



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

HFCs	*
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HFC consumption remaining eligible for funding (ODP tonnes)

n/a

CURRENT YEAR BUSINESS PLAN ALLOCATIONS**Funding US \$****Phase-out ODP tonnes**

(a)	0	0
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PROJECT TITLE:	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 ₂ 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

SECRETARIAT'S RECOMMENDATION

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 79th meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane,¹ 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.²
3. The two project proposals were included in the document on the Overview of issues identified during project review³ as they were submitted for individual consideration.

Discussion between UNDP and the Secretariat prior to the 79th meeting⁴

4. UNDP had submitted to the 79th 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).⁵ 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 79th meeting⁶

6. At the 79th 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 80th meeting.⁷

¹ UNEP/OzL.Pro/ExCom/79/31

² UNEP/OzL.Pro/ExCom/79/28.

³ UNEP/OzL.Pro/ExCom/79/19.

⁴ 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.

⁵ 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.

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

⁷ 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 80th meeting the project proposal submitted to the 79th 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 79th 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 79th meeting, it was above the latest proposed by UNDP at the 79th 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 79th 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 79th 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 79th meeting, based on the revised proposal submitted to the 80th 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 80th 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 CO₂-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
Sub-total production lines modification	811,500
<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
Sub-total general	181,700
Sub-total	993,200
Contingencies (10%)	81,150
Total ICC	1,074,350
Total IOC	0
Implementation of ban on HFC-134a-based equipment	40,000
Funding request to the Multilateral Fund	1,114,350

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 79th meeting fulfilled the requirements under decision 78/3(g); and
- (b) The project re-submitted to the 80th 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
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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
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B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

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

n/a

CURRENT YEAR BUSINESS PLAN
ALLOCATIONS

Funding US \$

Phase-out ODP tonnes

(a)	0	0
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PROJECT TITLE:	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 ₂ 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 79th 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 CO₂ 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 79th 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
Refrigeration									
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
Air conditioning									
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	-
Total	964.95	828.15	119.79	48.38	176.04	209.74	611.80	37.60	34.03

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 ₂ 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 60th 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
Total consumption	183.96
Average consumption	61.32
Average consumption (CO₂ tonnes)	87,688

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 ATEX¹ 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 2015² (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
Total	25

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 \$)
Storage and feeding system			
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

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

² Reglamento técnico de etiquetado: Colombian technical regulation on equipment labelling

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
Sub-total storage and feeding system			535,000
Production lines modification			
<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
Sub-total production lines modification			1,434,000
General			
<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
Sub-total general			812,600
Sub-total			2,781,600
Contingencies (10%)			278,160
Total cost			3,059,760

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
Total	61,540	43,393	1,978,169	1,761,556	3,844,658

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 79th meeting³ 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

³ 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 \$)
Storage and feeding system			
<i>Sub-total storage and feeding system</i>		350,000	135,000
Production lines modification			
<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
General			
<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
Sub-total		1,781,700	902,700
Contingencies (10%)		178,170	90,270
Total ICC		1,959,870	992,970
Total IOC		769,397	769,397
Implementation of ban on HFC-134a-based equipment		200,000	30,000
Co-financing by the enterprise		-(1,502,867)	n/a*
Estimated cost to the Multilateral Fund		1,426,400	1,792,367

* 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 CO₂ 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 CO₂ tonnes per year based on a grid emission factor of 0.374 kg of CO₂equiv/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.
