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DESK STUDY ON THE EVALUATION OF HCFC PHASE-OUT PROJECTS IN THE FOAM SECTOR

I. Executive Summary

1. The main objective of the evaluation is to analyze the progress made in phasing-out HCFCs in the foam sector for projects in stage I of HPMPs of Article 5 countries funded by the Multilateral Fund. For the purposes of the analysis all the Article 5 countries having foam sector projects were divided into groups, based on the levels of their baseline HCFC consumption. The baseline HCFC consumption of the 46 countries ranges from 1.4 ODP tonnes (Mongolia) to 19,269 ODP tonnes (China).

Main findings

2. The project preparatory phase took longer than planned, up to 53 months instead of 16 months as maximum estimated. This could have an impact on the completion of investment projects needed to phase out HCFCs to meet compliance obligations in 2013 and 2015.

3. As of September 2014, 23 per cent of the stand-alone investment projects approved in advance to the HPMPs had been completed in 30 per cent of the countries, phasing out 18 per cent of the total HCFC consumption of 612 ODP tonnes targeted to be phased out by these projects. The overall impact of such projects on HCFC reductions in advance to the 2013 freeze and the 10 per cent reduction by 1 January 2015 may, therefore, be considered to be so far moderate. However, HCFC phase-out to be achieved through these projects, even if completed after 2014, is expected to contribute to convert in permanent HCFC reductions initially achieved through licensing and quota systems.

4. Ten demonstration and systems house projects (eight in polyurethane (PU) and two in extruded polystyrene (XPS)) approved at a total cost of US $6.4 million, had an impact in the evaluation, validation and use of some new and emerging technologies and in demonstrating efficacy of widely used technology, such as the hydrocarbon (HC) technology, in new production circumstances in Article 5 countries. The impact of demonstration projects varied from country to country and among alternatives to HCFC. For example methyl formate and methylal is already being used by several enterprises in some applications in Mexico; and may need further optimization in other applications; pre-blended polyols with

cyclopentane is an alternative successfully demonstrated in China and Egypt, while the use of supercritical CO_2 in spray foam was found technically feasible under different climatic conditions in a demonstration project in Colombia. Concerning HFC-245fa, the technology did not appear to be of much utility because it high cost and high-global warming potential (GWP). In the XPS foam sector the use of HFO-1234ze raises several caveats with regard to system processability, foam properties and conversion costs. The demonstration project on carbon dioxide (CO_2) co-blowing with methyl formate that is implemented in China has been recently completed and results reported to the present meeting.

5. The demonstration projects have also helped to identify areas of the use of the chemicals that may need further study or special precaution during use.

6. About 60 per cent of the foam activities submitted within stage I of HPMPs was approved in the year 2011. The PU foam is the predominant sector consisting mostly of various rigid PU foam applications and integral skin foam and shoe soles in a few countries. Out of the total amount of US $182.2 million approved in foam projects, the PU foam sector accounted for US $142.7 million (78 per cent) to phase out 1,682 ODP tonnes of HCFC-141b (88 per cent of total HCFC being phased out in foam projects). At the end of June 2014, 38 out of estimated 1,056 currently assisted enterprises (including small and medium-sized enterprises (SMEs)) had completed their conversions. This data does not include completed projects in China where 11 of the 30 enterprises in the first tranche of China's PU foam sector plan that were converting to water-blown technology have completed their projects and have stopped the use of HCFC-141b as of 4 July 2014 (ahead of scheduled date of 9 December 2015).

7. Decision 54/39(i)(ii) of the Executive Committee influenced the role of industry associations. In many countries they play a leading role in the HCFC-phase-out and are a source of collective expertise and a conduit to the SMEs. China and Thailand are two examples on this subject. Furthermore, decision 54/39 encouraged countries to strengthen their institutional capacities and licensing and quota systems, which appears to have aided the reductions in consumption of HCFC.

8. One common reason for delays in project implementation is the time that it takes for the implementing agency to sign the initial project document or the memorandum of understanding (MOA) or grant agreement with the government. Causes of such delay could be political or administrative problems on the side of the recipient government, such as changes in departments or ministries, delay in appointing the ozone officer or in organizing the project management unit. Other causes of delay could be site preparation to accommodate the new technology and the ability of some beneficiary enterprises to raise the required counterpart funding, in particular for smaller enterprises introducing HCs.

Conclusions

9. In implementing decision XIX/6/11(a), in particular in prioritizing the phase out of HCFC-141b in the foam sector, the Executive Committee has agreed on the following:

(a) Establishment of rules and guidelines to aid the phase-out of HCFCs in the long term (decision 60/44);

(b) Funding of institutional capacity building and regulatory activities in Article 5 countries in support of HCFC phase-out, including in the foam sector;

(c) Funding of the preparation and implementation of HPMPs and investment activities that gave priority to the phase-out of HCFCs in the foam sector;

(d) Funding of investment projects for the phase-out HCFCs in the foam sector, including demonstration projects to enhance the technological capacity of Article 5 countries to phase out the HCFCs as well as funding investment projects in advance of the completion

of the HPMPs to facilitate more rapid HCFC phase-out; and

(e) Funding of investment projects for the phase-out HCFCs in the foam sector for enterprises that consume HCFC-141b contained in imported pre-blended polyols systems not reported as consumption under Article 7 (decision 61/47).

10. The first two non-investment activities have been a success, so to a great extent has been the investment of the amount of US $6.4 million in demonstration projects to develop, optimize and validate a number of emerging HCFC phase-out technologies to enhance the availability of phase-out technologies to all scales of foam production.

11. The implementation of the investment projects is ongoing, and in several countries has taken longer than initially envisaged. This could be partly due to time spent by countries to establish or strengthen their institutions for the uptake of the investment activities. In the XPS foam sector two of the projects approved in 2010 – one for Saudi Arabia and a group project for Turkey – are due to be completed in December 2014. These projects need to be kept in view and probably evaluated in early 2015 to determine what progress has been achieved and whether difficulties with conversion technologies in the sector would continue to be a factor against timely HCFC phase-out. There will be the need to evaluate some of projects including polyurethane (PU) foam projects in India and other countries, especially those with specific reduction commitments; to what extent the projects have met the scheduled phase-out deadlines.

12. With regard to the demonstration projects, further work to resolve outstanding issues relating to the use of methyl formate, methylal, pre-blended HCs and others will enhance their wider penetration of the foam industry and further assist small and medium scale foam producers. Although Article 5 countries in South East Asia (Indonesia, Thailand) which appear to prefer HFC-245fa as interim alternatives for some PU rigid foam applications in their stage I of HPMPs may need to revisit those applications in the wake of recent developments in hydrofluoroolefin (HFO) LBAs and developmental activities in HFO blowing agents that have been approved for India and Malaysia. The systems houses in India are reported to have signed Memoranda of Agreement (MOA) and in the process of researching and developing new formulations using HCFC-free blowing agents, mainly HFOs. Projects approved for use of HFC-245-fa could be brought up for review for a determination to be made with regard to their implementation.

13. With regard to demonstration projects that may require additional assistance, the following could be considered. With regard to HC-pre-blended polyols there is need to explore possibility of exporting HC-pre-blended polyols or systems from one country to another to make them available to a wider market.

14. The 2015 field evaluation could also be specifically tasked to collect cost data based on actual expenditure and purchase documents to facilitate more reliable assessment of incremental costs for stage II HPMP activities.

II. Background

15. As at 1 January 2010[1], with the assistance of the MLF, Article 5 countries had phased out the consumption of 65,626.7 ODP tonnes of CFCs used in the foam sector. As a result an estimated 12,550 tonnes equivalent to 1,380.5 ODP tonnes of HCFC-141b were phased in as an ODS replacement chemical requiring secondary or second stage phase -out in the rigid and integral skin PU foam sub-sector. In the polyethylene and polystyrene foam sub-sector the amount of HCFC-142b and HFC-22 phased in was negligible, being less than 2 per cent of the CFC-12 phased out. The amounts of CFCs

[1] All Article 5 Parties to the Montreal Protocol were expected to phase-out the production and consumption of CFCs by 1 January 2010.

phased out and correspondingly the HCFCs phased in are based only on the average consumption of the enterprises as reported in project proposals at the times of their approval and do not factor in growth in consumption.

16. In the same year (2010), all Article 5 countries (147) reported a total HCFC consumption of 37,148.1 ODP tonnes. Only about 40 per cent (58 of the countries) reported HCFC consumption above 20 ODP tonnes and about 15 per cent (23 of the countries) reported consumption exceeding 100 ODP tonnes. The large increase in the HCFC consumption can be attributed, *inter alia*, to expansion of previously funded enterprises and new enterprises established between the cut-off dates of 25 July 1995 for CFC phase-out funding eligibility and 21 September 2007 for HCFC phase-out funding eligibility including new XPS foam board manufacturing plants.

17. Several HCFC alternatives are available to replace HCFC-141b and HCFC-142b and/or HCFC-22 in PU and XPS foam manufacturing respectively. For the PU foam sub-sector, these include high-GWP HFCs as well as low-GWP alternatives such as HC technology which over the years has undergone optimization resulting in improvements in thermal performance, modified water blown formulations, which have become more widely used over the last few years, supercritical CO_2, and other emerging technologies based on oxygenated hydrocarbons (HCOs) which include methyl formate and methylal and HFOs also called unsaturated HFCs.

18. For the XPS sector CO_2 has been the main low-GWP alternative blowing agent and CO_2 co-blown with ethanol. Dimethyl ether (DME) and in particular, emerging gaseous unsaturated HFCs such as HFO-1234ze has significant prospects to replace HCFC-142b and HCFC-22 and even CO_2 which poses some processing and performance difficulties.

19. The phase-out process in this sector presents several particularities. Among these are the problems that arise in relation to the adoption of alternatives and emerging new technologies. Some of the problems that limited the use of HC technology to only larger foam producing enterprises still persist. These include lack of global availability of HC pre-blended systems, flammability risks that result in high cost of safety measures thus constraining its use by small enterprises that lack economies of scale. Other issues generally relate to lack of availability, high cost, and limited technical capacity to absorb the new technology. Other issues are related to the characteristics of the substances. For example, while HFCs do not contribute to ozone depletion, they have a significant GWP, which precludes their use as viable permanent solution given the presumption against their use as alternatives as dictated by Decision XIX/6.

20. The choice of alternatives also depends on the specific country context in which the phase-out takes place as well as foam production scale, supply infrastructure and application. In some countries there are systems houses and/or chemical enterprises specialized in bulk pre-blending of foam systems for distribution and sale to foam manufacturers, thus, making the transition to new technologies easier, while other enterprises may have to source their materials outside the country and could be affected by external commercial pressures and influences. On account of scale of production and/or type of product/foam application some enterprises have to install in-house premixing stations. To avoid the need to invest in in-house premixing station, enterprises especially, small and medium-scale (SMEs) ones prefer to purchase already commercially pre-formulated polyols from the systems houses or from chemical suppliers. A large number of enterprises use pre-blended polyols, either produced or imported from other countries.

21. It was acknowledged[2] that during the phase-out of CFC-11 in the foam sector systems houses played a key role in the market penetration of HCFC-141b as alternative blowing agent to CFC-11 in several Article 5 countries. Funding was provided to a limited number of systems houses for producing

[2] Revised analysis of relevant cost considerations surrounding the financing of HCFC phase-out (decisions 53/37(1) and 54/40), A policy paper submitted by the Fund Secretariat to the 55th meeting of the Executive Committee.

suitable non-CFC-based premixed polyols as well as for providing technology transfer and training for downstream rigid and integral skin foam manufacturers. For the next stage of phasing out the use of HCFC-141b in that sub-sector, it was considered essential to engage and support systems houses more broadly in the validation and optimization of new and emerging technologies for downstream foam producers through pilot and demonstration projects approved and implemented in good time to assist in the HCFC phase-out process. Since these activities should improve the availability of optimized foam systems based on pre-blended polyols they would facilitate the uptake of the alternative technologies in Article 5 countries, especially among SMEs.

Objectives

22. The main objective of the evaluation is to analyze the progress made in phasing-out HCFCs in the foam sector for projects in stage I of HPMPs of Article 5 countries funded by the MLF. The evaluation focuses on the challenges encountered during project implementation and identifies lessons learned for stage II of HPMPs. It is organized in two stages, a desk study and a series of case studies for various countries. This document includes finding of the desk study.

23. The desk study examined the existing documentation on project implementation in the foam sector. For the purposes of the analysis all the Article 5 countries having foam sector projects were divided into groups as indicated in Table 1 below, based on the levels of their baseline HCFC consumption. The baseline HCFC consumption of the 46 countries ranges from 1.4 ODP tonnes (Mongolia) to 19,269 ODP tonnes (China). The list of the countries in each group is in Annex I to this report.

Table 1: Article 5 countries with approved HCFC phase-out projects in the foam sector

Group	Range of HCFC baseline consumption (ODP tonnes)	Description of countries	Number of countries	Total 2012 HCFC consumption (ODP tonnes)	Total baseline consumption (ODP tonnes)	Average baseline consumption (ODP tonnes)
1	Over 5,000	Very high-volume HCFC consuming	1	21,094.7	19,269.0	19,269.0
2(a)	1,000-5,000	High-volume HCFC consuming – Sub-Group A	4	6,067.4	5,553.0	1,388.3
2(b)	250-1,000	High-volume HCFC consuming – Sub-Group B	10	5,395.0	4752.8	475.3
2(c)	25-250	High-volume HCFC consuming – Sub-Group C	17	1,912.5	866.5	66.7
3	Less than 25	Low and very low-volume HCFC consuming	14	158.7	150.8	10.1
TOTAL			**46**	**34,635.0**	**31,477.3**	

24. The review of the available information showed that 46 countries have approved foam sector projects, mainly in the PU foam sector, broken down as follows:

Investment and demonstration projects

(a) Thirty six countries had projects in the PU foam sector identified during the preparation of their HPMPs and approved as components of stage I of the HPMPs;

(b) Only three countries had projects in the XPS foam sector prepared and approved as components of stage I of the HPMPs;

(c) Fourteen countries had projects in the PU foam sector prepared and approved for implementation in advance of their HPMP and later included in the HPMP during its approval;

(d) Two countries had projects in the XPS foam sector prepared and approved for implementation in advance of the approval of their HPMPs and later included in their HPMPs; and

(e) Ten demonstration, pilot, and systems or technology validation projects (hereafter referred to as demonstration projects), eight in the PU sector and two in the XPS foam sector, were approved for implementation in six countries as global demonstration projects.

III. Main issues identified during the desk study

Preparatory phase

25. A review of existing documents shows that a period of 12 months following approval of HPMP preparation funding had been anticipated as the duration for preparing the HPMPs. The 12-month duration is assessed on the basis of the estimated duration provided in the requests made by the IAs to the 55th meeting of the Executive Committee in their work programme amendments[3].

26. Given that it is required to submit the HPMP and its stage I document 14 weeks prior to the meeting at which the document is to be considered, the duration for the preparation activity itself, when taken with reference to the Executive Committee meetings, would be fifteen and a half months or approximately sixteen months.

27. The actual time of the HPMP development for the countries [4] in the sample ranged from 28 to 53 months. Except for a few countries e.g. Nigeria (28 months) and Swaziland (29 months) many countries had their HPMP and stage I completed and approved, including agreement in a period of about three years or longer.

28. The effect of late approval of HPMPs relative to the transition period could, thus, cascade into late completion of the investment projects needed to phase out HCFCs to meet compliance obligations. Thus the foam projects in the first tranches of most countries were also approved much later than would have been required to have the desired impact. Even countries such as India, Malaysia, Mexico and others which had been earlier funded to carry out HCFC surveys also took three years or longer to complete the HPMP preparation and approval process

Table 2. Duration from HPMP preparation funding approval to Executive Committee approval of HPMP and stage I

Duration for China (Group 1):	36 months
Average period for sample of Group 2(a) countries:	41.5 months
Average period for sample of Group 2(b) countries:	41.7 months
Average period for sample of Group 2(c) countries	41.5 months
Average period for sample of Group 3 countries:	34.5 months

Investment projects approved in advance of completion of HPMPs

29. Decision 54/39 (d)(i) makes provision for countries that wished to submit investment projects for implementation in advance of the submission of their HPMPs. Such projects were expected to result in a

[3] Documents UNEP/OzL.Pro/ExCom/55/19 Add.1 and Add.2; UNEP/OzL.Pro/ExCom/55/21 and Add.1 Add.2; UNEP/OzL.Pro/ExCom/55/22 Add.1 and Add.2: Amendments to the Work Programmes for 2008 of UNDP, UNIDO and the World Bank respectively.

[4] Measured from the date of approval of the HPMP preparation funds to the date of approval of the HPMP document and its stage I implementation programme as well as Executive Committee's agreement with the respective Governments.

phase-out of HCFCs to count against the eligible consumption identified in the HPMP. These stand-alone could only be submitted until 2010, after which all submitted projects should be part of an HPMP. The purpose of this decision was primarily to enable countries to undertake investment projects that would contribute to meeting the freeze in their consumption at the baseline in 2013 and 10 per cent reduction by 2015. An overview of the stand-alone projects approved for the foam sector is presented in Table 3.

Table 3: Summary of stand-alone investment or group of investment projects approved in advance of HPMPs

Sector	Countries	Enter-prises	Projects completed	Projects ongoing*	Total project cost (US $)	HCFC to be phased out (ODP tonnes)	HCFC to be phased out (mt)	HCFC phased out (ODP tonnes)	HCFC phased out (mt)	Approval date range	Target phase-out date range
PU foam	15	43	11	32	27,488,117	460	4,181.80	74.9	680.9	Nov-09-Dec-10	Oct-12-Jan-16
XPS foam	2	7	0	7	7,204,494	170	2,214	0	0	Dec.10	Dec.14
Total	**17**	**50**	**11**	**39**	**34,692,611**	**630**	**6395.8**	**74.9**	**680.9**	**Nov-09-Dec-10**	**Oct-12-Jan-16**

30. Most projects in Table 3 were approved in 2010 for completion by December 2014 at the latest. XPS foam sub-sector projects were approved for only two countries, Saudi Arabia and Turkey. Two projects in the PU foam sub-sector accounting for 10.9 ODP tonnes were subsequently closed, one in Croatia for financial difficulties experienced by the enterprise and the other in Egypt following sale of the enterprise to non-Article 5 ownership.

Project impact

31. At the time of writing this report, UNDP provided additional information which indicated that four of the PU foam projects approved for Egypt in December 2010 (62nd meeting) had been completed in August 2014. Thus projects in five countries (Colombia (four projects), Egypt (four projects), Croatia, the Dominican Republic and Morocco (one project each)), i.e. 27 per cent of the 41 approved PU foam projects being implemented had been reported as completed as of the end of September 2014 (after the 72nd meeting). They phased out 110 ODP tonnes which is about 25 per cent of the HCFC consumption of 449.4 ODP tonnes targeted for phase-out from the active investment projects approved in advance of HPMPs in the PU foam sub-sector. None of the XPS foam sub-sector projects had been reported as completed as of September 2014.

32. Thus, as of September 2014, 23 per cent of the active investment projects approved in advance of the HPMPs had been completed in 30 per cent of the countries, phasing out 18 per cent of the total HCFC consumption of 612 ODP tonnes targeted to be phased out in the active foam projects approved in advance of the HPMPs of the respective countries.

33. The overall impact of such projects on HCFC reductions in advance to the 2013 freeze and the 10 per cent reduction by 1 January 2015 may therefore be considered to be so far moderate. However, HCFC phase-out to be achieved through these projects, even if completed after 2014, is expected to contribute to convert in permanent HCFC reductions initially achieved through licensing and quota systems.

34. The following technologies: cyclopentane, n-pentane, water/CO_2 (water-blown) and methyl formate, were used during the conversion of the projects, as shown in Table 4.

Table 4: Impact of implementation of investment projects approved in advance of HPMPs (as at end of September 2014)

Manufacturing activity	Country	Bilateral/ IA	Blowing agent/technology	Baseline HCFC consumption (ODP tonnes)	HCFC phased out (ODP tonnes)	HCFC phased out (tonnes)
Manufacture of commercial refrigerators	Dominican Republic (the)	UNDP	Cyclopentane	51.2	3.7	36.6
Manufacture of domestic refrigerators	Colombia	UNDP	Cyclopentane	225.6	56	509.1
Manufacture of domestic refrigerators	Morocco	UNIDO	Cyclopentane	59.7	11	100
Manufacture of panels (2 projects)	Egypt	UNDP	n-Pentane	386.3	23.8	216.4
Manufacture of rigid block foam and rigid pour in place insulation foam	Croatia	Italy	Water-blown	4	1.8	16.4
Manufacture of cold cure moulded flexible and integral skin foam and moulded foam	Croatia	Italy	Water-blown			
Manufacture of spray foam	Egypt	UNDP	Methyl formate	386.3	11.2	101.8
Manufacture of water heaters	Egypt	UNDP	Methyl formate	386.3	2.4	21.8
Total					**109.9**	**1002.1**

Demonstration projects (decision 55/43)

35. Ten demonstration and systems house projects were approved at the total cost of US $6.4 million, US $4.3 million in the PU and US $2.1 million in the XPS foam sectors respectively, for the validation of some new and emerging technologies or for demonstration of efficacy of widely used technology, such as the HC technology in new production circumstances in Article 5 countries. Eight of the ten demonstration projects were in the PU foam sector and two were in the XPS foam sector. Where systems houses were involved, the project involved development and optimization of the systems in a first phase and their validation and optimization through application at downstream enterprise level in a second phase. The demonstration projects were carried out in 6 countries as follows: Brazil (2 PU), China (3 PU and XPS), Colombia (PU), Egypt (PU), Mexico (PU) and Turkey (XPS).

36. Table 5 provides a summary of the status of the demonstration projects.

Table 5: Summary status of pilot and demonstration projects approved in advance of HPMPs

Country	Project title	IA	Amount approved (US$)	Date approved	Planned comple-tion date	Actual comple-tion date	Status as at end of June 2014
Brazil	Pilot project for validation of methyl formate as a blowing agent in the manufacture of PU foam (phase I) (BRA/FOA/56/DEM/285)	UNDP	401,500	Nov-08	Jun-09	Dec-10	Completed: PCR Submitted. Final report submitted Dec 2010 **Duration: 24 months**
	Pilot project to validate methylal as blowing agent in the manufacture of PU foams (phase I) (BRA/FOA/58/DEM/292)	UNDP	464,200	Jul-09	Jul-10	Dec-12	Completed: PCR Submitted. Final report submitted Apr 2012 **Duration: 42 months**
China	Conversion from HCFC-141b-based to HFC-245fa-based spray PU foam at Harbin Tianshuo Building Materials Co. Ltd. (CPR/FOA/59/INV/493)	IBRD	193,808	Nov-09	Nov-12	Nov-12	Completed; Final report submitted **Duration: 36 months**
	Conversion of the foam part of Jiangsu Huaiyin Huihuang Solar Co. Ltd. from HCFC-141b to cyclopentane (CPR/FOA/59/DEM/492)	IBRD	786,668	Nov-09	Nov-12	Nov-12	Completed; Final report submitted Dec 2012 **Duration: 36 months**
Colombia	Demonstration project to validate the use of super-critical CO_2 in the manufacture of sprayed PU rigid foam COL/FOA/60/DEM/75)	Japan	441,100	Apr-10	Jan-14	Jan-14	Completed; Final report submitted Dec 2013 **Duration: 45 months**

Country	Project title	IA	Amount approved (US$)	Date approved	Planned comple-tion date	Actual comple-tion date	Status as at end of June 2014
Mexico	Pilot project for validation of methyl formate in microcellular PU applications (phase I) (MEX/FOA/56/DEM/141)	UNDP	290,082	Nov-08	Nov-10	Nov-10	Completed: Final report submitted Dec 2010 **Duration: 24 months**
Sub-total			**2,577,358**				
China	Conversion demonstration from HCFC-141b-based to cyclopentane-based pre-blended polyol in the manufacture of rigid PU foam at Guangdong Wanhua Rongwei PU Co. Ltd (CPR/FOA/59/DEM/491)	IBRD	1,214,936	Nov-09	Jun-13		Expected to be completed June 2014. Site visit showed project completed. Project completion protocols pending. Enterprise distributing HC-based systems
Egypt	Validation/demonstration of low cost options for the use of HCs as foaming agent in the manufacture of PU foams (EGY/FOA/58/DEM/100)	UNDP	473,000	Jul-09	Dec-13		Partially completed. Technology report submitted to 66th Executive Committee. Workshop done with site visit.
Sub-Total			**1,687,936**				
Turkey	Validation of the use of HFO-1234ze as blowing agent in the manufacture of XPS foam boardstock (phase I) (TUR/FOA/60/DEM/96)	UNDP	165,000	Apr-10	Dec-11	Jun-12	Completed: PCR and Final report submitted June 2012 Duration: 26 months
China	Demonstration project for conversion from HCFC-22/HCFC-142b technology to CO_2 with methyl formate co-blowing in the manufacture of XPS foam at Feininger (Nanjing) Energy Saving Tech. Co. (CPR/FOA/64/DEM/507)	UNDP	1,973,300	Jul-11	Sep-13		Completed. Final report submitted to the 73rd meeting)
Sub-Total (IIB.1 and IIB.2)			**2,138,300**				
TOTAL FOR DEMONSTRATION PROJECTS			**6,403,594**				

37. The demonstration projects covered all rigid and integral foam applications, including spray foam, which is the sub-sector for which the choice of alternative blowing agents has proved to be difficult because of the emissive nature of its application in ambient environments. The duration of the demonstration projects ranged from 24-45 months as against the expected 18 months.

Impact of demonstration projects in the PU foam sector

38. In the PU foam sector the long experience, especially among SMEs, of production process based on liquid blowing agent (LBA), meant that for a successful transition from HCFC-141b to non-ODS technology among these enterprises a process that mimicked the rather transitional but convenient replacement for CFC-11 before it had to be found. While HFC-245fa in particular, and/or HFC-365mfc (blended with HFC-227ea) had good characteristics as blowing agents, their large impact in climate made them unsuitable as long-term replacement for HCFC-141b. Hence, the need arose for finding alternative solutions similar to HCFC-141b being replaced.

39. The support given by the Executive Committee to the demonstration projects has generated activities aimed at the use of the blowing agents in foam manufacturing in several countries. The demonstration projects have also helped to identify areas of the use of the chemicals that may need further study or special precaution during use.

40. The following briefly describes the impact the alternatives demonstrated has had on the foam sector.

Methyl formate

41. The demonstration project for the use of methyl formate has resulted in the use of various PU rigid foam applications including panels, commercial refrigeration, and integral skin foam applications in several Article 5 countries, involving more than 15 local systems houses and hundreds of downstream users with an aggregated consumption of about 5,000 tonnes of HCFC-141b. These include Brazil, Bosnia and Herzegovina, Cameroon, the Dominican Republic, Egypt, El Salvador, Indonesia, Jamaica, Mexico, Nigeria, South Africa and Trinidad and Tobago and now also Russia.

42. The final report on methyl formate to the Executive Committee[5] mentioned issues with very low densities (<35 kg/m^3) because of instability and the need not to exceed 5.5 php in formulations (with some variations based on the type of polyol). Thus in several Mexican projects HFC-365mfc is used to co-blend with methyl formate in lower density as an interim option until further system optimization has been performed—resulting in higher methyl formate concentrations or the use of HFO.

Methylal

43. The results of the project have indicated that methylal is better suited for integral skin and flexible foam applications. It is recognized that comparisons, such as 10 per cent penalty in insulation value for rigid foams, were being made between optimized HCFC-141b-based systems and recently developed methylal-based systems, cautioning the need for further optimization and evaluation of methylal systems in those applications at individual enterprises level. Methylal has proven to be very successful in integral skin and microcellular foams and is the technology of choice in Mexico shoesoles.

Pre-blended polyol with cyclopentane

44. Currently the use of pre-blended polyols with cyclopentane by downstream foam enterprises has been successfully demonstrated in China and Egypt. Building on the experience gained and lessons learned from the demonstration project at Wanhua Rongwei Polyurethane Co. Ltd (WHRW), China will contract six additional systems houses to develop and supply HC pre-blended polyols to enterprises that cannot or may not wish to install HC storage and pre-blending facilities due to financial, safety and other technical reasons. Discussions at the enterprise pointed to the potential for export of pre-blended HC systems to other countries. Should that be the case other smaller enterprises who desire to access the HC technology would receive the required assistance.

45. The Egyptian project proved the feasibility of pre-blending cyclopentane—not n-pentane—in fully formulated systems. The results of the project have been applied on industrial scale in a project in Mexico. Other use of fully blended polyols using cyclopentane exists in Europe. The Egyptian project also showed successfully the option of direct cyclopentane injection with a possibility of lowering densities at same blowing agent levels. The study has been extended to study this phenomenon—most likely related to less blowing agent losses—in more detail.

Supercritical carbon dioxide

46. The Executive Committee approved a project in Colombia for UNDP to demonstrate the use of CO_2 in supercritical state in PU spray foam applications, as CO_2 in this state can overcome the main limitations of CO_2 technology, namely poor dimensional stability, poor adhesion to substrates and high thermal conductivity. The technical feasibility of the use of super critical CO_2 technology in spray foam in different climatic conditions was demonstrated.

[5] UNDP, Methyl Formate as blowing Agent in the Manufacture of Polyurethane Foam Systems: An Assessment for the Application in MLF Projects, October 2010, also in UNEP/OzL.Pro/ExCom/62/9, Report on Implementation of Approved Projects with Specific Reporting Requirements, November 4, 2010.

HFC-245fa

47. Although the demonstration project was completed in China in November of 2012 the technology did not appear to be of much utility as there has been no evidence of any plans for its immediate application in the country. Apart from the high-GWP of HFC-245fa its high price could also be a factor in its very low uptake in Article 5 countries.

Impact of demonstration projects in the XPS foam sector

48. Two demonstration projects involving the use of HFO-1234ze and CO_2 with methyl formate have been undertaken in Turkey and China respectively, both of which could be considered as not fully completed.

HFO-1234ze

49. In the case of HFO-1234ze, which needs to be co-blown with DME to enhance its performance the report on the demonstration project has several caveats with regard to system processability, foam properties and conversion costs. In order to address the issues identified with its use and enhance its utility as a technology of choice additional work is recommended by the implementing agency and the host government which would require additional resources in time and funds. The Executive Committee was not willing to endorse such an extension and UNDP therefore did not submit such a request.

Carbon dioxide (CO_2) with methyl formate

50. This demonstration project being carried out in China involving co-blowing of CO_2 with methyl formate was recently completed in the demonstration and availability of an environmentally safe, cost-effective and replicable alternative for enterprises in the XPS foam sector in China and other Article 5 countries; usage of this product in different applications; and adoption of safety standards in manufacturing XPS panels. Although it appears that given additional costs of handling methyl formate, the XPS foam enterprises in China are opting for CO_2 and ethanol instead. China has already had approval for two tranches of funding for the sector that covered a total of 19 enterprises for the phase-out of 405.9 ODP tonnes (6,969.5 tonnes) of HCFCs. Seventeen of the 19 enterprises selected CO_2 with other co-blowing agents (mostly ethanol) as their replacement technology while two enterprise selected HC with other co-blowing agents.

51. A standing demonstration project on XPS foam conversion with CO_2 has been established at a local university with the assistance of the Government of Germany. The project continually assists the XPS foam industry resolve technological issues relating to this alternative, which from the review of the funding tranches appears to be predominantly the technology of choice among the Chinese XPS foam producers. The impact of this CO_2 technology demonstration center could also influence future selection of technology in the sector.

52. In order to have maximum advantage of the demonstration projects in XPS sector in China it would be necessary for the demonstration projects to work together and share the results of their findings.

HCFC investment projects in the foam sector approved in stage I of HPMPs

53. The first stage I of an HPMP including activities in the foam sector was approved for the Former Yugoslav Republic of Macedonia at the 60th meeting of the Executive Committee in April 2010. The approval for the amount of US $15,000 was for non-investment policy and other preparatory activities for the implementation later of foam and other sector projects. This was followed by approval of three other first tranches for foam sector projects or plans for Armenia, Nigeria and Sri Lanka at the 62nd meeting in December 2010.

54. Following the adoption by the Executive Committee of decision 60/44 at the 60th meeting in April 2010 which resolved almost all the outstanding issues of eligibility and funding of HCFC phase-out projects, over 50 per cent of countries with foam sector projects, in particular the large volume consuming countries, including China, Brazil and Mexico submitted their HPMPs and associated stage I activities for funding at the 64th and 65th meetings in July 2011 and November 2011, respectively. Subsequently they received the first tranche funding for the foam sector plans and projects. The HPMPs for India was approved at the 66th meeting (April 2012) and the HPMPs for Saudi Arabia and Thailand were approved at the 68th meeting (December 2012).

Effects of the HPMP approvals on HCFC phase-out in the foam sector

55. About 60 per cent of the foam sector activities submitted within stage I of HPMPs were approved in 2011. The time of the approval of stage I and related tranches has an impact on whether or not the implementation of identified investment projects would assist Article 5 countries meet their obligations under the Montreal Protocol or any other specified obligations.

56. Thus although the window of opportunity to achieve reductions before the Montreal Protocol HCFC consumption control measures entered into force in 2013, projects undertaken with funding from the first to the third tranches for countries receiving annual tranches, and from the first and second tranches for those having biennial tranches could potentially contribute to meeting and/or sustaining the freeze and 10 per cent reduction in HCFC consumption in 2015. As several countries agreed on additional HCFC consumption reduction beyond the 10 per cent target in 2015, although the implementation of the projects might not have a timely impact their Montreal Protocol obligations, they could still assist in meeting the obligations made under their agreements with the Executive Committee. Furthermore, any HCFC reduction achieved through the conversion of foam enterprises will be permanent and help countries to achieve lower sustained levels of HCFC consumption.

Submission by sector and status of implementation

57. Table 6 provides a summary of the status of implementation of the approved requests and funding, including the subsequent tranches approved up until the 72nd meeting in May 2014 following approval of the various HPMPs and their associated stage I implementation programmes. It may be noted that in a few cases the number of enterprises are given within a range, in which case the upper limit is used for the estimate. Also countries may overlap across sub-sectors. Actual numbers are subject to further verification following submission of tranche reports.

Table 6: Summary status of foam sector projects approved in stage I of HPMPs (as of June 2014)

Sector	Completed Projects					Ongoing Projects					TOTAL				
	Enterprises	Phases	Cost (US $)	ODP t)	Disbursed ODP t)	Enterprises	Phases	Cost (US $)	ODP t)	Disbursed ODP t)	Enterprises	Phases	Total Cost (US $)	ODP t)	Disbursed ODP t)
PU foam	10	38	12,109,585	166	166	31	1,056	130,556,435	1,541	107	41	1,056	142,666,020	1,094	273
XPS foam	0	0	0		0	3	26	39,544,412	238	0	3	26	39,544,412	238	0
Total	**10**	**38**	**12,109,585**	**166**	**166**	**34**	**1082**	**170,100,847**	**1,779**	**107**	**44**	**1,120**	**182,210,432**	**1,945**	**273**

PU foam sector

58. The PU foam sector is the predominant sector and consists mostly of various rigid PU foam applications and integral skin foam and shoe soles in a few countries. Out of the approved total amount of US $182.2 million, the PU foam sector accounted for US $142.7 million (78 per cent) to phase out 1,707 ODP tonnes of HCFC-141b equivalent to 88 per cent of approved tranches. All the countries that had foam sector projects had projects in the rigid PU foam sub-sector while a limited number, particularly in the higher volume HCFC consuming countries had some projects in the integral skin/microcellular foam subsector.

59. China, with the largest consumption of HCFC-141b in the PU foam sector as well as HCFC-22 and HCFC-142b in the XPS sector got approval for two separate sector plans under different IAs for phasing out HCFC-141b in the PU foam sector and HCFC-22/HCFC-142b in the XPS foam sector. However, the two sector plans were approved under a single agreement with the Executive Committee implemented by all four IAs (UNDP, UNEP, UNIDO and the World Bank) and two bilateral agencies (Germany and Japan).

60. As indicated in Table 6 above, as of the end of June 2014, 38 out of estimated 1,056 projects (3.6 per cent) had been completed at the cost of US $12.1 million (i.e. 8.5 per cent of the total cost of US $142.7 million) to phase out 273 ODP tonnes of HCFC-141b out of the targeted 1,094 ODP tonnes (25 per cent). All the completed projects were in the PU foam sector.

61. The completed projects included conversions of domestic and commercial refrigerator appliances, discontinuous panel manufacturing all of which converted to cyclopentane and conversion of various rigid foam producers in Malaysia and Mexico with assistance of systems houses.

62. At the time of writing this report information was received from the World Bank which indicated that 11 of the 30 enterprises in the first tranche of China's PU foam sector plan that were converting to water-blown technology have completed their projects and have stopped the use of HCFC-141b as of 4 July 2014. The 11 enterprises have phased out consumption of 1,229.41 tonnes (135.23 ODP tonnes) of HCFC-141b at the cost of US $3,434,178. This brings the total amount of HCFCs phased out from stage I of the HPMPs to 408 ODP tonnes (3,709.1 tonnes) at the cost of US $15,534,763 resulting in overall cost effectiveness of US $4.19/kg metric. As the planned completion date for the first tranche is December 2015, this group of the first tranche projects could be considered as completed ahead of schedule.

Table 7: Completed foam sector investment projects of the early tranches of stage I of HPMPs

Country	Project title	IAs	Date approved	Amount approved US $	No of enter-prises	Planned comple-tion Date	Duration (months)	HCFC phased out (ODP tonnes)	Activity
Armenia	HPMP (stage I, first tranche)	UNDP	Dec-10	265,661	1	Dec-13	36	2.2	Conversion of manufacture of commercial refrigerator appliances and cold rooms to cyclopentane
China	HPMP (stage I, first tranche)	IBRD	Jul-11	3,711,487*	11	Dec-15	24	135.2	Conversion of water heaters to water-blown technology. 11 out of 30 enterprises funded under first tranche. Completed July 2014 ahead of schedule
Costa Rica	HPMP (foam sector) (stage I, first tranche)	UNDP	Jul-11	593,523	1	Jul-13	24	14	Conversion of domestic refrigerator manufacturing to cyclopentane
Guatemala	HPMP(foam sector) (stage I, first tranche)	UNIDO	Jul-11	109,637	1	Jul-13	24	1.7	Conversion of commercial refrigeration to cyclopentane
Ecuador	HPMP (stage I, first tranche)	UNIDO	Nov-11	1,331,440	1	Jul-14	32	15	Conversion of domestic refrigerator manufacturing to cyclopentane
Lebanon	HPMP (foam sector plan) (stage I, first tranche)	UNDP	Jul-11	810,000	1	Jul-13	24	9.1	Conversion of panel manufacturing to cyclopentane
Malaysia	HPMP (stage I, first tranche) (PU foam sector plan)	UNDP	Nov-11	4,327,247	13	Dec-13	24	49.3	Conversion of panel manufacture to cyclopentane and 91 SMEs to various alternatives with 4 systems houses.

Country	Project title	IAs	Date approved	Amount approved US $	No of enter-prises	Planned comple-tion Date	Duration (months)	HCFC phased out (ODP tonnes)	Activity
Mexico	HPMP (foam sector plan for systems houses and local customers) (stage I, first tranche)	UNDP	Jul-11	2,502,526	12	Jul-13	24	66.8	(1) Conversion to METHYL FORMATE/methylal for IS and FM foam and production of HC-based pre-blended polyol systems at systems houses; (2) Conversion at enterprise level (3) Conversion of downstream foam enterprises with assistance from 12 systems houses
Nigeria	HPMP (stage I, first tranche)	UNDP	Dec-10	855,603	2	Oct-12	22	0	1st tranche completed with construction of HC production facility.
Nigeria	HPMP (stage I, first tranche)	UNIDO	Dec-10	550,000	1	Dec-13	36	0	Conversion of commercial refrigeration manufactures to methyl formate and water blown.
Swaziland	HPMP (stage I, first tranche)	UNDP	Apr-11	667,948	1	Nov-13	31	7.7	Conversion of domestic refrigerator manufacturing to cyclopentane.
Total				**15,109,585**	**37**		**27****	**301**	

* Represents actual disbursed funds. **Represents average duration of 11 tranches of investment activities

63. The planned duration of the investment projects depending on the anticipated complexity of implementation ranged from 24 to 36 months, with the average duration of 28 months. It may be noted that all the projects were approved in 2011 and expected to be completed in 2013. Thus all the projects may be said to been completed on time attesting to the fact that the project implementation cycle for the investment projects remained virtually unchanged.

XPS foam sector

64. The XPS foam sector within the Article 5 setting is relatively small compared to the PU foam sector. The XPS sector accounted for US $39.5 million or 22 per cent of the total funding requests as of the end of June 2014 to phase out 238 ODP tonnes of HCFCs (HCFC-22 and HCFC-142b) which is 12 per cent of the HCFCs to be phased out in the foam sector so far through the approved funds. The sector consists of only 6 countries (China, Kuwait, Mongolia, Qatar, Saudi Arabia and Turkey) with the bulk of the HCFC consumption and phase-out activities in China.

65. Two countries, Saudi Arabia and Turkey submitted to the 62nd meeting (December 2010) stand alone and umbrella projects respectively covering almost the entire sector in their countries for funding in advance of their HPMPs and do not submit tranche requests for phasing out HCFCs in this sector. Three of the remaining four countries China, Kuwait and Qatar, had their first tranches approved for this sector at the 64th and 66th meetings respectively. As of the end of June 2014 three funding tranches amounting to US $35.6 million to phase-out 168.8 ODP tonnes of HCFC had been approved for China. The first, second and third tranche projects are expected to be completed by December 2014, April 2015 and June 2016 respectively, with durations of two to three and a half years (24-42 months). The sector in Mongolia is small and the phase-out will be accomplished through bilateral cooperation with the Government of Japan.

Policy and institutional framework

Multilateral Fund policies and guidelines

66. As previously indicated the nature of the rules and regulations established by the Executive Committee to facilitate the phase-out of HCFC following the adoption of decision XIX/6 by the Parties and their timeliness would affect the manner in which the HCFCs would be phased out as a result of the implementation of investment projects. This issue was particularly pertinent to the foam sector since the Parties had expressed the desire to phase out the ODS with the highest ODP, in effect HCFC-141b used almost exclusively in the foam sector.

67. Decision XIX/6 was adopted at the 19th meeting of the Parties in Montreal (19th MOP), on 17-29 September 2007. Immediately after this decision the Executive Committee at its meetings on 26-30 November 2007 adopted its first substantive decision (decisions 53/37). This was followed with decision 54/39 at its first meetings in 2008 (7-11 April 2008). These decisions gave the initial directions needed by Article 5 countries to develop instruments to phase out HCFCs in the manufacturing sector.

68. Decision 54/39 gave guidance on how to approach the phase-out of HCFCs through the guidelines in the decision and the "indicative outline and contents of the HCFC phase-out management plans" annexed to the decision.

69. Although all the provisions of decision 54/39 were relevant to the foam sector, of particular significance were the following clauses of paragraph 1 of decision 54/39:

(a) (c)(ii) Gave directions on how to address manufacturing sectors, including the foam sector;

(b) (d)(ii) Gave guidance on submissions of investment projects in advance of the HPMP;

(c) (e) Emphasized the need and made provisions for funding national regulatory and other supportive measures, such as licensing systems etc.; and

(d) (i)(ii) Emphasized the need to address the roles and responsibilities of industry associations.

70. The impact of these decisions on HCFC phase-out has been significant. Decision 54/39(e) appears to have facilitated reductions in consumption for some countries through non-investment activities.

71. With regard to decision 54/39(i)(ii), the importance of the participation of industry associations was evident where such associations formally exist. As the foam sector is not large in many countries formal associations may not be needed and do not exist in many countries, especially those in group 2(c) and group 3 countries, such as Vietnam. In countries with large foam industry with significant proportion of SMEs they are found desirable as a source of collective expertise and a conduit to the SMEs. In China, Indonesia and Thailand it is evident that industry associations are playing leading roles in the HCFC phase-out in the foam sector and their roles are recognized and financially rewarded.

72. In Thailand the foam industry division of the Association of Thai Industries has been responsible for developing an Environmental Management Framework (EMF) which was verified by the Department of Industrial Works (the NOU) and approved by the World Bank as consistent with the MLF rules and disclosed to the public in December 2013, an important step in the implementation of Thailand HPMP. The EMF is a framework with which enterprises opting for HC technology would have to comply. All beneficiary enterprises must submit simple sub-project proposals describing baseline information and a list of equipment to be procured or retrofitted as well as the associated costs. For those opting for HC

technology, environmental management plans to ensure safe use of this technology must be provided. Based on these documents, a sub-grant agreement will be signed. The foam association will play an instrumental role in assisting beneficiary enterprises preparing these documents.

73. In China the collective expertise of the foam industry association has been found indispensable in the development and implementation of the country's HCFC phase-out, both in the PU and XPS foam sectors. About US $1.4 million has been approved to the PU foam sector over the past three tranches for technical assistance activities, while US $850,000 has been approved for the same purpose in the XPS sector over the past two tranches. These funds have gone to develop and strengthen national institutions and the country's capacity to develop, implement, evaluate, monitor and generally manage the phase-out programmes in the two sectors in an effective manner, thus enhancing national ownership of the activities. More detailed information on the development of institutional structure for managing the HCFC phase-out in China is provided in the country report in a separate document.

74. Other key decisions some of which have been earlier discussed relate to or build on this decision and others on multi-year agreements and provide or enhance equity and transparency required of management of a Fund with diverse beneficiaries and stakeholders. These include:

(a) Decision 55/43 relating to analysis of relevant cost considerations surrounding HCFC phase-out. Relevant aspects of this decision have been discussed in the earlier sections in particular decision 55/43(b). This decision led to development and implementation of demonstration and stand-alone projects for purposes, among others to collect accurate data to help in establishing project costs;

(b) Decision 55/13 on funding of HPMP preparation. Decision 55/13(f) exempted China from the funding structure under the decision for preparing HPMPs and HCFC investment activities. Given that the country's baseline HCFC consumption amounts to about 61 per cent of the global Article 5 consumption the exemption was needed to enable it to obtain adequate financial resources prepare its HPMP and related investment activities commensurate with the level of HCFC consumption;

(c) Decision 56/16 that defined elements of a cost structure for funding the preparation of an overall HCFC phase-out management plan (HPMP) in line with decision 54/39. The structure addressed *inter alia* (a) assistance for policy and legislation, e.g. to developing new or extending existing legislation regarding HCFC, products containing HCFCs, quotas and licences, (b) survey of HCFC use and analysis of data and (c) development and finalization of the HPMP including its stage one to address the 2013 and 2015 control measures; and

(d) Decision 60/44 that established *inter alia* the cut-off date of September 2007 and rules on funding second stage conversions; and

(e) Decision 61/47 that established the conditions for funding or enterprises consuming HCFC contained in imported pre-blended polyols not reported as consumption under Article 7.

National legislative and regulatory settings

75. By its decision 54/39, the Executive Committee encouraged countries to strengthen their institutional capacities and made that as a prerequisite for getting support for their HCFC phase-out efforts. Given this mandate from the Executive Committee, all countries made strengthening of existing policies and institutions, and/or establishing new ones a priority activity. Licensing systems or quota systems that did not include HCFCs were extended to them as controlled substances.

76. Fulfilling this requirement might have taken up part of the preparatory time for the investment projects. For instance, Ecuador, which had not fully implemented this decision, had its stage I HPMP approved but the implementation of the investment projects were made conditional upon establishment of a quota system that included HCFCs.

77. This approach appears to have aided the reductions in consumption of HCFCs, however, only when complete Article 7 data for 2013 is available further analysis could be undertaken.

Issues related to the implementation of investment projects approved in advance of HPMP

HCFC phase-out

78. By mid-2014 11 out of 48 foam sector projects approved between November 2009 and December 2010 had been completed to phase out 25 per cent of the targeted consumption of 460 ODP tonnes. Possible reasons for longer than expected time of completion include:

(a) Under estimation of project duration: In approving the projects it appears the assumption had been made that many of them could be completed before 2013 or by 2014. However, in spite of the expected completion dates it could be seen from the approved project documents that for most of the projects the completion dates had been set for between October 2012 and January 2016;

(b) Administrative delays related to the signature of contracts and legal agreements, Causes of such delay could be political or administrative problems on the side of the recipient government, such as changes in departments or ministries, delay in appointing the ozone officer or in organizing the project management unit. There may be causes that could be due to the implementing agency itself resulting possibly from internal capacity to handle the volume of work generated in relatively short periods of time;

(c) Complex procurement processes, which have resulted on re-advertising bids or re-negotiations with suppliers;

(d) Hesitation by several enterprises in adopting alternative technologies due to lack of know-how, lack of availability of components, or perceived competitive disadvantage. For example several XPS enterprises spent considerable length of time carefully or thoroughly considering technology options although a conversion technology option had been agreed during the project preparation and approval process and the project had been approved on the understanding that it was ready to be implemented;

(e) Site preparation to accommodate the new technology, which usually happens with conversions to HC technology. Sometimes new factories are constructed in new locations or industrial sites to meet fire safety rules;

(f) Unavailability of or lack of regular supply of foam systems, for instance methyl formate blowing agent that has to be supplied in a fully formulated system; and

(g) Projects where although the implementing agency envisages in the submission that the enterprise could provide counterpart funding, at the time of implementation the enterprise hesitates or have difficulties to provide it.

Providing accurate cost data from project implementation

79. The objective of providing accurate incremental cost data based on project implementation also was not fully met. The review showed that a few of the projects provided cost data and where such information was provided it was in the form of a comparison between approved amounts and actual cost of items of equipment or a group of items of equipment without any supporting documentation.

80. It seems that in (commercial) practice invoices or purchase contracts do not provide detailed breakdown of equipment cost by components and it was difficult to determine in the absence of any documentation if such breakdowns provided in progress reports were accurate reflection of the costs of the components or not.

81. Review of the project implementation documents and site visit showed that a simple, reliable way of making accurate data available is to provide data from the supply source. Every foam project whether in the HPMP or in advance of the HPMP involved procurement procedures that resulted in a final sales or purchase contract or similar document between the successful bidder (supplier) and the beneficiary enterprise. The contract document shows the equipment or groups of equipment to be supplied, unit prices, total price and payment arrangements. An extract from a sample sales contract is shown below. It lists the following groups of equipment (details omitted) but provides a single lump sum price for the equipment. Only when it has been provided with a critical mass of such invoices or sales contracts would it be possible for the Secretariat and the bilateral and implementing agencies to come up with some form of uniform guide to costs of equipment.

Table 8: Price list in a sample of sales contract

Description of goods/manufacture country of origin	Unit price (US$)	Price (US$)
1. Cyclopentane storage system	498,000	498,000
2. Cyclopentane premix and blending system	n/a	n/a
3. Foaming lines and dry plant retrofitting	n/a	n/a
4. Special ventilation fans and ducting systems	n/a	n/a
5. Safety monitoring and installation system	n/a	n/a
Total price CIF		**498,000**

82. A collection of the actual purchase contracts from foam projects that have been or will be completed in stage I could be reviewed with the view to arriving at incremental capital costs in a manner and with a high degree of confidence.

Issues relating to technology replacement

83. Technology of choice for larger foam manufacturers is cyclopentane as blowing agent for rigid PU insulation foam products, which is the predominant application, for most of the completed as well as the ongoing projects. Four completed domestic refrigeration and three of four commercial refrigeration projects converted to cyclopentane without any issues, while two panel manufacturing project converted to n-pentane, one commercial refrigeration project and a project consisting of a group of small commercial refrigeration appliance manufacturing enterprises converted to methyl formate. Eleven water heater manufacturers (China) converted to water while one manufacturer (Egypt) converted to methyl formate. One PU rigid block foam manufacturer converted to water.

84. Rapid uptake of methyl formate for several applications in some countries in Latin America and the Caribbean as well as in Africa, for instance, shows a potential for it to be a cost-effective technology of choice especially among SMEs where they can rely on an efficient systems house. However the main technological issue associated with this blowing agent is the current density restriction where it cannot be used for applications that demand lower densities than 35 kg/m^3. This problem could be solved through further optimization that may require the use of blends with HCFC-141b itself (partial phase-out), HFCs

or HFOs. A recent discussion with UNDP indicated that it is currently working on co-blowing of methyl formate/methylal and HFOs as a solution for low-density foams.

85. Cyclopentane is currently the technology of choice for manufacturers of PU rigid insulation foam in Article 5 countries. The use of the technology however is relatively capital intensive, which displays a good example of intrinsic inequities in the funding process. The technology requires the same high level of safety and similar basic demand in essential equipment irrespective of the scale of foam production where a medium scale and a large scale foam producers are concerned as described below.

Competing enterprises in the same country

86. It can occur that in the same country, enterprises that are competing on the same market inadvertently receive unequal treatment in terms of funding their HCFC conversions to cyclopentane. In Indonesia, for instance, the rigid PU foam sector has been divided between two agencies. One agency is responsible for three or four largest rigid foam manufacturers (and the SMEs) while another agency is allocated three medium-sized manufacturers, by virtue of their HCFC consumption. The three largest enterprises are receiving adequate funds to cover the full range of equipment as well as operating grants. On the other hand the other three enterprises are receiving funds for similar incremental capital items capped at the cost-effectiveness threshold and have to provide substantial counterpart funds to be able to get their conversions implemented. These enterprises have gone through two bidding exercises, the first which resulted in technically acceptable but financially high offers and 'revised' biding. It is not clear what the revised bids entailed. Implementation of the projects, which should have been completed by 2013 could be delayed even beyond 2015 and impact the country's ability to meet its obligations. Another umbrella project for mid-sized enterprises in Mexico was in a similar situation.

Modalities for the Implementation of the HPMPs

87. The role of bilateral and IAs is vital to the successful implementation of projects by Article 5 countries to enable compliance with their obligations under the Montreal Protocol. Their counterpart institutions in Article 5 countries are strengthened and better funded under the HPMPs, while the organizational structures especially for UNDP and the World Bank devolve much bigger role to the national executing organizations.

88. A review of the implementation of the foam sector investment projects led to the following observations:

UNIDO

89. As may be expected of an industrial developmental organization with in-house engineering expertise UNIDO appears to take more direct role in the implementation of projects, especially in individual and small umbrella projects. In China, however, in line with the country's chosen performance-based implementation modality UNIDO has recently signed an agreement with the Government which affects such approach. In some countries such as Turkey, a semi-autonomous project team which includes legal and technical advisors or experts is set up for the implementation of the projects, while UNIDO's technical experts take on oversight and monitoring responsibilities.

90. The direct implementation modality requires considerable amount of troubleshooting by UNIDO's technical experts and it depends on the available technical capacity in-house or available outside to conduct regular follow-ups and resolve difficult implementation issues, such as those involving procurement for a number of enterprises facing, sometimes intractable, issues of counterpart funding. The latter modality involving a project team enhances the national ownership of the programme.

Table 9: Summary of foam sector projects approved in stage I of HPMPs as of June 2014. Distribution by IAs

Sector	Completed Projects					Ongoing Projects					TOTAL				
	No of countries	No of Enterprises	Cost (US $)	Plan-ned HCFC Phase-out (ODP tonnes)	HCFC Phase-out (ODP tonnes)	No of countries	No of Enterprises	Cost (US $)	Plan-ned HCFC Phase-out (ODP t)	HCFC Phased Out (ODP t)	No of countries	No of Enterprises	Total Cost (US $)	Planned HCFC Phase-out (ODP t)	HCFC Phased out (ODP t)
PU Foam															
UNDP	7	31	10,022,508	149	149	14	403	45,703,117	721	55	21	434	55,725,625		
UNIDO	4	6	659,637		17	14	345	15,126,599	238	7	18	351	15,786,236	253	24
WB						6	297	75,893,471	694	0	6	297	75,893,471	694	0
Sub-total	**10**	**38**	**12,109,585**	**166**	**166**	**31**	**1,056**	**130,556,135**	**1,516**	**107**	**41**	**1,094**	**142,665,720**	**1,682**	**273**
XPS Foam															
UNIDO						3	46	39,544,312	238	7	3	46	39,544,312	238	7
Sub-total						3	46	39,544,412	238	7	3	46	39,544,412	238	7
TOTAL	**10**	**38**	**12,109,585**	**166**	**166**	**34**	**1102**	**170,100,547**	**1,754**	**114**	**44**	**1,140**	**182,210,132**	**1,920**	**280**

UNDP

91. UNDP is using the National Implementation (NIM) or Direct Implementation (DIM) modality. Under both NIM and DIM all implementation activities become part of a performance based agreement between UNDP and the Government concerned with a parallel mirror-agreement between the Government and the beneficiary enterprises.

92. In these cases, the modality requires less piecemeal procurement and recruitment actions and often results in faster delivery of project results, and monitoring is provided through UNDP's national and international consultants to verify that benchmarks were indeed accomplished as claimed. Besides, this approach results in greater levels of industry ownership of technology and equipment acquisition.

93. The modality is country-specific, depending on the capability of Government to use some of these modalities/sub-modalities.

The World Bank

94. World Bank has a similar performance-based implementation modality, starting with the signing of Grant Agreement with the Government of the beneficiary country which leads to policy and institutional arrangements agreed between the Government and the World Bank that transfer all aspects of programme implementation to designated national institutions. The Bank, however, provides day-to-day guidance and technical input to development of technical as well as investment activities through its rigorous review process. The modality involves the preparation of country-specific project implementation manual (PIM) or similar document by the Government, which is reviewed and endorsed by the World Bank as consistent with the rules and practices of the MLF.

95. The modality involves training and capacity building to ensure competency and responsible national ownership of the projects and their implementation, with the World Bank having oversight responsibilities. Project implementation units in different forms depending on the institutional structure of the country support the NOU in the implementation, evaluation and monitoring of the projects.

Training

96. In the foam sector training is typically enterprise-specific and is initially undertaken at the time of equipment trial and commissioning. Training is usually done by the equipment supplier with the chemicals or systems supplier, and where necessary together with experts of the executing or implementing agency, so there are no major issues. In view of the new implementation modalities training

on project preparation and implementation, including procurement practices may be organized for groups of foam manufacturing enterprises to provide knowledge on issues of eligibility, incremental costs, procurement issues, etc. Systems houses also provide technical assistance

Delays in project implementation

III. Conclusions

Country Studies

97. As indicated in paragraph 12 above, seven Article 5 countries in Africa, Asia and the Pacific, West Asia and Latin America and Caribbean regions were selected for field visits. These countries included China, Ecuador, Iran, Malaysia, Mexico, South Africa and Vietnam. In addition to regional representation the countries were also representative of the implementing agencies. Evaluation missions were undertaken to China, Malaysia, and Vietnam by consultants, and to Ecuador and Mexico by the Senior Monitoring and Evaluation Officer (SMEO) together with a consultant. Due to logistic reasons Iran and South Africa have not yet been visited as at the time of this report.

98. Table 10 provides the list of the countries and their foam sector HCFC consumption profile. The HCFC consumption in the foam sector for the countries range from 0 per cent (Ecuador) to 61 per cent (Malaysia) of the total HCFC consumption of the countries when consumption of HCFC-141b in imported pre-blended polyol is excluded. However, Ecuador's HCFC-141b consumption is made up entirely of HCFC-141b in imported pre-blended polyol and South Africa has some consumption of polyol pre-blended with HCFC-141b and Vietnam's consumption of HCFC-141b is made up significantly of HCFC-141b pre-blended in polyol. When this type of consumption is taken into account then HCFC-141b as a percentage of overall HCFC consumption of Ecuador, South Africa and Vietnam rise to 70 per cent, 56 per cent, and 115 per cent, respectively.

Table 10: List of countries selected for field evaluation in 2014. Profile of HCFC consumption in the foam sector

Country	Year	HCFC Consumption in Foam Sector (ODP tonnes)						Baseline HCFC Consumption (ODP tonnes)	Per Cent of Foam Sector HCFC Consumption of Baseline
		HCFC-22	HCFC-141b	Imported Pre-blended HCFC-141b	Total HCFC-141b	HCFC-142b	Total*		
ODP		0.055	0.11	0.11		0.065	0.23		
China	2012	1,892	6,501.98	0	6,501.98	637	9,030.98	19,269.00	46.9
Ecuador	2013	0	0	16.59	16.59	0	0.00	23.49	0.0
Iran	2013	1.46	115.47	0	115.47	0	116.93	380.50	30.7
Malaysia	2013	0	315.61	0	315.61	0	315.61	515.80	61.2
Mexico	2013	6.77	215.45	0	215.45	5.79	228.00	1,148.80	19.8
South Africa	2012	1.43	174.9	32.01	206.91	2.54	178.87	369.70	48.4
Vietnam	2012	0	37.62	216.92	254.540	0	37.62	221.20	17.0

* Total sector HCFC consumption excluding HCFC-141b in imported pre-blended polyol.

99. Country reports on the visits already undertaken are being prepared and will be posted on the Evaluation website.

Table 11. Countries with PU and XPS sectors to be visited during the 2nd stage of the evaluation

Africa	Latin America and Caribbean	Asia and Pacific	West Asia	Europe and Central Asia
Cameroon	Argentina	Bangladesh	Kuwait	Turkey
Egypt	Brazil	China	Lebanon	Bosnia and Herzegovina
Nigeria	Cuba	India	Qatar	
Sudan (the)	Dominican Republic (the)	Indonesia	Saudi Arabia	

Africa	Latin America and Caribbean	Asia and Pacific	West Asia	Europe and Central Asia
	Jamaica	Philippines		
		Thailand		

IV. Recommendation

100. The Executive Committee may wish to note the desk study on the Evaluation of the phase-out of the HCFC in the foam sector contained in document UNEP/OzL.Pro/ExCom/73/8 and its conclusions.

Annex I

CLASSIFICATION OF ARTICLE 5 COUNTRIES WITH FOAM SECTOR PROJECTS IN THEIR HPMPS ACCORDING TO LEVELS OF BASELINE HCFC CONSUMPTION

Number	Country	2013 Consumption (ODP tonnes)*	Baseline consumption (ODP tonnes)	10% Reduction level in 2015 consumption
Group 1: Very High Volume HCFC Consuming Country				
1	China	N/A	19,269.00	17,342.10
Sub-Total			**19,269.00**	**17,342.10**
Group 2 (a): High Volume HCFC consuming countries (Sub-Group A)				
1	India	N/A	1,608.20	1,447.38
2	Saudi Arabia	N/A	1,468.70	1,321.83
3	Brazil	1,189.25	1,327.30	1,194.57
4	Mexico	835.17	1,148.80	1,033.92
Sub-Total		**2,024.42**	**5,553.00**	**4,997.70**
Group 2 (b): High Volume HCFC consuming countries (Sub-Group B)				
1	Thailand	N/A	927.60	834.84
2	Turkey	N/A	551.47	496.32
3	Malaysia	N/A	515.80	464.22
4	Kuwait	N/A	418.60	376.74
5	Indonesia	N/A	403.90	363.51
6	Argentina	N/A	400.70	360.63
7	Nigeria	N/A	398.20	358.38
8	Egypt	297	386.30	347.67
9	Iran (Islamic Republic of)	N/A	380.50	342.45
10	South Africa	N/A	369.70	332.73
Sub-Total		**297**	**4,752.77**	**4277.493**
Group 2 (c): High Volume HCFC consuming countries (Sub-Group C)				
1	Pakistan	N/A	247.40	222.66
2	Colombia	N/A	225.60	203.04
3	Viet Nam	N/A	221.20	199.08
4	Philippines (the)	N/A	208.40	187.56
5	Syrian Arab Republic	N/A	135.00	121.50
6	Cameroon	N/A	88.80	79.92
7	Qatar	N/A	86.90	78.21
8	Jordan	N/A	83.00	74.70
9	Lebanon	N/A	73.50	66.15
10	Bangladesh	N/A	72.6	65.34
11	Algeria	N/A	62.12	55.91
12	Morocco	49.41	59.7	53.73
13	Sudan (the)	N/A	52.7	47.43
14	Dominican Republic (the)	34.78	51.2	46.08
15	Trinidad and Tobago	N/A	46	41.40

Number	Country	2013 Consumption (ODP tonnes)*	Baseline consumption (ODP tonnes)	10% Reduction level in 2015 consumption
16	Oman	28.87	31.5	28.35
17	Ecuador	N/A	23.49	21.14
Sub-total		**113.06**	**1745.62**	**1571.058**
Group 3: Low Volume HCFC Consuming Countries				
Number	**Country**	**2013 Consumption (ODP tonnes)***	**Baseline Consumption (ODP tonnes)**	**10% Reduction Level in 2015 Consumption**
1	Zimbabwe	15.76	17.8	16.02
2	Cuba	12.19	16.9	15.21
3	Jamaica	N/A	16.3	14.67
4	Costa Rica	N/A	14.1	12.69
5	Sri Lanka	13.37	13.9	12.51
6	El Salvador	N/A	11.7	10.53
7	Guatemala	11.28	8.3	7.47
8	Swaziland	1.18	7.3	6.57
19	Armenia	N/A	7	6.30
10	Nicaragua	N/A	6.8	6.12
11	Bosnia and Herzegovina	N/A	6.1	5.49
12	Croatia	N/A	4	3.60
13	the former Yugoslav Republic of Macedonia	0.72	1.8	1.62
14	Mongolia	0.94	1.4	1.26
Sub-Total		**55.44**	**156.89**	**141.201**
TOTAL		**2,489.92**	**31,477.28**	**28,329.55**

* N/A: Data were not available as of end of July 2014 as the countries had not reported their sector-based production and consumption data in respect of the progress of implementation of their country programmes in 2013 that is due by 1 May of 2014.

Annex II

HPMP PREPARATION AND APPROVAL PROFILE OF SOME ARTICLE 5 COUNTRIES WITH FOAM PROJECTS AND POTENTIAL IMPACT ON HCFC PHASE-OUT IN THE FOAM SECTOR

Country	IAs	Funds Approved for HPMP Preparation (US $)	Executive Committee Meetings Relating to HPMP Approval Process			Total Time for Preparation and Approval of HPMP (months)	Comments
			Approval of HPMP Prep. Funds	HPMP Submission for Approval	Final Approval of HPMP & Stage I Funding		
Group 1 country							
China	UNEP, UNDP, UNIDO, IBRD, GIZ	4,039,569	55th, (56th additional funds)	63rd, 64th	64th	36	Discussions on overarching strategy and policy and related cost issues at Executive Committee level and eligible incremental costs at Secretariat, implementing agency and national levels. *Updated agreement approved at 67th Executive Committee.*
Group 2(a) countries							
India	UNDP, UNEP, UNIDO, GIZ	1,055,020	56th	66th	66th	41	
Saudi Arabia	UNEP, UNIDO	195,000	55th	68th	68th	53	Major investment projects in the XPS foam sector approved at 62nd Executive Committee (Dec. 2010) 2 years ahead of approval of HPMP.
Brazil	UNDP, GIZ	173,750	55th	64th	64th	36	
Mexico	UNDP, UNIDO	173,750	55th	64th	64th	36	A major project in the PU foam sector approved at 59th meeting (Nov. 2009)
Sub-total		**1,597,520**				**41.5**	***Average duration for group***

Sample of group 2(b) countries

Country	Implementing agency	Funds approved for HPMP preparation (US $)	Executive Committee meetings relating to HPMP approval process			Total time for preparation and approval of HPMP (months)	Comments
			Approval of HPMP prep. funds	HPMP submission for approval	Final approval of HPMP & stage I funding		
Thailand	IBRD	195,000	55th	66th, 67th	68th	53	Discussion of sectoral phase-out and policy issues and related eligibility issues
Turkey	UNIDO	195,000	55th	68th	68th	53	Major investment projects in both PU and XPS foam sectors approved at 62nd Executive Committee (Dec. 2010) 2 years ahead of approval of HPMP.
Malaysia	UNDP, UNEP, UNIDO	173,750	55th	65th	65th	40	
Kuwait	UNEP, UNIDO	195,000	55th	66th	66th	45	
Indonesia	UNDP, IBRD	323,750	55th & 56th	62nd, 63rd	64th	36	Discussion of sectoral phase-out and policy issues and related eligibility issues
Argentina	UNDP, UNIDO	173,250	55th	66th	66th	45	
Nigeria	UNDP, UNIDO	150,000	55th & 56th	62nd	62nd	28	*Revised agreement approved at 66th Executive Committee*
Egypt	UNIDO	195,000	55th	65th	65th	40	
Iran (Islamic Republic of)	UNDP, UNIDO, GIZ	462,250	56th	63rd	63rd	29	
South Africa	UNIDO	195,000	55th	67th	67th	48	
Sub-total		**2,258,000**				**41.7**	***Average duration for group***
Sample of groups 2(c) countries							
Colombia	UNDP	173,750	55th	62nd	62nd	36	Major investment projects in PU foam approved at 60th Executive Committee (April 2010) ahead of HPMP approval at 62nd meeting. *Revised agreement approved 66th meeting*
Viet Nam	IBRD	195,000	55th	63rd	63rd	33	
Philippines (the)	IBRD	195,000	55th	68th	68th	53	Foam sector phase-out plan approved 62nd Executive Committee. (Dec 2010) ahead of HPMP approval at 68th meeting (Dec. 2012)
Jordan	UNIDO	150,000	55th	64th, 65th	65th	40	Approval of stage I HPMP deferred on policy issue and priorization of ODS phase-out.
Algeria	UNIDO	85,000	55th	66th	66th	45	One project approved at 62nd meeting ahead of HPMP approval at the 66th meeting.

Country	Implementing agency	Funds approved for HPMP preparation (US $)	Executive Committee meetings relating to HPMP approval process			Total Time for preparation and approval of HPMP (months)	Comments
			Approval of HPMP prep. Funds	HPMP submission for approval	Final approval of HPMP & Stage I Funding		
Sudan (the)	UNIDO	30,000	55th	66th	66th	45	One umbrella project in PU foam approved at 62nd meeting ahead of HPMP approval at 66th meeting.
Trinidad and Tobago	UNDP	85,000	55th	64th	64th	36	
Ecuador	IBRD	150,000	55th	65th	65th	40	
Sub-total		**1,063,750**				**41**	
Sample of countries in Group 3							
Cuba	UNDP	150,000	56th	65th	65th	36	
El Salvador	UNDP	150,000	55th	64th	65th?	36	
Swaziland	UNEP	85,000	56th	63rd	63rd	29	
Armenia	UNDP	85,000	55th	62nd	62nd	28	
Croatia	UNIDO	150,000	55th	66th	66th	45	Two projects approved, one at 59th meeting (Nov 2009) (subsequently closed) and another at 62nd meeting (Dec 2010)
Mongolia	UNEP	85,000	55th	63rd	63rd	33	
Sub-total		**705,000**				**34.5**	

Legend:

55th Executive Committee	14-18 July 2008	64th Executive Committee	25-29 July 2011
56th Executive Committee	8-12 November 2008	65th Executive Committee	13-17 November 2011
57th Executive Committee	30 Mar-3 Apr 2009	66th Executive Committee	16-20 April 2012
62nd Executive Committee	29 November - 3 December 2010	67th Executive Committee	16-20 July 2012
63rd Executive Committee	4-8 April 2011	68th Executive Committee	3-7 December 2012

Annex III

HCFC CONSUMPTION, COMMITMENT TO ACCELERATED PHASE-OUT FOR COUNTRIES WITH FOAM PROJECTS IN HPMPS AND POTENTIAL IMPACT OF APPROVED PROJECTS

No.	Country	2012 Consumption (ODP tonnes)	2013 (Freeze) consumption (ODP tonnes)	Baseline consumption (BL) (ODP tonnes)	10% Reduced consumption in 2015	Diff between 2012 Cons and BL (ODP tonnes)	Funded HCFC phase-out (ODP tonnes)*	Completion Dates	HCFC phased Out (ODP tonnes)	Other non-foam project phase-out (ODP tonnes)	Total phase-out (ODP tonnes)	Foam Sector HCFC Remaining to phase Out (ODPt)	Commitment to phase out in stage 1		
													Committed target year	Committed % of BL reduction	Amount of HCFC reduction required (ODP tonnes)
Group 1: Very High Volume HCFC Consuming Country															
1	China	21,094.65		19,269.00	17,342.10	1,825.65	554.2	2014; 2015	148.84	0	148.84	405.4	2015	10	1926.9
Sub-Total		21,094.65		**19,269.00**	**17,342.10**	1,825.65	554.2		0						
Group 2(a): High Volume HCFC Consuming Countries (Sub-Group A)															
1	India	1,653.85		1,608.20	1,447.38	45.65	262.7	Dec-14; Dec-15	0	0	0.00	262.7	2015	10	160.82
2	Saudi Arabia	1,921.69		1,468.70	1,321.83	452.99	100.0	Dec. 15	0	0	0.00	100.0	2020	35	514.05
3	Brazil	1,387.87	1,189.25	1,327.30	1,194.57	60.57	48.7	Apr -15; Dec-15	48.7	138.05	186.75	0.0	2015	10	132.73
4	Mexico	1,103.98	835.17	1,148.80	1,033.92	-44.82	304.2	Jul 13; Jan 15; Sep 14; Jun 16; Dec 14	66.8	313.63	380.43	237.4	2015	30	344.64
Sub-Total		**6,067.39**		**5,553.00**	**4,997.70**	**514.39**									
Group 2(b): High Volume HCFC consuming countries (Sub-Group B)															
1	Thailand	1,154.64		927.60	834.84	227.04	33.4	Jun. 15	0	0			2018	15	139.14
2	Turkey	318.18		551.47	496.32	-233.29	16.3	Dec. 15	0	0	0		2017	86.4	476.47
3	Malaysia	736.9	N/R	515.80	464.22	221.10	85.1	Dec. 13; Dec. 15	49.3	0			2016	15	77.37

No.	Country	2012 Consumption (ODP tonnes)	2013 (Freeze) consumption (ODP tonnes)	Baseline consumption (BL) (ODP tonnes)	10% Reduced consumption in 2015	Diff between 2012 Cons and BL (ODP tonnes)	Funded HCFC phase-out (ODP tonnes)*	Completion Dates	HCFC phased Out (ODP tonnes)	Other non-foam project phase-out (ODP tonnes)	Total phase-out (ODP tonnes)	Foam Sector HCFC Remaining to phase Out (ODPt)	Commitment to phase out in stage 1		
													Committed target year	Committed % of BL reduction	Amount of HCFC reduction required (ODP tonnes)
4	Kuwait	420.15		418.60	376.74	1.55	60.7	Jun. 14; Jun. 16	0				2018	39	163.25
5	Indonesia	329.38		403.90	363.51	-74.52	65.6	Dec-14; Dec-15	0				2015	20	80.78
6	Argentina	571.39		400.70	360.63	170.69	18.5		0				2017	18	72.126
7	Nigeria	512.56		398.20	358.38	114.36	0.0	Dec. 14	0				2015	10	39.82
8	Egypt	513.78	297	386.30	347.67	127.48	84.2	Nov. 11; Dec. 12	42.1				2018	25	96.58
9	Iran (Islamic Republic of)	376.31		380.50	342.45	-4.19	61.0	Mar-12; Mar-15; Dec-15	3	0	3		2015	10	38.05
10	South Africa	461.71		369.70	332.73	92.01	60.6	Dec. 14; Jun. 16					2020	35	129.40
Sub-Total		**5395.0**		**4,752.77**	**4277.493**	**642.23**									
Group 2(c): High Volume HCFC Consuming Countries (Sub-Group C)															
1	Pakistan	326.23		247.40	222.66	78.83							2015	10	24.74
2	Colombia	285.5		225.60	203.04	59.90	0.0						2015	10	22.56
3	Viet Nam	199.93		221.20	199.08	-21.27	134.1	Dec.14; Dec. 15					2015	10	22.12
4	Philippines (the)	195.65		208.40	187.56	-12.75							2015	10	20.84
5	Syrian Arab Republic	83.18		135.00	121.50	-51.82							2015	10	13.50
6	Cameroon	73.78		88.80	79.92	-15.02	15.7		7.2				2015	20	17.76
7	Qatar	93.57		86.90	78.21	6.67	19.1	Dec. 15	0				2015	20	17.38
8	Jordan	124.85		83.00	74.70	41.85							2017	20	16.60
9	Lebanon	94.67		73.50	66.15	21.17	0.0	Jul. 14					2015	18	13.23
10	Bangladesh	66.47		72.6	65.34	-6.13							2018	30	21.78

No.	Country	2012 Consumption (ODP tonnes)	2013 (Freeze) consumption (ODP tonnes)	Baseline consumption (BL) (ODP tonnes)	10% Reduced consumption in 2015	Diff between 2012 Cons and BL (ODP tonnes)	Funded HCFC phase-out (ODP tonnes)*	Completion Dates	HCFC phased Out (ODP tonnes)	Other non-foam project phase-out (ODP tonnes)	Total phase-out (ODP tonnes)	Foam Sector HCFC Remaining to phase Out (ODPt)	Commitment to phase out in stage 1		
													Committed target year	Committed % of BL reduction	Amount of HCFC reduction required (ODP tonnes)
11	Algeria	56.56		62.12	55.91	-5.56							2017	20	12.42
12	Morocco	68.84	49.41	59.7	53.73	9.14							2017	20	11.94
13	Sudan (the)	58.91		52.7	47.43	6.21							2017	30	15.81
14	Dominican Republic (the)	40.87	34.78	51.2	46.08	-10.33	8.2		0				2015	10	5.12
15	Trinidad and Tobago	88.5		46	41.40	42.50	6.7	Dec. 15; Jan. 15	0				2020	35	16.10
16	Oman	54.95	28.87	31.5	28.35	23.45	2.3	Jun. 13					2015	10	3.15
17	Ecuador	33.76		23.49	21.14	10.27							2020	35	8.22
Sub-total		**1946.22**		**1769.11**	**1592.199**	**177.11**									
Group 3: Low and Very Low Volume HCFC Consuming Countries															
1	Zimbabwe	16.2	15.76	17.8	16.02	-1.60	15.0		15				2020	35	6.23
2	Cuba	14.9	12.19	16.9	15.21	-2.00							2020	35	5.92
3	Jamaica	6.3		16.3	14.67	-10.00	3.6	Jun. 14	0				2020	35	5.71
4	Costa Rica	23		14.1	12.69	8.90	14.0						2020	35	4.94
5	Sri Lanka	18.02	13.37	13.9	12.51	4.12	0.4	Dec. 14	0				2020	35	4.87
6	El Salvador	9.32		11.7	10.53	-2.38	4.9		0				2020	35	4.10
7	Guatemala	8.68	11.28	8.3	7.47	0.38	1.7		1.7				2020	35	2.91
8	Swaziland	3.74	1.18	7.3	6.57	-3.56	7.7	Nov. 13	7.7				2020	35	2.56
9	Armenia	5.67		7	6.30	-1.33	2.2		2.2				2020	35	2.45
10	Nicaragua	11.87		6.8	6.12	5.07		Dec. 14	0				2020	35	2.38
11	Bosnia and Herzegovina	6.79		6.1	5.49	0.69	5.1						2020	35	2.14
12	Croatia	3.63		4	3.60	-0.37							2020	100	4.00

No.	Country	2012 Consumption (ODP tonnes)	2013 (Freeze) consumption (ODP tonnes)	Baseline consumption (BL) (ODP tonnes)	10% Reduced consumption in 2015	Diff between 2012 Cons and BL (ODP tonnes)	Funded HCFC phase-out (ODP tonnes)*	Completion Dates	HCFC phased Out (ODP tonnes)	Other non-foam project phase-out (ODP tonnes)	Total phase-out (ODP tonnes)	Foam Sector HCFC Remaining to phase Out (ODPt)	Commitment to phase out in stage 1		
													Committed target year	Committed % of BL reduction	Amount of HCFC reduction required (ODP tonnes)
13	the former Yugoslav Republic of Macedonia	0.74	0.72	1.8	1.62	-1.06		Dec. 13					2020	35	0.63
14	Mongolia	2.87	0.94	1.4	1.26	1.47							2020	35	0.49
Sub-Total		**131.73**		**133.4**	**120.06**	**-1.67**									
TO-TAL		**34,634.99**		**31,477.28**	**28,329.55**	**3,157.71**									
		Countries that are committed to faster accelerated HCFC phase-out.													

Annex IV

INVESTMENT PROJECTS IN THE FOAM SECTOR SCHEDULED FOR COMPLETION IN 2014 AND 2015

PU sub-sector: completion 2014				PU sub-sector: completion 2015			
Country	**HCFC phase-out (ODP tonnes)**	**Completion month**	**IA**	**Country**	**HCFC phase-out (ODP tonnes)**	**Completion month**	**IA**
Algeria*	2.4	December	UNIDO	Brazil	48.7	December	UNDP/Germany
Argentina	18.5	November	IBRD	China	357.4	December	IBRD
Bangladesh*	20.2	December	UNDP	Egypt	42.1	November	UNDP
Bosnia and Herzegovina	5.1	October	UNIDO	El Salvador	4.9	November	UNDP
Cameroon	15.7	December	UNIDO	India	117.3	December	UNDP
Croatia*	1.8	Sep-13	Italy	Indonesia	11.9	December	IBRD
Egypt *	17.6	November	UNIDO	Iran (Islamic Republic of)	30.5	December	UNIDO
Egypt	9	December	UNIDO	Malaysia	35.8	December	UNDP
India	145.4	December	UNDP	Mexico	101.5	January	UNDP
Indonesia	18.9	December	IBRD	Saudi Arabia	52.1	December	UNIDO
Indonesia	10.4	December	UNIDO	Thailand	33.4	June	IBRD
Jamaica	3.6	June	UNDP	Trinidad and Tobago	2.5	January	UNDP
Jordan	8.1	December	UNIDO		4.2	December	UNDP
the former Yugoslav Republic of Macedonia	1.6	December	UNIDO	Turkey	16.3	December	UNIDO
Mexico	55.8	July	UNDP	Viet Nam	89.4	December	IBRD
Mexico	23	December	UNIDO	**Sub-total**	**948**		
Nicaragua	0.5	December	UNIDO				
Nigeria	0	July	UNIDO				
Oman	2.3	June	UNIDO				
Pakistan*	71.6	December	UNIDO				
Philippines (the)*	40	September	UNIDO				
Sudan (the)*	11.9	January	UNIDO				
Turkey*	99	December	UNIDO				
Viet Nam	44.7	December	IBRD				
Sub-Total	**663.1**						
XPS subsector: completion 2014				**XPS sub-sector: completion 2015**			
China*	6.3	September	UNDP	China	121.1	April	UNIDO/Germany
China		December	UNIDO	Qatar	19.1	December	UNIDO
Saudi Arabia*	28.9	December	UNIDO	**Sub-total**	**140.2**		
Turkey*	114.2	December	UNIDO				
Sub-total	**149.4**						
Total	**812.5**			**Total**	**1088.2**		

*Projects approved in advance of HPMP approvals