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FINAL REPORT ON THE EVALUATION OF HCFC PHASE-OUT PROJECTS IN THE FOAM SECTOR

Background

1. The evaluation of the phasing out of the HCFC in the foam sector was approved at the 72nd meeting (decision 72/8). The objective of the evaluation is to analyze the progress made in the phasing-out of HCFCs in the foam sector for projects funded by the Multilateral Fund. The evaluation, *inter alia*, assess issues related to the preparation and implementation of projects, legislation, technology replacement, and causes of delays. The present report summarizes the outcomes and extracts the main findings and conclusions of a desk study as well as the ten case studies prepared following field visits[1]. Additional information can be found in these documents posted on the Secretariat website (restricted area).

Main findings

2. All ten of the countries in the sample achieved the 2013 freeze target reducing 6,623.3 ODP tonnes HCFCs from 2012 consumption. HCFC reductions in 2013 were achieved mainly through legislative mechanisms such as licensing and quota systems which were prerequisite for approval of HPMP funding. This reduction is still low, as many of the foam projects in these countries are still ongoing, and will be completed after 2015. About five per cent of HCFC reductions in 2013 were associated with completed stand-alone projects approved in advance of HPMPs. In Colombia, however, the impact from completed stand-alone foam projects was significant in 2013, representing 24.8 per cent of the baseline, contributing to the freeze and the 10 per cent reduction in 2015. Additional phase-out was achieved through conversion of systems houses and some downstream users in Malaysia, Mexico, and South Africa. The 2012 – 2013 HCFC phase-out targets, which were originally claimed in HPMP approved projects, have

[1] Cameroon, China, Colombia, Ecuador, the Islamic Republic of Iran, Malaysia, Mexico, Saudi Arabia, South Africa and Viet Nam were visited by independent consultants

not been met yet due to project implementation delays. Annex I shows that the 2013 consumption in all ten countries was below the baseline.

3. A number of projects in the sample countries are near completion, hence more pronounced effect in terms of HCFC phase-out in the foam sector can be expected in 2015 contributing to meeting the 10 per cent reduction target.

Policies and regulations

4. In April 2010, the Executive Committee decided on the cut-off date of September 2007 and on funding the second stage conversion. This encouraged Article 5 countries to establish licensing and quota systems to control HCFC consumption[2]. This was a prerequisite for getting funds for their HCFC phase-out activities. The country studies indicate that all ten countries adopted legislation on licensing and quota systems.

5. Decision 60/47[3] established the conditions for funding of enterprises consuming HCFC contained in imported pre-blended polyols not reported as consumption under Article 7. Consumption of HCFC-141b in Cameroon is 100 per cent from imported polyols. As of 2010, Cameroon decided to report all imported HCFC-141b pre-blended in polyols as consumption under Article 7 data and the starting point for sustained aggregate reduction of HCFC consumption was established accordingly. In addition, necessary arrangements have been taken in this respect for Ecuador, South Africa and Viet Nam to fulfill the requirements of decision 61/47.

6. In Viet Nam, the World Bank indicated that sub-grant agreements signed between the Government and the beneficiary enterprises have clauses that compel enterprises to stop using HCFC-141b in both bulk and contained in pre-blended polyols.

7. Some countries took additional measures to reinforce the sustainability of achieved phase-out. Thus, in China, the Ministry of Environmental Protection (MEP) has issued a "Circular on Strict Management of HCFC Production, Sale and Consumption" (7 August 2013) to ensure achievement of the freeze target in 2013, and the 10 per cent reduction in 2015. Under this system, enterprises with more than 100 metric tonnes (mt) of annual HCFC consumption for controlled uses, should hold quota permits.

8. In Viet Nam**,** the Government intends to ban the import of bulk HCFC-141b in 2016 and cap the import of imported polyols containing HCFC-141b to the levels commensurate with the demand for the remaining small and medium-sized enterprises (SMEs). Thus, there would be no incentive for importers to import and distribute since the market price as well as the volumes would not be commercially attractive to the relatively larger foam manufacturers. The World Bank further advised that import controls of HCFC-141b contained in imported pre-blended polyols had been included in the licensing system, and the importation requires an import permit. Currently, imported polyols are not subject to a quota.

9. In South Africa, the following regulatory measures were included in the updated ODS regulation: quota system for the assignment of import licenses for all HCFCs as of1 January 2013; and ban on imports of HCFC-141b, either pure or as a component of blended chemical, by 1 January 2016.

10. Saudi Arabia does not monitor imports of pre-blended polyol containing HCFC and did not add HCFC-141b contained in imported pre-blended polyol systems to the starting point as this was going to be phased out without assistance from the Multilateral Fund. The Government is committed to issue a

[2] Decision 54/39(e) requires confirmation of the implementation of the HCFC control measures in legislation, regulations and licensing systems as a pre-requisite for funding the implementation of the HPMP

[3] Decision 60/47, UNEP/Ozl.Pro/ExCom/60/54

quota for the import of bulk HCFC-141b and will ban the import of HCFC-141b contained in pre-blended polyols, as well as the export of domestically blended HCFC polyols by 2018.

Project implementation issues

11. Bilateral and implementing agencies (IAs) adopted different project implementation modalities. UNDP and the World Bank are using national implementation modality built upon a performance-based agreement. UNIDO rely on in-house engineering expertise and procurement capability and take a more direct role in implementation of projects, especially in individual and small umbrella projects. UNIDO is using modalities comparable to UNDP and the World Bank when it is involved in dealing with HPMP tranches. The duration of completed or nearly completed projects implemented by the World Bank, UNDP and UNIDO varies from 25 to 56 months, 24 to 65 months and 24 to 52 months, respectively. There were no complaints from beneficiaries in regard to implementation modalities used by IAs and no salient issues due to the modality of implementation during the field trip, but the topic may deserve a more in-depth examination.

12. In countries where HPMPs address a large number of SMEs a verification in the field was required. Some flexibility in the procedure permitted the approval of funds before the verification was done. Some countries (e.g., Saudi Arabia) encountered problems in identifying the SMEs which were clients of systems houses because the systems houses were reluctant to disclose this information as they considered it to be private. The phase out at the level of the SME will therefore be implemented and monitored by the systems houses only, which may have an impact on the capability of the IA of monitoring the phase out process.

Delays in implementation

13. Projects preparatory phase varied from 14 to 39 months, with delays encountered stemming from the necessary setup and implementation mechanisms. This, however, may not be expected in stage II of HPMPs as these implementation arrangements will already be in place.

14. Other reasons for delays include complex procurement processes; hesitation by enterprises in adopting technologies due to lack of know-how or perceived competitive disadvantages; extended time for site preparation or relocation to accommodate new technologies, typically in case of adoption of hydrocarbons (HC) technology; unavailability or lack of regular supply of new alternative foam formulation; difficulties in providing counterpart funding; and the complexity of work, especially when systems houses are involved in interactions with many end-users (mostly SMEs), which put forward their specific requirements for foam formulations.

15. Delays also occurred because of difficulties in the supply and higher cost of equipment and raw material due to economic sanctions, (e.g., Islamic Republic of Iran), problems in obtaining customs clearance for equipment required for conversion (e.g., Saudi Arabia), and difficulties in adapting new technologies (e.g., methyl formate (MF) technology in South Africa).

Technology

16. The selection of the most appropriate technology in replacing HCFC blowing agent was and still remains the issue for many foam manufacturing companies. A number of demonstration projects were approved prior to HPMPs development to facilitate the choice of the replacement technology in Article 5 countries.

17. In China, the project demonstrating conversion from HCFC-141b-based to cyclopentane-based pre-blended polyol in the manufacture of rigid PU foam was successfully completed. The systems house developed pre-blended polyol in phase I and applied it at four small enterprises with different lines of

foam products with the cost-effectiveness of US $13.29/kg. The project demonstrated successfully the production and distribution of HC pre-blended polyol to downstream foam manufacturers. This signifies that SMEs in the rigid polyurethane (PU) foam sector with consumption in the range of up to 20 mt can be converted rather cost-effectively applying pre-blended HC polyols. The systems house also developed the method of safe transportation of pre-blended polyol in drums. The company proved the possibility to export the products to neighboring countries in special containers. The issue of safe transportation of HC pre-blended polyol is critical for the potential wider dissemination of this technology.

18. In Colombia, a demonstration project implemented by Japan and UNDP validated the use of super-critical CO_2 in the manufacture of spray foam as a low global warming potential (GWP) alternative with acceptable technical parameters, except moderately inferior thermo-conductivity value. The evaluator was informed about some operational difficulties in using the retrofitted spray machine. Yet, this technology could be successfully applied in Article 5 countries if the vendor of the technology provides assistance in developing the foam formulation based on local resources. Therefore the high incremental costs of the proprietary foam formulation and, respectively, poor cost-effectiveness, can be overcome.

19. Phase I of the pilot project for development, optimization and validation of MF in PU foam shoe sole applications in Mexico, through a systems house (Zadro), was also successfully completed. The outcomes of the MF samples performed equally or better compared to standards derived from HCFC-141b foam; production lines had been fully converted; the necessary safety audits had been conducted as required. MF-based formulations for shoe sole applications and methylal-based formulations for other applications were approved and commercially available and the retrofit kits have been delivered to downstream users. In addition, clients' test and field optimization were completed and the company was collecting incremental operating cost (IOC) data.

20. Under the HPMP implementation, the leading South African systems house completed its conversion and is supplying MF blown two-component systems to their downstream clients. The company stated that MF technology is never a simple 'drop in' alternative to HCFC-141b, but requires an individual approach in formulating and testing for each specific application. Technical assistance needs to be provided to the downstream clients in commissioning the new technology, a time consuming and costly, but indispensable procedure. The systems house anticipates phasing out the use of HCFC-141b by the end of the third quarter of 2015 and is actively involved in assisting about 15 per cent of the remaining clients, with training and technical assistance. Three other companies manufacturing insulation panels and commercial refrigeration products experienced difficulties with the MF technology, but still decided to adopt it in due course. Another systems house and manufacturer of panels tried to adopt MF technology with negative results. The company decided to switch over to cyclopentane technology.

21. In Mexico, at least four national and three international systems houses are testing HFO blowing agents in foam formulations for different applications, and a number of systems houses are also testing MF. The evaluation team visited seven of these system houses. While the systems houses are allowed to change to any alternative technology that has 0 ODP/very low GWP, all associated costs, however, are based on changing to MF.

22. At this point, MF-blown foam with low density (in the range of 28 to 32 kg/m^3), especially spray foam, shows shrinkage to the point that the product is not useable (shrinkage in spray foam shows itself as loss of adhesion and cohesion). The intermediate solution at most, if not all enterprises, is to use a 50/50 blend of MF and HCFC-141b. This leaves the issue of whether or not the technology exists to formulate without HCFC-141b to eliminate HCFC-141b in the foam sector by 2018. An obvious alternative would be to increase densities to the point where the problem does not occur ($\geq$34 kg/m^3). Formulations that resolve the technical issues are being studied by most of the major polyurethane chemical suppliers.

23. One enterprise in Ecuador is expecting a drum of an HFO blended system to do testing. While this may seem like the ultimate solution, this material is more expensive and has some stability issues.

24. Similarly, a systems house in Colombia is working on HFO-based formulations. However, results on specific applications have not been reported yet.

25. In the XPS subsector in China, the demonstration project on conversion from HCFC-22/HCFC-142b technology to CO_2 with MF co-blowing technology encountered some challenges; at present, the equipment cost and the safety-related cost are higher than the cost of HCFC technology. On this basis, many of the XPS foam enterprises in China preferred to convert to CO_2/ethanol technology. The evaluation mission confirmed that, as documented, the CO_2/MF technology did not meet the expectations for being cost-effectively transferred to a large number of enterprises in XPS foam sub-sector. As the technology matures, if the cost decreases, it will be possible to use it.

26. In Cameroon, the very high operational efficiency compared to the baseline manufacturing operations makes the conversion to MF technology attractive to the enterprises. However, as availability of HCFC-141b would make the foam systems cheaper and the insulation business with the new machine even more profitable, and unless HCFC-141b is made unavailable and the MF systems made readily available, the post-phase-out sustainability could be impaired. In this regard efforts to establish MF-based systems house in the neighbouring country Nigeria could enhance sustainability of the conversion.

Safety and security

27. The conversion to HC needs a special attention in meeting safety requirements. At the initial stage of the project, an assessment needs to be made on whether the company's existing setup for using flammable and explosive material meets local building and fire codes or zoning bylaws. It also requires well trained operators, well maintained plant and equipment with correctly positioned ventilation and safety devices to minimize the risks involved. In Viet Nam, the adherence to local safety rules required relocation of the production to a new site resulting in delay and substantial co-funding of the project.

28. Not all Article 5 countries have national safety standards regulating the use of flammable and explosive material in the production process. It is the responsibility of the equipment and foam formulation suppliers to provide the advice on all safety requirements to the beneficiary of the project. In Ecuador, at Indurama, a safety audit was conducted after the production with cyclopentane had already commenced. The audit identified a number of safety shortcomings which have been rectified at a later stage.

29. The quality of the training offered by the technology supplier to the enterprises seems minimal in many cases. The frequency and content of training syllabus is the responsibility of the management of the enterprises converted to HC and varies from country to country.

Counterpart funding

30. Counterpart funding becomes necessary when eligible incremental costs of an individual enterprise exceeds approved funds calculated using the cost-effectiveness threshold value. The potential counterpart funds cannot be calculated accurately upfront before the approval of the project and sometimes the lack of information on this funding makes it difficult to determine the actual cost of the project. In several countries where conversion to HC of SMEs was approved, using cost-effectiveness threshold of US $9.79 (including the 25 per cent premium for introducing low GWP technology), the counterpart funding appeared to be excessive, jeopardizing the sustainability of the project. The counterpart funding was especially big when the relocation of the plant was required due to local fire safety codes and bylaws.

31. In Viet Nam, for three companies covered by the evaluation mission, analysis of the projects' budgets and expenditure showed that even though equipment procurement was within allocated funds, conversion to HC resulted in high co-funding from the beneficiary enterprises for on site preparation and activities to accommodate the new technology and meet local zoning bylaws.

32. In Colombia, the conversion to cyclopentane of a company with HCFC consumption of 21.7 mt was approved with cost-effectiveness US $29.74, within the umbrella cost-effectiveness of US $9.39/kg. The favorable overall cost-effectiveness was a result of inclusion of a large volume of HCFC consuming enterprise with about 50 per cent of foreign ownership into the umbrella project. The company successfully completed the conversion with the actual cost of conversion slightly below the approved funding.

Training

33. The quality of the training offered by the technology suppliers to the enterprises (typically training of three days plus one week production support) seems minimal. The providers of cyclopentane-based foam formulation usually conduct the initial training on safety regulations followed up by training at the enterprise level. In many countries in the sample there is no professional foam association to assist in the dissemination of safety related information. The IAs conducted training seminars on implementation modalities and reporting requirements, which were found very helpful.

Destruction of HCFC equipment

34. The timely destruction of HCFC-based equipment replaced by equipment based on alternative technology is an important aspect ensuring the sustainability of the conversion. Most of the companies visited confirmed that the existing HCFC-141b equipment will be either converted to alternative technology or destroyed. The bilateral and IAs should monitor the destruction and can relate the release of the last funding installment with the destruction of old equipment.

Monitoring

35. National ozone units (NOUs) and bilateral and IAs have the overall responsibility for monitoring the projects. In China, for both PU and XPS foam sectors there are verifications and monitoring activities at every stage of the implementation of the plan by accounting firms. In addition, the staff of bilateral and IAs carries out regular evaluation missions and discusses progress of implementation with the Foreign Economic Cooperation Office of the Ministry for Environmental Protection. Furthermore, the bilateral and IAs report to the Executive Committee in accordance with the reporting requirements.

36. In some countries, consultants are involved in developing management information system (MIS) for tracking imported bulk of HCFCs as well as imported HCFC-141b contained in pre-blended polyols. The MIS provides another tool for monitoring the use of HCFCs at the enterprise level as well as the rate or extent of HCFC reductions in the foam industry.

37. In all sample countries the NOUs confirmed that post conversion monitoring is now in place, as well as a quota system. This will also have an implicit impact on sustainability. It was noted that in Ecuador the industry complained about the complexity of the administrative procedures, which hindered the efficient control and coordination in the foam sector.

38. The quality of the information collected also depends on the type of infrastructure, such as HCFC identifiers provided to Customs and relevant institutions. MIS established linkages between data collection and data reporting institutions in the country and the expertise and efficiency of the personnel that use it.

Conclusions

39. In some countries, customs clearance for equipment required for conversion is a difficult and lengthy process. Such problems call for an urgent solution at Government level.

40. Because of the lack of information on and understanding of emerging alternative technologies by companies, it is recommended that bilateral and IAs collect and disseminate such information. This was already agreed between the Secretariat and UNIDO in the case of introduction of CO_2/ethanol in the XPS sector in China.

41. The evaluation found that several systems houses had problems adopting MF technology. This, however does not invalidate MF as a viable blowing agent, but confirms that the application of the technology should be considered on a case-by-case basis. Projects that intend to use MF should be implemented through qualified systems houses as fully formulated systems, particularly given the scarcity of adequately qualified technical personnel to carryout evaluation trials amongst the downstream SMEs.

42. In the conversion to HC-based technology, given the risk associated to the technology, bilateral and IAs should ensure that equipment suppliers in all cases provide the full checklist with all possible safety problems when installing new equipment required. IAs should be more proactive in encouraging the equipment suppliers to provide initial safety training and assistance; preparing the appropriate training syllabus for follow up training; and prepare the enterprise management to retrain the staff after the completion of the project.

43. The lack of controls on imported polyol blends containing HCFC-141b in Saudi Arabia endangers the sustainability of the HCFC conversion projects. The import of polyol blends containing HCFC requires regulation if not prohibition. UNIDO should discuss with the Government the possibility of banning imports of polyol blends containing HCFC as early as possible, but prior to 2018.

44. Few, if any technology suppliers will guarantee a delivery date of less than three months from the date of signing a contract. These three months are considered the minimum time required for procurement of, *inter alia*, hardware, assembly, testing, disassembly, painting, crating, and preparation of relevant documentation. Three months may be insufficient in the case of specialized or complex one-off plant and equipment. It is essential therefore that the NOU and the bilateral and IAs have a very accurate knowledge of each technology suppliers' status and capacity. Each contract signed should include a significant penalty clause if delivery dates are not fully respected.

45. Bilateral and IAs should be more proactive in encouraging the equipment suppliers to provide initial safety training and assistance; preparing the appropriate training syllabus for follow up training; and prepare the enterprise management to retrain the staff after the completion of the project.

46. Bilateral and IAs should make sure that implementation agreements between Governments/IAs and beneficiary enterprises include clauses where enterprises commit to stop using HCFC-141b in both bulk and/or as contained in imported pre-blended polyols.

Recommendation

47. The Executive Committee may wish:

(a) To take note of the final report on the evaluation of the HCFC phase-out projects in the foam sector contained in document UNEP/OzL.Pro/ExCom/74/9; and

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

Annex I

PROFILE OF HCFC CONSUMPTION IN THE FOAM SECTOR AND HCFC PHASE-OUT FOR STAND-ALONE HCFC PHASE-OUT MANAGEMENT PLAN PROJECTS IN COUNTRIES SELECTED FOR THE FIELD EVALUATION

Country	Year	HCFC Consumption in Foam and Refrigeration Manufacturing Sectors (ODP tonnes)*						Baseline HCFC Consumption (ODP tonnes)	Per Cent of Foam Sector Bulk and Pre-blended HCFC Consumption of Baseline	2012 Consumption	2013 HCFC Consumption	2013 Reduction in HCFC Consumption Against 2012 consumption	2013 Reduction in HCFC Consumption Against Baseline	Reported Phase-out from Foam Stand-alone and HPMP Projects
		HCFC-22	HCFC-141b	Imported Pre-blended HCFC-141b	Total HCFC-141b	HCFC-142b	Total							
Cameroon**	2013	-	11.8	-	11.8	-	11.8	88.8	13.3	73.8	82.3	(8.5)	6.5	
China	2013	1,644.5	5,097.2	-	5,097.2	732.2	7,473.9	19,269.0	38.8	21,094.6	15,757.0	5,337.6	3,512.0	161.2
Colombia***	2013		181.7		181.7		181.7	225.6	80.5	285.5	176.7	108.9	49.0	56.0
Ecuador	2013	-	-	16.6	16.6	-	16.6	23.5	70.6	33.8	22.0	11.8	1.5	19.4
the Islamic Republic of Iran	2013	1.5	115.5	-	115.5	-	116.9	380.5	30.7	376.3	357.4	18.9	23.1	2.8
Malaysia	2013	-	315.6	-	315.6	-	315.6	515.8	61.2	736.9	445.8	291.1	70.0	49.3
Mexico	2013	6.8	215.5	-	215.4	5.8	228.0	1,148.0	19.8	1,104.0	779.1	324.9	368.9	66.8
Saudi Arabia****	2012	89.9	406.1		406.1	153.7	649.7	1,468.7	44.2	1,921.7	1,433.7	488.0	35.0	0.0
South Africa	2012	1.4	175.0	32.0	200.7	2.5	204.6	369.7	55.3	345.6	288.8	56.8	80.9	n.a.
Viet Nam*****	2013	-	22.7	217.4	240.1	-	240.1	221.2		199.9	202.9	(2.9)	18.4	n.a
Total		1,744.0	6,541.1	266.0	6,800.7	894.2	14,942.2	23,710.8	39.8	26,172.1	19,545.8	6,626.3	4,165.0	355.5

*For the majority of cases HCFC-22 is used alone or combined with HCFC-142b for the production of XPS foam. In a few cases (e.g., Mexico) HCFC-22 is also used in PU foam.
**Cameroon does not import pure HCFC-141b and reports its consumption based on HCFC-141b in imported pre-blended polyol.
***Colombia and Mexico exported HCFC-141b contained in pre-blended polyol. The national consumption is discounted accordingly.
**** Country has a limited control over imported HCFC-141b pre-blended polyol.
***** Viet Nam does not report consumption of HCFC-141b imported in pre-blended polyol as Article 7 data.

Annex II

SELECTION OF TECHNOLOGY IN THE TEN SAMPLE COUNTRIES

	Country	Foam sub-sector	Application	Technology selected/tested
1	Cameroon	Rigid PU	Pipe insulation	Imported MF pre-blended polyol
2	China	Rigid PU	Pipe insulation	Water blown
			Refrigeration appliances insulation	Cyclopentane
			Reefer container insulation	Cyclopentane
			Insulation foam at SMEs	Cyclopentane pre-blended polyol
		XPS Foam	XPS Insulation	CO_2/MF co-blowing
			XPS Insulation	CO_2/ethanol co-blowing
3	Colombia	Rigid PU	Spray foam	Super critical CO2, HFO,CP
			Refrigeration appliances insulation	Cyclopentane
4	Ecuador	Rigid PU	Refrigeration appliances insulation	Cyclopentane
			Refrigeration appliances insulation	HFO
5	Islamic Republic of Iran	Rigid PU	Refrigeration appliances insulation	Cyclopentane
			Continuous and discontinuous insulation panels	Cyclopentane
6	Malaysia	Rigid PU	Discontinuous insulation panels	Cyclopentane
		Rigid PU/PIR	Continuous insulation panels	N-pentane
		Rigid PU	Insulation of fish boxes	Cyclopentane
		Rigid PU Systems Houses	Variety of applications	MF, HFO
7	Mexico	Rigid PU	Refrigeration appliances insulation	Cyclopentane
		Rigid PU Systems Houses	Variety of applications	MF, water, methylal, methylal/HFC (low density spray), HFO, cyclopentane pre-blended
8	Saudi Arabia	Rigid PU	Continuous and discontinuous insulation panels	N-pentane
		XPS Foam	XPS Insulation boards	Isobutane/ CO_2
		Rigid PU System Houses	Variety of applications	Experimenting with pentane, MF, HFC 245, HFC 365, HFO
9	South Africa	Rigid PU System Houses	Variety of applications	MF
		Rigid PU	Insulation boards	Cyclopentane
		Rigid PU	Refrigeration appliances	Cyclopentane

	Country	Foam sub-sector	Application	Technology selected/tested
			insulation	
		Rigid PU	Refrigeration appliances insulation	MF
10	Viet Nam	Rigid PU	Continuous and discontinuous insulation panels	Cyclopentane

Annex III

STATUS AND DELAYS IN IMPLEMENTAITON OF COMPLETED AND ONGOING PROJECTS IN THE TEN SAMPLE COUNTRIES

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
Cameroon (completed	Rigid PU; Phase-out of HCFC-141b used in the pipe insulation contracting industry applying MF-based technology; (15.7 ODP tonnes)*	UNIDO, direct implementation	12	Delays in delivery of equipment by the supplier for about 12 months; delays in equipment clearance at the port. Project completed
China (completed)	Rigid PU; Phase-out of HCFC-141b used by 11 pipe manufacturing enterprises applying water-blown technology; (135.2 ODP tonnes); (CE US $4.50/kg)	World Bank, performance-based modality	18	Performance-based modality required about 18 months for preparatory work and institutional setup, and 18 months of work at the enterprise level
China (completed)	Rigid PU; Conversion demonstration at WHRW (Guandong) from HCFC-141b to cyclopentane-based pre-blended polyol; (6.87 ODP tonnes); (CE US $13.29/kg)	World Bank, performance-based modality	32	Delays due to the complexity of the project consisting of two phases: development of the pre-blended polyol formulation and transfer to four downstream enterprises. The logistical challenges involved were underestimated. There were other unforeseen circumstances such as enterprises dropping out of the project resulting in searches for replacements
China (completed)	XPS Foam; Demonstration project on conversion to CO_2 co-blowing with MF; (12.3 ODP tonnes)	UNDP, performance based modality	22	Delays are explained by challenges experienced in adoption of the new technology. Cost-effectiveness cannot be calculated yet due to lack of IOC data
China (on-going)	Rigid PU; Conversion of CIMC reefer container manufacturer to HC (235.4 ODP tonnes); (CE US $3.71/kg)	World Bank, performance-based modality	n.a.	Production had to be relocated to a new site due to safety requirements and to meet approval of local authorities. As of December 2014, installation of equipment at the new site was completed and commissioned. Commercial production expected at the beginning of 2015 after the stock of HCFC-141b has been depleted

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
China (on-going)	Rigid PU, Shandong Hongstai Domestic refrigeration Electrical Appliance (15.23 ODP tonnes); (CE US $7.72/kg)	World Bank, performance-based modality	n.a.	Equipment is installed and commissioned. The company is awaiting the issuance of the certificate from the local fire-fighting authority and ready to stop using HCFC-141b
China (on-going)	XPS foam Beijing Bockman Extruded Product Co. Conversion to CO_2 with other co-blowing agent (116.5 ODP tonnes); (CE US $3.56/kg)	UNIDO, performance-based modality	n.a.	As of December 2014 equipment was delivered and installed awaiting commissioning
Colombia (completed)	Rigid PU; Spray foam; Demonstration project to validate the use of super-critical CO_2 in the manufacture of sprayed PU rigid foam	UNDP, performance-based modality	29	Delay due to long preparation and signing documents (24 months), influenced by interactions between UNDP, the Government and the enterprise
Colombia (completed)	Rigid PU; Conversion of four enterprises HCFCs to HC in the production of PU rigid insulation foam in the domestic refrigeration subsector; (60.5 ODP tonnes)	UNDP, performance-based modality	5	The preparatory period was short (6 months). The completion of the project, with a five month delay, at the four domestic refrigeration should be considered effective given the complexity of conversion to HC
Ecuador (completed)	Rigid PU Phase-out of HCFC 141b contained in imported pre-blended polyol converting to cyclopentane in Indurama (19.43 ODP tones) (CE US $9.79/kg)	UNIDO, performance-based modality	4	As of March 2014, the company used solely cyclopentane foam
the Islamic Republic of Iran (completed)	Rigid PU Conversion of Gol Asay Sarma from HCFC to cyclopentane in the production of PU rigid insulation foam in the domestic refrigeration subsector; (2.77 ODP tones)	UNIDO, performance-based modality	9	Agreement with IA was signed within 20 months and project was completed within 30 months

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
the Islamic Republic of Iran (ongoing)	<u>Rigid PU conversion to cyclopentane</u> Asresard (Sandwich panels) Namsazan (insulating decorative sandwich panels Electro Steel (insulated sandwich panels, refrigerators, prefabricated units) Soren Housware (assembly and insulation of domestic refrigerators) Kian Panel (insulating panels) USC systems house and production of sandwich panels	UNIDO GIZ (Germany) GIZ (Germany) GIZ (Germany) UNIDO GIZ (Germany) UNDP Performance-based modality for all IAs	n.a.	Installation of production equipment is under way. Equipment delivered; installation is expected to commence early 2015 followed by commissioning and training. As of the 74th meeting, USC's participation in HPMP, both as a systems house project and a foam manufacturer, have not been pursued due to the enterprise's inability to identify technically and commercially feasible options. UNDP's technical assistance has therefore also been postponed. Agreements with IAs were signed within 14 (Astesard) to 39 months (Electro Steel). International sanctions against the Islamic Republic of Iran are the major barrier in timely HPMP implementation
Malaysia (completed)	<u>Rigid foam</u> Conversion of 13 enterprises to cyclopentane With consumption from 33 mt to 207mt (94.6 ODP tonnes) (US $8.87/kg) Four systems houses (30.58 ODP tones) US $4.00/kg	UNDP, performance based modality	12	As of the field mission of August 2014, two companies completed their projects and run production with CP; two companies are fully converted and will run CP-based production as HCFC-141b stock is exhausted; two companies will be completed by the end of 2014. Equipment to Linear Panel is due to arrive in Sept 2014. Data of Insafoam conversion is uncertain. Initially, delays were caused by foam quality problems in two companies, later rectified and problems with insufficient cooling capacity of the heat exchanger at one company. The problem was resolved. The four systems houses had already developed and tested one formulation based on MF, while two of them had also developed one formulation based on HFO-1233zd. Two of the systems houses had already reported procurement of equipment

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
Mexico (completed)	Microcellular foam: Pilot project for development, optimization and validation of MF in PU foam shoe sole applications (phase I and II) (66.8 ODP tonnes)	UNDP, performance based modality	7	It took 24 months for development, optimization and validation of MF formulation at the systems houses (phase I). Adoption of the technology by end-users (phase II) is completed under HPMP project
Mexico (ongoing)	Rigid PU Conversion in the manufacture of insulation foam for domestic refrigerators to cyclopentane at Mabe (55.9 ODP tonnes) (CE US $3.83/kg)**	UNDP, performance-based modality	20	As of January 2015, conversion is completed; new CP-based formulation has been already used. Commercial production expected to start in early 2015. There was a delay in equipment delivery from the international supplier in 2013
Mexico (ongoing)	Rigid PU Phase-out of HCFC-141b in three commercial refrigeration enterprises (Metalfrio, Fersa Torrey, Ojeda Frigopanel) converting to cyclopentane (23 ODP tonnes) (CE US $9.79/kg)	UNIDO, performance-based modality	n.a.	Metalfrio completed the conversion. The production is expected to start early 2015 after safety audit. Fersa has not signed the contract with the equipment supplier. Ojeda has not completed the bidding process yet and considers to source ancillary equipment locally to reduce the counterpart funding. The funding was reduced to match the cost-effectiveness threshold. The major reason for delay is that the enterprises have problems to cover committed contribution of US $853,290
Mexico (ongoing)	Rigid PU HCFC-141b phase-out in systems houses and foam customers (299.9 ODP tonnes) (CE US $4.11/kg)	UNDP, performance-based modality	n.a.	Ten eligible systems houses have installed equipment and developed the new HCFC-free formulations (based mostly on MF, water-based, methylal). Four systems houses (Zadro, Aepsa, Urethane, Valcom) have already phased out HCFC-141b. The majority of systems houses were fully operational without HCFCs by the end of 2014 and their downstream foam users will be converted during 2015. Few systems houses will take longer during 2016 to implement due to the complexity of their alternatives or the number of downstream foam-users

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
Saudi Arabia (ongoing)	XPS Foam Conversion XPS Manufacturing Arabian Chemical Company to isobutane (34 ODP tonnes) (US $1.21/kg)*** Conversion XPS Manufacturing Al Watania Company to isobutane	UNIDO/Japan performance-based modality	n.a.	In 2013 the Government decreed a ban for producing XPS for companies established after the cut-off date of September 2007. This regulatory measure introduced by the Government intends to ensure complete phase-out of HCFCs in the XPS foam sector and would allow Saudi Arabia to comply with the reduction targets up to 2015
Saudi Arabia (ongoing)	Rigid PU SFP conversion to pentane in production of continuous and discontinuous panels	UNIDO performance-based modality	n.a.	The first tranche is assisting three enterprises manufacturing continuous and discontinuous panels (HESCO, Saptex, SPF) with a total consumption of 30.8 ODP tonnes to convert to pentane. The related equipment has already been purchased and arrived at a Jeddah port but is blocked pending payment of a custom levy amounting to 5 per cent of the invoiced value of the goods. Until this sum is paid (or waived) SPF's conversion project is at a standstill
Saudi Arabia (ongoing)	Rigid PU Hesco conversion of manufacturing continuous insulation panels using n-pentane technology	UNIDO performance-based modality	n.a.	Plant No 1 is fully operational using n-pentane lowing agent since December 2014. Equipment for Plant No.2 arrived to Port Saudi but blocked since July 2014 pending payment of customs fee of about 5 per cent of the value of the goods
Saudi Arabia (ongoing)	Rigid PU Jundi Chemical Systems House	UNIDO performance-based modality	n.a.	Introduction of alternative formulations is intentionally delayed since many of Jundi's clients would continue to seek the cheaper HCFC-141b system after they convert thus risking losing clients
Saudi Arabia (ongoing)	Rigid PU Almutlak conversion to pentane in manufacturing continuous and discontinuous insulation panels	UNIDO performance-based modality	n.a.	Equipment for the conversion of continuous panel production line is on site and work will start in May 2015. There is no decision on conversion of discontinuous panel production
South Africa (completed)	Rigid PU Resichem systems house Conversion to MF	UNIDO performance-based modal	12	The project is fully implemented and they are supplying MF blown two-component systems to their downstream clients

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
South Africa (ongoing)	Rigid PU Expense Urethane systems house conversion to MF	UNIDO performance-based modality	22	After about two years of trials the company obtained satisfactory results and is planning to discontinue the use of HCFC-141b in October 2015
South Africa (ongoing)	Rigid PU Conversion of Aerothane in production of rigid foam insulation blocks, systems for buoyancy, boat building, insulated panels to cyclopentane (7.2 ODP tonnes) (US $2.86/kg)	UNIDO performance-based modality	n.a.	After unsuccessful trials with MF (shrinkage and excessive exotherm temperatures), the company switched to CP and runs trials so far successfully
South Africa (ongoing)	Rigid PU Conversion of Defy manufacturer of domestic Refrigerators to cyclopentane (31,7 ODP tonnes) US $8.03 per kg	UNIDO performance-based modality	n.a.	Installation of equipment is in progress. The beginning of commissioning and trial is scheduled for March 2015
South Africa (completed)	Rigid PU Conversion of Zero Refrigeration Applinaces to MF	UNIDO performance-based modality	6	Zero is one of downstream enterprises benefited from the conversion of Resichem and converting to MF after corrosion/erosion problems had been addressed by modifying metering pumps. Conversion completed in June 2014
South Africa (ongoing)	Rigid PU Conversion of Colcab commercial refrigerator manufacturer to MF	UNIDO performance-based modality	n.a.	Colcab experienced serious problems with adoption of MF technology, foam density, foam exotherm, foam shrinkage and poor adhesion. Yet the company committed to continue trials with MF
Viet Nam (completed)	Microcellular foam MIDICO conversion of production of shoe soles to water blown technology	WB performance-based modality	5	Project completed in May 2013
Viet Nam (completed)	Rigid PU Conversion of Thanh Canh production of PU foam blocks to cyclopentane	WB performance-based modality	22	As of October 2014, installation completed, trials and commissioning are completed. Relocation of the plant caused serious delays
Viet Nam (ongoing)	Rigid PU Conversion of Insulation Panel Co. to cyclopentane	WB performance-based modality	n.a.	Installation of equipment is in progress

Country	Foam projects	IAs and Implementation Modality	Delays (months)	Remarks
	(3.9 ODP tonnes in bulk 13.8 ODP tonnes in imported polyol)			

* The actual impact of the project, in terms of HCFC phase-out, can be assessed from the data provided in 2015 for 2014 reporting year.

** Cost-effectiveness is based on funding of US $2,529,541 corresponding to 51.6 per cent national ownership of Mabe company.

*** Cost-effectiveness was calculated on the basis of conversion of two remaining production lines by the company itself.