T	
Paraguay	Stage I	X	X	X	X		X*		Voluntary standards for the use of refrig.
	Stage I.2	X	X	X	X		X*		
PIC (12 Pacific Island Countries)	Stage I	X					PALS*	RRR;S	PIC EE Labelling Standards
	Stage I.3	X	X				PALS*	RRR;S	
Saint Kitts and Nevis	Stage I	X	X					S	
	Stage 1.2	X	X					S	
Surinam	Stage I	X	X				CVQ*	RRR; S	* Caribbean Vocational Quality Standards
	Stage 1.3	X	X				CVQ*	RRR; S	
Sudan	Stage I	X		X				S;T	
	Stage I.3	X						S;T	
Uruguay	Stage I	X	X					S;T	
	Stage II.3	X	X					S;T	
Thailand	Stage I	X	X					T	
	Stage II	X	X					T	

\*GSP: Good Servicing Practices

\*HFR: Handling Flammable Refrigerants

\*RRR; T; S: Equipment for training and RRR facilities, and servicing technicians.

<sup>1</sup> Specifies the requirements for the safety of persons and property, provides guidance for the protection of the environment, and establishes procedures for the operation, maintenance, and repair of refrigerating systems and the recovery of refrigerants.

## Annex IV

### TRAINING WORKSHOP IN BANGLADESH

1. Training workshop on “Good Service Practices in Refrigeration and Air-conditioning” was organized by the Department of Environment of Bangladesh under HCFC Phase-out Management Plan – UNEP Component project during 5-8 November 2017 at Feni. The participants were refrigeration and air-conditioning (RAC) service technicians from Feni and some participants are from Comilla and Noakhali. Participants with basic technical knowledge to handle air-conditioner and refrigerator were invited. The participants were divided into two batches. Each batch had two days long training on Good Service Practices in RAC sectors. Fifty-five participants attended the first batch and 51 participants attended in the second batch.
2. On the first day, the three core trainers mainly focused on the following topics:
  - (a) Environmental Impact and Human Health Impacts of ODS Refrigerants;
  - (b) Alternatives to HCFCs and their characteristics;
  - (c) Handling of HFCs refrigerants;
  - (d) Servicing of HCFC and HFC Based Air-conditioners;
  - (e) Tools & Equipment for servicing;
  - (f) Dos and Don'ts in Refrigeration & Air-Conditioning Servicing;
  - (g) Handling and Safety Issues of HC Refrigerants;
  - (h) Servicing of Hydrocarbon (HC) based Air-conditioners;
  - (i) Installation procedure of split air conditioners; and
  - (j) Video on servicing and installation procedure was shown.
3. The second day of the training workshop begins with the recap of the previous day topics. The trainers covered the following topics:
  - (a) Refrigerant recovery, recycling and cylinders;
  - (b) Economics of refrigerant reclamation and best service;
  - (c) Contaminated refrigerants and refrigerant identifier;
  - (d) Selection and safe usage of cleaning solvents;
  - (e) Maximising climate benefits through servicing sector;
  - (f) Recovery machine – maintenance;
  - (g) Single stage vs. double stage nitrogen regulator; and
  - (h) Simulation video on refrigerant recovery and recycling.
4. A hands-on training on evacuation of the systems was conducted as well as a recap on the second day topics.
5. The concluding session for both batches was held on the fourth day of the workshop. The Chief Guest and other guests distributed certificates among the participant.
6. After the training, technician should be able to achieve the following servicing operations:
  - (a) Right way of leak detection, purging and evacuation;
  - (b) Right way of charging refrigerants;
  - (c) Identifying the servicing-specific tubing tools and techniques, bending, flaring, swaging, piercing, pinching and welding;
  - (d) Identifying the proper use of servicing instruments: manifold gauges, charging scales, and thermometers; and
  - (e) Good practice in servicing and installation of ACs.



## Annex V

### THE STATUS OF THE CERTIFICATION SCHEME IN 15 SELECTED ARTICLE 5 COUNTRIES

The following information on the certification schemes in 15 Article 5 countries has been collected from the HPMP progress reports and from the information note published by the International Institute of Refrigeration.<sup>1</sup>

**Argentina:** Technicians are trained in middle school and do not need a certification to work in the refrigeration field. But there are some companies such as AAF (“Asociación Argentina del Frio”) where technicians interested in receiving certificates should pass an examination similar to the ASHRAE certification. Recently, the Universidad Tecnológica Nacional (UTN) was designated as the national certification body for the safe management of flammable substances. Under the HPMP stage II training component, 18 trainers were certified in Italy using the REAL programme for the safe handling of flammable refrigerants. In order to promote certification, European REAL training standards will apply in subsequent training and certification of technicians.

**Chile:** The certification of technicians is not yet mandatory in Chile. A total of 492 technicians were certified. The certification process is validated and certified by the Institute belonging to the Ministries of Work, Economy, and Education. Currently, the technicians are certified in one or two of the following profiles: installer of air-conditioning systems, installer of refrigeration systems, and/or installer/maintenance of air-conditioning and refrigeration equipment.

**China:** The operation and monitoring of the certification systems for refrigerant servicing technicians is the responsibility of the Ministry of Human Resources and Social Security (MHRSS). The Foreign Economic Cooperation Office (FECO) / Ministry of Environmental Protection (MEP) recently updated existing qualification authentication systems to cover handling the new generation of refrigerants which can be flammable, toxic or with higher working pressure. In consultation with MHRSS, FECO/ MEP signed an agreement with the Vocational Training and Qualification Certification Association of China for the implementation of the current certification system and for the development of the certification syllabus to be used by various training institutes. It was noted that being aware of the presence of millions of servicing technicians and thousands of training and certification centres in China, the upgrading of the certification system has to be treated carefully with certain degree of flexibility.

For servicing enterprises involved in industrial and commercial refrigeration and air-conditioning equipment servicing, the China Refrigeration and Air-Conditioning Industry Association and China Association of Equipment Management have been jointly implementing a voluntary Qualification Certificate System for these servicing companies. Since August 2015, around 1400 servicing companies have been certified under this scheme and it was well accepted by the refrigeration market. A number of different certification practices exist within China. Under one system, the technicians are encouraged to receive their qualification certificates before they are allowed to enter the refrigeration servicing sector as technicians. Under another system, the technicians are required to have compulsory certificates or permit to be qualified to work in legally defined, specialised sectors due to the nature of the safety concerns.

The Standardisation Administration of China (SAC) accredited the National Standards Committee of RAC equipment SAC/TC238 as the technical standardization body. Requirements for certification of refrigeration technicians are defined in national standard GB 9237 “Mechanical refrigerating systems used for Cooling and Heating-Safety requirements” and are similar to requirements under ISO 5149.

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<sup>1</sup> IIR 28th Information Note on Refrigeration Technologies / September 2015 Qualification and Certification of Refrigeration Technicians

**Colombia:** There is no mandatory qualification or certification of refrigeration engineers, but technicians have to meet certification requirements. According to the National Training Service of Colombia (SENA), which defines training and assessment methodology, there are 11,707 certifications granted in the sector of RAC systems.

**Costa Rica:** The Instituto Nacional de Aprendizaje (INA) evaluated 418 RAC technicians through its skills upgrading programme, and 373 technicians were certified on good practices and refrigerant handling by the Ministry of Environment and Energy (MINAE). A draft regulation, which would regulate the activities of RAC service technicians and make RAC technician certification mandatory, is under review. The country is strengthening the technician certification programme by establishing regulations requiring the mandatory use of those certified technicians with MINAE cards to control the purchase, use and final disposal of refrigerants. The INA issues a certificate of good practice to those RAC technicians that have completed the training on good practices in servicing in a satisfactory manner. There are currently no formal restrictions in place for uncertified technicians. However, Government institutions and some private companies require technicians to be certified in order to participate in competitive bidding for equipment installation and servicing. Thus, the certification system is expected to gain broader acceptance in the future.

**Indonesia:** A total of 27 out of 32 technicians earned a competency certificate from the National Professional Certification Agency (BNSP). The national professional competency standard for refrigerant handling is being updated to reflect technologies available in Indonesia, including HFC-32, and safety standards. A study tour to Australia was conducted in August 2018 to assess the technicians' licensing system and to collect lessons that could help Indonesia replicate such a scheme. The Government is reviewing the qualifications and skills system for licensing or certifying technicians. The current scheme is voluntary and regulated by the Ministry of Environment. The update to the national professional competency standard is being developed in collaboration with the Ministry of Manpower. Once completed, the certification scheme will be mandatory for all RAC technicians.

**Kuwait:** In February 2018, UNEP has contracted an international institute (Italian Association of Refrigeration Technicians, ATF) in designing a local environmental certification programme for refrigerant management similar to F-Gas certification in the European Union, but tailored to local conditions. Twenty master trainers were certified in accordance with the F-Gas certification programme in October 2018. The Memorandum of Understanding has been signed with the Public Authority for Applied Education for their training centre to administer certification under this programme. The number of centres would increase to three in as many years. The Environmental Protection Agency (EPA), with the assistance from UNEP, is finalising the legal documentation to enact the certification programme, in line with the mandate of the EPA. Training programmes were expected to start in 2019, thus linking the training programmes with the certification programme.

**Malaysia:** Certification Programme for Technicians in Malaysia has conducted training and certification of refrigeration and air-conditioning servicing technicians since 2007 under the National CFC Phase-out Plan and in line with the requirements of the Environmental Quality Act (Refrigerant Management). Initially, the training for refrigeration and air-conditioning servicing technicians was organised by 29 Authorised Training Centres (ATCs) throughout the country. The ATCs were established by the Department of Environment (DOE) through cooperation with the private sector, particularly with the refrigeration and air-conditioning service workshops, and with several Government institutions such as the Manpower Department, the Ministry of Youth and Sports and the Ministry of Rural and Regional Development. Recently, the number of ATCs was increased to 41 to enable the country to effectively fulfil its commitments to the Montreal Protocol under the stage I of the HPMP (2012 to 2016). Among them, 30 ATCs are operated by the Government and 11 by the private sector. All ATCs were provided with at least one recovery and recycling machine setup and with basic tools to run the programme. A number of training courses were conducted for master-trainers, including a regional master trainer programme. The trainees have to pass theoretical and practical examinations. To date, more than 4,000 technicians were certified by the Malaysian the Department of Environment under this programme. Online system Electronic Certification for Servicing Technicians

Programme (eCSTP) was developed and recently upgraded resulting in online certification of 2,268 technicians, as of June 2018.

**North Macedonia:** The legal basis for the Training and Certification scheme in the country is the Law on Environment (amended in March 2014). The Ministry of Environment and Physical Planning (MEPP) establish and maintain an official register of issued, withdrawn and extended licenses. According to this law, a legal and/or natural person handling refrigerant or equipment containing refrigerants should have a licence for refrigerant management. Licences of different categories are issued depending on the refrigerant, category of equipment to be serviced or/and installed, and recovery and recycling procedures. The Law also determines a number of requirements related to a person (legal or natural) applying for a licence, to training obtained, and the supervision of the theoretical and practical examination and certification release process. Licenses issued are valid for five years, with the possibility for extension of an additional five years.

According to the new amended Law on Environment, the training should be conducted by persons/institutions authorised by the MEPP. They should be properly equipped to conduct practical training, develop a programme for training in good practices of refrigerants handling, servicing, recovery, recycling, and employ at least one person with a university diploma and five years of experience in the field of handling of refrigerants and equipment containing refrigerants. The programme has to be approved by the four-member Commission established for this purpose followed by an on-site visit of MEPP authorities.

**Pacific Island Countries:** The training and certification of refrigeration and air-conditioning servicing technicians is provided by the Australia Pacific Technical College (APTC). The APTC is funded by the Australian Government and managed through the Department of Foreign Affairs and Trade - Australia Aid. The APTC was designed as a centre of training excellence to build skills and qualifications. APTC has campuses in five countries: Fiji, Papua New Guinea, Samoa, the Solomon Islands and Vanuatu. The Samoa campus provides training and certification in refrigeration and air-conditioning.

The Certificate III in Engineering course is designed to offer students in these Pacific Island Countries the opportunity to further develop their skills and experience within the RAC industry and obtain an Australian qualification. The Australian Government subsidises the cost of the course including materials and consumables. The programme is designed to provide RAC training and take over 20 weeks' full time to complete. Course content covers the broad area of competency including general principles and skills related to mechanical work and OHS as well as specific competency in servicing and repair of domestic and commercial refrigeration and air-conditioning equipment. Prospective Pacific Island students for the certification course are required to be currently employed in the RAC industry and/or hold a local qualification. The programme is also offered to graduates of local Technical Vocational Education & Training programmes with limited or no work experience. Applicants need to complete literacy and numeracy assessments and an entry level knowledge and skills assessment. The scholarship programme provides for the possibility of financial assistance to Pacific Islanders for full or partial scholarship assistance.

**Paraguay:** There are two certification institutions accredited by the National Certification Organisation. Two hundred and ten technicians were certified under the “management of refrigerants used in the refrigeration and air-conditioning systems” standard by the Chamber of Refrigeration and Air-conditioning Enterprises or by the National Institute of Technology and Standards (INTN). A database of certified technicians was prepared and published. End-users will be able to identify certified technicians in any locality or municipality.

**Saint Lucia:** The NOU (Ministry of Sustainable Development, Energy, Science and Technology) is the recognised implementing body for the training and certification course and issues the ID cards/certificates.

**South Africa:** In South Africa there is a national standard (SANS 10147), which requires that RAC technicians involved in servicing and handling of refrigerants have to be registered as being competent in their specific fields. The scheme is implemented by the South African Qualification & Certification Committee. The design and operation of RAC systems have to comply with national standard (SANS 10147), which in many respects is similar to EN378. SANS 10147 is a part of Occupational Health & Safety Act (OSH). The design and operation of all machinery and plants in the country have to comply with OSH requirements.

**Tunisia:** There is a collaborative project between the Technical Centre for Mechanical and Electrical Industries (CETIME) and the French centre of expertise in refrigeration (Cemafruid) for the establishment of certification system.

**Zambia:** The ODS control regulations, which are under the Environmental Management Act of 2011, apply to the technicians servicing RAC equipment, as well as institutions using controlled substances. The corresponding regulations include specific guidelines for technicians in the handling of ODS, which ban venting and retrofitting to HCFCs. The same regulations specify that certification is required for the servicing of products or technology that contains or uses ODS. If the technician is required to handle ODS, a permit should be requested from the Zambia Environmental Management Agency providing a certificate issued by the Vocational Training College, which is under the supervision by the Government of the Republic of Zambia, with assistance from GIZ. If approved, a permit to handle refrigerants is issued. The scheme relies on close cooperation between the NOU, the Refrigeration and Air-conditioning Association of Zambia (RAAZ) and the Vocational Training Institutions.



Annex VI

**LABELLING AND ENERGY PERFORMANCE STANDARDS IN SELECTED ARTICLE 5 COUNTRIES**

No	Country	Comparative Labelling					Endorsement Labelling					Energy Performance Standards				
		AC Central	AC Room	AC Split	Ref. Freezer	Ref. Com.	AC Central	AC Room	AC Split	Ref. Freezer	Ref. Com.	AC Central	AC Room	AC Split	Ref. Freezer	Ref. Com.
1	Albania		M	M	M								M	M	M	
2	Argentina		M	M	M								M	M	M	
3	Algeria		M		M								M		M	
4	Bangladesh		P		M								P		M	
5	Barbados		X		X											
6	Bolivia (Plurinational States of)		P	P	X								P	P	P	
7	Brazil		M		M			M		M			M		M	
8	Brunei Darussalam		P	P												
9	Chile	P	M		M								M		M	
10	China	M	M	M	M	M	V	V	V	V	V	M	M	M	M	M
11	Colombia		M	M	M	M										
12	Cook Island		X	X	M								M		M	
13	Costa Rica		M		M	M							M		M	M
14	Cuba		X		X											
15	Democratic People's Republic of Korea (the)				X			X		X			X		X	
16	Dominican Republic (the)				P											
17	Ecuador		X		X								X		X	
18	Egypt		M		M								M	M	M	
19	Eswatini														X	
20	El Salvador				X	X									X	
21	Ghana		M	M	M								M	M	M	
22	Fiji				X										X	
23	India		M		M					V			V		M	
24	Indonesia		V		V								P		M	P

No	Country	Comparative Labelling					Endorsement Labelling					Energy Performance Standards				
		AC Central	AC Room	AC Split	Ref. Freezer	Ref. Com.	AC Central	AC Room	AC Split	Ref. Freezer	Ref. Com.	AC Central	AC Room	AC Split	Ref. Freezer	Ref. Com.
25	Islamic Republic of Iran		M		M								V		M	M
26	Jamaica		M		M								M	M	M	
27	Jordan		P		X								P		P	
28	Kenya		M	M	M								M	M	M	P
29	Lebanon				P									V	V	
30	Kiribati		X		X								X		X	
31	Malaysia		V		M			V		V			M	M	M	
32	Mexico		M	M	M	M	V	V		V	V	M	M	M	M	M
33	Namibia		P	P	P								P	P	P	
34	Nicaragua				M											
35	Nigeria		P		P								P		P	
36	Pakistan		X		P								X		P	
37	Peru		M		V								M		M	
38	Philippines		M	M	M									M	M	
39	Saudi Arabia	M	M	M	M								M	M	M	
40	South Africa	P	M	M	M							P	M		M	
41	Sri Lanka		P		P								M		P	
42	St. Lucia		X		X											
43	Thailand		V	V	M		V	V	V	V			P		M	
44	Tunisia		M		M								M		M	
45	Turkey		M	M	M		P	P	P			P	P	P	P	
46	UAE		M		P								M			
47	Uganda		P	P	P								V		M	
48	Uruguay				M								M		M	
49	Venezuela (Bolivarian Republic of)		M		M								M		M	
50	Viet Nam		M		M	P		V		P	P		M	M	M	M

Data specified as P (proposed), V (voluntary) and M (mandatory) mostly refer to 2013<sup>1</sup> with some more recent updates extracted from CLASP<sup>2</sup>. Data designated with X were reported to have such programmes. Data extracted from Table 1 of document UNEP/OzL.Pro/ExCom/83/40.

<sup>1</sup> L. Harington Energy Labelling and Standard Programmes Throughout the World

<sup>2</sup> <https://www.clasp.ngo/policies>

## ADDITIONAL INFORMATION ON SOME INITIATIVES UNDERTAKEN IN ARTICLE 5 COUNTRIES ON LABELLING AND MEPS

1. Argentina: The standards and labelling programme was initiated in 1996. Although MEPS thresholds have been gradually tightened, they are still rather weak, as they correspond to the previous EU energy efficiency classes A–C4. MEPS threshold equivalent to label classes C were established for refrigerators and refrigerator-freezers since 2009 and for freezers since 2011. MEPS thresholds for split and compact room air conditioners were gradually strengthened in 2010, 2011, 2013 and 2014 and are currently equivalent to label class A for cooling mode and to class C for heating mode for systems with a cooling capacity of  $\leq 7$  kW.
2. Bhutan: Drafted the National Energy Efficiency and Conservation Plan which is under the parliamentary approval. Standards and labelling have been drafted (with support from the Asian Development Bank) for some products including air-conditioning and refrigerators, there are some market incentives such as tax incentives. Labelling design and MEPS need to be carefully considered as the programme is at present based on Indian energy efficiency standards. Include energy efficiency components in refrigeration and air conditioning training. Require assistance from the CAP team in terms of identifying expert in conducting the training. Initiate the rebate scheme for high energy efficient refrigerators. mass awareness programme to be planned.
3. China: Communication and coordination is established with the National Energy Policy Maker. Explore the mechanism that could combine the ozone protection and energy efficiency linkage.
4. Democratic People’s Republic of Korea: Technical cooperation is established through south-south collaboration. Assistance requested from UNEP to develop a national cooling plan and to train the technicians.
5. Ghana: Prior to the adoption of energy efficiency regulations and ban on second-hand refrigerators and air-conditioners, the average domestic refrigerator consumed 1,200 kWh per year, and 80 per cent of the market used imported appliances, mainly from Europe. The most popular refrigerator was the most inefficient on the market and almost all cooling appliances used CFCs. Following the adoption of standards and labelling policies between 2005 and 2009, over 10,000 used and inefficient refrigerators were replaced with new and more efficient ones, over 34,000 illegally imported were confiscated and destroyed, 1,500 kg of CFC was recovered, and 400 GWh of electricity saved. All these benefits occurred with no change in the price of refrigerators.<sup>1</sup> Ghana adopted energy efficiency standards and labelling regulations for non-ducted air-conditioners in 2005 according to the table below. By virtue of its excellent products and ultra-high energy efficiency, Midea won the joint bid of Ghana's Ministry of Environmental Protection and the federally owned Deutsche GIZ GmbH, becoming the first company authorized to export and sell products with R-290 in the market in Ghana (410 units were sold in 2018).

### Energy Efficiency Star Rating for Non-ducted air-conditioners

Stars	Energy efficiency ratio (EER)*
5 stars	$4.00 < \text{EER}$
4 stars	$4.00 > \text{EER} > 3.75$
3 stars	$3.75 \text{ EER} > 3.45$
2 stars	$3.45 > \text{EER} > 3.15$
1 star	$3.15 > \text{EER} > 2.80$

\* EER means ratio of the total cooling capacity to the effective power input (Watt/Watt) in any given set of rating conditions.

6. India: The Cooling Action Plan was launched in October 2018.
7. Indonesia: In August 2016, the Indonesian Ministry of Energy and Mineral Resources adopted a regulation for labelling and MEPS requirement for residential AC. For ACs, the star rating starts from

<sup>1</sup> According to Kofi Agyarko, director of energy efficiency and climate change at the Ghana Energy Commission.

1-star, which has a minimum of (2.5 W/W) to 4-star which has minimum of (3.0 W/W). The AC appliances testing was to be carried out appropriately by the certifying agency and the MEPS updated every two years. However, in 2017, test results of energy performance measurements showed that more than 70 per cent of air-conditioners in the market already had a 4-star rating, which meant that the regulation fixed a very low baseline for the minimum energy performance level. As a result, Indonesian MEPS were updated. The updated Regulation stipulates the phasing-out of the most inefficient air-conditioning split units by increasing the level of MEPS. Starting in August 2018, split air-conditioning units in the market must achieve a minimum of (2.64 W/W). In August 2020, the MEPS was further strengthened to (2.92 W/W). Having realized the importance in setting a realistic baseline to trigger a transformation in the market, Indonesia is preparing for the review MEPS for residential air-conditioners aiming to achieve a total emission reduction commitment of 17 per cent by 2030.

8. Islamic Republic of Iran: The NOU has started talks and consultation on Energy Efficiency with the Ministry of Energy which will be part of the National Ozone Committee (the Steering Committee for the implementation decisions related to Montreal Protocol). There is a need to promote energy efficiency labels & standards in refrigeration and air conditioning equipment, buildings and industries; to develop energy audit module in the building sector; to launch awareness and outreach on energy efficiency, ozone and climate linkages in various sectors; and to promote in-kind technologies, for example, desiccant evaporative coolers.

9. Kenya: It first introduced RAC MEPS in 2016, but the industry immediately called for revisions. The revision process was supported through a technical workshop, a market assessment and policy analysis, and continued policy support throughout the revision process. Implementation of the revised RAC MEPS began in April 2019. The revision increased the required efficiency levels for products by 11 per cent and eliminated 73 per cent of models on the market in 2018. Because the RAC market in Kenya is entirely import-based, distributors had to source more energy-efficient products to meet the new standard. By October 2019, only six months since the start of implementation, the national standardization agency (EPRA) registered 63 models into the Kenyan market that met the revised MEPS. While the revised MEPS significantly increased the efficiency baseline for ACs in Kenya, importers responded and easily sourced higher efficiency units. This transition was easier than anticipated because energy-efficient products are readily available in the source countries like China, Kenya's largest RAC exporter.<sup>2</sup>

10. Maldives: It provides capacity building/training for women on the refrigeration and air-conditioning sector. There is a need to develop energy audit modules. Develop/propose green criteria for public procurement of refrigeration and air conditioning equipment. Submit proposals for the Global Environment Facility (GEF) and the Green Climate Fund (GCF) on promoting energy efficiency and ODS phase out linkage.

11. Mongolia: The country adopted the energy conservation law to be followed by six regulations (on high energy consumers, energy auditing, labelling, designated consumers, accreditation of ESCO companies, and energy auditing companies, incentive policies). The first regulation currently being developed is on energy labelling for appliances and for building. Energy efficiency labelling will be mandatory for the highest energy consuming products including freezers and refrigerators and electric heaters. The products are mostly imported. It will be voluntary for other products. The preparation of the National Cooling Action Program will be proposed as well as the assessment of the cold chain sector in the country. Funding will be sought for low-GWP technology adoption in cold chain sector. The country will cooperate with UNEP on the RDL project.

12. Nepal: The NOU is authorized to work on energy efficiency standards and will take up activities on MEPS for the RAC sector and will cooperate with the Ministry of Energy to develop the appropriate regulations and policy. Nepal has developed a National Strategy Paper on Energy Efficiency and it will use

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<sup>2</sup> <https://www.clasp.ngo/updates/2019/kenyas-new-ac-standards-increase-efficiency-baseline-while-reducing-harmful-refrigerants>

this strategy to develop national policy and regulations. There is a need to develop a strategy/action plan in promoting ozone and climate friendly energy efficient technologies. There is also a need to increase awareness among all the relevant stakeholders on ozone, climate friendly and energy efficient technologies.

13. Nigeria: The energy consumption labelling was adopted by the Standards Organization of Nigeria in collaboration with the Nigerian Energy Support Programme (NESP) for air-conditioners and refrigerators in August 2017. The project was funded by the European Union and the German Government. The labels identify the efficiency rating of appliances with one star for less efficient to five stars for more efficient appliances. With the conformity to the MEPS in Nigeria, any air-conditioner that has less than a 1-star rating will no longer be allowed into the Nigerian market. The enforcement of the label was scheduled to commence 18 months after the launching the labelling programme. This was to allow old stocks to be exhausted while enabling importers of more efficient units to fully comply with the standard and label requirements, six months after the launch.<sup>3</sup>

14. Pakistan: The country is in the process of designing its standards and the labelling programme for the refrigeration and air-conditioning sector, including refrigerant-based efficiency level, inverter-based efficiency level and conventional RAC equipment. The NOU is providing inputs to National Energy Conservation Agency (NECA) for RAC energy efficiency. There are plans: to hold national consultative dialogue on Cooling Action Plan for Pakistan and relevant updates in the National Energy Efficiency and Conservation Policy; to undertake the scope of work for market assessment of cooling appliances; to initiate dialogue for integration of bulk procurement of refrigeration and air-conditioning equipment into greening of public buildings programme; and to establish cooperation of the NOU and NECA on sharing data related to imports of RAC equipment.

15. Samoa: The country is the first in using the Pacific Appliance Database (PADs) to implement the product registration programme under the Pacific Appliances Labeling Standards (PALS). This system has been very useful for the country to access information of the energy efficiency of various appliances, which could facilitate the product that is in compliance with MEPS regulation entering the market.

16. Saudi Arabia: It has addressed energy efficiency in AC systems since 2007, initially with the optional energy labelling project initiated by the Saudi Standards, Metrology and Quality Organization (SASO) for residential systems. In 2011, the Saudi Energy Efficiency Centre (SEEC) was formed to be the regulatory coordinating body for all energy efficiency improvement initiatives. The first MEPS for residential air-conditioners systems SASO 2663 was introduced in 2012 as result of industry collaboration with government bodies under the leadership of SEEC calling for 9.5 EER (Btu/h/W = 2.8 W/W) MEPS for residential splits at T1 condition and 6.84 EER (Btu/h/W = 2.0 W/W) at T3 condition as per ISO 5151 conditions. Two years later, MEPS were increased to 11.5 EER (Btu/h/W = 3.37 W/W) at T1 condition and 8.28 EER (Btu/h/W = 2.43 W/W) at T3 condition with mandatory transition to HFC refrigerants. Today, MEPS for residential splits have reached 11.8 EER (Btu/h/W = 3.46 W/W) at T1 condition and 8.3 EER (Btu/h/W = 2.4 W/W) at T3 condition, and MEPS regulations are covering all product types sold in the kingdom with strict implementation, all with HFC technology.<sup>4</sup>

17. Sri Lanka: Energy efficiency standards for refrigerators have to be reviewed. Strengthened awareness programmes are conducted for the general public on energy efficiency. Plan for market mechanisms that would promote low-GWP and energy efficient RAC equipment.

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<sup>3</sup> <http://www.son.gov.ng/nigeria-launches-energy-efficiency-label#>

<sup>4</sup> Dr. Nicholas Howarth. <https://www.mdpi.com/2225-1154/8/1/4/html>