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DESK STUDY ON THE EVALUATION OF HCFC PHASE-OUT PROJECTS IN THE REFRIGERATION AND AIR-CONDITIONING MANUFACTURING SECTOR

1. The desk study of the evaluation of refrigeration and air-conditioning (RAC) manufacturing projects has the objective of providing information on the progress made in the phasing out of HCFCs in the this sector. The following text summarizes the main findings of the desk study covering a total of 25 projects for the RAC manufacturing sector approved for 15 countries and one region, according to the type of issues defined in the corresponding terms of reference[1] contained in Annex I to the present document.

Main findings

Policy, legal and regulatory frameworks

2. In general, the policy framework for HCFC phase-out is becoming more homogeneous throughout the countries when it comes to the control of import/export and trade of HCFCs as well as the ban of new production facilities relying on HCFCs. Furthermore, even Executive Committee recommendations are being adopted in a generalized way, such as the recommendation to apply measures to curb the growth of the installed HCFC-based equipment base through imports. There seems to be an important exception, though, concerning the standards for the use of alternative technologies, which needs to be thoroughly addressed.

3. All of the countries included in the desk study used energy efficiency as a criterion for selection of the alternative technology, and many countries used energy efficiency as an element to seek to establish synergies with other environmental agreements and/or independent energy programmes. Only one country, Thailand, included an energy efficiency policy measure as part of the HCFC phase-out management plan (HPMP), namely the plan for the development of standards and a regulatory framework

[1] UNEP/OzL.Pro/ExCom/74/10/Corr.1.

supporting the introduction of energy efficiencies in HFC-32 air-conditioning (AC). This experience may be worth disseminating to other countries.

4. The enforcement procedures and monitoring tools being utilized to control HCFC use are the same as those used for CFCs, with the appropriate modifications. This has been a very cost-effective and logical approach. Those procedures and tools are: the HCFC quota and licensing system enhanced with electronic capabilities in many cases; training for customs officers and other public and private staff linked to the trade of HCFCs; and awareness campaigns. Some countries have made specific modifications suited to their particular characteristics.

5. There are indications that the level of development of national standards for the use of some alternatives to HCFCs may have hindered the start of operations. It has probably also hindered the timely completion of a significant number of conversions towards low-global warming potential (GWP) flammable, semi-flammable or toxic alternatives.

6. There are also indications that the product certification procedures associated with the establishment of standards and codes for the use of low-GWP flammable or toxic alternatives can be complex and lengthy. Enough time must be allowed within HPMP planning for completion of these procedures, since they can constitute a serious obstacle for the marketing of products.

Technology–related issues

7. One characteristic of the projects included in the study is the high rate of delays. Eighty per cent of projects either present or have presented substantial delays, with a general average delay of 26.18 months. On the other hand, only 50 per cent of delayed projects reported reasons for the delay, and the most recurrent reasons were the change of national ozone unit (NOU), administrative delays, and slow or no feedback from the beneficiary company. The delays due to change of NOU and administrative reasons would seem to indicate that project management infrastructures and procedures at the national level still have room for improvement. Also, the lack of the appropriate standards and related processes for the use of the chosen alternative seems to have caused an important number of project delays that were not clearly reported as such.

8. There are a number of conclusions that can be drawn from the demonstration projects that have reported results. Not only do they demonstrate the feasibility of the new technology for the specific application, which is the paramount objective of the project; they also help to promote the acceptability of the new technology and products in the local market of end-users and manufacturers alike. Demonstration projects also serve to ascertain the actual technology characteristics needed for the given environment, the costs of the conversions and of the new production processes and end products, the actual duration of the conversion process, as well as the most challenging technical difficulties and their solutions. They also help show inter-dependency with other supporting actions such as the establishment of the relevant standards and codes for products and procedures, even if this information can only be indicative in nature due to the changing nature of all the variables involved.

9. It should be pointed out, however, that this information is only useful when it is transmitted effectively to the appropriate target audience, as has been done in these projects through different means, such as national and international conferences and workshops. Timely delivery and compliance with a minimum set of requirements aimed at providing the most relevant information would increase the usefulness of completion reports.

10. With regard to other aspects, a common factor that must be taken into account in the selection of alternative technologies is the influence of local, regional and global market leaders, whose actions can drive the entire market. This is corroborated by illustrative cases where the local industry’s choice of alternative technology was driven by the local and regional markets, and other cases where governments

undertook special efforts to ensure that both national and regional market leaders agreed to endorse the desired low-GWP technology.

11. As for issues related to safety, flammability, and toxicity, project proposals show that the majority of countries implementing conversion projects that involved toxic, flammable or mildly flammable alternatives included additional safety-related equipment with the corresponding changes in project costs, and training and operational procedures within the enterprises; training related to the proper installation and servicing of equipment using the selected alternatives; and steps towards implementing standards and codes for the use of the chosen technologies, which had to include design, manufacturing, installation, servicing and transport.

12. The project management structure under the Multilateral Fund (MLF) has the mechanism to ascertain the first elements of project sustainability, which are a sound design, sound implementation, and successful completion of the conversion project, with the corresponding destruction of old equipment. It has not, however, established a procedure to follow up on completed projects and thus ascertain their medium- or long-term sustainability.

13. Under the present procedures, the technical verification carried out upon completion of a project includes verification of the destruction of related equipment. Only those components that are still needed and usable for other non-converted production lines within the same company can be spared, provided that they cannot be used for upgrading an existing production line or setting up a new one, depending on the specific characteristics of the converted company.

Technical assistance and awareness

14. Most of the projects in this study have included additional capacity-building efforts during project implementation in order to enable company personnel to effectively execute their corresponding tasks within the production process. A significant number of the projects also included capacity-building efforts before project implementation, often with cost-effective and innovative approaches, to address issues as varied as research and development on new technologies, including the dissemination of the results to the relevant industrial sector; technical assistance to all conversion projects by a single specialized unit to provide on-demand assistance for project implementation; and activities to promote familiarity with technology, as well as technology transfer agreements in order to foster the selection of more environmentally friendly alternatives.

15. Awareness-raising efforts within most of the conversion projects in the study have shown the high priority assigned to the need to influence the technological decisions made by industry, as well as the importance of promoting the observance of the supporting policy and regulatory framework by HCFC stakeholders. There is, however, no information regarding the actual results of awareness-raising efforts.

Financing-related issues

16. With regard to differences between the planned and actual costs of project implementation, there is only information available for the four demonstrations projects in China, and only for incremental capital costs (ICCs), since incremental operational costs (IOCs) had not been disbursed at the time of the reports. For most of these projects the actual ICCs ranged from 9.69 per cent lower to 2.49 per cent higher than originally planned, which is within the normal range of difference expected and generally shows the sound budgeting practices used during project preparation. The actual ICCs also ranged from 47.09 per cent to 81.23 per cent higher than the funds allocated by the MLF. These latter figures indicate the level of co-funding that has been necessary.

17. The general impression concerning the changes observed in subcategories of costs of project implementation is that these changes seem to be common in the implementation of complex technical

projects for different reasons, such as: plain underestimation, the need for higher quality design standards, the need to adapt the changes to the actual production capacity of the equipment and not the eligible capacity, additional items that were not foreseen in the original budget, and changes in price at the time of implementation, among others. These changes are to be expected in the future and the flexibility inherent in the financial mechanism seems to be serving the purpose of project facilitation well.

Introduction

18. At its 54th meeting, the Executive Committee approved guidelines for the preparation of HCFC phase-out management plans (HPMPs) and released advance funding to the implementing agencies (IAs) to begin HPMP preparations. The guidelines adopted a staged approach allowing for updates as new technologies developed. Subsequently, at its 55th meeting the Executive Committee invited bilateral agencies and IAs to prepare and submit proposals for demonstration projects for the conversion of HCFCs in the RAC manufacturing sub-sectors to low-GWP technologies, in order to identify all the steps required and assess their associated costs (decision 55/43).

19. Following decision 55/43, four demonstration projects were implemented in various subsectors in China. In addition, approximately 14 countries submitted stand-alone investment projects and other projects included in their HPMP to phase out HCFC-22 in several subsectors and applications in the RAC sector. Due to the complicated technical issues involved, some of the investment projects also included technical assistance components.

Objectives

20. This desk study is part of the 2015 monitoring and evaluation work programme of the MLF and has the objective of providing information on the progress made in the phasing-out of HCFCs in the RAC manufacturing sector. It covers a total of 25 projects for the RAC manufacturing sector approved for 15 countries and one region, according to the type of issues defined in the corresponding terms of reference. It will examine projects approved in various RAC sub-sectors and will address issues related to low-GWP alternatives. It may also indicate areas and topics for a more in-depth, detailed evaluation, with concrete objectives and scope that could be useful for the implementation of RAC projects associated with stage II of HPMPs.

Methodology

21. The desk study was developed through in-depth review of the existing documentation as well as the information gathered from specific questions to members of the implementing agencies. Summaries of the responses and comments received have been incorporated into the study as applicable, or will be considered during the second phase of the study. The documents reviewed included the inventory of approved projects of the MLF, project proposals, evaluation sheets, progress reports, tranche implementation reports, completion reports, and verification reports where applicable, among others.

22. This study includes 19 conversion projects and six demonstration projects in the RAC manufacturing sector approved under the HPMP for 15 countries, namely: Algeria, Argentina, Armenia, Bahrain, China, Indonesia, Iran, Jordan, Lebanon, Mexico, Nigeria, Serbia, Syria, Thailand, and Tunisia. Four of these conversion projects are stand-alone projects approved before the HPMP. The study also includes six demonstration projects for the same sector approved for China (4) and for the West Asia region (2).[2] These projects are listed in Annex II of the present document.

General overview

[2] There are actually only 18 conversion and five demonstration projects since the two projects for Argentina are one project with two approvals for different implementing agencies, as is the case for the West Asia region. For the purposes of the study they will be treated as separate projects unless stated otherwise.

23. This general overview is based primarily on the inventory of approved projects of the MLF, updated as of the 74th meeting. Other documents may have been consulted to complete some of the information. A brief update on progress reports for the 75th meeting was received shortly before the consultant's deadline and was included as part of Annex III of the present document due to lack of time to include it in the analysis.

24. Of the 19 conversion projects only five have been completed, three of them with delays ranging from 12 to 24 months, while one was completed right on time and one 15 months in advance. Of the 14 remaining projects, 12 report ongoing delays ranging from six to 44 months, with an average delay of 25.09 months, while the remaining two projects were approved recently. UNIDO is the implementing agency for nine of the projects, UNDP for five projects, the World Bank for 2, and France, Italy and Germany for one each. The alternatives used for each of the projects can be found in Annex III to the present document.

25. Five of the projects propose the introduction of HFC-32 technology (Algeria, Indonesia, Thailand and Tunisia); two propose HC-290 technology (Armenia and Mexico), six propose HFC-410A technology (Argentina, Iran, Jordan, Lebanon and Syrian Arab Republic); and the remaining five proposed various technologies (i.e., Bahrain and one project for China with HFC-410A and HFC-32; one project for China with HC-290 and HFC-161; one project in Nigeria with HC-600, HC-600a and HC-290; and one project in Serbia with R-717, HFC-410A and HC-290).

26. The two demonstration projects for the West Asia region are ongoing and report delays of 11 and 12 months, respectively. One of the projects is using HFC-410A as the alternative and the other deals with non-investment activities. Concerning the four demonstration projects for China, one has been completed with a 15 month delay while the remaining three report delays of 33 to 44 months. UNDP is the implementing agency for two of the projects and UNIDO for the remaining two. The demonstration projects for China are using HFC-32, ammonia/CO_2, and propane (2) as alternatives. More details on this are presented in Annex III of the present document.

27. On closer examination, the five projects completed are for Armenia, China, Islamic Republic of Iran, Lebanon and Nigeria. The project for Armenia was actually cancelled after the equipment was delivered, due to financial difficulties on the part of the beneficiary enterprise, which eventually went out of business. The projects for Islamic Republic of Iran and Lebanon use HFC-410A as the only alternative. Only the conversion project for China's industrial and commercial refrigeration and air-conditioning sector plan (ICR), which includes HFC-32 as one of the alternatives, and the demonstration project for the production of hydrocarbon (HC) refrigerant in Nigeria, will provide some experience regarding a complete conversion towards flammable or mildly flammable refrigerants.

28. Apart from the recently approved projects for Mexico and Tunisia, there are seven additional projects that show low disbursement rates ranging from zero per cent to 9.22 per cent. These are the projects approved for Algeria, Bahrain, Indonesia, Jordan, Syrian Arab Republic, Thailand, and one demonstration project for the West Asia region.

29. In summary, including ongoing and completed projects, 20 out of 25 projects (80 per cent) are presenting or have presented substantial delays (26.18 months on average). Of the completed projects, only two may provide insight about completed projects involving conversion to flammable or mildly flammable refrigerants.

Policy, legal and regulatory frameworks

30. All the discussions under this section relate only to the conversion projects approved as part of an HPMP and exclude the four so-called stand-alone projects, namely the two projects for Argentina, and the projects for Jordan (Petra) and Syrian Arab Republic. This is in view of the fact that stand-alone projects

do not usually include any consideration or measures related to the prevailing policy, legal and regulatory framework, and their inclusion would skew the results of the analysis.

Actions taken

31. All the conversion projects in this study included an analysis of existing policies in the country in order to facilitate the phase-out of HCFCs in the RAC sector and the introduction of HCFC-free RAC technology. This is because such an analysis is a prerequisite for presentation of the HPMP project proposal. Similarly, all of the projects included measures related to establishing the quota and licensing system for HCFCs, which was also a prerequisite for project presentation.

32. With regard to non-mandatory measures, specific measures to curb the growth of the installed base of HCFC-based equipment through imports were taken by all countries, whereas measures to control the future local manufacturing of HCFC-based equipment were taken by only eight countries. Measures related to establishing standards relevant to the use of alternatives to HCFCs were only included by six countries (Bahrain, China, Indonesia, Mexico, Nigeria and Thailand), despite the fact that there are a total of 10 countries implementing conversion projects that include toxic, flammable or mildly flammable alternatives, either as the only alternative or as part of a portfolio of alternatives.

33. Concerning the four countries that are working with flammable, mildly flammable or toxic alternatives and have not included measures for establishing standards relevant to the use of these alternatives (Algeria, Tunisia, Armenia and Serbia), it was noted that Algeria and Tunisia, having HFC-32 as the only alternative substance, had initially selected HFC-410A as their alternative of choice. It was only after discussions with the Secretariat that they finally selected HFC-32. They might not have had the time to include the appropriate plans for establishing the standards, contrary to Indonesia and Thailand, which were in the same situation concerning the selected alternative but had their projects initially deferred to the following meeting and hence might have had the time to make the corresponding changes in relation to the required standards.

34. On the other hand, Armenia, which selected HC-290 as the only alternative, does not mention any existing or planned standard with respect to the use of this substance, although the project included all the relevant safety measures. The implementing agency later informed that the introduction of safety standards had been under discussion with the NOU during implementation. Concerning Serbia, which selected a portfolio of alternatives formed by R-717, HFC-410A and HC-290, it has been clearly indicated that the country has the necessary regulatory and infrastructure framework for the use of R-717, which is the alternative to be used first.

Effectiveness and timing

35. When it comes to effectiveness and timing, the HCFC licensing and quota system has been the backbone of all the HCFC phase-out efforts in the policy area. Other measures that have proven to be extremely time-sensitive and essential for introducing alternative technologies have been the standards and codes relative to the use of alternatives to HCFCs, as experienced or reported by several countries.

36. China, for instance, reported "… one production line was converted to HFC-32 in 2012, but production has not commenced due to outstanding standard ISO5149 needed for marketing of the product …" concerning implementation of the ICR sector plans. The implementing agency later reported that, indeed, "lack of standards have affected market introduction of the products", and it would be useful to know in detail how this situation has been handled for the benefit of other countries that may want to pursue this path in their efforts for HCFC phase out.

37. Likewise, Indonesia should be well advanced in converting its commercial refrigeration, and commercial and residential air-conditioning sectors to HFC-32 and pentane but has only reported that "…

to facilitate adoption of R-32 by the industry, the Government has also put in place a regulation that removes R-32 from the list of highly flammable substances. The Ministry of Industry is currently working on the development of standards for safe use of R-32 in refrigeration and air-conditioning equipment in Indonesian market …" It is of interest to this study to obtain more detailed information concerning the status of development of said standards and their influence on the conversion of the Indonesian industry to mildly flammable refrigerants.

38. Another interesting experience to develop further would be the demonstration project for the production of HC refrigerant completed by Nigeria, which reported in November 2014 that "… The safety audit for the HC production facility has been completed. The production is on a trial basis, and it is expected to be in the full production by the end of 2014. Marketing of HC refrigerants and training for technicians have started …", although the country has not reported on the development of the relevant standards which is part of a comprehensive plan to ensure safe introduction of HC refrigerants. The implementing agency later informed that the development of the relevant standards is still ongoing but highlighted the pilot nature of the project.

Energy efficiency

39. In relation to how energy efficiency has been addressed relative to the policies and regulations identified only one country, Thailand, included energy efficiency measures as part of the HPMP, such as the plan for the development of standards and a regulatory framework supporting the introduction of energy efficiencies in HFC-32 AC.

40. On the other hand, all 13 countries (with HPMP-related conversion projects) included in this study used energy efficiency as a criterion for selection of the alternative technology, and seven countries (i.e., Algeria, Armenia, Indonesia, Jordan, Mexico, Thailand and Tunisia) used energy efficiency as an element to seek to establish synergies with other environmental agreements and/or independent energy programmes. In this respect, five countries (i.e., Algeria, China, Jordan, Mexico and Thailand) have independent energy efficiency programmes that define additional conditions for the alternative technologies that can be selected but can also be a source for co-funding, as discussed in the section on co-funding of this document.

41. The lack of sufficient progress and respective feedback on project implementation prevents this study from developing this point any further.

Enforcement procedures and monitoring tools

42. All of the countries in the study revised their HCFC import/export quota and licensing system to include the new controls on HCFCs, and eight of those countries also reinforced their quota and licensing system with electronic capabilities in order to optimise its operation. The only countries that did not introduce electronic capabilities were Jordan, Lebanon, Mexico, Serbia and Tunisia.

43. All the countries in the study, except Thailand, organized the corresponding HCFC trade-related training for customs officers as well as for other officers both from Government and private enterprises. All of the countries, without exception, also organized awareness campaigns concerning the new provisions under the law, among others. Countries such as China and Indonesia went a step further by designing and implementing specific programmes aimed at empowering local authorities, thus optimising the enforcement and monitoring of HCFC phase-out activities in general and of related policies in particular.

44. In the case of China this is being implemented through the "national enabling programme" which comprises: capacity-building of national and local authorities; policy training for authorities to strengthen the enforcement of the ODS import and export regulations; a policy enforcement/inspection, and

information system with rewards and penalties; and strengthening the import and export controls for HCFCs, including a communications strategy.

45. Similarly, Indonesia undertook the following key initiatives, among others: maintaining liaison with enforcement authorities on a regular basis and promoting the decentralization of implementation and enforcement of policies and regulations by interacting with and empowering the district-level environment focal points, with the aim of strengthening the enforcement and monitoring of HCFC phase-out related policies.

Standards and codes relevant to the use of alternatives to HCFCs

46. Only six countries have reported taking steps towards implementing standards and codes relevant to the use of alternatives to HCFCs, namely: Bahrain, China, Indonesia, Mexico, Nigeria, and Thailand. Only five of those countries are specific about the alternatives for which those standards are being created: China, which lists HFC-32, HC-290 and R-161, among others; Indonesia and Thailand, which are preparing the acceptance of HFC-32 by the market; Mexico, which will determine guidelines and standards with regard to the application of HC to AC systems; and Nigeria, which is adopting European standards for the use of HCs as refrigerants. Bahrain, under the Unified Regulation for GCC states, endeavours to "promote research (on long term feasible alternatives) and adopt relevant codes and standards".

47. China has provided some details on the action plan specifying that initially 15 different standards concerning product safety (six) and product application (nine), and covering product design, production, transportation, storage, installation and servicing, to be updated before 2015. The subsequent progress reports state that one standard, the GB4706.32[3] came into effect in May 2013, while two others, the standard equivalent to ISO 5419[4] and the standard GB9237[5] were under revision with the contract for the latter expected to be signed in September 2014. Work on three more standards was foreseen for 2014[6].

48. In summary, only one standard has come into effect in 2013, while several other reports inform that: (1) in the ICR sector one production line was converted to HFC-32 in 2012, but production has not commenced due to outstanding standard ISO5149 needed for marketing of the product, (2) in the AC sector 19 production lines (including the Midea demonstration production line) are to be converted to HC-290 and room air-conditioners with HC-290 refrigerant were to be put on the market around the end of 2013, and (3) a number of manufacturers applied for product certification of HC 290-based air-conditioners, but the certification body had not defined the respective test and no certification had been approved so far.

49. Indonesia states in its action plan that "(The) Indonesian Government would work closely with the industry to ensure appropriate regulations, standards and infrastructure for managing the safe use of this (HFC-32) technology throughout the product lifecycle". In the subsequent progress reports the Government informs that (1) "For the introduction of HFC-32 technology in some of the refrigeration and air conditioning activities, additional preparatory and awareness efforts had to be undertaken and enterprises needed to be convinced; this would explain certain delays", and (2) "(The) Ministry of Industry is currently working on (the) development of standards for safe use of R-32 in (the) refrigeration and air-conditioning equipment in (the) Indonesian market" without any additional detail.

[3] Standard of Safety of Household and Similar Electrical Appliances – Particular Requirements for Heat Pumps, Air-Conditioner and Dehumidifier.

[4] Standard that deals with refrigeration applications in general, and currently does not allow for the use of hydrocarbons in RAC equipment.

[5] Standard for products in the industrial and commercial refrigeration sector.

[6] All three are needed for the facilitation of the introduction of hydrocarbon air conditioners: standards on installation and servicing of room air conditioners with flammable refrigerant; on the production lines for room air conditioners with flammable refrigerant; and on the transportation of room air conditioners with flammable refrigerant.

50. Nigeria reported in November 2014 that "The safety audit for the hydrocarbon production facility has been completed. The production is on a trial basis, and it is expected to be in full production by the end of 2014" but did not mention any progress on the establishment of the new HC standards.

Inspections and certification infrastructure

51. Only five of the six countries working towards implementing standards for alternative refrigerants have included in their action plans the creation of certification procedures for the new products. On the other hand, only China has reported back on the issue that "The first pre-condition for marketing HC-290-based air-conditioners is the appropriate product certification. A number of manufacturers applied for this certification, and the products were sent for testing. However, the certification body has no experience with testing the safety of air-conditioners with a flammable refrigerant, and needs to define a suitable test for this type of equipment. To date, no certification has been approved".

52. The above example, although an isolated case for lack of additional feedback, shows that the product certification process can be a complex and lengthy one and enough time must be allowed within HPMP planning for its completion. As a matter of fact, it would seem wise to schedule the development of standards and all the associated initiatives such as product certification procedures some time before the actual conversion. It would be of interest to future similar initiatives to develop this experience further to be shared with other countries.

Technology–related issues

53. There are a total of 12 conversion projects towards low-GWP, flammable, mildly flammable or toxic alternatives, either as the only alternative or as part of a portfolio of alternatives. Only Argentina, the Islamic Republic of Iran, Jordan, Lebanon and the Syrian Arab Republic used HFC-410A as their only alternative. Of these projects, only those for Algeria, Indonesia (two projects), Thailand and Tunisia had not originally selected these alternative technologies, but rather did so after discussions with the Secretariat prompted by some members of the Executive Committee.

54. In the case of Thailand, after the change of technology, three companies withdrew from the conversion project, one before presentation of the revised project and two more after initial discussions during project implementation. It would be of interest to this study to investigate these companies' future plans concerning their production processes, and how they fare in the future.

Delays in project implementation and causes

55. Based on the data in the inventory of approved projects[7], out of the total of 19 conversion projects 15 show delays ranging from six to 44 months (three of them have been completed), two have been completed on or ahead of time and two have been recently approved. The two demonstration projects for the West Asia region show delays of 11 and 12 months, and out of the four demonstration projects for China, one has been completed with a 15 months delay and the remaining three report ongoing delays of between 33 to 44 months.

56. Out of the 15 conversion projects with delays, four did not mention any reason for delay in the progress reports, namely China (both projects), Nigeria and Serbia. On the other hand Argentina (both projects), Indonesia (both projects), one of the projects for Jordan, Syrian Arab Republic, and Thailand gave one reason each, respectively: "supplier's delay in the release of equipment", "for the introduction of HFC-32 … additional preparatory and awareness efforts had to be undertaken as enterprises needed to be convinced", "slow processing of disbursement-related prerequisites", "situation in the country prevents

[7]Updated as of the 74th Executive Committee meeting.

any on-site operation involving purchase of equipment overseas.", and "political situation in the country". (Table 1)

Table 1. Reasons for delays

Project	Agency	Reasons for delay
ARG/REF/61/INV/163 (Argentina)	Italy	Supplier's delay in the release of equipment.
ARG/REF/61/INV/164 (Argentina)	UNIDO	Supplier's delay in the release of equipment.
IDS/PHA/64/INV/193 (Indonesia)	UNDP	For the introduction of HFC-32 … additional preparatory and awareness efforts had to be undertaken as enterprises needed to be convinced.
IDS/PHA/64/INV/195 (Indonesia)	UNDP	For the introduction of HFC-32 … additional preparatory and awareness efforts had to be undertaken as enterprises needed to be convinced.
JOR/PHA/65/INV/91 (Jordan)	IBRD	Slow processing of disbursement-related prerequisites.
SYR/REF/62/INV/103 (Syrian Arab Republic)	UNIDO	Situation in the country prevents any on-site operation involving purchase of equipment overseas.

57. Additionally, Jordan provided two reasons for delay: "delays during the production of the heat exchangers by the supplier", and "for the amount of money available, there was no offer received on the bidding for heat exchangers". Algeria, Armenia and Bahrain gave several reasons for delay in the different progress reports (Table 2). As shown, "Change of NOU" is a reason common to all three countries, and "lack of feedback from beneficiary" is common to Algeria and Bahrain. Algeria and Bahrain also cite administrative delays such as "delay in agreement" and "other government institutions delays" respectively, and only Algeria cites a technical reason such as "more time is required for the beneficiary to produce a prototype on selected new technology".

Table 2. Reasons for delays Algeria, Armenia, Bahrain

Algeria	Armenia	Bahrain
• Change of NOU twice • Lack of support from NOU • Delay in agreement • Lack of feedback from beneficiary company • More time is required for the beneficiary to produce a prototype on selected technology and to get agreement on the TOR	• A new NOU officer was also appointed in the last quarter of 2013 • The financial situation of SAGA (beneficiary company) • Completion of local works was postponed • Health issues of SAGA´s director	• Change of NOU for retirement • Other government institutions delays • Lack of feedback from beneficiary

58. In summary, out of the 10 projects that reported reasons for delay, the most recurrent reasons were the change of NOU, cited three times, administrative delays, cited three times, and slow or no feedback from the beneficiary company, also cited three times. The change of NOU and the administrative delays as reasons for project delays would seem to indicate that national project management infrastructures and procedures still have room for improvement.

59. In the case of China, other reports on the ICR plan stated that "one production line has been converted to HFC-32 in 2012, but production has not commenced due to outstanding standard ISO5149 needed for marketing of the product; completion of conversion is therefore only estimated." Similarly, another report for the room air-conditioning sector plan states that "The Chinese standard equivalent to ISO 5419) deals with refrigeration applications in general, and currently does not allow for the use of hydrocarbons in RAC equipment. Under these circumstances, manufacturers in China are reluctant to market a new technology if it is not facilitated by all applicable standards". It can be inferred that the lack

of appropriate standards may have delayed the completion of conversion projects towards some alternative refrigerants in China. However, this needs to be investigated further.

60. A similar case may be occurring for Nigeria with the project to establish a production facility for locally produced refrigerant-grade HCs, for which it was reported at the 66th meeting: "it will go into operation in the third quarter of 2012" and then again at the 73rd meeting: "it is expected to be in full production by the end of 2014". The question is that along with the HC production project, the Government has developed a comprehensive plan to ensure the safe introduction of HC refrigerants, which included the "adoption of relevant standards and Nigeria's HC certification system", for which there is no progress report. This might be the underlying cause for the delay in putting the HC production facility into full operation, pending further clarification.

61. Concerning the demonstration projects for China, a closer look at the completion reports reveals that all projects have been technically completed, but at least three of them were pending release of the IOCs for the following two years. Only the project at Meizhi is marked completed in the inventory, probably because it did not have IOC funds approved. The timing of the completion reports (March 2014 for Tong Fang and Yantai Moon, and October 2014 for Meizhi and Midea) reveal a previous delay that may be explained by the comments related to the lack of appropriate standards, as extracted from the tranche implementation reports, as included in Table 3.

Table 3. Tranche Implementation reports

Project	Tranche implementation reports
Demonstration project for conversion from HCFC-22 technology to HFC-32 technology in the manufacture of commercial air-source chillers/heat pumps at Tsinghua Tong Fang Artificial Environment Co. Ltd. (CPR/REF/60/DEM/498)	July 2013: "Project achieved technical completion in June 2012. Enterprise awaiting standards revisions to put products on the market. Final verification in progress. Project targeted for completion in 2013."
Demonstration project for conversion from HCFC-22 technology to ammonia/CO_2 technology in the manufacture of two-stage refrigeration systems for cold storage and freezing applications at Yantai Moon Group Co. Ltd. (CPR/REF/60/DEM/499)	July 2013: "Project achieved technical completion in June 2012. Final verification in progress. Project targeted for completion in 2013." March 2013: "Enterprise already offering products with new Ammonia-CO_2 technology."
Demonstration sub-project for conversion of room air-conditioning compressor manufacturing from HCFC-22 to propane at Guangdong Meizhi Co. (CPR/REF/61/DEM/502)	March 2013: "Conversion activities were finished and the project will be completed upon national acceptance that is foreseen for the second quarter (of) 2013. The slight delay is due to the fact that national acceptance cannot be organized before the second quarter of 2013 and that the national standard allowing the use of flammable alternatives comes in to effect as of 1 May 2013."
Demonstration sub-project for conversion from HCFC-22 to propane at Midea room air-conditioning manufacturing company (CPR/REF/61/DEM/503)	November 2014: "National standard allowing the use of flammable alternatives came in to effect 1 May 2013. The conversion of the production line has been finished in July 2013. … National acceptance and official ceremony of the converted production line was done in December 2013" July 2013: "The slight delay is due to the fact that national acceptance cannot be organized before the second quarter of 2013 and that the national standard allowing the use of flammable alternatives comes in to effect only (on) 1 May 2013."

62. The only project not providing any reason for delay is the project at Yantai Moon Group Co. Ltd., which achieved technical completion in 2012 and has been offering HCFC-free products since March 2013, probably because local standards allow ammonia-CO_2 products. It has not been declared completed,

however, which means that this situation merits further investigation. The implementing agency later reported: "there are no local standards regarding the ammonia-CO_2 equipment in the application for cold storage".

Role of demonstration projects

63. There are eight demonstrations projects among the projects included in this study, namely the four demonstrations projects for China, two projects for the West Asia region, and the projects for Mexico and Nigeria, these last two classified as investment projects. The project for Mexico has been newly approved and although the project for Nigeria was expected to be in full production by the end of 2014, a detailed completion report has not been presented as of yet. The projects for West Asia are at the stage of testing some of the prototypes but have not produced a technical report. Only the demonstration projects for China have provided ample feedback so far.

64. All four demonstration projects for China have been technically completed at least since the end of 2013, although only one of them has been reported as completed, and all four have been successful in achieving the proposed objectives. The most outstanding results of these projects are summarized below. Information provided on costs and other issues are mentioned under other specific sections.

65. For the project for conversion to HFC-32 technology in the manufacture of small-sized commercial air-source chillers/heat pumps at Tsinghua Tong Fang, the salient results are: for the same refrigeration capacity, the charge for HFC-32 is 60-80 per cent of the charge for HCFC-22 depending on the application; the actual efficiency of the HFC-32 system in this project is from three per cent to five per cent higher than for the HCFC-22 system, but the performance efficiency is expected to grow with further optimization in compressors and other accessories; and the cost of the new system is 20 per cent higher than the previous one, but the cost is expected to drop with large-scale applications of HFC-32.

66. For the project for conversion to ammonia/CO_2 technology in the manufacture of two-stage refrigeration systems for cold storage and freezing applications at Yantai Moon, the most outstanding points are: (ammonia) NH_3/CO_2 cascade refrigeration system technology can effectively address the toxicity issue of NH_3, since the toxicity is greatly reduced as compared with the pure NH_3 refrigeration system due to a reduction of 90 per cent in the quantity of NH_3 used, and the fact that the circuit using NH_3 is isolated from the operator access area; the efficiency of the new system is 20 per cent higher as compared to the old HCFC-22 system; and most of the large-scale low-temperature refrigeration systems use open-type compressors and open system design, with a significant amount of leakage and low recovery rate of refrigerant during maintenance, thus the consumption of HCFCs in servicing for such systems is very high, and therefore, conversion in such applications is very favourable from an environmental standpoint.

67. Concerning the conversion of room air-conditioning compressor manufacturing from HCFC-22 to propane at Meizhi, the energy efficiency ratio of the HC-290 compressor is from two per cent to three per cent higher than the equivalent HCFC-22 compressor.

68. With respect to the conversion of room air-conditioner manufacturing from HCFC-22 to HC-290 at Midea, compared to the HCFC-22-based units, the new air-conditioning units based on HC-290 show a reduction of five per cent to 12 per cent in energy consumption. Further efficiency improvement both in compressors and AC units could be achieved if the charge sizes specified in international standards were relaxed, since there is a relationship between charge and efficiency, and hence also an optimal charge. Until then, efficiency improvement is mainly dependent on the actual research and development investment on the product, and also on system optimization, which is a requirement in all conversions.

69. Additionally, the project at Midea has provided feedback on major principles to be followed during the product and technology conversion in order to reduce hazards in the manufacturing of RAC

units, but it also underlines that developments must continue post-project with the aim to minimize and simplify product modifications while maintaining safety, in order to expand the range of products. It also highlights that besides these principles, relevant foreign standards and practices for the production of HC-290-based room air-conditioners and compressors can be a reference to national manufacturers.

Other technical and economic aspects and related influences to consider in the adoption of alternative technology

70. The majority of countries have cited a very comprehensive set of aspects that need to be considered for the adoption of alternative technologies, namely: technical factors: processing characteristics, lubricant compatibility with the replacement refrigerant and the components, functionality in end-product (end-product properties and performance), proven and mature technology, energy efficiency, etc.; commercial factors: cost-effective conversion with minimal disruption of current manufacturing operations, cost-effectiveness of operations and end product, market acceptability, reliable availability of alternatives in local market, compliance with established local and international standards for health safety and environment, after-sales servicing requirements and conditions, etc.; health and safety factors: low risk for occupational health, low risk for physical safety (flammability, toxicity), etc.; and environmental factors: zero ozone impact, and low direct and indirect climate impacts.

71. There are, however cases where there are specific reasons that determine the choice of technology, such as the case of Mexico's demonstration project on HC replacement which falls in line with Mexico's National Strategy on Climate Change, or the case of Nigeria's demonstration project for an HC production facility which is driven by the need to address the extended use of "cooking gas" as a refrigerant, without any consideration for safety or standards of any kind.

72. Similarly, the cases of Algeria, Indonesia, Thailand and Tunisia merit a special mention since these countries had initially selected HFC-410A as their alternative of choice and only selected HFC-32 after discussions with the Secretariat. The reasons most commonly provided for the initial choice were: wide market presence and acceptability, proven and trusted technology, cost-effective conversion with minimal disruption of current manufacturing operations and availability of parts at competitive prices, all of this being a result of the prevailing technologies chosen by the market leaders in their own countries and in the countries in the region. Annex IV of this document presents in more detail the reasons provided by these countries.

73. In 2011, the officials from Indonesia's Ministry of Environment and Ministry of Industry, and Japan's Ministry of Economy, Trade and Industry (METI), with the support of UNDP and the Institute for Governance and Sustainable Development (IGSD), reached an agreement with Daikin and Panasonic, multinationals from Japan, to introduce high-efficiency HFC-32 air-conditioners in the Indonesian market.

74. Likewise, in 2012, the World Bank and a group of Thai air-conditioning manufacturers, under the auspices of METI, had discussions with Daikin, Japan Refrigeration, the Air Conditioning Industry Association (JRAIA), Panasonic, Fujitsu General, Hitachi, and Toshiba-Carrier to discuss and agree on the transfer of HFC-32 AC technology to the Thai AC manufacturers, and a commitment by major Japanese AC manufacturers operating in Thailand to launch similar HFC-32 products in Thailand in 2015.

Issues related to safety, flammability, and toxicity

75. Sixteen out of 25 conversion and demonstration projects (involving 10 countries) deal with flammable, mildly flammable or toxic alternatives, either as the only alternative or as part of a portfolio of alternatives. Of these 16 projects only the four demonstration projects for China have produced completion reports which have been very informative concerning the equipment and infrastructure needed

for addressing the safety issues in each project and their associated costs, as discussed in the section on costs of this document. However, there was no mention of any problem concerning the availability of safety-related components or of how the commissioning was done.

76. However, based on the project proposals, of the 10 countries implementing conversion projects that include toxic, flammable or mildly flammable alternatives, eight of them included additional safety-related equipment with the corresponding change in training and operational procedures. The exceptions are Bahrain, which has scheduled said conversion for a later stage, and Tunisia, whose final technology choice depends on the availability of a component, as explained below. Also, only six countries are taking steps towards implementing such standards and codes, which must include manufacturing, installation, servicing and transport. All of the aforementioned eight countries also included training related to the proper installation and servicing of equipment using the chosen alternatives.

77. As an example of the above, in order to facilitate the preparation of projects for the conversion of AC manufacturing to HFC-32 technology, the Government of Thailand assisted twelve beneficiary manufacturers in developing environmental management plans. The environmental management plans provide guidelines and best practices for the AC manufacturers to employ in their operations during and after conversion to HFC-32 technology, including safe handling of HFC-32, and installation and servicing of HFC-32 AC units.

78. Concerning the availability of safety-related components, the revised HPMP for Tunisia included the conversion of the largest four enterprises in the manufacturing of residential AC to the use of HFC-32, HFO or propane as the alternatives. The choice of alternatives of these four enterprises is limited since all are using a knock-down (CKD[8]) kits to manufacture their room air-conditioners. The lack of available CKD kits for the aforementioned alternatives on the market means that the conversions in the room AC sub-sector can only commence in 2016.

79. In addition, the establishment of safety standards and codes along with the infrastructure and processes related to product certification has resulted in a more complex and time-consuming task than expected. This has caused some conversion projects to be ready for production before the required standards and codes are applicable in the country. This situation may raise issues of safety, quality, and consequently, sustainability unless production is stopped until the right conditions are met, which, in turn, may be economically unsustainable for many enterprises. This circumstance may be affecting the projects that are experiencing implementation delays, as described in this document.

Sustainability of the projects

80. The initial elements that ensure the sustainability of a conversion project are: a sound project design that responds to the national and regional market circumstances, a successful conversion that meets the expected specifications, and the destruction of the old equipment. These elements are ensured by the project management structure under the MLF through careful planning, appropriate and timely financial and technical assistance, and sound verification procedures.

81. After the conversion has taken place, however, it is expected that only the successful operation of the company will guarantee the sustainability of the project. This depends on many complex factors that are often beyond the control of the company and of the MLF project management structure, which is out of the picture by then. Nevertheless, some of the factors that will affect the success of the company´s operations are the same as those considered for the selection of the alternative technology, namely: technical factors: functionality in end-product (end-product properties and performance), energy

[8] A kit containing the parts needed to assemble a product. The parts are typically manufactured in one country or region, then exported to another country or region for final assembly. Variant names include knockdown kit, knocked-down kit, or simply knockdown.

efficiency, etc.; and commercial factors: cost-effectiveness, market acceptability, reliable availability of alternatives on the local market, after-sales servicing requirements and conditions, etc.

82. Some of the above elements can also be influenced by supporting actions taken by the Government, such as an appropriate regulatory and policy framework, and training and awareness programmes. This simply points to the importance of the initial steps for project design, planning and implementation, and supporting actions by the Government.

83. Of the five completed conversion projects covered by this study, one of which (Armenia) was cancelled due to financial difficulties by the company, which eventually went out of business. There is not enough information to ascertain whether the financial strain caused by the conversion could have played a role in this failure and whether there is something that could have been done to prevent it, but in any case it appears that this would have been the entire responsibility of the company´s management. The implementing agency later informed that the company is arguing that the cost difference between one m^2 of foam panel with the new technology (c-pentane) and HCFC-141b is around US $5.00, which did not allow them to continue working successfully. The conclusion remains the same: the company´s management should have made this analysis before even embarking on the project.

84. With regard to the other four completed projects for China, the Islamic Republic of Iran, Lebanon and Nigeria, all of them were completed in 2013, and only the project for China has presented a verification report dated 2014 which ascertained that the verified companies, only two[9] out of a total of three companies to be verified, were operating successfully according to the conversion specifications. The third company[10] that needed verification had the converted production line undergoing repairs and was not operating at that time. All three companies were converted to HFC-410A. No other report has been received concerning the present operation of the successfully completed conversion projects.

85. One point to take into account is that after the verification report and financial completion of a project, there is no procedure established to follow up on completed conversion projects and thus no means to ascertain the sustainability of the projects in the medium or long term.

Destruction of manufacturing plant equipment

86. Out of the five completed projects, destruction of the equipment is a procedure that does not apply to Armenia since the project was cancelled, or to Nigeria since the project for construction of an HC production facility from scratch did not involve any pre-existing equipment. Two other financially completed projects for the Islamic Republic of Iran and Lebanon have not yet submitted their verification report ascertaining the destruction of the equipment. The only technical verification report available is for stage I of ICR sector plan for China.

87. In the case of China, the verification report concerned three companies[11] of the room air-conditioning sector selected out of four converted. There was one 4th company converted[12] to HC-290 which was not included in the verification. The three companies were converted to HFC-410A and in all three cases the HCFC-22 refrigerant charging machine was destroyed. Leak detectors, vacuum pumps and other equipment were also destroyed. Other parts of the inspection line (controls, valves, sensors) that could be converted were spared.

88. The components not destroyed (if any) can be used as spare parts for the lines not yet converted within the same company. However, those components themselves do not constitute any production

[9] Sichuan Changhong Air-conditioning Co. Ltd, and TCL, Wuhan.
[10] Gree (Chongqing) Electric Appliances Co., Ltd.
[11] Sichuan Changhong Air-conditioning Co. Ltd, Gree (Chongqing) Electric Appliances Co., Ltd., and TCL, Wuhan.
[12] Chunlan, Taizhou.

capacity and cannot be used for the installation of a new line or to upgrade the production capacity of any existing HCFC-based manufacturing line. In one case, other equipment or installation such as the HCFC-22 refrigerant storage facilities and pipeline are needed to feed the manufacturing lines not yet converted in the company, hence it can only be destroyed upon total conversion of the enterprise.

Technical assistance and awareness

Capacity-building activities

89. Two separate types of capacity-building efforts for improving the technical capacities of the RAC manufacturing enterprises in using alternative technologies have been identified within the 25 projects included in this study: capacity-building initiatives before the actual conversion decision is taken by the enterprise, to enable its management to make an informed decision when selecting the HCFC alternative; and capacity-building activities during the conversion process in order to enable company personnel to effectively execute their corresponding tasks within the production process.

90. Within this latter category of capacity building we have the standard training for equipment operation, among others, provided by the equipment supplier, but there can also be additional capacity-building efforts included in the project design, consisting generally of additional training and technical assistance as part of project implementation.

91. Based on this categorization, 18 projects out of the total of 25 in this study included additional capacity-building efforts in the way of training and technical assistance within project implementation activities, and only one, Algeria, did not do so. Of these 18 projects, a total of 14 introduced capacity-building programmes rather than activities, determined by the size or complexity of the initiative. In addition, 11 countries in total included capacity-building efforts previous to the actual investment project, which included assessment of existing alternatives and technology, among others.

92. Among these latter cases, it is worth mentioning the case of China, where the capacity-building efforts included: actual research and development on new technologies and their respective applications, including dissemination to the relevant industrial sector, as well as technical assistance to the undergoing conversion efforts structured through a National Technical Support Programme, in order to provide technical consulting services according to the demands of project implementation, which is probably a very cost-effective strategy due to the number of companies undergoing conversion at any given time.

93. Within the technical assistance programme structure in China there is also a complex and vast training programme which includes tailored training for all business units within the beneficiary company, namely: related designers, technicians, production management staff, manufacturing workers, product application engineers, technicians for installation and debugging, equipment maintenance personnel, related user operators, and equipment administrative personnel. For instance, in the case of the demonstration project for Yantai Moon, a total of 734 members of personnel were trained. This is most probably due to the complexity and size of the companies involved.

94. Equally noteworthy are the initiatives in Indonesia and Thailand, which go above and beyond mere capacity building, since they promoted study tours and technical meetings between local equipment manufacturers, transnational companies from Japan, and the respective governments, with the purpose of fostering technology acquaintance, technology transfer agreements and eventually the selection by the multinationals and the local equipment manufacturers of more environmentally friendly alternatives, thus ensuring a more levelled and fair local business environment.

Awareness-related challenges and awareness-raising strategies

95. Any awareness-raising strategy is essentially a communication strategy, and as such, it is defined by a set of basic elements such as objectives, target audience, and communication resources or media (what, who and how), among other elements[13]. In the case of the 15 countries with projects covered by the study, 12 countries included conversion project-related awareness-raising strategies which defined the target audiences and respective messages (which represent the objective to be achieved). Five countries also defined the communication resources to be utilised.

96. Within the 12 strategies defined, the most favoured target audience is the industry sector, with a total of seven countries mentioning it, followed by the general public with six mentions, and three mentions of government bodies. Concerning the content of the messages, seven countries included policy issues, seven countries included technology issues and alternatives, four countries included general messages concerning ODS issues, and two included project-specific information. In relation to the communication resources or means to be used, five countries included workshops, seminars and technical meetings, two countries mentioned printed material such as booklets, posters, and two countries mentioned industry associations.

97. Concerning the four demonstration projects for China, which are not included in the above analysis, only the project for Yantai Moon reported that it concentrated its information campaign on the results of the projects itself. The campaign was directed toward other companies in the sector and specific government bodies through workshops, seminars, industry fairs, printed material and industry associations.

98. Regarding the results of the awareness-raising efforts, countries only report back on the activities being carried out and not on the results within the target audiences. This would require at least an initial measurement or evaluation of the variable to be affected, for instance, of the target audience's attitudes before the implementation of the awareness raising activities, in order to use it as a baseline for comparison with the corresponding measurement after its implementation.

Financing-related issues

Comparison of planned and actual costs for implementing the projects

99. Only five conversion projects in the study have been completed, one of which (Armenia) was actually cancelled, and of the remaining four (China, the Islamic Republic of Iran, Lebanon and Nigeria) only the verification report for the room air-conditioning sector plan in China has been received. This verification report did not contain any detailed financial information.

100. The four demonstration projects for China have been technically, although not financially completed, but have already produced comprehensive completion reports with actual financial information for ICCs only, since the IOCs had not been disbursed as of the time of the reports. The exception is the project for Meizhi which did not include IOCs. A summary of these costs for all four projects is presented in Annex V of this document. Table 4 below provides details.

Table 4. Incremental capital cost (US $)

Project	Inventory (allocated)	Original proposal	Completion report	Difference 1 (%)	Difference 2 (%)
Tong Fang (CPR/REF/60/DEM/498)	552,928	905,050	830,344	-8.25	50.17
Yantai Moon	2,847,668	3,150,442	4,188,630	32.95	47.09

[13] The ABCs of Strategic Communications, Kathy Bonk, Henry Griggs and Emily Tynes, 1999, The Evaluation Exchange, Volume VII, Number 1, Winter 2001, Harvard Graduate School of Education.

Project	Inventory (allocated)	Original proposal	Completion report	Difference 1 (%)	Difference 2 (%)
(CPR/REF/60/DEM/499)					
Meizhi (CPR/REF/61/DEM/502)	1,875,000	3,762,527	3,398,093	-9.69	81.23
Midea (CPR/REF/61/DEM/503)	2,514,507	3,842,156	3,938,004	2.49	56.61

Difference 1: Difference between ICC as reported in completion report and as indicated in original proposal
Difference 2: Difference between ICC as reported in completion report and as allocated by MLF

101. Only the difference for the Yantai Moon project stands out and begs some explanation, which is that there were big differences in certain categories of costs between planned and actual costs, as indicated in Table 5 below. The differences in price were not explained in the report.

Table 5. Categories of costs

Category	Planned (US $)	Actual (US $)	Difference
Modification of production line	1,183,000	1,625,537	37%
Manufacturing of prototypes	474,095	1,119,506	136%

102. Concerning differences in planned versus actual costs for sub categories of cost, the reports for the projects for Tong Fang and Yantai Moon do not give any reason for cost differences, but the Meizhi and Midea reports do. This discussion therefore focuses on the data provided specifically by Midea, since both data reports are very extensive and provide the same kind of information. For ease of reference, Annex VI of this document provides details of cost differences as provided by Midea.

103. Some of the differences in costs have been explained as follows:

(a) The actual cost of the combined pre-charging H_2/N_2 pressure- and leak test was US $74,444 compared to the approved budget of US $32,000. The reason given is that the budget approved was not sufficient, and in the future higher costs should be budgeted for a HE leak testing system;

(b) The cost of the ex-proof HC-290 storage room was US $59,841, whereas the approved budget was US $32,961. The reason was that the beneficiary installed a bigger storage room than required for the one line in order to cater to the needs of additional HC-290 lines in future;

(c) The cost of the HC-290 storage tank and pipeline including installation amounted to US $132,698 compared to an approved budget of US $64,039, for the same reason as the previous point;

(d) Additional items were required, which were originally not budgeted, such as: a booster pump that ensures that the inlet of the charging machine is fed with sub-cooled refrigerant, Nitto quick couplings to avoid leaks during charging and in particular testing, as well as variable-frequency power supply to facilitate 110V and 220V as required by different A5 markets. These additional items had additional costs of US $60,000;

(e) The cost of the heat exchanger conversion was three times higher than the approved budget, however funding was provided only for 60 per cent of the estimated conversion costs, since the production capacity of the HE was about 330,000 unit per year (before and after conversion), while the converted production line had a capacity of only 200,000. For this reason, the approved budget was reduced according to line capacity. However, the conversion of the heat exchanger equipment had to be done for the original full capacity (330,000 units) and costs were consequently higher; and

(f) The cost of other items was similar to the approved budget with differences of up to +/-20 per cent.

Comparison of planned and actual co-funding

104. Out of the 19 conversion and demonstration projects covered by this study, a total of 13 projects incorporated specific discussions concerning co-funding modalities and sources, although only four of them assigned a monetary value to the expected co-funding, and three more (three demonstration projects for China) did so after project completion. Additionally, a total of nine projects defined the co-funding source as coming from the beneficiary enterprises, five from other sources and two from the government.

105. Table 6 summarises information concerning the monetary value assigned to co-funding both before and or after implementation, as applicable. This shows that the co-funding value for those projects that provided the relevant information can be calculated between seven per cent and 72 per cent of total project cost, and in the case of one of China's demonstration project, where the comparison between planned and actual co-funding could be done, the difference was 432 per cent higher for the actual co-funding, although no explanation was provided. It should be noted that the projects for Algeria and Thailand are not completed as of yet.

Table 6. Monetary value of co-funding

Project	US $ implementation	US $ post-implementation	%*	Difference	Source
ALG/PHA/66/INV/76 (Algeria)	3,062,379	NA	72%	NA	Enterprise
NIR/PHA/62/INV/129 (Nigeria)	1,200,000	NA	71%	NA	Enterprise
THA/PHA/68/INV/162 (Thailand)	NA	98,000	4%	NA	Government
	NA	840,881	29%	NA	Enterprises
CPR/REF/60/DEM/498 (China)	NA	96,814	7%	NA	Enterprise
CPR/REF/60/DEM/499 (China)	392,786	1,697,694	30%	432%	Enterprise
CPR/REF/61/DEM/502 (China)	NA	1,523,093	45%	NA	Enterprise
CPR/REF/61/DEM/503 (China)	NA	1,554,037	28%	NA	Enterprise

* Percentage of co-funding value versus total project cost

** For five enterprises so far. Co-funding by each enterprise varied from 10 per cent to 75 per cent with an average of 25 per cent of total individual project cost.

106. Concerning other sources for co-funding cited by five countries in the study, all five countries mentioned the Global Environment Facility (GEF), one country mentioned GIZ[14], and two countries mentioned other sources. All of these sources are mentioned as a means of leveraging efforts in the sector and not directly for co-funding of the project in question, and are detailed in Annex VII of this document.

Post-sale servicing

107. None of the issues related to post-sale servicing, such as the availability and affordability of spare parts and refrigerants, as well as installation and post-sale cost issues, including market acceptance of the new products can be reported upon, since there isn't sufficient feedback, as previously mentioned. Only the plans concerning training for servicing are discussed in the section on capacity building in this document. It should be noted that unless the appropriate reporting mechanism is defined, these issues will

[14] Die Deutsche Gesellschaft für Internationale Zusammenarbeit.

never come to be known since there is no after-completion reporting defined within the MLF project management structure. An appropriate recommendation concerning this point has already been made under a different issue.

Conclusions and Recommendations

Policy, legal and regulatory frameworks

108. Project proposals that include flammable, mildly flammable or toxic alternatives should be required to present either the existing relevant national standards and codes relative to the use of the selected alternative to HCFC and the associated product certification infrastructure if they are already in place in the country, or the corresponding plans for the creation of such standards and infrastructure. It should also be ensured that progress reports mention progress in implementing such standards and codes, when applicable.

109. The experiences of those countries trying to establish synergies between their MLF programme and other independent energy programmes could be disseminated to other countries that may be interested in similar initiatives.

110. It would be of interest for future similar initiatives to further develop a study on experiences with product certification processes, covering the steps involved, their actual duration, the main difficulties encountered and their solution, so that results could be shared with other countries.

Technology–related issues

111. The technical assistance provided by the MLF could focus on further improving project management infrastructures and procedures at the national level, and providing guidance for the establishment of appropriate standards and related processes for the use of the chosen alternatives during project preparation and implementation in order to prevent unnecessary project delays.

112. Project completion reports and progress reports should be tailored to respond to the information and evaluation needs of the Executive Committee and the entire Montreal Protocol community, and the corresponding formats should be appropriately modified and enforced. A revision of the appropriate formats should be performed after a thorough evaluation of the information needs of the Executive Committee.

113. A wider audience for the valuable information produced by demonstration projects could be reached by producing related and structured documentation made available through different dissemination means, including the internet, aimed at specific platforms, in order to be used as initial guidelines for similar initiatives.

114. Experience with Government efforts to ensure that national and regional market leaders would endorse the desired low-GWP technology, such as the experiences of Indonesia and Thailand, could be developed into informative documents to be disseminated to other countries.

115. Countries could be required to report on completed projects two years after completion, for instance, if the Executive Committee considers it convenient, in order to establish a mechanism to ascertain project sustainability in the medium term. One implementing agency suggested that, instead of adding more reporting obligations to the countries, it could become a periodic objective of the Monitoring and Evaluation Unit of the MLF to develop a study about completed projects, thus adding independence and credibility to the study.

116. Another recommendation from an implementing agency on sustainability was that it would have been interesting for the study to delve more into the energy-efficiency dimension, namely what needs to be in place to ensure that there is buy-in at the consumer level to purchase more energy-efficient alternative-based AC; to find out whether these new appliances are more costly, and by how much; to evaluate the role of testing and enforcement. Related to this are the expectations for improved energy efficiency and linkages to national initiatives (standards) by the MLF in accordance with the funding provided.

Technical assistance and awareness

117. Comprehensive or innovative capacity-building approaches should be disseminated for the benefit of other countries, even if some of these experiences may seem to be applicable in principle only to countries with bigger infrastructures and comparatively more significant levels of resources, such as China and Indonesia.

118. In order to be able to measure the actual results of awareness-raising strategies, project proposals should be required to include an initial measurement or evaluation of the variable to be affected, for instance, the attitude of the target audience, before the implementation of activities, as well as a corresponding similar measurement after implementation.

Financing-related issues

119. Not all of the completion reports examined contained the same kind of cost information. In this respect it would be useful, for the purpose of future analysis, to establish a minimum required format for such reports that provides a satisfactory response to all of the information needs of the Executive Committee.

120. One implementing agency noted that the desk study was largely based on planned information because many of the projects studied were in earlier stages of implementation. The implementing agency saw a need for an update or similar study in the sector at a later date when there was more information on implementation and project outcomes. This would be even more helpful for stage II projects and beyond.

121. One implementing agency pointed out that the financing-related conclusions do not look at how the lack of funds or additional funds for related energy-efficiency measures at the plant and national level influence decision-making on types of technologies, on product acceptance and market penetration and sustainability.

Second phase of the study

122. One objective of the next phase of this study might be finding out how long it has taken to introduce the required standards for the use of flammable and mildly flammable refrigerants, specifically in China, Indonesia, Nigeria and Thailand, as this has been the main obstacle to smoother implementation. The actions taken with regard to those obstacles and the completion of the relevant conversion projects should also be examined, with special attention to safety, product quality, and sustainability issues.

123. The second phase of this study would benefit from greater insight into the projects for China, Indonesia, Nigeria and Thailand, for three reasons: they are all well advanced; they use alternatives that require specific standards not always in use in the countries; most of them have used innovative approaches that will shed additional light on the complexities and challenges of such conversions. Further study of the projects for the Islamic Republic of Iran and Lebanon may also be of interest because they were completed ahead of time and on time respectively, although the use of HFC-410A as the alternative may reduce the interest of their experiences somewhat. Additionally, the projects for Algeria, Bahrain and

Jordan show significant delays that seem unrelated to technical issues and thus may provide more understanding of administrative and other challenges for the timely implementation of conversion projects.

RECOMMENDATION

124. The Executive Committee may wish:

(a) To take note of the desk study on the evaluation of HCFC phase-out projects in the refrigeration and air-conditioning (RAC) manufacturing sector contained in document UNEP/OzL.Pro/ExCom/75/9; and

(b) To invite the bilateral and implementing agencies to apply, when appropriate, the findings and recommendations of the desk study on the evaluation of HCFC phase-out projects in the RAC manufacturing sector in the design and implementation of projects in this sector.

Annex I

TERMS OF REFERENCE FOR THE DESK STUDY OF THE EVALUATION OF REFRIGERATION AND AIR-CONDITIONING (RAC) MANUFACTURING PROJECTS

Background

1. At its 54th meeting, the Executive Committee approved guidelines for the preparation of HCFC phase-out management plans (HPMPs) and released funding in advance to the implementing agencies (IAs) to begin HPMP preparations[15]. The guidelines adopted a staged approach that allows for updates as new technologies are developed. Subsequently, at its 55th meeting the Executive Committee invited bilateral and IAs to prepare and submit proposals for demonstration projects for the conversion of HCFC in the RAC manufacturing sub-sectors to low-global warming potential (GWP) technologies to identify all the steps required and to assess their associated costs[16]. Following decision 55/43, four demonstration projects were implemented in various subsectors in China[17]. In addition, about fourteen countries submitted stand-alone investment projects and projects included in their HPMP to phase out HCFC-22 in several subsectors and applications in the RAC sector. Due to complicated technical issues involved, some of the investment projects also included technical assistance components.

Objective and scope

2. The desk study will provide background information on the progress made in the phasing-out of HCFC in the RAC manufacturing sector. It will examine projects in various RAC sub-sectors, namely: room air conditioning, commercial refrigeration, industrial refrigeration and air-conditioning (ICR) and will address issues related to low GWP alternatives. It may indicate areas and topics for a more in-depth, detailed evaluation, with concrete objectives and scope that could be useful for the implementation of RAC projects associated with stage II of HPMP.

3. The desk study will focus on the following:

Policy, legal and regulatory frameworks

4. The guidelines for preparing HPMPs encouraged countries to revise their licensing systems to accommodate the adjustments required by the phasing-out of HCFCs, to include a monitoring and control system as well as other policies activities to address HCFC in the RAC sector. The following issues will be addressed:

(a) Were existing policies reviewed to facilitate the phase-out of HCFCs in RAC sector and in the introduction of HCFC-free RAC technology? What actions were taken in the area of policies legislation and regulations?

(b) Were there new enforcement procedures and monitoring tools developed to control HCFC use in the sector as well as HCFC-based equipment imports?

(c) Were the policies and regulations including import/export legislations concerning the HCFC and HCFC-based equipment effective? How did the timing of legislation affect the projects?

[15] Decision 54/39.
[16] Decision 55/43.
[17] Conversion from HCFC-22 to ammonia/CO_2 technology in the manufacture of two-stage refrigeration system; conversion of room air-conditioning compressor manufacturing from HCFC-22 to propane; conversion from HCFC-22 technology to HFC-32 technology in the manufacture of commercial air-source chillers/heat pumps; and conversion from HCFC-22 to propane.

(d) How has energy efficiency been addressed relative to policies and regulations identified?

(e) Were there inspections and certification infrastructure, standardized technical testing, and enforceable technical standards for the alternative technology?

(f) Were there activities to assess standards and codes relevant to the RAC sector use of alternatives to HCFCs?

Technology–related issues

5. Using HCFC-free technology implies adopting innovating approaches leading to environmental benefits, but also overcoming barriers. The desk study will assess issues related to the use of low GWP technologies and alternatives and will address the following issues:

(a) Were there delays in project implementation and if so what were their causes?

(b) What was the role of demonstration projects in testing alternative technologies and facilitating the collection of accurate data on costs and application of the technologies and the conditions relevant for the introduction of the alternative technology in the country on a larger scale?

(c) How did projects deal with issues related to safety and flammability, high GWP and toxicity? Were there requirements for additional investments on safety equipment and systems? Were the various components needed available? How was the commissioning of equipment done?

(d) How did the international companies influence the adoption of the alternative technology? How did SMEs implement the phase-out process?

(e) What happened after project completion? How is the sustainability of the project being ensured? How is the project designed to guarantee and monitor sustainable outcomes?

(f) Were the manufacturing plant equipment destroyed, and, if not, why?

Technical assistance and awareness

6. Many project documents mention the need of improving the technical capacities of the RAC manufacturing enterprises in using alternative technology and in applying appropriate safety and security measures. The evaluation will assess the availability and use of updated information on technically and economically feasible alternative technologies that can be applied by local RAC manufacturers. It will examine the capacity building activities implemented by the project.

7. In some countries the users are not aware of the availability and benefits of the energy efficient variety of RAC technology. The evaluation will examine how technical assistance projects addressed awareness-related challenge. What awareness-raising strategy was used and what were the results? How did the RAC community changed following these activities? What was the role of professional refrigeration associations in helping with and disseminating information about the new technology?

Financing-related issues

8. The evaluation will examine, appropriately and to the degree possible, the information related to the incremental capital cost (ICC), the incremental operational costs (IOC) and sub-categories for implementing the project (comparing planned to actual costs); what was the cost-effectiveness of the

projects and whether there were any changes, when applicable; and determination of the split between energy costs and other operating costs when applicable.

9. The study will investigate the co-funding from enterprises for implementing the project and compare this to the planned co-funding. The desk study will draw lessons from co-funding experiences, in terms of both challenges and opportunities.

Post-sale servicing

10. The desk study will tackle issues related to *inter alia*, training, availability and affordability of spare parts and refrigerants, installation and post-sale costs issues, including market acceptance of the new product. How did the servicing sector manage with the introduction of low GWP alternatives?

Methodology and schedule of submission

11. The desk study will include an in-depth review of the existing documentation as well as the information gathered from interviews and discussions with members of the Secretariat, bilateral and IAs.

12. The findings from the desk study, as well as lessons learned and recommendations, will be presented to the Executive Committee for consideration at the 75th meeting. Further data collection and analysis may be needed, which will require field visits in a number of selected countries during the second stage of the evaluation.

13. A budget of US $12,000 was approved for this desk study component of the evaluation at the 73rd meeting[18].

[18] Decision 73/7(c), UNEP/OzL.Pro/ExCom/73/62.

Annex II

LIST OF PROJECTS INCLUDED IN THE STUDY

CONVERSION PROJECTS FOR THE RAC MANUFACTURING SECTOR

N°	Project	Agency	Title
1	ALG/PHA/66/INV/76 (Algeria)	UNIDO	HCFC phase-out management plan (stage I, first tranche) (conversion from HCFC-22 in the manufacture of room air conditioners at Condor)
2	ARG/REF/61/INV/163 (Argentina)	Italy	Phase-out of HCFC-22 in the room and unitary air-conditioning equipment manufacturing sector
3	ARG/REF/61/INV/164 (Argentina)	UNIDO	Phase-out of HCFC-22 in the room and unitary air-conditioning equipment manufacturing sector
4	ARM/PHA/62/INV/06 (Armenia)	UNDP	HCFC phase-out management plan (stage I, first tranche) (Conversion of Saga Ltd, commercial refrigerator appliances and cold rooms)
5	BAH/PHA/68/INV/27 (Bahrain)	UNIDO	HCFC phase-out management plan (stage I, first tranche) (phase-out of HCFC-22 from the manufacturing of central air-conditioning and window air-conditioning at Awal Gulf manufacturing company)
6	CPR/PHA/64/INV/512 (China)	UNDP	HCFC phase-out management plan (stage I, first tranche) (industrial and commercial refrigeration and AC sector plan)
7	CPR/PHA/64/INV/513 (China)	UNIDO	HCFC phase-out management plan (stage I, first tranche) (room air-conditioner manufacturing sector plan)
8	IDS/PHA/64/INV/193 (Indonesia)	UNDP	HCFC phase-out management plan (stage I, first tranche) (refrigeration sector plan) (Conversion from HCFC-22 to HFC-32)
9	IDS/PHA/64/INV/195 (Indonesia)	UNDP	HCFC phase-out management plan (AC sector plan) (stage I, first tranche)
10	IRA/PHA/63/INV/199 (Islamic Republic of Iran)	UNDP	HCFC phase-out management plan (stage I, first tranche) (AC sector plan)
11	JOR/REF/60/INV/86 (Jordan)	UNIDO	Phase-out of HCFC-22 and HCFC-141b from the manufacture of unitary air-conditioning equipment at Petra Engineering Industries Co.
12	JOR/PHA/65/INV/91 (Jordan)	IBRD	HCFC phase-out management plan (stage I, first tranche) (air-conditioning sector plan)
13	LEB/PHA/64/INV/74 (Lebanon)	UNDP	HCFC phase-out management plan (stage I, first tranche) (AC sector plan) (Conversion at Lematic s.a.l., to HFC-410A)
14	MEX/PHA/73/INV/172 (Mexico)	Germany	HCFC phase-out management plan (stage II, first tranche) (HC demonstration and training)
15	NIR/PHA/62/INV/129 (Nigeria)	UNIDO	HCFC phase-out management plan (stage I, first tranche) (Demonstration project for the production of hydrocarbon refrigerant (UNDP))
16	SYR/REF/62/INV/103 (Syrian Arab Republic)	UNIDO	Phase-out of HCFC-22 and HCFC-141b from the manufacture of unitary air-conditioning equipment and rigid polyurethane insulation panels at Al Hafez Group
17	THA/PHA/68/INV/162 (Thailand)	IBRD	HCFC phase-out management plan (stage I, first tranche) (residential air-conditioning group project)
18	TUN/PHA/72/INV/57 (Tunisia)	France	HCFC phase-out management plan (stage I, first tranche) (residential air-conditioning manufacturing sector plan)
19	YUG/PHA/62/INV/38 (Serbia)	UNIDO	HCFC phase-out management plan (stage I, first tranche) (Phase-out of HCFC used in manufacturing refrigeration and air-conditioning equipment)

Note: only the first tranche is presented for projects with multiple tranches approved (China, Indonesia, Islamic Republic of Iran, Lebanon, Nigeria, Thailand and Tunisia)

DEMONSTRATION PROJECTS FOR THE RAC MANUFACTURING SECTOR

Project	Agency	Title
ASP/REF/69/DEM/56 (Asia region)	UNEP	Promoting low-global warming potential refrigerants for air-conditioning sectors in high-ambient temperature countries in West Asia
ASP/REF/69/DEM/57 (Asia region)	UNIDO	Promoting low-global warming potential refrigerants for air-conditioning sectors in high-ambient temperature countries in West Asia
CPR/REF/60/DEM/498 (China)	UNDP	Demonstration project for conversion from HCFC-22 technology to HFC-32 technology in the manufacture of commercial air-source chillers/heat pumps at Tsinghua Tong Fang Artificial Environment Co. Ltd. (Tong Fang for short)
CPR/REF/60/DEM/499 (China)	UNDP	Demonstration project for conversion from HCFC-22 technology to ammonia/CO2 technology in the manufacture of two-stage refrigeration systems for cold storage and freezing applications at Yantai Moon Group Co. Ltd. (Yantai Moon for short)
CPR/REF/61/DEM/502 (China)	UNIDO	Demonstration sub-project for conversion of room air-conditioning compressor manufacturing from HCFC-22 to propane at Guangdong Meizhi Co. (Meizhi for short)
CPR/REF/61/DEM/503 (China)	UNIDO	Demonstration sub-project for conversion from HCFC-22 to propane at Midea Room Air-conditioning Manufacturing Company (Midea for short)

Annex III

OVERVIEW OF PROJECTS INCLUDED IN THE STUDY

CONVERSION PROJECTS

N°	Project	Agency	Alt	Status	Approved Duration	Actual Duration	Delay	Ongoing Duration	Ongoing Delay	Disb. Rate (*)
					Months					
1	ALG/PHA/66/INV/76	UNIDO	HFC-32	ONG	12			38	26	0.45%
2	ARG/REF/61/INV/163	Italy	NA	ONG	37			59	22	40.67%
3	ARG/REF/61/INV/164	UNIDO	HFC-410A	ONG	36			59	23	72.40%
4	ARM/PHA/62/INV/06	UNIDO	HC-290	COM	24	36	12			100.00%
5	BAH/PHA/68/INV/27	UNIDO	HFC-410A/ HFC-32	ONG	24			30	6	1.41%
6	CPR/PHA/64/INV/512	UNDP	HFC-410A/ HFC-32	FIN	12	29	17			100.00%
7	CPR/PHA/64/INV/513	UNIDO	HC-290/ HFC-161	ONG	12			47	35	90.00%
8	IDS/PHA/64/INV/193	UNDP	HFC-32	ONG	20			47	27	86.91%
9	IDS/PHA/64/INV/195	UNDP	HFC-32	ONG	20			47	27	0.00%
10	IRA/PHA/63/INV/199	UNDP	HFC-410A	FIN	47	32	-15			100.00%
11	JOR/REF/60/INV/86	UNIDO	HFC-410A	ONG	18			62	44	69.14%
12	JOR/PHA/65/INV/91	IBRD	HFC-410A	ONG	24			43	19	0.00%
13	LEB/PHA/64/INV/74	UNDP	HFC-410A	FIN	24	24	-			100.00%
14	MEX/PHA/73/INV/172	Germany	HC-290	ONG	25			7		0.00%
15	NIR/PHA/62/INV/129	UNIDO	HC-600 and HC-290	COM	12	36	24			68.00%
16	SYR/REF/62/INV/103	UNIDO	HFC-410A	ONG	31			54	23	9.22%
17	THA/PHA/68/INV/162	IBRD	HFC-32	ONG	11			30	19	0.00%
18	TUN/PHA/72/INV/57	France	HFC-32	ONG	36			13		0.00%
19	YUG/PHA/62/INV/38	UNIDO	R-717 / HFC-410A HC-290	ONG	24			54	30	41.97%

(*) Disbursement rate in MF inventory of projects

Note: only the first tranche is presented for projects with multiple tranches approved (China, Indonesia, Islamic Republic of Iran, Lebanon, Nigeria, Thailand and Tunisia, etc.)

DEMONSTRATION PROJECTS

N°	Project	Agency	Alt	Status	Approved Duration (months)	Actual Duration (months)	Delay (months)	Ongoing Duration (months)	Ongoing Delay (months)	Disb. Rate (%)
1	ASP/REF/69/DEM/56	UNEP	NA	ONG	15			26	11	34.53
2	ASP/REF/69/DEM/57	UNIDO	Several	ONG	14			26	12	4.04
3	CPR/REF/60/DEM/498	UNDP	HFC-32	ONG	18			62	44	98.38
4	CPR/REF/60/DEM/499	UNDP	Ammonia/CO_2	ONG	18			62	44	100.00
5	CPR/REF/61/DEM/502	UNIDO	Propane	COM	26	41	15			89.29
6	CPR/REF/61/DEM/503	UNIDO	Propane	ONG	26			59	33	69.30

BRIEF PROGRESS UPDATE AS OF 75TH EXECUTIVE COMMITTEE MEETING

CONVERSION PROJECTS

N°	Project	Progress
1	ALG/PHA/66/INV/76	No update
2	ARG/REF/61/INV/163	No update
3	ARG/REF/61/INV/164	No update
4	ARM/PHA/62/INV/06	An action plan was developed to contact SAGA to start project cancellation.
5	BAH/PHA/68/INV/27	No update
6	CPR/PHA/64/INV/512	No update
7	CPR/PHA/64/INV/513	No update
8	IDS/PHA/64/INV/193	Completed in 2014. During the year 2014, project implementation was undertaken satisfactory in large beneficiary enterprises.
9	IDS/PHA/64/INV/195	During the year 2014, project implementation was undertaken satisfactorily in large beneficiary enterprises.
10	IRA/PHA/63/INV/199	Financially completed in 2013. (*)
11	JOR/REF/60/INV/86	Some delays occurred during the production of the heat exchangers by the supplier, but the situation was solved. Equipment installed in March 2015. Contract prepared and signed for final IOC payment.
12	JOR/PHA/65/INV/91	No update
13	LEB/PHA/64/INV/74	Financially completed in 2013
14	MEX/PHA/73/INV/172	No update
15	NIR/PHA/62/INV/129	No update
16	SYR/REF/62/INV/103	For the time being, any activity involving the procurement and delivery of equipment in the company's facilities is not possible due to the situation in the country. Prototype units working on R410A selected.
17	THA/PHA/68/INV/162	No update
18	TUN/PHA/72/INV/57	Agreement AFD/UNIDO signed in Jan 2015 and all funds have been transferred to UNIDO for implementation. Technical assistance activities are ongoing for the participating companies.
19	YUG/PHA/62/INV/38	Conversion of 2 enterprises has been completed and technology fully committed.

N°	Project	Progress
		Train the trainer component was achieved in parallel with the up-date of the policies and regulations on the certification system.

(*) Note by the implementing agency: Please note that the project is still under implementation and the final milestones would be completed by end of the year 2015. Please note that these projects are sectoral and/or have funding disbursed over multiple tranches.

DEMONSTRATION PROJECTS

N°	Project	Progress
1	ASP/REF/69/DEM/56	No update
2	ASP/REF/69/DEM/57	Prototypes are being built and are undergoing preliminary tests at respective OEM testing sites. Testing on prototypes commenced in July 2015. Continuous process, until all prototypes have been tested: receiving sample refrigerants, compressors; building of prototypes; shipment of prototypes to testing facility.
3	CPR/REF/60/DEM/498	No update
4	CPR/REF/60/DEM/499	No update
5	CPR/REF/61/DEM/502	Project will be financially completed upon clearance of all obligations.
6	CPR/REF/61/DEM/503	No update

Annex IV

ASPECTS FOR ADOPTION OF ALTERNATIVES IN SELECTED COUNTRIES

Project	Alternative	Aspects for adoption of alternative
ALG/PHA/66/INV/76	HFC-32	HFC-410A chosen initially due to: • Lower LCCP than HCFC-22 giving it a positive climate impact; • Speedy application to meet the 2015 reduction step because of the availability of kits; • Reasonable incremental capital cost: a relatively limited conversion of tools and equipment is needed; • Affordable component and refrigerant gas prices that limit the incremental operating cost; • Market acceptability as some foreign companies and governmental institutions in Algeria are already specifying it in their project requirements.
IDS/PHA/64/INV/193 and IDS/PHA/64/INV/195	HFC-32	HFC-410A chosen initially due to: • Proven and reasonably mature technology • End-product properties and performance should be maintained • Cost-effective conversion with minimal disruption of current manufacturing operations • Compliance with established local and international standards for health safety and environment • Low overall direct and indirect CO2-equivalent emissions • Implementable in a relatively short time frame
THA/PHA/68/INV/162	HFC-32	HFC-410A chosen initially due to: • HFC-410A was originally chosen due to wide market presence, and acceptability, proven and trusted technology, and availability of parts at competitive prices. • On this basis, all the domestic residential air-conditioner manufacturers have originally requested assistance to convert to R-410A technology.
TUN/PHA/72/INV/57	HFC-32	HFC-410A chosen initially due to: • Market availability of alternatives is very limited in the Tunisian market; the two only companies in this sector which have moved away from HCFC-22 systems (Société SICAD Coala and New Tabrid Company) have both started working with HFC-410A. Other companies in the sector which are considering phase-out of HCFC-22 in their production processes have taken such conversions as an example to follow, due to the fact that both companies are major players in the Tunisian market. • In this context, consideration of alternatives other than HFC-410A will require a significant degree of technical assistance in order to familiarize companies in the sector with alternatives other than HFC-410A.

Annex V

COMPARISON OF PLANNED VERSUS ACTUAL COSTS

Tong Fang (CPR/REF/60/DEM/498)

Item	Type	Inventory (Allocated funds)	Original proposal	Completion report
C1	ICC	552,928	905,050	830,344
C2	IOC*	676,408	904,445	
C3	Contingency		90,505	
C4	Total1 (C1+C2+C3)	1,229,336	1,900,000	830,344
C5	Counterpart			96,814
C6	Total2 (C4-C5)		1,900,000	733,530
C7	Local ownership		100%	
C8	Requested grant (~C6*C7)		1,900,000	

* IOC to be disbursed in the following two years, only ICC disbursed so far

Yantai Moon (CPR/REF/60/DEM/499)

Item	Type	Inventory (Allocated funds)	Original proposal	Completion report
C1	ICC	2,847,668	3,150,442	4,188,630
C2	IOC*	1,116,790	1,207,300	
C3	Contingency		315,044	
C4	Total1 (C1+C2+C3)	3,964,458	4,672,786	4,188,630
C5	Counterpart		392,786	1,697,694
C6	Total2 (C4-C5)		4,280,000	2,490,936
C7	Local ownership		100%	
C8	Requested grant (~C6*C7)		4,280,000	

* IOC to be disbursed in the following two years, only ICC disbursed so far

Meizhi (CPR/REF/61/DEM/502)

Item	Type	Inventory (Allocated funds)	Original proposal	Completion report
C1	ICC	1,875,000	3,762,527	3,398,093
C2	IOC*			
C3	Contingency		333,628	
C4	Total1 (C1+C2+C3)	1,875,000	4,096,155	3,398,093
C5	Counterpart			1,523,093
C6	Total2 (C4-C5)		4,096,155	1,875,000
C7	Local ownership		60%	
C8	Requested grant (~C6*C7)		2,543,685	

Midea (CPR/REF/61/DEM/503)

Item	Type	Inventory (Allocated funds)	Original proposal	Completion report
C1	ICC	2,514,507	3,842,156	3,938,004
C2	IOC*	1,512,000	2,140,000	
C3	Contingency		333,323	
C4	Total1 (C1+C2+C3)	4,026,507	6,315,479	3,938,004
C5	Counterpart			1,554,037
C6	Total2 (C4-C5)		6,315,479	2,383,967
C7	Local ownership		80%	
C8	Requested grant (~C6*C7)		5,102,304	

* IOC to be disbursed in the following two years, only ICC disbursed so far

Annex VI

COMPARISON OF PLANNED VERSUS ACTUAL COSTS OF SPECIFIC ITEMS (CASE OF MIDEA)

Conversion details	Budget (USD)	Budget (USD) *	Actual cost (USD)	MLF financing (USD)	Company co-financing (USD)	Remarks
Assembly line relocation	117,000	117,000	227,302	140,400	86,902	The beneficiary has installed a new line, instead of converting the original one. This was the main reason for the higher costs. 20 per cent beyond the budget was compensated in line with existing MLF rules
Antistatic floor and ground circuit in the hazardous areas						
Power distribution explosion-proof modification for the production line variable frequency power supply						
Nitto quick coupling for the products						Additional items purchased that were required. 275 units of quick couplings were purchased for charging to avoid leakage. Frequency power supply was required since various countries have various needs and the tests have to be made accordingly
Function test units adjusted to the properties of HC-290 (including electrical safety tester and new quick connectors)	85,000	85,000	99,365	85,000	14,365	30 test units, difference less than 20 per cent
New refrigerant charging machines (including the transportation pump in the storage room)	100,000	320,000	352,143	320,000	32,143	Difference less than 20 per cent
Gas detection (included in the safety system)	-					
Safety ventilation system for HC-290-based RAC production line	80,000					
Safety alarm system for HC-290-based RAC production line and HC-290 storage room	140,000					
Ex-proof R290 storage room	32,961	32,961	59,841	32,961	26,880	The beneficiary installed a bigger storage room than required for the one line in order to cater for the needs of additional HC-290 lines in future. 20 per cent beyond the budget was compensated in line with MLF rules
New storage tank for HC-290 and New HC-290 pipeline installation for the production line and HC-290 storage room	64,039	64,039	132,698	76,847	55,851	
Ex-proof vacuum pumps	-	-	88,198	-	88,198	Not eligible item
Vacuum meter						
Vacuum measuring system modification						
He leak testing system	32,000	32,000	74,444	38,400	36,044	The budget approved was not sufficient and in future higher cost should be approved for a He leak testing system. 20 per cent beyond the budget was compensated in line with MLF rules

Conversion details	Budget (USD)	Budget (USD) *	Actual cost (USD)	MLF financing (USD)	Company co-financing (USD)	Remarks
New portable HC-290 detectors for production line/test room/storage and new helium leak detector for heat exchanger	80,000	80,000	83,200	80,000	3,200	Difference less than 20 per cent
Lokring sealing machine	60,000	60,000	11,762	11,762	-	
Conversion of various parts of the high speed fin press and its stacker, fixtures and parts	103,700	417,850	1,646,337	459,635	1,186,702	The production capacity of the heat exchanger was about 330,000 unit per year (before and after conversion), while the converted production line had a capacity of only 200,000. For this reason, the approved budget was reduced according to the line capacity. However, the conversion of the heat exchanger producing equipment had to be done for the original full capacity (330,000 units) and thus, costs were consequently higher.
Procurement of moulds for fin press	314,150					
Conversion of the Ø9.52-sized hair pin bending machine to Ø5-sized one, new tools.	24,000	24,000	62,698	24,000	38,698	
Conversion of the Ø9.52-sized connection curve bending machine to Ø5-sized one, new tools.	12,000	12,000	18,651	12,000	6,651	
Conversion of the Ø9.52-sized cutting machine to Ø5-sized one, new tools.	15,000	15,000	23,810	15,000	8,810	
Conversion of the Ø9.52-sized CNC tube bending machine to Ø5-sized one, new tools	16,000	16,000	21,746	16,376	5,370	
Conversion of the Ø9.52-sized automatic tube end processing machine to Ø5-sized ones, new tools	13,000	13,000	10,397	10,397	-	
For small diameter of tube	198,250	332,450	660,317	332,450	327,867	
For small diameter of tube	134,200					
For small diameter of tube	20,000	20,000	19,381	19,381	-	
New cleaning machine for Ø5-sized tubes	18,000	18,000	18,730	18,730	-	
Explosion-proof modification of the function test	20,000	259,000	326,984	284,900	42,084	Actual costs confirm that the original budget was somewhat underestimated. For this reason, 10 per cent beyond the budget was compensated in line with existing MLF rules.
Capacity test unit suitable for HC-290 RAC	159,000					
Life test units suitable for HC-290 RAC	80,000					
Ex-proof recovery stations for HC-290	10,000	10,000	see remarks			Will be additional costs and are required as eligible items

- Aggregated budget

Annex VII

OTHER SOURCES FOR CO-FUNDING

PROJECT	PLANNED
CPR/PHA/64/INV/513	• FECO has recently started the implementation of a GEF project related to the RAC sector. Some non-investment technical assistance components (e.g. modification of training curricula, awareness programme etc.) of this project will be implemented in such a way that their outcome would give benefits the aims of this HPMP. • FECO in cooperation with GIZ is finalizing a project introducing HC technology at a RAC manufacturer in China. This project will also help to collect experience using this new technology and promote its early penetration into the industry. It will also contribute to the introduction to the market of HC based RAC products.
JOR/PHA/65/INV/91	• Jordan Renewable Energy Efficiency Fund (JREEF - investment). US$40 million credit line for investments in clean energy, including for scaling up EE in residential, commercial and industrial sectors with assistance from GEF, World Bank and AFD. Technical support would be available to the sector, including non-eligible enterprises. • GEF/UNDP Energy Efficiency Standards and Labelling project (TA). US$2 million ($1 million GEF) to reduce GHGs from energy consumption in appliances by transforming the market through energy labels and minimum energy performance standards. Energy labelling for AC is in effect as of July 2011. • USAID Energy Efficiency Program (Energy Efficiency Regulatory Incentive Mechanism for Jordan). US$29 million – 2012 up to total $77 million over ten years to encourage fast deployment of EE measures through the electricity transmission and distribution companies. Testing laboratory for AC benchmarking, testing and enforcement is currently being procured.
LEB/PHA/64/INV/74	• Currently, the GEF-V programming cycle is underway and the country is exploring possibilities to seek GEF financing for energy efficiency improvements in the refrigeration and air conditioning sectors, for a project to be developed and submitted during 2012.
MEX/PHA/73/INV/172	• In view of the urgency of phasing out the most potent ozone-depleting HCFC, the Government and UNIDO are seeking funding from two sources to assist Whirlpool Mexico to phase out over 1,700 MT of HCFC-141b: GEF; NAMA*
THA/PHA/68/INV/162	• For a conducive environment for adoption of more energy-efficient but also more expensive air-conditioning appliances, it was agreed to pair the development and implementation of the group air-conditioning investment component of the Stage I HPMP, as well as the proposed associated TA (promotion of non-HCFC based RAC equipment in green buildings) with the proposed GEF “green energy for low-carbon growth” in Thailand project. The proposed US$10 million in GEF funds is hoped to leverage another US$20-25 million from the Government of Thailand.

* The NAMA (Nationally Appropriate Mitigation Actions) Facility is a joint programme of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the UK Department of Energy and Climate Change (DECC), the Danish Ministry of Climate, Energy and Building (MCEB) and the European Commission.