



**United Nations  
Environment  
Programme**

Distr.  
GENERAL

UNEP/OzL.Pro/ExCom/81/30  
29 May 2018

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eighty-first Meeting  
Montreal, 18-22 June 2018

**PROJECT PROPOSALS: COLOMBIA**

This document consists of the comments and recommendations of the Secretariat on the following project proposals:

Phase-out

- HCFC phase-out management plan (stage II, second tranche) UNDP/UNEP/Germany

Refrigeration

- Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia UNDP

**PROJECT EVALUATION SHEET – MULTI-YEAR PROJECTS**

**Colombia**

(I) PROJECT TITLE	AGENCY	MEETING APPROVED	CONTROL MEASURE
HCFC phase-out plan (stage II)	UNDP (Lead), UNEP and Germany	75th	65% by 2021

(II) LATEST ARTICLE 7 DATA (Annex C Group I)	Year: 2016	136.54 (ODP tonnes)
--	------------	---------------------

(III) LATEST COUNTRY PROGRAMME SECTORAL DATA (ODP tonnes)								Year: 2017	
Chemical	Aerosol	Foam	Fire fighting	Refrigeration		Solvent	Process agent	Lab use	Total sector consumption
				Manufacturing	Servicing				
HCFC-22	0.19			0.63	43.53				44.34
HCFC-123			0.13		0.04				0.17
HCFC-141b	0.29	94.98	6.26		2.40				103.92
HCFC-142b					0.08				0.08
HCFC-141b in imported pre-blended polyol		0.85							0.85

(IV) CONSUMPTION DATA (ODP tonnes)			
2009 - 2010 baseline:	225.6	Starting point for sustained aggregate reductions:	225.6
CONSUMPTION ELIGIBLE FOR FUNDING (ODP tonnes)			
Already approved:	201.21	Remaining:	24.32

(V) BUSINESS PLAN		2018	2019	2020	After 2020	Total
UNDP	ODS phase-out (ODP tonnes)	29.70	14.89	0	6.02	50.61
	Funding (US \$)	1,356,768	680,251	0	275,133	2,312,152
UNEP	ODS phase-out (ODP tonnes)	1.17	1.17	0	0.59	2.93
	Funding (US \$)	56,500	56,500	0	28,250	141,250
Germany	ODS phase-out (ODP tonnes)	3.82	0	0	1.30	5.12
	Funding (US \$)	183,819	0	0	61,273	245,092

(VI) PROJECT DATA			2015	2016	2017	2018	2019	2020	2021	Total
Montreal Protocol consumption limits			203.01	203.01	203.01	203.01	203.01	146.62	146.62	n/a
Maximum allowable consumption (ODP tonnes)			203.01	203.01	203.01	203.01	203.01	90.24	78.96	n/a
Agreed funding (US \$)	UNDP	Project costs	2,342,591	0	0	1,268,007	635,749	0	257,134	4,503,481
		Support costs	163,981	0	0	88,761	44,502	0	17,999	315,244
	UNEP	Project costs	50,000	0	0	50,000	50,000	0	25,000	175,000
		Support costs	6,500	0	0	6,500	6,500	0	3,250	22,750
	Germany	Project costs	325,800	0	0	162,900	0	0	54,300	543,000
		Support costs	41,838	0	0	20,919	0	0	6,973	69,730
Funds approved by ExCom (US \$)	Project costs	2,718,391	0	0						2,718,391
	Support costs	212,319	0	0						212,319
Total funds requested for approval at this meeting (US \$)	Project costs				1,480,907					1,480,907
	Support costs				116,180					116,180

<b>Secretariat's recommendation:</b>	For blanket approval
--------------------------------------	----------------------

## PROJECT DESCRIPTION

1. On behalf of the Government of Colombia, UNDP as the lead implementing agency, has submitted a request for funding for the second tranche of stage II of the HCFC phase-out management plan (HPMP), at a total cost of US \$1,597,087, consisting of US \$1,268,007, plus agency support costs of US \$88,761 for UNDP, US \$50,000, plus agency support costs of US \$6,500 for UNEP and US \$162,900, plus agency support costs of US \$20,919 for the Government of Germany.<sup>1</sup> The submission includes a progress report on the implementation of the first tranche, and the tranche implementation plan for 2018 to 2019.

### Report on HCFC consumption

2. The Government of Colombia reported a consumption of 136.54 ODP tonnes for 2016 and estimated a consumption of 148.51 ODP tonnes for 2017, which is 39 per cent and 34 per cent below the HCFC baseline for compliance, respectively. The 2013-2017 HCFC consumption is shown in Table 1.

**Table 1. HCFC consumption in Colombia (2013-2017 Article 7 data)**

HCFC	2013	2014	2015	2016	2017*	Baseline
<b>Metric tonnes</b>						
HCFC-22	1,053.40	1,226.16	1,081.54	947.44	806.21	1,292.6
HCFC-123	104.30	103.58	93.91	78.81	8.31	110.4
HCFC-124	1.34	0.70	0.40	0	0	1.8
HCFC-141b	1,054.23	783.83	938.40	753.26	944.75	1,379.5
HCFC-142b	9.77	4.35	0.10	0	1.25	7.5
Sub-total (mt)	2,223.04	2,118.62	2,114.35	1,779.51	1,760.52	2,791.7
HCFC-141b in imported pre-blended polyols	8.27	0.03	6.30	7.94	7.75	n/a
<b>Total (mt)</b>	<b>2,231.31</b>	<b>2,118.65</b>	<b>2,120.65</b>	<b>1,787.45</b>	<b>1,768.27</b>	<b>2,791.7</b>
<b>ODP tonnes</b>						
HCFC-22	57.94	67.44	59.48	52.11	44.34	71.1
HCFC-123	2.09	2.07	1.88	1.58	0.17	2.2
HCFC-124	0.03	0.02	0.01	0	0.00	0.0
HCFC-141b	115.97	86.22	103.22	82.86	103.92	151.7
HCFC-142b	0.64	0.28	0.01	0	0.08	0.5
Sub-total (ODP tonnes)	176.65	156.03	164.60	136.54	148.51	225.6
HCFC-141b in imported pre-blended polyols	0.91	0.003	0.69	0.87	0.85	n/a
<b>Total (ODP tonnes)</b>	<b>177.56</b>	<b>156.033</b>	<b>165.29</b>	<b>137.41</b>	<b>149.36</b>	<b>225.6</b>

\*Country programme data submitted on 26 April 2018.

3. Consumption of HCFC-22 continues to decline, with reductions both in servicing and in manufacturing. Consumption of HCFC-141b increased in 2017, returning to approximately the same level as the 2015 consumption, as the conversion activities undertaken during stage II are still ongoing.

### *Country programme (CP) implementation report*

4. The Government of Colombia reported HCFC sector consumption data under the 2016 CP implementation report which is consistent with the data reported under Article 7 of the Montreal Protocol.

<sup>1</sup> As per the letter of 12 April 2018 from the Ministry of Environment and Sustainable Development of Colombia to UNDP.

Progress report on the implementation of the first tranche of the HPMP

*Legal framework*

5. The Government modified the quota system for HCFCs imports within the existing control measures to achieve the reduction of HCFC consumption by 65 per cent of the baseline by 2021 consistent with its Agreement with the Executive Committee.

6. A proposed regulation prohibiting the release or emission of ODS, including HCFCs, and instituting measures that would apply to both ODS and HFCs to prevent the release, leakage or emission of those substances during the installation, operation, maintenance and dismantling activities of refrigeration and air-conditioning (RAC) equipment is expected to be finalized in 2019. Implementation of the regulation would allow the establishment of the mandatory certification in the labor competency standard which would take effect in 2020.

*Technical assistance for regulatory activities*

7. The following activities were undertaken:

- (a) Licenses, permits, and quotas for imports of HCFCs were issued and monitored;
- (b) A pollutant release and transfer registry was designed that importers, manufacturers and end-users will be obliged to register annual information on the use and emissions of ODS and HFCs;
- (c) Four workshops to train 132 customs officers on preventing illegal trade and refrigerant identification, and a meeting was held with customs, the National Institute of Food and Drugs Monitoring, and the Ministry of Commerce, Industry and Tourism to strengthen the links between those entities for better detection of illegal trade in controlled substances;
- (d) Two workshops for importers of refrigerants and foaming blowing agents were held on labelling and customs requirements, including on custom codes specific to hydrocarbons; and
- (e) Awareness-raising activities, including the development of a guide on how to integrate ozone layer protection topics into school environmental projects, were carried out; four digital bulletins were distributed on new low-global warming potential (GWP) ACs, district cooling, nationally appropriate mitigation action for the domestic refrigeration sector, and technician training and certification; a publication to promote the operation of the recovery, recycling and reclamation network was developed and delivered; and a technical document on environmentally friendly alternatives for the refrigeration sector was delivered to end-users.

*Activities in the foam sector*

8. Three enterprises signed their agreements with the Ministry of Environment and have started their conversion process as shown in Table 2. The four systems houses (Espumlatex, GMP, Olaflex, and QIC) are expected to sign their agreements by July 2018, and development of reduced hydrofluoro-olefins (HFO) formulations to follow shortly thereafter.

**Table 2. Progress at three foam enterprises**

Enterprises	Technology	Expected equipment delivery date	Expected date of completion
Espumlatex, rigid sheets	Water blown/reduced HFO	Not applicable	July 2021
Olaflex, rigid sheets	Cyclopentane	August 2018	November 2019
Rojas Hermanos, discontinuous panels	Cyclopentane	July 2018	November 2019

*Activities in the refrigeration servicing sector*

9. The following activities were undertaken:

- (a) A draft best practices handbook for service technicians was developed; a workshop focused on servicing of industrial and commercial refrigeration equipment for 51 trainers was held; the beneficiary for the natural refrigerant training centre was selected; and progress to adapt as a national technical standard the ISO technical standard on safety and environmental requirements for refrigerating systems and heat pumps;
- (b) Seven meetings were held to review and update labour competence standards for certification in the safe use of low-GWP refrigerants, resulting in a proposed new standard under review; two meetings to identify institutions other than the “Servicio Nacional de Aprendizaje” (SENA) to certify labor competency of service technicians; 1,281 technicians were certified in the existing standard at SENA training centres, bringing the total number of technicians certified in good servicing practices between 2005 and 2017 to 10,110; and 29 awareness-raising activities in 24 cities for 1,000 technicians and companies in the RAC sector were held;
- (c) The recovery, recycling and reclamation programme was strengthened through: the purchase of 260 recovery units and associated 520 storage cylinders, as well as eight 1,000 kg and 622 13.6 kg cylinders for the reclamation centers, with distribution of this equipment still ongoing; and 15 training workshops were held for 207 technicians (of which four were women); and
- (d) Activities to promote the use of environmentally friendly alternatives were conducted, including: six regional meetings on environmental management of ODS; work with business associations to integrate environmentally friendly RAC alternatives into the associations’ strategies, including the Hotels and Tourist Association of Colombia on environmentally friendly cooling systems and ODS management, and information dissemination to the National Association of Public Utilities and Communication Companies, National Federation of Commerce, Hospitals and Clinics Association, Colombian Chamber of Building, National Association of Industry and Entrepreneurship, the Chamber of Drinks, Food and Health, and the Colombian Association of Flower Growers; adoption of a value-added tax (VAT) exemption for end-users of cooling systems that apply energy efficiency and low environmental impact criteria; an agreement between a supermarket chain and an assembly company to install the first transcritical CO<sub>2</sub> system in the country; an agreement to implement a cogeneration and heat recovery project with an absorption cooling system to supply a hotel’s AC; and a three-day international congress for comprehensive management of ODS and their contribution to climate stability held in September 2017.

*Activities in the fire protection sector*

10. The following activities were undertaken:

- (a) A technical document on safety and environmental considerations for portable fire extinguishers was developed;
- (b) An assessment of the maintenance and recharge activities at five enterprises was conducted;
- (c) Technical input for the publication of a guideline to promote best practices in the maintenance and recharge of portable fire extinguishers; and
- (d) Three workshops to disseminate the results of the environmental and safety impact assessments and good practices to carry out the loading, recharging and maintenance activities of portable extinguishers with HCFC-123.

*Project implementation and monitoring unit (PMU)*

11. The PMU undertook management and monitoring of activities with the assistance of four consultants for the foam sector, the training and certification activities in the RAC sector, the servicing sector, and activities related to trade control.

Level of fund disbursement

12. As of May 2018, of the US \$2,718,391 approved so far (US \$2,342,591 for UNDP, US \$50,000 for UNEP and US \$325,800 for the Government of Germany), US \$1,069,239 (39.33 per cent) had been disbursed (US \$742,774 for UNDP, US \$12,579 for UNEP and US \$313,886 for the Government of Germany). The balance of US \$1,649,152 will be disbursed in 2018 and 2019.

Implementation plan for the second tranche of the HPMP

13. The following activities will be implemented between 2018 and July 2021:

- (a) Technical assistance for strengthening the regulatory framework (UNDP) (US \$10,000);
- (b) Technical assistance to strengthen control of trade of HCFC-based substances and equipment, including participation in the electronic information exchange on ODS trade (i-PIC); and participating in the implementation of a Global Harmonized System (GHS) for chemical products with an emphasis on HCFC labeling (UNEP) (US \$50,000);
- (c) Conversion at the foam enterprises and systems houses to hydrocarbons, reduced HFOs, and water-blown technologies in the foam sector (UNDP) (US \$1,137,247);
- (d) Training of 30 trainers on better containment of HCFCs in RAC equipment; tools and demonstration equipment for the establishment of a natural refrigerants training centre; training of 30 trainers in the safe use of natural and other low-GWP refrigerants; training of SENA trainers' workshops, and adaptation of the ISO safety and environmental requirements for refrigerating systems and heat pumps standard as a national technical standard (Germany) (US \$162,900);

- (e) Development of new labor competence standards for certification in the safe use of low-GWP refrigerants, with a focus on natural refrigerants, and workshops to promote the certification of RAC technicians (UNDP) (US \$25,000);
- (f) Meetings and monitoring activities of the recovery, recycling and reclamation network (UNDP) (US \$10,000);
- (g) Coordination activities, workshops, and meetings with RAC end-users; support for training end-users to perform the required procedures and access the VAT tax exemption benefit; and technical assistance for the safe use of environmentally friendly alternatives in the pilot projects with the supermarket chain and the hotel (UNDP) (US \$55,000);
- (h) Awareness-raising activities, including integrating ozone layer issues in school environmental education projects, and continued outreach to end users (UNDP) (US \$15,000); and
- (i) Continued project monitoring and implementation (UNDP) (US \$15,760).

## **SECRETARIAT'S COMMENTS AND RECOMMENDATION**

### **COMMENTS**

#### Report on HCFC consumption

##### *Verification report*

14. The verification report for 2015-2017 was submitted on 27 May 2018. The Secretariat will review the 2015-2017 verification report subsequent to the 81<sup>st</sup> meeting. In line with decision 72/19, funds approved under the second tranche will not be transferred until the Secretariat has reviewed the verification report and confirmed that the Government is in compliance with the Montreal Protocol and its Agreement with the Executive Committee.

#### Completion of stage I of the HPMP

15. In line with decision 72/25(a), the project completion report (PCR) for the stage I was to be submitted to the second meeting of 2016; however, that report had not yet been submitted. The project has been reported completed and the remaining balances of US \$111, plus agency support costs of US \$8, were returned<sup>2</sup> to the 81<sup>st</sup> meeting.

#### Progress report on the implementation of the first tranche of the HPMP

##### *Legal framework*

16. The Government of Colombia has already issued HCFC import quotas for 2018 in accordance with the Montreal Protocol control targets.

---

<sup>2</sup> UNEP/OzL.Pro/ExCom/81/4

*Technical assistance for regulatory activities*

17. Regarding the ban on the use of HCFC-141b in the fire protection sector that was to be implemented by 31 December 2017 in line with decision 75/44(b)(ii), UNDP explained that the draft resolution is under review by the Legal Office of the Ministry of Environment and Sustainable Development. It is expected that the ban will be implemented by the end of 2018. Noting that the use of HCFC-141b for this use was not safe, the Secretariat suggested that the third tranche of stage II of the HPMP would not be submitted until the ban was in place.

*Activities in the foam sector*

18. In response to decision 75/44(b)(vi), UNDP reported that the expected incremental operating costs (IOC) for the introduction of HFO-based systems will be above US \$10/kg due to the higher raw material costs and the additional work required to develop the reduced HFO formulations. The Secretariat noted that HFOs are not yet commercially available in the country, but are expected to be available once the systems houses submit their purchase orders, and that the IOCs will depend on the formulations and prices at the time of conversion. In addition, the Secretariat noted the final report on the demonstration project to validate the use of HFOs for discontinuous panels in Article 5 Parties through the development of cost-effective formulations<sup>3</sup> in Colombia, which indicated that IOCs could vary between US \$9.17/kg to US \$3.48/kg for HFO-1233zd(E) and between US \$21.60/kg and US \$8.14/kg for HFO-1336mzz(Z). Since the IOCs will depend on the formulations used, and in particular on the extent to which reduced HFO formulations were used, the Secretariat recommended that UNDP report the actual IOC incurred during the conversion to reduced-HFO formulations in the foam sector when requesting a future tranche of stage II of the HPMP, on the understanding that if the IOC were below US \$2.13/kg the Government of Colombia would return the associated funds to the Multilateral Fund in line with decision 75/44(b)(vi).

19. Regarding the conversions through the four systems houses, the first stage will be for the systems houses to develop formulations and will be implemented until 1 December 2019. The second stage will be the production and commercialization of polyols for different applications, including production of polyols for different applications, technology transfer to downstream users in different applications, and initiation and verification of sales, and will end by 31 July 2021.

*Activities in the servicing sector*

20. The activities undertaken are part of a coherent framework to strengthen the servicing sector and facilitate the introduction of environmentally friendly, low-GWP alternatives, including measures that apply to both ODS and HFCs to prevent the release, leakage or emission of those substances during the installation, operation, maintenance and dismantling activities of RAC equipment; training on the safe use of low-GWP alternatives; development of codes of practice and technical standards, labor competence standards for the certification in the safe use of low-GWP alternatives; work with end-users to integrate the use of low-GWP alternatives and energy efficiency criteria into their strategies; the adoption of a VAT exemption for end users of cooling systems that apply energy efficiency and low environmental impact criteria; and other activities.

Conclusion

21. The HPMP is progressing, the country's import licensing and quota system is operational and will enable HCFC consumption reductions in line with the Montreal Protocol's phase-out schedule and the country's Agreement with the Executive Committee. While the review by the Secretariat of the verification report is still outstanding, the reported consumption is below the targets specified in the Agreement. The

---

<sup>3</sup> Contained in Status reports and reports on projects with specific reporting requirements (UNEP/OzL.Pro/ExCom/81/10).



level of disbursement is 39.33 per cent. Conversions at the foam enterprises are progressing, and the systems houses are expected to commence their conversion activities soon. Activities to curb the use of HCFC-141b in fire protection have been undertaken and the ban on the use of HCFC-141b in the fire protection sector, while delayed, is expected to be implemented soon. The activities undertaken in the servicing sector are part of a well-planned, coherent framework to strengthen the sector, facilitate the introduction of environmentally friendly, low-GWP alternatives, and are expected to ensure the long-term sustainability of the activities, and continue to help enable the country to meet its compliance obligations under the Protocol.

**RECOMMENDATION**

22. The Fund Secretariat recommends that the Executive Committee takes note of the progress report on the implementation of the first tranche of stage II of the HCFC phase-out management plan of (HPMP) for Colombia; and further recommends blanket approval of the second tranche of stage II of the HPMP for Colombia, and the corresponding 2018-2019 tranche implementation plan, at the funding levels shown in the table below, on the understanding that:

- (a) The approved funds would not be transferred to UNDP, UNEP and the Government of Germany until the Secretariat had reviewed the verification report for 2015, 2016 and 2017 and confirmed that the Government of Colombia was in compliance with the Montreal Protocol and the Agreement between the Government and the Executive Committee;
- (b) UNDP would report the actual incremental operating costs (IOC) incurred during the conversion to reduced-HFO formulations in the foam sector when requesting a future tranche of stage II of the HPMP, on the understanding that if the IOC were below US \$2.13/kg the Government of Colombia would return the associated funds to the Multilateral Fund in line with decision 75/44(b)(vi); and
- (c) UNDP would continue assisting the Government of Colombia to enact the ban on the use of HCFC-141b in the fire protection sector as soon as possible.

	<b>Project title</b>	<b>Project funding (US \$)</b>	<b>Support cost (US \$)</b>	<b>Implementing agency</b>
(a)	HCFC phase-out management plan (stage II, second tranche)	1,268,007	88,761	UNDP
(b)	HCFC phase-out management plan (stage II, second tranche)	50,000	6,500	UNEP
(c)	HCFC phase-out management plan (stage II, second tranche)	162,900	20,919	Germany

## PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

## COLOMBIA

## PROJECT TITLE

## BILATERAL/IMPLEMENTING AGENCY

(a) Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
---	------

## NATIONAL CO-ORDINATING AGENCY

Ozone Technical Unit, Ministry of Environment and Sustainable Development

## LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

## A: ARTICLE-7 DATA (METRIC TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])\*

HFCs	mt	n/a
	mt CO <sub>2</sub> -eq.	n/a

## B: COUNTRY PROGRAMME SECTORAL DATA (METRIC TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])\*

HFCs	mt	n/a
	mt CO <sub>2</sub> -eq.	n/a

\* A total use of 1,568 mt of HFC (including 927 mt of HFC-134a) was estimated in 2015 (source: "Survey of ODS and ODS alternatives in Colombia", Government of Germany/Ministry of Environment and Sustainable Development-Ozone Technical Unit, January 2017)

HFC consumption remaining eligible for funding	mt	n/a
	mt CO <sub>2</sub> -eq.	n/a

CURRENT YEAR BUSINESS PLAN ALLOCATIONS		Funding US \$	Phase-out ODP tonnes
	(a)	0	0

<b>PROJECT TITLE:</b>	Mabe	
HFC-134a used at enterprise:	mt	67.28
	mt CO <sub>2</sub> -eq.	96,210
HFC-134a to be phased out through this project:	mt	67.28
	mt CO <sub>2</sub> -eq.	96,210
Alternative to be phased in through this project: R-600a:	mt	26.91
	mt CO <sub>2</sub> -eq.	80.73
Project duration (months):		12
Initial amount requested (US \$):		3,829,127
Final project costs (US \$):		
Incremental capital cost:		1,074,350
Contingency (10%):		81,150
Incremental operating cost:		0
Total project cost:		1,114,350
Local ownership (%):		100
Export component (%):		0
Requested grant (US \$):		1,114,350
Cost-effectiveness:	US \$/kg	16.56
	US \$/mt CO <sub>2</sub> -eq.	11.58
Implementing agency support cost (US \$):		78,005
Total cost of project to Multilateral Fund (US \$):		1,192,355
Status of counterpart funding (Y/N):		Y
Project monitoring milestones included (Y/N):		N

<b>SECRETARIAT'S RECOMMENDATION</b>	For individual consideration
-------------------------------------	------------------------------

## Note from the Secretariat

### Background

23. On behalf of the Government of Colombia, UNDP submitted to the 79<sup>th</sup> meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane,<sup>4</sup> pursuant to decision 78/3(g). Subsequent to the Executive Committee's decision to defer the project to the 80<sup>th</sup> meeting (decision 79/39), UNDP resubmitted a revised proposal<sup>5</sup> to the 80<sup>th</sup> meeting. At the 80<sup>th</sup> meeting, the Executive Committee deferred consideration of the project to the 81<sup>st</sup> meeting.

24. On behalf of the Government of Colombia, UNDP resubmitted to the 81<sup>st</sup> meeting the project proposal submitted to the 80<sup>th</sup> meeting, with the following modifications: an increase in the phase-out of HFC-134a from 61.32 metric tonnes (mt) (87,688 mt CO<sub>2</sub>-eq.) to 67.28 mt (96,210 (mt CO<sub>2</sub>-eq.) based on updated consumption information at the enterprise as shown in Table 1, and a reduction in the duration of the project from 18 to 12 months.

**Table 1. Consumption of HFC-134a at Mabe Colombia (2014-2017)**

Year	Consumption	
	mt	mt CO <sub>2</sub> -eq.
2014	58.31	83,383
2015	49.52	70,814
2016	76.13	108,866
2017	76.18	108,937
Average 2015-2017	67.28	96,210

25. The submission reiterated the commitment by the Government of Colombia to issue a ban to the manufacture and import of domestic refrigerators with HFC as refrigerant once the enterprise converts its production.

26. Subsequent to the submission of the project proposal to the 81<sup>st</sup> meeting, UNDP clarified that the enterprise had already made most of the investments for which funding was requested when the project was originally submitted to the 79<sup>th</sup> meeting and 80<sup>th</sup> meeting.

27. The document on the project proposal submitted by the Government of Colombia to the 80<sup>th</sup> meeting is attached to the present note from the Secretariat.

### Secretariat's comments

28. UNDP confirmed that, in line with decision 78/3(g), the project would collect data on incremental operating costs (IOCs) and the final project report would include that data, notwithstanding that IOCs were not requested; and that, in line with decision 22/38 and subsequent decisions of the Executive Committee, equipment to be replaced by the project would be destroyed or rendered unusable as part of the project.

29. The Secretariat sought further clarification on the status of the conversion at the enterprise. UNDP clarified that since 2016 Mabe Colombia decided to move towards an environmentally sound production process in line with the strong environmental commitment of the Government of Colombia that encourages enterprises in the refrigeration and air-conditioning sector to pursue long-term technologies that minimize negative environmental impact. The decision by Mabe Colombia was reinforced by the adoption of the Kigali Amendment. Accordingly, the planning and implementation of the conversion process at the enterprise has been on-going for at least the past two years, using only funding provided by the enterprise.

<sup>4</sup> UNEP/OzL.Pro/ExCom/79/31

<sup>5</sup> UNEP/OzL.Pro/ExCom/80/38

30. UNDP further explained that the conversion process is in an advanced stage: the equipment necessary for the conversion as described in the project proposal submitted to the Executive Committee has been procured and installed at the enterprise. The enterprise is still working in the redesign and certification of products, quality assurance, field tests and training. The remaining work can be completed within the 12-month timeframe, with manufacturing based on the new technology starting immediately after.

### **Recommendation**

31. The Executive Committee may wish to consider:

- (a) The project proposal for the conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia, in the context of its discussion on HFC stand-alone projects submitted to the 81<sup>st</sup> meeting in line with decision 78/3(g), as described in the document Overview of issues identified during project review (UNEP/Oz.L.Pro/ExCom/81/14);
- (b) Whether or not to approve the project proposal indicated in sub-paragraph (a) above in the amount of US \$1,114,350, plus agency support cost of US \$78,005 for UNDP, on the understanding, if the project were to be approved:
  - (i) That no further funding would be available until the instrument of ratification by the Government of Colombia had been received by the depositary at the Headquarters of the United Nations in New York;
  - (ii) That 67.28 mt (96,210 mt CO<sub>2</sub>-eq.) of HFC-134a would be deducted from the starting point for sustained aggregate reduction in HFC once it has been established;
  - (iii) That the project would be completed within 12 months of the transfer of funds to UNDP, and a comprehensive completion report with detailed information on the eligible incremental capital costs, incremental operating costs, any possible savings incurred during the conversion and relevant factors that facilitated implementation, would be submitted within six months of the project completion; and
  - (iv) That any remaining funds will be returned to the Multilateral Fund no later than one year after the date of project completion.



**United Nations  
Environment  
Programme**

Distr.  
GENERAL

UNEP/OzL.Pro/ExCom/80/38  
17 October 2017

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eightieth Meeting  
Montreal, 13-17 November 2017

**PROJECT PROPOSAL: COLOMBIA**

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia

UNDP

## PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

## COLOMBIA

## PROJECT TITLE(S) BILATERAL/IMPLEMENTING AGENCY

(a) Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
---	------

NATIONAL CO-ORDINATING AGENCY	Ozone Technical Unit of the Ministry of Environment and Sustainable Development
-------------------------------	---

## LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

## A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	*
------	---

## B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	*
------	---

HFC consumption remaining eligible for funding (ODP tonnes)	n/a
---	-----

CURRENT YEAR BUSINESS PLAN ALLOCATIONS		Funding US \$	Phase-out ODP tonnes
	(a)	0	0

<b>PROJECT TITLE:</b>	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased out (mt CO <sub>2</sub> equivalent):	87,688
Project duration (months):	18
Initial amount requested (US \$):	3,024,067
Final project costs (US \$):	
Incremental capital cost:	1,033,200
Contingency:	81,150
Incremental operating cost:	0
Total project cost:	1,114,350
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,114,350
Cost-effectiveness (US \$/kg):	18.17
Implementing agency support cost (US \$):	78,005
Total cost of project to Multilateral Fund (US \$):	1,192,355
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

<b>SECRETARIAT'S RECOMMENDATION</b>	For individual consideration
-------------------------------------	------------------------------

\* A total use of 1,568 mt of HFC (including 927 mt of HFC-134a) was estimated in 2015 (source ODS survey)

## PROJECT DESCRIPTION

### Background

1. On behalf of the Government of Colombia, UNDP submitted to the 79<sup>th</sup> meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane,<sup>6</sup> pursuant to decision 78/3(g).
2. At the same meeting, UNDP submitted an additional project proposal for the phase-out of HFC-134a used in the manufacturing of domestic refrigerators in Bangladesh.<sup>7</sup>
3. The two project proposals were included in the document on the Overview of issues identified during project review<sup>8</sup> as they were submitted for individual consideration.

### Discussion between UNDP and the Secretariat prior to the 79<sup>th</sup> meeting<sup>9</sup>

4. UNDP had submitted to the 79<sup>th</sup> meeting a proposal for US \$3,829,157 (including incremental capital cost (ICC) of US \$3,059,760 and incremental operational cost (IOC) of US \$769,397).<sup>10</sup> Upon discussions with the Secretariat, UNDP provided a revised proposal for US \$2,929,267 consisting of ICC of US \$1,959,870, IOCs of US \$769,397 and US \$200,000 to implement a ban on manufacturing and importing HFC-134a-based equipment, of which US \$1,426,400 was requested from the Fund and US \$1,502,867 co-financed by Mabe.
5. Based on its analysis, the Secretariat estimated the ICC of conversion at US \$992,970, and suggested an additional US \$30,000 to implement a ban on HFC-134a-based equipment. The Secretariat did not propose changes to the IOC of US \$769,397, noting that it did not have sufficient experience to assess those costs. Based on the revised costs estimated by the Secretariat (i.e., US \$1,792,367), the enterprise needed additional time to consider those costs and an appropriate level of co-funding, if any.

### Discussion at the 79<sup>th</sup> meeting<sup>11</sup>

6. At the 79<sup>th</sup> meeting, the Executive Committee agreed to consider the two project proposals (from Bangladesh and Colombia) in the contact group established under agenda item 11(c)(i), Matters related to the Kigali Amendment to the Montreal Protocol: draft criteria for funding. However, discussions at the contact group focussed on additional criteria for the consideration of HFC-related investment project proposals, rather than on the actual proposals. Consequently, the Executive Committee agreed to defer the consideration of the two HFC-related projects to the 80<sup>th</sup> meeting.<sup>12</sup>

---

<sup>6</sup> UNEP/OzL.Pro/ExCom/79/31

<sup>7</sup> UNEP/OzL.Pro/ExCom/79/28.

<sup>8</sup> UNEP/OzL.Pro/ExCom/79/19.

<sup>9</sup> The full text of the discussions is contained in paragraphs 14 to 27 of document UNEP/OzL.Pro/ExCom/79/31, attached to this note.

<sup>10</sup> The proposal also included additional costs associated (US \$3,075,261) with improving the energy efficiency of equipment manufactured that would be borne by enterprise.

<sup>11</sup> The full text of the discussions is contained in paragraphs 87 to 89 and 143 of document UNEP/OzL.Pro/ExCom/79/51.

<sup>12</sup> Decision 79/39 and decision 79/40.

## **Resubmission of the HFC-related investment project for Colombia**

7. On behalf of the Government of Colombia, UNDP resubmitted to the 80<sup>th</sup> meeting the project proposal submitted to the 79<sup>th</sup> meeting with a reduction in requested funding from the Multilateral Fund from US \$3,829,175 to US \$3,024,067, as submitted. The duration of the project is 18 months.

8. The project document submitted to the 79<sup>th</sup> meeting, including project description and Secretariat's comments and recommendation has been attached to the present document.

## **SECRETARIAT'S COMMENTS AND RECOMMENDATION**

### **COMMENTS**

9. The Secretariat noted that while the funding requested in the revised proposal was below that originally submitted to the 79<sup>th</sup> meeting, it was above the latest proposed by UNDP at the 79<sup>th</sup> meeting (US \$2,929,267 of which US \$1,426,400 requested from the Fund). It was therefore agreed to use the costs estimated by the Secretariat at the 79<sup>th</sup> meeting as a basis for discussing the level of funding for the project. On that basis, UNDP and the Secretariat entered into a detailed discussion about the costs of the project.

10. A key difference between the costs estimated by the Secretariat and the proposal made by UNDP at the 79<sup>th</sup> meeting was the level of additional co-financing provided by the enterprise. Further to the discussion, it was agreed that the IOCs be considered as co-financing provided by the enterprise, noting that the provision of incremental costs was intended as an incentive for early adoption of technologies and the other two enterprises manufacturing domestic refrigerators in the country had already converted to R-600a using their own resources. The Secretariat would emphasize that the agreement for not requesting IOCs should not be considered as a precedent; while the Secretariat considers this appropriate in this circumstance, it may not be appropriate in other circumstances.

11. With regard to the ICC proposed by the Secretariat at the 79<sup>th</sup> meeting, based on the revised proposal submitted to the 80<sup>th</sup> meeting, review of additional information and further discussions with UNDP, the following changes of some of the equipment items were agreed:

- (a) The incremental cost of the storage and feeding system was increased from US \$135,000 to US \$142,500 as the layout at the enterprise will require the R-600a storage tank to be located several hundred meters from the manufacturing facility, requiring long pipes, additional shut-off valves and accumulators for R-600a;
- (b) The cost of the helium vacuum and leak test was increased from US \$24,000 to US \$45,000 per unit, for a total of US \$135,000 considering a review of additional information, including from other projects submitted to the 80<sup>th</sup> meeting;
- (c) The cost of an R-600a charging station was increased from US \$43,333 to US \$50,000 per unit for a total of US \$150,000;
- (d) Contingencies were adjusted to US \$81,150 in line with the revised costs related to capital equipment (only); and
- (e) Funding for the implementation of a ban on manufacturing and importing HFC-134a-based equipment was agreed at US \$40,000.

12. On that basis, the agreed level of funding requested from the Multilateral Fund was US \$1,114,350 (US \$18.17/kg). Implementation of the project would result in the phase-out of 61.34 mt of HFC-134a



(87,688 CO<sub>2</sub>-eq tonnes), the complete phase-out of HFC-134a in the manufacturing of domestic refrigerators in the country and a ban on the manufacture and import of such equipment, noting that domestic refrigerators manufactured in Colombia are exported to neighbouring countries.

**Table 1. Agreed costs for Mabe Colombia project**

<b>Item</b>	<b>Agreed cost (US \$)</b>
<i>Sub-total storage and feeding system</i>	142,500
<i>Vacuum and leak test</i>	135,000
<i>Refrigerant charge system</i>	
HC charging station (3)	150,000
Ultrasonic welding equipment (3)	90,000
HC leak detectors (3)	90,000
<i>Zone of functional repairs</i>	9,000
<i>Associated works</i>	
Civil works	15,000
Safety system	120,000
Ventilation system (fans, motors, ducts and platforms)	60,000
<b>Sub-total production lines modification</b>	<b>811,500</b>
<i>Installation and start-up</i>	50,000
<i>Trials, test, product certification, safety audit</i>	
Refrigerator for trials	24,200
Field tests	5,000
Certification of new products	27,500
General safety certification	25,000
<i>Human resources</i>	
Training	20,000
Technical assistance	30,000
<b>Sub-total general</b>	<b>181,700</b>
<b>Sub-total</b>	<b>993,200</b>
Contingencies (10%)	81,150
<b>Total ICC</b>	<b>1,074,350</b>
<b>Total IOC</b>	<b>0</b>
Implementation of ban on HFC-134a-based equipment	40,000
<b>Funding request to the Multilateral Fund</b>	<b>1,114,350</b>

13. While agreeing to the level of funding requested from the Multilateral Fund, the Government of Colombia noted that it considered the total cost of conversion to be above the agreed level. The Secretariat notes that the enterprise will implement with its own funds a component of the project aimed at improving the energy efficiency of most of their models produced, with an expected efficiency improvement of approximately 25 per cent. However, the Secretariat has not assessed the costs associated with that component. In addition, the Secretariat notes that the purpose of implementing projects under decision 78/3(g) is to gain experience in the ICCs and IOCs that might be associated with phasing down HFCs. Based on available information at the time of review, the Secretariat considers that the agreed costs are its best estimates of the overall incremental costs of conversion, but those estimates might change as more information becomes available, and according to the specific characteristics of the enterprises. The Secretariat therefore considers that the agreed costs would not constitute a precedent.

14. The Secretariat further notes as follows:

- (a) The project that was submitted to the 79<sup>th</sup> meeting fulfilled the requirements under decision 78/3(g); and
- (b) The project re-submitted to the 80<sup>th</sup> meeting fulfills all the additional requirements under decision 79/45, i.e., the project is submitted by an individual domestic refrigerator

enterprise to convert from HFC-134a to isobutane, a mature technology that have been introduced in similar enterprises in other Article 5 countries when replacing CFC-12 as refrigerant. The results of the project could be replicated in other HFC-134a-based domestic refrigerator manufacturing enterprises in Article 5 countries. The project will be fully implemented in less than two years, a comprehensive report will be issued once it is completed with detailed information on the eligible ICCs and IOCs, and any remaining funds would be returned to the Fund no later than one year after the date of project completion.

## **RECOMMENDATION**

15. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 79/45 and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/80/22.

---



**United Nations  
Environment  
Programme**

Distr.  
GENERAL

UNEP/OzL.Pro/ExCom/79/31  
16 June 2017

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Seventy-ninth Meeting  
Bangkok, 3-7 July 2017

**PROJECT PROPOSAL: COLOMBIA**

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia

UNDP

## PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

## COLOMBIA

## PROJECT TITLE(S)

## BILATERAL/IMPLEMENTING AGENCY

(a) Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
---	------

NATIONAL CO-ORDINATING AGENCY	Ozone Technical Unit of the Ministry of Environment and Sustainable Development
-------------------------------	---

## LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

## A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
------	-----

## B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
------	-----

HFC consumption remaining eligible for funding (ODP tonnes)	n/a
---	-----

CURRENT YEAR BUSINESS PLAN ALLOCATIONS		Funding US \$	Phase-out ODP tonnes
	(a)	0	0

<b>PROJECT TITLE:</b>	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased in (mt CO <sub>2</sub> equivalent):	87,688
Project duration (months):	24
Initial amount requested (US \$):	3,829,157
Final project costs (US \$):	
Incremental capital cost:	1,781,700
Contingency (10 %):	178,170
Incremental operating cost:	769,397
Total project cost:	2,729,267
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,426,400
Cost-effectiveness (US \$/kg):	23.26
Implementing agency support cost (US \$):	99,848
Total cost of project to Multilateral Fund (US \$):	1,526,248
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

SECRETARIAT'S RECOMMENDATION	For individual consideration
------------------------------	------------------------------

## PROJECT DESCRIPTION

1. On behalf of the Government of Colombia, UNDP has submitted to the 79<sup>th</sup> meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane (R-600a) at a total cost of US \$3,829,157, plus agency support costs of US \$268,041, as originally submitted.

2. In line with decision 78/3(g), the endorsement letter from the Government of Colombia for the project indicates the Government's intention to ratify the Kigali Amendment; that the Government is aware that no further funding would be available until the instrument of ratification of the Kigali Amendment had been received by the depositary at the United Nations Headquarters in New York, if this project would be approved by the Executive Committee; and that the Government acknowledges that in case this project is approved, any HFC reduced would be deducted from its starting point (which may be agreed in the future). The Secretariat also notes with appreciation that this proposal was submitted without preparation funding.

### Project objective

3. The project will eliminate the annual consumption of 61.32 metric tonnes (mt) (87,688 of CO<sub>2</sub> tonnes) of HFC-134a at three lines manufacturing domestic refrigerators at Mabe Colombia. The energy efficiency of the domestic refrigerators will also be improved by 25 per cent through modifications of the production lines and components.

### HFC consumption and sector background

4. In 2015, a consumption of 1,613 mt of HFCs was identified in the refrigeration and air-conditioning (RAC) sector in Colombia, of which 98.16 mt (6.1 per cent) was in the manufacturing of domestic refrigerators by three enterprises. About 1.1 million domestic refrigerators were manufactured, of which 21 per cent were exported to neighbouring countries with approximately the same amount being imported. Of the imported domestic refrigerators, approximately 68 per cent are HFC-134a-based and 32 per cent are R-600a-based. Since 2015, two of the domestic refrigeration manufacturing enterprises have completed their conversion to R-600a and no longer consume HFC-134a; the only domestic refrigerator manufacturer in the country currently consuming HFC-134a is Mabe. The 2015 consumption of ODS alternatives in the RAC sector as estimated by the Government of Colombia as part of the survey of ODS alternatives submitted to the 79<sup>th</sup> meeting is summarized in Table 1.

**Table 1. Refrigerant consumption in the RAC sector in 2015 (mt) as reported in the survey of ODS alternatives**

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
<b>Refrigeration</b>									
Domestic refrigeration manufacturing	-	98.16	-	-	-	-	-	-	1.24
Commercial refrigeration manufacturing	134.65	140.12	17.03	0.21	-	39.11	-	-	1.88
Industrial refrigeration manufacturing	91.12	80.08	21.10	3.95	-	43.86	458.85	-	0.23
Transportation refrigeration	0.42	0.56	1.65	-	-	-	-	0.08	-
Servicing	492.20	219.65	80.01	17.80	-	126.78	152.95	32.86	18.10
<b>Air conditioning</b>									
AC manufacturing	164.92	21.06	-	3.64	95.19	-	-	0.16	0.89
Mobile AC manufacturing	-	75.01	-	-	-	-	-	-	-
AC servicing	81.63	33.96	-	22.77	80.85	-	-	4.32	11.70
Mobile AC servicing	-	159.55	-	-	-	-	-	0.18	-
<b>Total</b>	<b>964.95</b>	<b>828.15</b>	<b>119.79</b>	<b>48.38</b>	<b>176.04</b>	<b>209.74</b>	<b>611.80</b>	<b>37.60</b>	<b>34.03</b>

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
% of consumption in mt	32	27	4	2	6	7	20	1	1
% of consumption in CO <sub>2</sub> equiv	36	24	10	2	8	17	-	1	2

### Enterprise background

5. Mabe Group (Controladora Mabe) is one of the largest producers of domestic refrigerators in Latin America and has Mexican and Chinese ownership. Mabe Colombia (Mabe), which is part of Mabe Group, has produced kitchen appliances since 1955 and is 100 per cent Article 5 owned.

6. All three production lines at Mabe manufacturing 11 models of domestic refrigerators have the same lay-out and similar installed capacity. In 1997 Mabe received Multilateral Fund assistance to convert its manufacturing capacity from CFC-11 to HCFC-141b and HCFC-22 (insulation foam component) and from CFC-12 to HFC-134a (refrigeration component). Subsequently, at the 60<sup>th</sup> meeting Mabe received Multilateral Fund assistance to convert the insulation foam component from HCFC-141b and HCFC-22 to cyclopentane. The project has been successfully implemented resulting in the phase-out of 381.10 mt (32.10 ODP tonnes) of HCFC-141b/HCFC-22.

### HFC consumption by the enterprise

7. The 2014-2016 HFC-134a consumption at Mabe Colombia is shown in Table 2.

**Table 2. Consumption of HFC-134a at Mabe Colombia (2014-2016)**

Year	Quantity (mt)
2014	58.31
2015	49.52
2016	76.13
<b>Total consumption</b>	<b>183.96</b>
<b>Average consumption</b>	<b>61.32</b>
<b>Average consumption (CO<sub>2</sub> tonnes)</b>	<b>87,688</b>

### Selection of alternative technology

8. Isobutane (R-600a) was selected as the alternative technology as it is 30 per cent cheaper than HFC-134a in terms of the charge per appliance and with a higher coefficient of performance and energy efficiency ratio compared to HFC-134a; the cooling system requires less purification; and the technology is proven and widely used in Colombia.

### Project description

9. Given the high flammability of R-600a, changes are foreseen to the production process at the three manufacturing lines and the end-products, as well as modifications to its testing laboratory to work with hydrocarbon-based (HC) refrigerants. The project contains three components for which funds are requested from the Multilateral Fund:

- (a) Modifications to the storage and feeding of refrigerant include explosion proof pumping and pipeline system to download, store and distribute the refrigerant at the plant; a storage tank; a safety system (i.e., leak detectors, fire-fighting equipment, shut-off valves and flux and pressure sensors, water sprinkler, smoke detectors); equipment installation and civil works (i.e., construction of pump and transfer rooms); and relevant certifications;

- (b) Production line modifications include introduction of helium in the pre-charge leak detection; three new refrigerant charging stations suitable for R-600a and ATEX<sup>13</sup> certified; introduction of ultrasound sealing of the refrigeration system; two post-charge leak detectors per line; safety system and ATEX certified equipment for the repair zone; civil works; and installation of a safety system and a ventilation system in the manufacturing area; and
- (c) General activities include the modification of the laboratory for development and testing (i.e., addition of an ATEX certified refrigerant charging station, a refrigeration test booth, air extraction system, ultrasonic welding equipment and leak detectors); modifications to the electrical controls of the HC-based fridges to ensure safe operation; installation and start-up of all the new equipment in the plant; trials and tests; training of personnel; relevant final HC-based product certification; plant safety certification; technical assistance by international experts including supervision of conversions; and others (a set of ATEX certified tools to avoid possible source of sparks and portable HC detectors to conduct inspections and tests both to the production line and the products).

10. In addition, the enterprise will implement with its own funds a fourth component aimed to improve the energy efficiency of most of their models to the level band A in accordance with RETIQ 2015<sup>14</sup> (this is equivalent to an energy consumption improvement of 25 per cent from their HFC-134a based refrigerators). Since no changes to the cabinet or doors of the refrigerators are proposed, no capital investments would be needed. Table 3 shows the average improvement in energy efficiency expected by each of the refrigerant system components.

**Table 3. Expected energy efficiency gains**

Component	Expected efficiency improvement (%)
Efficiency improvement of R-600a compressor	12
Defrosting cycle improvement	4
Efficiency improvement of R-600a fan	5
Improvement of heat exchangers and airflow	4
<b>Total</b>	<b>25</b>

#### Project costs and co-financing

11. The incremental capital costs (ICC), as originally submitted, were at US \$3,059,760, as shown in Table 4.

**Table 4. ICC for the conversion at Mabe Colombia**

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
<b>Storage and feeding system</b>			
Storage tank	1	120,000	120,000
Tank charging system	1	150,000	150,000
Pumping system	1	30,000	30,000
Safety system	1	30,000	30,000
Civil works	1	35,000	35,000
HC distribution to plant (piping, gangway and mounting)	1	90,000	90,000
Installation (tank, pipes, valves, pumping system and safety system)	1	50,000	50,000
Piping welding certification	1	18,000	18,000
Safety installation certification	1	12,000	12,000

<sup>13</sup> (Appareils destinés à être utilisés en ATmosphères EXplosibles): Directives on equipment and work environment allowed in an environment with an explosive atmosphere.

<sup>14</sup> Reglamento técnico de etiquetado: Colombian technical regulation on equipment labelling

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
<b>Sub-total storage and feeding system</b>			<b>535,000</b>
<b>Production lines modification</b>			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	35,000	105,000
Helium leak detectors	6	26,000	156,000
Helium recovery unit	3	50,000	150,000
<i>Refrigerant charge system</i>			
HC charging station	3	75,000	225,000
Ultrasonic welding equipment	3	50,000	150,000
HC leak detectors	6	35,000	210,000
<i>Zone of functional repairs</i>			
HC recovery units	3	20,000	60,000
Vacuum units	3	6,000	18,000
<i>Associated works</i>			
Civil works	3	15,000	45,000
Installation and supply pipelines	3	35,000	105,000
Safety system	3	45,000	135,000
Ventilation system (fans, motors, ducts and platforms)	3	25,000	75,000
<b>Sub-total production lines modification</b>			<b>1,434,000</b>
<b>General</b>			
<i>Modification of the laboratory for development and test</i>			
Equipment	1	160,000	160,000
Safety system	1	35,000	35,000
Ventilation system	1	20,000	20,000
<i>Changes in the electrical control</i>			
Equipment for testing electronic controls	1	210,900	210,900
Electronic control dies	1	60,000	60,000
<i>Installation and start-up</i>			
Installation and start-up	1	100,000	100,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	2,500	27,500
General safety certification	1	30,000	30,000
<i>Human resources</i>			
Training	1	30,000	30,000
Technical assistance	1	100,000	100,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	5,000	5,000
Portable HC detectors	2	2,500	5,000
<b>Sub-total general</b>			<b>812,600</b>
Sub-total			2,781,600
Contingencies (10%)			278,160
<b>Total cost</b>			<b>3,059,760</b>

12. The incremental operating costs (IOC) were estimated based on the cost of raw materials, considering safety and rearrangement of electric components, and improvement in energy efficiency. The price of HFC-134a and R-600a was reported at US \$4.45/kg and US \$8.00/kg, respectively. The IOC for the four types of refrigerators (single door, two doors cyclical, non-frost from 230 to 300 litres (*l*) and 360/ to 420/ based on the units produced by Mabe (average 2014-2016) are presented in Table 5, noting that IOCs related to the energy efficiency will be covered by the enterprise.



**Table 5. IOC for the conversion at Mabe Colombia**

IOC	Single door	Two doors cyclical	Non-frost (230/ to 300/)	Non-frost (360/ to 420/)	Total (US \$)
Due to change to R-600a	12,402	8,774	395,910	352,311	769,397
Due to energy efficiency gains	49,138	34,619	1,582,259	1,409,245	3,075,261
<b>Total</b>	<b>61,540</b>	<b>43,393</b>	<b>1,978,169</b>	<b>1,761,556</b>	<b>3,844,658</b>

13. The total cost of the project is US \$6,904,418, of which US \$3,829,157 is requested from the Multilateral Fund, as originally submitted, while the remaining US \$3,075,261 (i.e., the IOC associated with the energy efficiency gains) would be co-funded by the enterprise. The total cost-effectiveness of the project, excluding co-financing by the enterprise, is US \$62.45/kg. The duration of the project is 24 months.

## SECRETARIAT'S COMMENTS AND RECOMMENDATION

### COMMENTS

#### *Eligibility*

14. This project has been submitted in line with decision 78/3(g). The Secretariat reviewed the project proposal based on current policies and decisions of the Multilateral Fund and the review of similar conversion projects for CFC phase-out approved (i.e., conversion of refrigerant component from CFC-12 to R-600a involving product and manufacturing process redesign).

#### *Regulatory framework*

15. The Secretariat noted that all domestic refrigeration manufacturing in the country would be converted to R-600a with the conversion of Mabe, and inquired whether the Government of Colombia had considered regulatory measures to ensure the sustainability of the conversion. It was agreed that with approval of the project, the country would ban the import and manufacturing of domestic refrigerators with HFC-134a by 2020. The Secretariat considers that such a ban would not only help in phasing down the consumption of HFC-134a in the local market, but would also reduce future servicing demand of HFC-based equipment in the regional market as the country exports domestic refrigerators.

#### *Selection of enterprise*

16. The Secretariat notes that Mabe received funding from the Multilateral Fund in 1997 to convert from CFC-11 as a blowing agent and CFC-12 as a refrigerant to HCFC-141b/HCFC-22 and HFC-134a, respectively. As such, the Secretariat considers that this conversion falls under paragraph 18(b) of decision XXVIII/2.

17. The Secretariat noted that the two other enterprises in the sector had already converted to R-600a, and inquired why Mabe had not done so. UNDP clarified that the one enterprise converted during a relocation of the manufacturing facility, which allowed the conversion to take place at a substantially reduced cost, and the other due to a business decision of the enterprise.

#### *Proposed costs*

18. The Secretariat noted the project for the conversion of the domestic refrigerator manufacturing at Walton Hitech Industries Limited (Walton) in Bangladesh from HFC-134a to R-600a submitted by UNDP to the 79<sup>th</sup> meeting<sup>15</sup> had a cost-effectiveness of US \$11.97/kg, as submitted, while the cost-effectiveness

<sup>15</sup> UNEP/OzL.Pro/ExCom/79/28

of the conversion at Mabe was US \$62.45/kg, and inquired whether cost savings at Mabe could be considered. On this basis, UNDP undertook a detailed review of the project submission, and proposed adjusting the ICC as follows:

- (a) Storage and feeding system: a reduction to US \$350,000 (from US \$535,000) through reductions in the cost of the R-600a storage tank, feeding system, and associated equipment, installation and certification;
- (b) Production lines modification: a reduction to US \$1,200,000 (from US \$1,434,000) through reductions in the cost of vacuum and leak test, the refrigerant charge system, zone for functional repairs, and associated works;
- (c) Not to request funding for: modification of the laboratory for development and test noting the baseline equipment currently in the laboratory; changes in the electrical control and tools; quality assurance equipment; and portable HC detectors; and
- (d) Rationalization of costs for installation and start-up (to US \$50,000 from US \$100,000), general safety certification (to US \$25,000 from US \$30,000), and technical assistance and training (to US \$100,000 from US \$120,000).

19. On this basis, the revised ICC of the conversion is US \$1,959,870, including 10 per cent for contingencies. Combined with the IOC of US \$769,397, the total project costs are estimated at US \$2,729,267 (US \$44.51/kg). Noting that a ban on the manufacture and import of HFC-134a-based domestic refrigerators had not originally been planned, and that implementing such a ban could be complex, an additional US \$200,000 in technical assistance to establish the ban was requested.

20. The enterprise was prepared to provide co-financing of US \$1,502,867 beyond the co-funding related to the IOC associated with the energy efficiency gains (US \$3,075,261). On this basis, the funding requested of the Multilateral Fund amounts to US \$1,426,400 (US \$23.26/kg).

21. Noting the revised costs with appreciation, the Secretariat undertook a detailed analysis of the revised proposed ICC, taking into consideration previously approved projects to flammable alternatives in RAC sector, and the agreed costs for the project at Walton in Bangladesh, and suggested the following changes:

- (a) Funding requested for the storage and feeding system (US \$350,000) was adjusted to US \$135,000, as the enterprise already consumes cyclopentane and the R-600a tank would be adjacent to the cyclopentane tank; and rationalizing costs for installation for tank, pipes, valves, pumping system, and safety system, piping welding certification, and safety installation certification;
- (b) The cost for a vacuum and helium leak test as agreed for the project at Walton in Bangladesh (US \$24,000 each) could similarly be applied by Mabe reaching a total value of US \$72,000;
- (c) Of the three HFC-134a charging machines in the enterprise, two are 23 years old and likely nearing the end of their useful life. Therefore, incremental costs should be based on the cost, from the same supplier, of a new machine, from which has been deducted a proportion of the cost of a replacement HFC-134a machine, in line with decision 18/25, resulting in a reduction from US \$195,000 to US \$130,000;

- (d) A unit cost of US \$15,000 for a HC leak detector based on previously approved projects in the RAC sector, and based on the agreed costs for the project at Walton in Bangladesh US \$30,000 for the unit cost of ultrasonic welding equipment;
- (e) Adjustment to the explosion proof vacuum pump costs from US \$5,000/pump to US \$3,000/pump, and exclusion of the HC recovery system (US \$15,000/unit) as when leakage of R-600a is detected, the faulty refrigerator is sent to the functional repair zone where R-600a is extracted and vented to the exhaust system; the leak is then fixed and the refrigerator sent to the helium leak test station prior to being recharged. Common industrial practice is to use an explosion proof vacuum pump to vent the leaked HC in the exhaust system rather than to recover the R-600a; and
- (f) Rationalizing the costs associated with civil works (US \$30,000 to US \$15,000), installation and supply pipelines (included in installation and start-up) and technical assistance (US \$80,000 to US \$30,000).

22. The revised costs are shown in Table 6.

**Table 6. Revised costs for Mabe Colombia project**

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
<b>Storage and feeding system</b>			
<i>Sub-total storage and feeding system</i>		350,000	135,000
<b>Production lines modification</b>			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	90,000	72,000
Helium leak detectors	6	120,000	
Helium recovery unit and all	3	120,000	
<i>Refrigerant charge system</i>			
HC charging station	3	195,000	130,000
Ultrasonic welding equipment	3	135,000	90,000
HC leak detectors	6	180,000	90,000
<i>Zone of functional repairs</i>			
HC recovery units	3	45,000	-
Vacuum units	3	15,000	9,000
<i>Associated works</i>			
Civil works	3	30,000	15,000
Installation and supply pipelines	3	90,000	-
Safety system	3	120,000	120,000
Ventilation system (fans, motors, ducts and platforms)	3	60,000	60,000
<i>Sub-total production lines modification</i>		1,200,000	586,000
<b>General</b>			
<i>Installation and start-up</i>			
Installation and start-up	1	50,000	50,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	24,200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	27,500	27,500
General safety certification.	1	25,000	25,000
<i>Human resources</i>			
Training	1	20,000	20,000
Technical assistance	1	80,000	30,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	-	-

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
Portable HC detectors	2	-	-
Sub-total general		231,700	181,700
<b>Sub-total</b>		<b>1,781,700</b>	<b>902,700</b>
Contingencies (10%)		178,170	90,270
<b>Total ICC</b>		<b>1,959,870</b>	<b>992,970</b>
<b>Total IOC</b>		<b>769,397</b>	<b>769,397</b>
Implementation of ban on HFC-134a-based equipment		200,000	30,000
Co-financing by the enterprise		-(1,502,867)	n/a*
<b>Estimated cost to the Multilateral Fund</b>		<b>1,426,400</b>	<b>1,792,367</b>

\* The enterprise needed additional time to consider the costs proposed by the Secretariat and an appropriate level of co-funding, if any.

23. Based on those changes, and accounting for 10 per cent for contingencies, the incremental capital costs of the conversion of the three lines are estimated at US \$992,970. The Secretariat did not propose changes to the IOC of US \$769,397 (US \$12.54/kg), noting that it did not have sufficient experience to assess those costs. On that basis, the total cost of conversion is estimated at US \$1,762,367, noting that investment projects submitted in line with decision 78/3(g) were intended in part to gain experience in the incremental costs that might be associated with phasing down HFCs in Article 5 countries.

24. The Secretariat noted the request for technical assistance to establish the ban on the import and manufacturing of HFC-134a-based domestic refrigerators. The Secretariat considers the ban a key component to ensure the sustainability of the conversion and enhance the likelihood of also affecting the regional market, and considers that US \$30,000 instead of US \$200,000 for technical assistance could usefully be provided for that purpose.

25. UNDP and the Secretariat discussed the costs suggested by the Secretariat. Based on the revised costs proposed by the Secretariat, the enterprise needed additional time to consider those costs and an appropriate level of co-funding.

#### Climate benefits

26. The direct climate benefits of the conversion are the avoidance of emissions into the atmosphere of about 87,618 of CO<sub>2</sub> tonnes per year based on a consumption of 61.32 mt of HFC-142a (GWP = 1,430) and the expected introduction of 23.36 mt of R-600a (GWP = 3). The climate benefits of the energy efficiency enhancement are estimated at 19,759 of CO<sub>2</sub> tonnes per year based on a grid emission factor of 0.374 kg of CO<sub>2</sub>equiv/kWh, annual production of 536,025 units, and annual energy consumption per unit of 492.81 kWh prior to conversion and 394.25 kWh after conversion (20 per cent improved energy efficiency).

#### Conclusion

27. The project would enable the phase-out of HFC-134a in domestic refrigerator manufacturing in Colombia, introduce more energy-efficient equipment, and influence the regional market. The enhancement in the energy efficiency of the manufactured refrigerators would be undertaken at the enterprise's expense.

#### **Business plan 2017 -2019**

28. This project does not fall under the regular business plans submitted to the Secretariat and is presented to the Executive Committee as it falls under the purview of decision 78/3(g).

**RECOMMENDATION**

29. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 78/3(g) and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/79/19.

---



**United Nations  
Environment  
Programme**

Distr.  
GENERAL

UNEP/OzL.Pro/ExCom/80/38  
17 October 2017

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Eightieth Meeting  
Montreal, 13-17 November 2017

**PROJECT PROPOSAL: COLOMBIA**

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia

UNDP

**PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT****COLOMBIA****PROJECT TITLE(S) BILATERAL/IMPLEMENTING AGENCY**

(a) Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
---	------

<b>NATIONAL CO-ORDINATING AGENCY</b>	Ozone Technical Unit of the Ministry of Environment and Sustainable Development
--------------------------------------	---

**LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT****A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])**

HFCs	*
------	---

**B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])**

HFCs	*
------	---

<b>HFC consumption remaining eligible for funding (ODP tonnes)</b>	n/a
--	-----

<b>CURRENT YEAR BUSINESS PLAN ALLOCATIONS</b>		<b>Funding US \$</b>	<b>Phase-out ODP tonnes</b>
	(a)	0	0

<b>PROJECT TITLE:</b>	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased out (mt CO <sub>2</sub> equivalent):	87,688
Project duration (months):	18
Initial amount requested (US \$):	3,024,067
Final project costs (US \$):	
Incremental capital cost:	1,033,200
Contingency:	81,150
Incremental operating cost:	0
Total project cost:	1,114,350
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,114,350
Cost-effectiveness (US \$/kg):	18.17
Implementing agency support cost (US \$):	78,005
Total cost of project to Multilateral Fund (US \$):	1,192,355
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

<b>SECRETARIAT'S RECOMMENDATION</b>	For individual consideration
-------------------------------------	------------------------------

\* A total use of 1,568 mt of HFC (including 927 mt of HFC-134a) was estimated in 2015 (source ODS survey)

## PROJECT DESCRIPTION

### Background

1. On behalf of the Government of Colombia, UNDP submitted to the 79<sup>th</sup> meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane,<sup>1</sup> pursuant to decision 78/3(g).
2. At the same meeting, UNDP submitted an additional project proposal for the phase-out of HFC-134a used in the manufacturing of domestic refrigerators in Bangladesh.<sup>2</sup>
3. The two project proposals were included in the document on the Overview of issues identified during project review<sup>3</sup> as they were submitted for individual consideration.

### Discussion between UNDP and the Secretariat prior to the 79<sup>th</sup> meeting<sup>4</sup>

4. UNDP had submitted to the 79<sup>th</sup> meeting a proposal for US \$3,829,157 (including incremental capital cost (ICC) of US \$3,059,760 and incremental operational cost (IOC) of US \$769,397).<sup>5</sup> Upon discussions with the Secretariat, UNDP provided a revised proposal for US \$2,929,267 consisting of ICC of US \$1,959,870, IOCs of US \$769,397 and US \$200,000 to implement a ban on manufacturing and importing HFC-134a-based equipment, of which US \$1,426,400 was requested from the Fund and US \$1,502,867 co-financed by Mabe.
5. Based on its analysis, the Secretariat estimated the ICC of conversion at US \$992,970, and suggested an additional US \$30,000 to implement a ban on HFC-134a-based equipment. The Secretariat did not propose changes to the IOC of US \$769,397, noting that it did not have sufficient experience to assess those costs. Based on the revised costs estimated by the Secretariat (i.e., US \$1,792,367), the enterprise needed additional time to consider those costs and an appropriate level of co-funding, if any.

### Discussion at the 79<sup>th</sup> meeting<sup>6</sup>

6. At the 79<sup>th</sup> meeting, the Executive Committee agreed to consider the two project proposals (from Bangladesh and Colombia) in the contact group established under agenda item 11(c)(i), Matters related to the Kigali Amendment to the Montreal Protocol: draft criteria for funding. However, discussions at the contact group focussed on additional criteria for the consideration of HFC-related investment project proposals, rather than on the actual proposals. Consequently, the Executive Committee agreed to defer the consideration of the two HFC-related projects to the 80<sup>th</sup> meeting.<sup>7</sup>

---

<sup>1</sup> UNEP/OzL.Pro/ExCom/79/31

<sup>2</sup> UNEP/OzL.Pro/ExCom/79/28.

<sup>3</sup> UNEP/OzL.Pro/ExCom/79/19.

<sup>4</sup> The full text of the discussions is contained in paragraphs 14 to 27 of document UNEP/OzL.Pro/ExCom/79/31, attached to this note.

<sup>5</sup> The proposal also included additional costs associated (US \$3,075,261) with improving the energy efficiency of equipment manufactured that would be borne by enterprise.

<sup>6</sup> The full text of the discussions is contained in paragraphs 87 to 89 and 143 of document UNEP/OzL.Pro/ExCom/79/51.

<sup>7</sup> Decision 79/39 and decision 79/40.



## **Resubmission of the HFC-related investment project for Colombia**

7. On behalf of the Government of Colombia, UNDP resubmitted to the 80<sup>th</sup> meeting the project proposal submitted to the 79<sup>th</sup> meeting with a reduction in requested funding from the Multilateral Fund from US \$3,829,175 to US \$3,024,067, as submitted. The duration of the project is 18 months.

8. The project document submitted to the 79<sup>th</sup> meeting, including project description and Secretariat's comments and recommendation has been attached to the present document.

## **SECRETARIAT'S COMMENTS AND RECOMMENDATION**

### **COMMENTS**

9. The Secretariat noted that while the funding requested in the revised proposal was below that originally submitted to the 79<sup>th</sup> meeting, it was above the latest proposed by UNDP at the 79<sup>th</sup> meeting (US \$2,929,267 of which US \$1,426,400 requested from the Fund). It was therefore agreed to use the costs estimated by the Secretariat at the 79<sup>th</sup> meeting as a basis for discussing the level of funding for the project. On that basis, UNDP and the Secretariat entered into a detailed discussion about the costs of the project.

10. A key difference between the costs estimated by the Secretariat and the proposal made by UNDP at the 79<sup>th</sup> meeting was the level of additional co-financing provided by the enterprise. Further to the discussion, it was agreed that the IOCs be considered as co-financing provided by the enterprise, noting that the provision of incremental costs was intended as an incentive for early adoption of technologies and the other two enterprises manufacturing domestic refrigerators in the country had already converted to R-600a using their own resources. The Secretariat would emphasize that the agreement for not requesting IOCs should not be considered as a precedent; while the Secretariat considers this appropriate in this circumstance, it may not be appropriate in other circumstances.

11. With regard to the ICC proposed by the Secretariat at the 79<sup>th</sup> meeting, based on the revised proposal submitted to the 80<sup>th</sup> meeting, review of additional information and further discussions with UNDP, the following changes of some of the equipment items were agreed:

- (a) The incremental cost of the storage and feeding system was increased from US \$135,000 to US \$142,500 as the layout at the enterprise will require the R-600a storage tank to be located several hundred meters from the manufacturing facility, requiring long pipes, additional shut-off valves and accumulators for R-600a;
- (b) The cost of the helium vacuum and leak test was increased from US \$24,000 to US \$45,000 per unit, for a total of US \$135,000 considering a review of additional information, including from other projects submitted to the 80<sup>th</sup> meeting;
- (c) The cost of an R-600a charging station was increased from US \$43,333 to US \$50,000 per unit for a total of US \$150,000;
- (d) Contingencies were adjusted to US \$81,150 in line with the revised costs related to capital equipment (only); and
- (e) Funding for the implementation of a ban on manufacturing and importing HFC-134a-based equipment was agreed at US \$40,000.

12. On that basis, the agreed level of funding requested from the Multilateral Fund was US \$1,114,350 (US \$18.17/kg). Implementation of the project would result in the phase-out of 61.34 mt of HFC-134a

(87,688 CO<sub>2</sub>-eq tonnes), the complete phase-out of HFC-134a in the manufacturing of domestic refrigerators in the country and a ban on the manufacture and import of such equipment, noting that domestic refrigerators manufactured in Colombia are exported to neighbouring countries.

**Table 1. Agreed costs for Mabe Colombia project**

Item	Agreed cost (US \$)
<i>Sub-total storage and feeding system</i>	142,500
<i>Vacuum and leak test</i>	135,000
<i>Refrigerant charge system</i>	
HC charging station (3)	150,000
Ultrasonic welding equipment (3)	90,000
HC leak detectors (3)	90,000
<i>Zone of functional repairs</i>	9,000
<i>Associated works</i>	
Civil works	15,000
Safety system	120,000
Ventilation system (fans, motors, ducts and platforms)	60,000
<b>Sub-total production lines modification</b>	<b>811,500</b>
<i>Installation and start-up</i>	50,000
<i>Trials, test, product certification, safety audit</i>	
Refrigerator for trials	24,200
Field tests	5,000
Certification of new products	27,500
General safety certification	25,000
<i>Human resources</i>	
Training	20,000
Technical assistance	30,000
<b>Sub-total general</b>	<b>181,700</b>
<b>Sub-total</b>	<b>993,200</b>
Contingencies (10%)	81,150
<b>Total ICC</b>	<b>1,074,350</b>
<b>Total IOC</b>	<b>0</b>
Implementation of ban on HFC-134a-based equipment	40,000
<b>Funding request to the Multilateral Fund</b>	<b>1,114,350</b>

13. While agreeing to the level of funding requested from the Multilateral Fund, the Government of Colombia noted that it considered the total cost of conversion to be above the agreed level. The Secretariat notes that the enterprise will implement with its own funds a component of the project aimed at improving the energy efficiency of most of their models produced, with an expected efficiency improvement of approximately 25 per cent. However, the Secretariat has not assessed the costs associated with that component. In addition, the Secretariat notes that the purpose of implementing projects under decision 78/3(g) is to gain experience in the ICCs and IOCs that might be associated with phasing down HFCs. Based on available information at the time of review, the Secretariat considers that the agreed costs are its best estimates of the overall incremental costs of conversion, but those estimates might change as more information becomes available, and according to the specific characteristics of the enterprises. The Secretariat therefore considers that the agreed costs would not constitute a precedent.

14. The Secretariat further notes as follows:

- (a) The project that was submitted to the 79<sup>th</sup> meeting fulfilled the requirements under decision 78/3(g); and
- (b) The project re-submitted to the 80<sup>th</sup> meeting fulfills all the additional requirements under decision 79/45, i.e., the project is submitted by an individual domestic refrigerator

enterprise to convert from HFC-134a to isobutane, a mature technology that have been introduced in similar enterprises in other Article 5 countries when replacing CFC-12 as refrigerant. The results of the project could be replicated in other HFC-134a-based domestic refrigerator manufacturing enterprises in Article 5 countries. The project will be fully implemented in less than two years, a comprehensive report will be issued once it is completed with detailed information on the eligible ICCs and IOCs, and any remaining funds would be returned to the Fund no later than one year after the date of project completion.

## **RECOMMENDATION**

15. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 79/45 and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/80/22.

---



**United Nations  
Environment  
Programme**

Distr.  
GENERAL

UNEP/OzL.Pro/ExCom/79/31  
16 June 2017

ORIGINAL: ENGLISH



EXECUTIVE COMMITTEE OF  
THE MULTILATERAL FUND FOR THE  
IMPLEMENTATION OF THE MONTREAL PROTOCOL  
Seventy-ninth Meeting  
Bangkok, 3-7 July 2017

**PROJECT PROPOSAL: COLOMBIA**

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia UNDP

## PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

## COLOMBIA

## PROJECT TITLE(S)

## BILATERAL/IMPLEMENTING AGENCY

(a) Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
---	------

## NATIONAL CO-ORDINATING AGENCY

Ozone Technical Unit of the Ministry of Environment and Sustainable Development

## LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

## A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
------	-----

## B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
------	-----

## HFC consumption remaining eligible for funding (ODP tonnes)

n/a

## CURRENT YEAR BUSINESS PLAN ALLOCATIONS

## Funding US \$

## Phase-out ODP tonnes

(a)	0	0
-----	---	---

<b>PROJECT TITLE:</b>	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased in (mt CO <sub>2</sub> equivalent):	87,688
Project duration (months):	24
Initial amount requested (US \$):	3,829,157
Final project costs (US \$):	
Incremental capital cost:	1,781,700
Contingency (10 %):	178,170
Incremental operating cost:	769,397
Total project cost:	2,729,267
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,426,400
Cost-effectiveness (US \$/kg):	23.26
Implementing agency support cost (US \$):	99,848
Total cost of project to Multilateral Fund (US \$):	1,526,248
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

## SECRETARIAT'S RECOMMENDATION

For individual consideration

## PROJECT DESCRIPTION

1. On behalf of the Government of Colombia, UNDP has submitted to the 79<sup>th</sup> meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane (R-600a) at a total cost of US \$3,829,157, plus agency support costs of US \$268,041, as originally submitted.

2. In line with decision 78/3(g), the endorsement letter from the Government of Colombia for the project indicates the Government's intention to ratify the Kigali Amendment; that the Government is aware that no further funding would be available until the instrument of ratification of the Kigali Amendment had been received by the depositary at the United Nations Headquarters in New York, if this project would be approved by the Executive Committee; and that the Government acknowledges that in case this project is approved, any HFC reduced would be deducted from its starting point (which may be agreed in the future). The Secretariat also notes with appreciation that this proposal was submitted without preparation funding.

### Project objective

3. The project will eliminate the annual consumption of 61.32 metric tonnes (mt) (87,688 of CO<sub>2</sub> tonnes) of HFC-134a at three lines manufacturing domestic refrigerators at Mabe Colombia. The energy efficiency of the domestic refrigerators will also be improved by 25 per cent through modifications of the production lines and components.

### HFC consumption and sector background

4. In 2015, a consumption of 1,613 mt of HFCs was identified in the refrigeration and air-conditioning (RAC) sector in Colombia, of which 98.16 mt (6.1 per cent) was in the manufacturing of domestic refrigerators by three enterprises. About 1.1 million domestic refrigerators were manufactured, of which 21 per cent were exported to neighbouring countries with approximately the same amount being imported. Of the imported domestic refrigerators, approximately 68 per cent are HFC-134a-based and 32 per cent are R-600a-based. Since 2015, two of the domestic refrigeration manufacturing enterprises have completed their conversion to R-600a and no longer consume HFC-134a; the only domestic refrigerator manufacturer in the country currently consuming HFC-134a is Mabe. The 2015 consumption of ODS alternatives in the RAC sector as estimated by the Government of Colombia as part of the survey of ODS alternatives submitted to the 79<sup>th</sup> meeting is summarized in Table 1.

**Table 1. Refrigerant consumption in the RAC sector in 2015 (mt) as reported in the survey of ODS alternatives**

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
<b>Refrigeration</b>									
Domestic refrigeration manufacturing	-	98.16	-	-	-	-	-	-	1.24
Commercial refrigeration manufacturing	134.65	140.12	17.03	0.21	-	39.11	-	-	1.88
Industrial refrigeration manufacturing	91.12	80.08	21.10	3.95	-	43.86	458.85	-	0.23
Transportation refrigeration	0.42	0.56	1.65	-	-	-	-	0.08	-
Servicing	492.20	219.65	80.01	17.80	-	126.78	152.95	32.86	18.10
<b>Air conditioning</b>									
AC manufacturing	164.92	21.06	-	3.64	95.19	-	-	0.16	0.89
Mobile AC manufacturing	-	75.01	-	-	-	-	-	-	-
AC servicing	81.63	33.96	-	22.77	80.85	-	-	4.32	11.70
Mobile AC servicing	-	159.55	-	-	-	-	-	0.18	-
<b>Total</b>	<b>964.95</b>	<b>828.15</b>	<b>119.79</b>	<b>48.38</b>	<b>176.04</b>	<b>209.74</b>	<b>611.80</b>	<b>37.60</b>	<b>34.03</b>

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
% of consumption in mt	32	27	4	2	6	7	20	1	1
% of consumption in CO <sub>2</sub> equiv	36	24	10	2	8	17	-	1	2

#### Enterprise background

5. Mabe Group (Controladora Mabe) is one of the largest producers of domestic refrigerators in Latin America and has Mexican and Chinese ownership. Mabe Colombia (Mabe), which is part of Mabe Group, has produced kitchen appliances since 1955 and is 100 per cent Article 5 owned.

6. All three production lines at Mabe manufacturing 11 models of domestic refrigerators have the same lay-out and similar installed capacity. In 1997 Mabe received Multilateral Fund assistance to convert its manufacturing capacity from CFC-11 to HCFC-141b and HCFC-22 (insulation foam component) and from CFC-12 to HFC-134a (refrigeration component). Subsequently, at the 60<sup>th</sup> meeting Mabe received Multilateral Fund assistance to convert the insulation foam component from HCFC-141b and HCFC-22 to cyclopentane. The project has been successfully implemented resulting in the phase-out of 381.10 mt (32.10 ODP tonnes) of HCFC-141b/HCFC-22.

#### HFC consumption by the enterprise

7. The 2014-2016 HFC-134a consumption at Mabe Colombia is shown in Table 2.

**Table 2. Consumption of HFC-134a at Mabe Colombia (2014-2016)**

Year	Quantity (mt)
2014	58.31
2015	49.52
2016	76.13
<b>Total consumption</b>	<b>183.96</b>
<b>Average consumption</b>	<b>61.32</b>
<b>Average consumption (CO<sub>2</sub> tonnes)</b>	<b>87,688</b>

#### Selection of alternative technology

8. Isobutane (R-600a) was selected as the alternative technology as it is 30 per cent cheaper than HFC-134a in terms of the charge per appliance and with a higher coefficient of performance and energy efficiency ratio compared to HFC-134a; the cooling system requires less purification; and the technology is proven and widely used in Colombia.

#### Project description

9. Given the high flammability of R-600a, changes are foreseen to the production process at the three manufacturing lines and the end-products, as well as modifications to its testing laboratory to work with hydrocarbon-based (HC) refrigerants. The project contains three components for which funds are requested from the Multilateral Fund:

- (a) Modifications to the storage and feeding of refrigerant include explosion proof pumping and pipeline system to download, store and distribute the refrigerant at the plant; a storage tank; a safety system (i.e., leak detectors, fire-fighting equipment, shut-off valves and flux and pressure sensors, water sprinkler, smoke detectors); equipment installation and civil works (i.e., construction of pump and transfer rooms); and relevant certifications;

- (b) Production line modifications include introduction of helium in the pre-charge leak detection; three new refrigerant charging stations suitable for R-600a and ATEX<sup>1</sup> certified; introduction of ultrasound sealing of the refrigeration system; two post-charge leak detectors per line; safety system and ATEX certified equipment for the repair zone; civil works; and installation of a safety system and a ventilation system in the manufacturing area; and
- (c) General activities include the modification of the laboratory for development and testing (i.e., addition of an ATEX certified refrigerant charging station, a refrigeration test booth, air extraction system, ultrasonic welding equipment and leak detectors); modifications to the electrical controls of the HC-based fridges to ensure safe operation; installation and start-up of all the new equipment in the plant; trials and tests; training of personnel; relevant final HC-based product certification; plant safety certification; technical assistance by international experts including supervision of conversions; and others (a set of ATEX certified tools to avoid possible source of sparks and portable HC detectors to conduct inspections and tests both to the production line and the products).

10. In addition, the enterprise will implement with its own funds a fourth component aimed to improve the energy efficiency of most of their models to the level band A in accordance with RETIQ 2015<sup>2</sup> (this is equivalent to an energy consumption improvement of 25 per cent from their HFC-134a based refrigerators). Since no changes to the cabinet or doors of the refrigerators are proposed, no capital investments would be needed. Table 3 shows the average improvement in energy efficiency expected by each of the refrigerant system components.

**Table 3. Expected energy efficiency gains**

Component	Expected efficiency improvement (%)
Efficiency improvement of R-600a compressor	12
Defrosting cycle improvement	4
Efficiency improvement of R-600a fan	5
Improvement of heat exchangers and airflow	4
<b>Total</b>	<b>25</b>

#### Project costs and co-financing

11. The incremental capital costs (ICC), as originally submitted, were at US \$3,059,760, as shown in Table 4.

**Table 4. ICC for the conversion at Mabe Colombia**

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
<b>Storage and feeding system</b>			
Storage tank	1	120,000	120,000
Tank charging system	1	150,000	150,000
Pumping system	1	30,000	30,000
Safety system	1	30,000	30,000
Civil works	1	35,000	35,000
HC distribution to plant (piping, gangway and mounting)	1	90,000	90,000
Installation (tank, pipes, valves, pumping system and safety system)	1	50,000	50,000
Piping welding certification	1	18,000	18,000
Safety installation certification	1	12,000	12,000

<sup>1</sup> (Appareils destinés à être utilisés en ATmosphères EXplosibles): Directives on equipment and work environment allowed in an environment with an explosive atmosphere.

<sup>2</sup> Reglamento técnico de etiquetado: Colombian technical regulation on equipment labelling



Item	Quantity	Unit cost (US \$)	Total cost (US \$)
<b>Sub-total storage and feeding system</b>			<b>535,000</b>
<b>Production lines modification</b>			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	35,000	105,000
Helium leak detectors	6	26,000	156,000
Helium recovery unit	3	50,000	150,000
<i>Refrigerant charge system</i>			
HC charging station	3	75,000	225,000
Ultrasonic welding equipment	3	50,000	150,000
HC leak detectors	6	35,000	210,000
<i>Zone of functional repairs</i>			
HC recovery units	3	20,000	60,000
Vacuum units	3	6,000	18,000
<i>Associated works</i>			
Civil works	3	15,000	45,000
Installation and supply pipelines	3	35,000	105,000
Safety system	3	45,000	135,000
Ventilation system (fans, motors, ducts and platforms)	3	25,000	75,000
<b>Sub-total production lines modification</b>			<b>1,434,000</b>
<b>General</b>			
<i>Modification of the laboratory for development and test</i>			
Equipment	1	160,000	160,000
Safety system	1	35,000	35,000
Ventilation system	1	20,000	20,000
<i>Changes in the electrical control</i>			
Equipment for testing electronic controls	1	210,900	210,900
Electronic control dies	1	60,000	60,000
<i>Installation and start-up</i>			
Installation and start-up	1	100,000	100,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	2,500	27,500
General safety certification	1	30,000	30,000
<i>Human resources</i>			
Training	1	30,000	30,000
Technical assistance	1	100,000	100,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	5,000	5,000
Portable HC detectors	2	2,500	5,000
<b>Sub-total general</b>			<b>812,600</b>
Sub-total			2,781,600
Contingencies (10%)			278,160
<b>Total cost</b>			<b>3,059,760</b>

12. The incremental operating costs (IOC) were estimated based on the cost of raw materials, considering safety and rearrangement of electric components, and improvement in energy efficiency. The price of HFC-134a and R-600a was reported at US \$4.45/kg and US \$8.00/kg, respectively. The IOC for the four types of refrigerators (single door, two doors cyclical, non-frost from 230 to 300 litres (*l*) and 360*l* to 420*l*) based on the units produced by Mabe (average 2014-2016) are presented in Table 5, noting that IOCs related to the energy efficiency will be covered by the enterprise.

**Table 5. IOC for the conversion at Mabe Colombia**

IOC	Single door	Two doors cyclical	Non-frost (230/ to 300/)	Non-frost (360/ to 420/)	Total (US \$)
Due to change to R-600a	12,402	8,774	395,910	352,311	769,397
Due to energy efficiency gains	49,138	34,619	1,582,259	1,409,245	3,075,261
<b>Total</b>	<b>61,540</b>	<b>43,393</b>	<b>1,978,169</b>	<b>1,761,556</b>	<b>3,844,658</b>

13. The total cost of the project is US \$6,904,418, of which US \$3,829,157 is requested from the Multilateral Fund, as originally submitted, while the remaining US \$3,075,261 (i.e., the IOC associated with the energy efficiency gains) would be co-funded by the enterprise. The total cost-effectiveness of the project, excluding co-financing by the enterprise, is US \$62.45/kg. The duration of the project is 24 months.

## SECRETARIAT'S COMMENTS AND RECOMMENDATION

### COMMENTS

#### *Eligibility*

14. This project has been submitted in line with decision 78/3(g). The Secretariat reviewed the project proposal based on current policies and decisions of the Multilateral Fund and the review of similar conversion projects for CFC phase-out approved (i.e., conversion of refrigerant component from CFC-12 to R-600a involving product and manufacturing process redesign).

#### *Regulatory framework*

15. The Secretariat noted that all domestic refrigeration manufacturing in the country would be converted to R-600a with the conversion of Mabe, and inquired whether the Government of Colombia had considered regulatory measures to ensure the sustainability of the conversion. It was agreed that with approval of the project, the country would ban the import and manufacturing of domestic refrigerators with HFC-134a by 2020. The Secretariat considers that such a ban would not only help in phasing down the consumption of HFC-134a in the local market, but would also reduce future servicing demand of HFC-based equipment in the regional market as the country exports domestic refrigerators.

#### *Selection of enterprise*

16. The Secretariat notes that Mabe received funding from the Multilateral Fund in 1997 to convert from CFC-11 as a blowing agent and CFC-12 as a refrigerant to HCFC-141b/HCFC-22 and HFC-134a, respectively. As such, the Secretariat considers that this conversion falls under paragraph 18(b) of decision XXVIII/2.

17. The Secretariat noted that the two other enterprises in the sector had already converted to R-600a, and inquired why Mabe had not done so. UNDP clarified that the one enterprise converted during a relocation of the manufacturing facility, which allowed the conversion to take place at a substantially reduced cost, and the other due to a business decision of the enterprise.

*Proposed costs*

18. The Secretariat noted the project for the conversion of the domestic refrigerator manufacturing at Walton Hitech Industries Limited (Walton) in Bangladesh from HFC-134a to R-600a submitted by UNDP to the 79<sup>th</sup> meeting<sup>3</sup> had a cost-effectiveness of US \$11.97/kg, as submitted, while the cost-effectiveness of the conversion at Mabe was US \$62.45/kg, and inquired whether cost savings at Mabe could be considered. On this basis, UNDP undertook a detailed review of the project submission, and proposed adjusting the ICC as follows:

- (a) Storage and feeding system: a reduction to US \$350,000 (from US \$535,000) through reductions in the cost of the R-600a storage tank, feeding system, and associated equipment, installation and certification;
- (b) Production lines modification: a reduction to US \$1,200,000 (from US \$1,434,000) through reductions in the cost of vacuum and leak test, the refrigerant charge system, zone for functional repairs, and associated works;
- (c) Not to request funding for: modification of the laboratory for development and test noting the baseline equipment currently in the laboratory; changes in the electrical control and tools; quality assurance equipment; and portable HC detectors; and
- (d) Rationalization of costs for installation and start-up (to US \$50,000 from US \$100,000), general safety certification (to US \$25,000 from US \$30,000), and technical assistance and training (to US \$100,000 from US \$120,000).

19. On this basis, the revised ICC of the conversion is US \$1,959,870, including 10 per cent for contingencies. Combined with the IOC of US \$769,397, the total project costs are estimated at US \$2,729,267 (US \$44.51/kg). Noting that a ban on the manufacture and import of HFC-134a-based domestic refrigerators had not originally been planned, and that implementing such a ban could be complex, an additional US \$200,000 in technical assistance to establish the ban was requested.

20. The enterprise was prepared to provide co-financing of US \$1,502,867 beyond the co-funding related to the IOC associated with the energy efficiency gains (US \$3,075,261). On this basis, the funding requested of the Multilateral Fund amounts to US \$1,426,400 (US \$23.26/kg).

21. Noting the revised costs with appreciation, the Secretariat undertook a detailed analysis of the revised proposed ICC, taking into consideration previously approved projects to flammable alternatives in RAC sector, and the agreed costs for the project at Walton in Bangladesh, and suggested the following changes:

- (a) Funding requested for the storage and feeding system (US \$350,000) was adjusted to US \$135,000, as the enterprise already consumes cyclopentane and the R-600a tank would be adjacent to the cyclopentane tank; and rationalizing costs for installation for tank, pipes, valves, pumping system, and safety system, piping welding certification, and safety installation certification;
- (b) The cost for a vacuum and helium leak test as agreed for the project at Walton in Bangladesh (US \$24,000 each) could similarly be applied by Mabe reaching a total value of US \$72,000;
- (c) Of the three HFC-134a charging machines in the enterprise, two are 23 years old and

---

<sup>3</sup> UNEP/OzL.Pro/ExCom/79/28

likely nearing the end of their useful life. Therefore, incremental costs should be based on the cost, from the same supplier, of a new machine, from which has been deducted a proportion of the cost of a replacement HFC-134a machine, in line with decision 18/25, resulting in a reduction from US \$195,000 to US \$130,000;

- (d) A unit cost of US \$15,000 for a HC leak detector based on previously approved projects in the RAC sector, and based on the agreed costs for the project at Walton in Bangladesh US \$30,000 for the unit cost of ultrasonic welding equipment;
- (e) Adjustment to the explosion proof vacuum pump costs from US \$5,000/pump to US \$3,000/pump, and exclusion of the HC recovery system (US \$15,000/unit) as when leakage of R-600a is detected, the faulty refrigerator is sent to the functional repair zone where R-600a is extracted and vented to the exhaust system; the leak is then fixed and the refrigerator sent to the helium leak test station prior to being recharged. Common industrial practice is to use an explosion proof vacuum pump to vent the leaked HC in the exhaust system rather than to recover the R-600a; and
- (f) Rationalizing the costs associated with civil works (US \$30,000 to US \$15,000), installation and supply pipelines (included in installation and start-up) and technical assistance (US \$80,000 to US \$30,000).

22. The revised costs are shown in Table 6.

**Table 6. Revised costs for Mabe Colombia project**

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
<b>Storage and feeding system</b>			
<i>Sub-total storage and feeding system</i>		350,000	135,000
<b>Production lines modification</b>			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	90,000	72,000
Helium leak detectors	6	120,000	
Helium recovery unit and all	3	120,000	
<i>Refrigerant charge system</i>			
HC charging station	3	195,000	130,000
Ultrasonic welding equipment	3	135,000	90,000
HC leak detectors	6	180,000	90,000
<i>Zone of functional repairs</i>			
HC recovery units	3	45,000	-
Vacuum units	3	15,000	9,000
<i>Associated works</i>			
Civil works	3	30,000	15,000
Installation and supply pipelines	3	90,000	-
Safety system	3	120,000	120,000
Ventilation system (fans, motors, ducts and platforms)	3	60,000	60,000
<i>Sub-total production lines modification</i>		1,200,000	586,000
<b>General</b>			
<i>Installation and start-up</i>			
Installation and start-up	1	50,000	50,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	24,200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	27,500	27,500
General safety certification.	1	25,000	25,000

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
<i>Human resources</i>			
Training	1	20,000	20,000
Technical assistance	1	80,000	30,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	-	-
Portable HC detectors	2	-	-
Sub-total general		231,700	181,700
<b>Sub-total</b>		<b>1,781,700</b>	<b>902,700</b>
Contingencies (10%)		178,170	90,270
<b>Total ICC</b>		<b>1,959,870</b>	<b>992,970</b>
<b>Total IOC</b>		<b>769,397</b>	<b>769,397</b>
Implementation of ban on HFC-134a-based equipment		200,000	30,000
Co-financing by the enterprise		-(1,502,867)	n/a*
<b>Estimated cost to the Multilateral Fund</b>		<b>1,426,400</b>	<b>1,792,367</b>

\* The enterprise needed additional time to consider the costs proposed by the Secretariat and an appropriate level of co-funding, if any.

23. Based on those changes, and accounting for 10 per cent for contingencies, the incremental capital costs of the conversion of the three lines are estimated at US \$992,970. The Secretariat did not propose changes to the IOC of US \$769,397 (US \$12.54/kg), noting that it did not have sufficient experience to assess those costs. On that basis, the total cost of conversion is estimated at US \$1,762,367, noting that investment projects submitted in line with decision 78/3(g) were intended in part to gain experience in the incremental costs that might be associated with phasing down HFCs in Article 5 countries.

24. The Secretariat noted the request for technical assistance to establish the ban on the import and manufacturing of HFC-134a-based domestic refrigerators. The Secretariat considers the ban a key component to ensure the sustainability of the conversion and enhance the likelihood of also affecting the regional market, and considers that US \$30,000 instead of US \$200,000 for technical assistance could usefully be provided for that purpose.

25. UNDP and the Secretariat discussed the costs suggested by the Secretariat. Based on the revised costs proposed by the Secretariat, the enterprise needed additional time to consider those costs and an appropriate level of co-funding.

### Climate benefits

26. The direct climate benefits of the conversion are the avoidance of emissions into the atmosphere of about 87,618 of CO<sub>2</sub> tonnes per year based on a consumption of 61.32 mt of HFC-142a (GWP = 1,430) and the expected introduction of 23.36 mt of R-600a (GWP = 3). The climate benefits of the energy efficiency enhancement are estimated at 19,759 of CO<sub>2</sub> tonnes per year based on a grid emission factor of 0.374 kg of CO<sub>2</sub>equiv/kWh, annual production of 536,025 units, and annual energy consumption per unit of 492.81 kWh prior to conversion and 394.25 kWh after conversion (20 per cent improved energy efficiency).

### Conclusion

27. The project would enable the phase-out of HFC-134a in domestic refrigerator manufacturing in Colombia, introduce more energy-efficient equipment, and influence the regional market. The enhancement in the energy efficiency of the manufactured refrigerators would be undertaken at the enterprise's expense.

**Business plan 2017 -2019**

28. This project does not fall under the regular business plans submitted to the Secretariat and is presented to the Executive Committee as it falls under the purview of decision 78/3(g).

**RECOMMENDATION**

29. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 78/3(g) and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/79/19.

---