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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Ninety-fifth Meeting
Montreal, 4-8 December 2024
Item 9(d) of the provisional agenda¹

PROJECT PROPOSAL: MOROCCO

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

Refrigeration (HFC)

- | | | |
|---|-------|--------------------------|
| <ul style="list-style-type: none">• Conversion of two production lines in one enterprise (MANAR) manufacturing domestic refrigeration equipment from HFC-134a to R-600a | UNIDO | Individual consideration |
|---|-------|--------------------------|

¹ UNEP/OzL.Pro/ExCom/95/1

PROJECT EVALUATION SHEET – MULTI-YEAR PROJECTS
MOROCCO

PROJECT TITLE**IMPLEMENTING AGENCY**

Conversion of two production lines in one enterprise (“MANAR”) manufacturing domestic refrigeration equipment from HFC-134a to R-600a	UNIDO
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NATIONAL CO-ORDINATING AGENCY	National Ozone Unit
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LATEST REPORTED CONSUMPTION DATA FOR HFC ADDRESSED IN PROJECT**A: ARTICLE-7 DATA (2023)**

HFC-134a	869.54 mt	1,243,442 CO ₂ -eq tonnes
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B: COUNTRY PROGRAMME SECTORAL DATA (2023)

HFC-134a	896.33 mt	1,281,752 CO ₂ -eq tonnes
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HFC consumption remaining eligible for funding	mt	TBD
	CO ₂ -eq tonnes	TBD

CURRENT YEAR BUSINESS PLAN ALLOCATIONS	Enterprise	Funding (US \$)	Phase-out (mt)	
	MANAR	428,000	mt	26.04
			CO ₂ -eq tonnes	n/a

Particular	MANAR	
HFC used at enterprise	HFC-134a	
HFC to be phased out through this project	mt	25.65
	CO ₂ -eq tonnes	36,684
Project duration (months)	18	
Initial amount requested (US \$)	2,660,887	
Final project costs (US \$):		
Incremental capital costs	425,731	
Contingency (10 % of equipment)	0	
Incremental operating costs	0	
Total project cost	425,731	
Local ownership (%)	100	
Export component (%)	0	
Requested grant (US \$)	352,985	
Cost-effectiveness	US \$/kg	13.76
	US \$/CO ₂ -eq tonne	9.62
Implementing agency support costs (US \$)	24,709	
Total cost of project to Multilateral Fund (US \$)	377,694	
Counterpart funding (Y/N)	Y	
Project monitoring milestones included (Y/N)	Y	

SECRETARIAT’S RECOMMENDATION	Individual consideration
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PROJECT DESCRIPTION

1. On behalf of the Government of Morocco, UNIDO has submitted a proposal for a project to convert the production lines of one enterprise manufacturing domestic refrigeration equipment at a total cost of US \$2,660,887, plus agency support costs of US \$186,262, as originally submitted.²

Project objective

2. The project will convert two domestic refrigeration manufacturing lines³ at the enterprise MANAR from HFC-134a to R-600a to eliminate 25.65 metric tonnes (mt) (36,684 CO₂-equivalent tonnes (CO₂-eq tonnes)) of HFC-134a consumption (2023 consumption).

HFC consumption

3. Morocco reported a total HFC consumption of 1,917.39 mt (4,579,557 CO₂-eq) in 2023 under Article 7 of the Montreal Protocol of which the consumption of HFC-134a constitutes 45.35 per cent in metric tonnes, and 27.2 per cent in CO₂-eq tonnes. Table 1 presents a summary of HFC-134a consumption in Morocco as reported to the Ozone Secretariat.

Table 1. HFC-134a consumption in Morocco (2020-2023 Article 7 data)

HFC	GWP	2020	2021	2022	2023
Metric tonnes (mt)					
HFC-134a	1,430	357.25	312.42	359.32	869.54
CO₂-eq tonnes					
HFC-134a	1,430	510,868	446,761	513,820	1,243,442

4. The consumption level of HFC-134a in Morocco decreased in 2021 but increased in 2022. This fluctuation was possibly influenced by the impact of the COVID-19 pandemic. However, consumption in 2023 more than doubled and at the enterprise MANAR the consumption has risen steadily during this period due to increased demand for refrigeration equipment. Stage I of the Kigali HFC Implementation Plan (KIP) for Morocco is currently being prepared and is expected to be submitted to the 96th meeting. The KIP will provide more detailed information on HFC consumption and sector distribution in the country.

Established HFC baseline

5. The Government of Morocco reported the Article 7 data for 2020-2022. The country's HFC consumption baseline was established at 2,134,520 CO₂-eq tonnes by adding 65 per cent of its HCFC baseline (expressed in CO₂-eq tonnes) to its average HFC consumption in 2020-2022, as shown in table 2.

Table 2. HFC baseline calculation for Morocco (CO₂-eq tonnes)

Baseline calculation components	2020	2021	2022
HFC annual consumption	1,687,148	1,475,421	590,302
HFC average consumption in 2020-2022	1,250,957		
HCFC baseline (65%)	883,563		
HFC baseline	2,134,520		

² As per the letter of 2 August 2024 from the National Ozone Unit of the Ministry of Industry and Trade of Morocco to UNIDO.

³ A third manufacturing line is in the planning stage. This line would not be covered by the project.

6. Project preparation for stage I of the KIP was approved at the 91st meeting and the country also received funds to conduct a survey on ODS alternatives approved at the 75th meeting and for enabling activities for HFC phase-down at the 81st meeting. Morocco ratified the Kigali Amendment in April 2022.

Sector and enterprise background

7. The domestic refrigeration manufacturing sector in Morocco consists of only one enterprise, MANAR, which was established in 1956 and is 100 per cent Moroccan-owned. MANAR holds a market share of about 30 per cent, while the remaining 70 per cent of national demand is met through imported appliances. Additionally, there are manufacturing enterprises that use HFCs in the commercial refrigeration and foam sectors. Stage I of the KIP will provide more details on HFC consumption and distribution in Morocco.

8. MANAR consumes HFCs exclusively in domestic refrigeration manufacturing. Historically, MANAR received funding to phase out CFCs and HCFC-141b. At the 29th meeting, the Executive Committee approved a project to convert its polyurethane (PU) foam manufacturing from CFC-11 to HCFC-141b as an interim solution, and to transition domestic refrigeration manufacturing from CFC-12 to HFC-134a. At the 62nd meeting, the Executive Committee approved US \$951,740 to further convert its foam manufacturing from HCFC-141b to cyclopentane. This conversion phased out 11 ODP tonnes of HCFC-141b and was completed by December 2013.

Enterprise-level HFC consumption

9. MANAR has two manufacturing lines and manufactures 14 models of refrigerators and freezers. Line 1 has a daily manufacturing capacity of 700 units, while line 2 can produce 300 units per day. In 2023, the enterprise produced 161,371 units of refrigeration equipment. The total annual consumption of HFC-134a from 2020 to 2023 is detailed in table 3 below.

Table 3. Consumption of HFC-134a at MANAR from 2020-2023

Year	After-sales service consumption ⁴	Manufacturing consumption	Total annual consumption
mt			
2020	0.54	23.00	23.54
2021	0.59	25.45	26.04
2022	0.73	23.25	23.98
2023	0.77	25.65	26.42
Average 2021-2023	0.69	24.80	25.48
CO ₂ -eq tonnes			
2020	768	31,547	32,315
2021	842	36,398	37,240
2022	1,042	33,249	34,291
2023	1,094	36,684	37,778
Average 2021-2023	993	35,444	36,436

Project description

10. MANAR had selected R-600a as the replacement technology as it is well-established globally as an alternative refrigerant in domestic refrigeration. To test the technology, the enterprise has installed partial equipment for the R-600a-based production in line 1 to facilitate a limited production of approximately

⁴ MANAR after-sales service refers to refrigerant gas for maintenance and filling of refrigerators with gas during their lifetime and this operation concerns only products manufactured in MANAR.

70 units per day on a trial basis. The conversion is not expected to hinder the enterprise's competitiveness in Morocco.

Incremental capital costs

11. The conversion includes the modification of manufacturing lines to incorporate new equipment, replacement of equipment, and installation of safety measures and equipment to ensure safe production with a flammable refrigerant. The refrigerant storage and pumping area would be moved to outside of the production lines. The replacement equipment would include a transfer pump, safety system installation (leak detection sensors, ventilation system, accumulators, antistatic floor, grounding, fire extinguishers, control system, etc.), piping to connect the transfer pump to the gas charging machines, charging machine, ultrasound welding, etc. The detailed incremental capital costs (ICCs) requested, at the amount of US \$1,426,233, are summarised in table 4 below.

Table 4: Estimated ICCs for conversion of two domestic refrigerator manufacturing lines at MANAR

Description	Line 1	Line 2	Total Price (US \$)
Capital costs			
R-600a gas charging station	1	2	304,782
Charger safety (drop box, valve box, safe-in master, gas detectors)	1	2	129,822
Vacuum pumps		13	51,441
Gas supply (transfer pump + accessories)		1	26,114
Piping (stainless steel piping with accessories, argon welding, certification)	1	1	7,614
Storage area layout and gas supply (civil engineering, framework, safety)		1	43,600
Ventilation system	1	2	23,262
Workstation safety (ATEX zone, changing risky components, grounding, antistatic mats, fire extinguishers, display)		1	54,500
Supply safety (accumulator, safety valves)		1	12,745
Portable gas leak detector for piping control		1 (lines 1 and 2)	7,615
Portable gas leak detector for piping inspection		1 (lines 1 and 2)	7,194
Blow off pump in repair area		1	5,702
Ultrasonic welding machine (Kobra III type)		2	61,280
Lockring Tool (Vulkan)		2	6,714
Calibration tools		1	2,381
Leak detector high precision (0.05 gr/year) (Ecotec E 3000 detectors)	3	4 (1 is a back up for both lines)	210,000
Helium leak detection (control, detection and recovery)	1	1	180,000
Modification of conveyors to install helium leak detection	1	1	70,000
Spare parts		1 (lines 1 and 2)	21,102
Technical assistance			
Technical assistance for project implementation, safety certification			20,000
Transportation of equipment			10,000
Installation and commissioning			22,722
Training for the operators (two lines)			17,986
Subtotal general costs			70,708
Total			1,296,576
Contingencies (10 per cent of ICC)			129,658
Total capital costs			1,426,234

Incremental operating costs

12. The incremental operating costs (IOCs) for converting from HFC-134a to R-600a have been calculated at US \$1,234,653, based on the price and quantity of refrigerants required and the difference in compressor costs for one year of production.

Total project costs

13. The total incremental costs of the conversion from HFC-134a to R-600a to phase out 25.65 mt (36,684 CO₂-eq tonnes) has a cost-effectiveness of US \$103.74/kg as shown in table 5 below. The planned project duration is 18 months.

Table 5. Estimated costs for conversion of two domestic refrigerator manufacturing lines at MANAR

Particulars	US \$	HFC-134a phase-out (mt)	HFC-134a phase-out (CO ₂ -eq tonne)	Cost – effectiveness (US \$/kg)	Cost – effectiveness (US \$/ CO ₂ - eq tonne)
Incremental capital costs	1,426,233	25.65	36,684	103.74	72.54
Incremental operating costs	1,234,653				
Total	2,660,887				

SECRETARIAT'S COMMENTS AND RECOMMENDATION**COMMENTS**Relation to stage I of the Kigali HFC implementation plan and sustainability of HFC reductions

14. The Secretariat also noted that stage the project was submitted in line with decision 87/50(e) in advance of stage I of its KIP, which is still under preparation and is expected to be submitted to the 96th meeting in 2025.

Regulatory measures for achieving the sustainability of the conversion

15. The Secretariat noted that MANAR is the only enterprise that manufactures domestic refrigeration equipment in Morocco. In line with decision 79/25, the Government is required to include the necessary regulatory measures to ensure the sustainability of the complete phase-out in that specific sector. Upon discussion, UNIDO informed that the national ozone unit has confirmed that regulatory measures will be established to ban the manufacturing and import of HFC-134a-based domestic refrigerators once the conversion project is completed. In addition, the enterprise, MANAR commits to not using HFCs in all its manufacturing processes once the conversion project is fully implemented, including the third line that has been planned for the manufacturing of chest freezers covering three models (100, 150, and 200 litres) with an annual capacity of 40,000 units.

Deduction of HFC reductions from the starting point

16. The phase-out of 25.65 mt of HFC-134a (36,684 CO₂-eq tonnes) resulting from the approval of the present project will be deducted from the country's HFC consumption eligible for funding identified in the KIP. Accordingly, once the starting point for sustained aggregate reduction in HFC consumption is established, the reductions proposed by this project will need to be deducted in accordance with the methodology agreed under the HFC cost guidelines (currently under discussion).

Technical and cost-related issues

17. The Secretariat noted that the current project will eliminate the use of HFC-134a in the manufacturing of domestic refrigeration equipment, which will also reduce the demand for servicing with HFC-134a. Additionally, a regulatory ban on the import of HFC-134a-based domestic refrigerators will be implemented to support the sectoral transition to low-GWP, R-600a-based technology as part of this project. Therefore, the project will provide enhanced environmental benefits.

18. The potential for energy efficiency enhancements as part of the conversion project was discussed. UNIDO explained that the current project will focus solely on refrigerant transition and not on improving energy efficiency. A separate project to increase energy efficiency of domestic refrigerators has been planned and the project preparation request will be submitted to the 96th meeting under decision 94/60.

19. The project costs were discussed, and several adjustments were made:

- (a) Contingencies of some equipment costs were removed as these were based on the supplier's quotation;
- (b) The equipment for leak detection, charging, and welding for the repair lines was removed as the repaired units can be returned to the production lines;
- (c) The cost for transfer pumps, vacuum pumps, leak detection, refrigerant storage, the ventilation system, ultrasound welding, helium leak detection, modification of the conveyor belt, spare parts, and installation and commissioning were removed or reduced to further rationalize the costs, as some equipment (a transfer pump, a charge machine, and pipelines) had been installed in line 1 to facilitate the test production with alternatives; and
- (d) The lockring tools were removed as these will be used for servicing.

20. The revised ICCs for the conversion of two manufacturing lines are presented in table 6 below.

Table 6. Agreed ICCs for the conversion of two domestic refrigerator manufacturing lines at MANAR (US \$)

Description	Proposed cost	Agreed cost
Capital costs		
R-600a gas charging station	304,782	60,000
Charger safety (drop box, valve box, safe-in master, gas detectors)	129,822	43,274
Vacuum pumps	51,441	0
Gas supply (transfer pump + accessories)	26,114	0
Piping (stainless steel piping with accessories, argon welding, certification)	7,614	3,807
Storage area layout and gas supply (civil engineering, framework, safety)	43,600	0
Ventilation system	23,262	7,754
Workstation safety (ATEX zone, changing risky components, grounding, antistatic mats, fire extinguishers, display)	54,500	54,500
Supply safety (accumulator, safety valves)	12,745	12,745
Portable gas leak detector for piping control	7,615	7,615
Portable gas leak detector for piping inspection	7,194	7,194
Blow off pump in repair area	5,702	5,702
Ultrasonic welding machine	61,280	30,640
Lockring tools	6,714	0
Calibration tools	2,381	0
Leak detector high precision (0.05 gr/year) (Ecotec E 3000 to replace INFICON HLD 5000 detectors)	210,000	30,000
Helium leak detection (control, detection and recovery)	180,000	60,000
Modification of conveyors to install helium leak detection	70,000	52,500

Description	Proposed cost	Agreed cost
Capital costs		
Set of spare parts	21,102	0
Subtotal capital costs	1,225,868	375,731
General cost for both lines		
Technical assistance for project execution and safety verification after completion of conversion	20,000	25,000
Transportation of equipment	10,000	0
Installation and commissioning	22,722	0
Training for the operators (two production lines)	17,986	25,000
Subtotal general costs	70,708	50,000
<i>Contingencies (10% of ICC)</i>	<i>129,658</i>	<i>0</i>
Total ICC	1,426,234	425,731

21. Although the Secretariat has implemented the above cost reductions based on the guidelines of the Executive Committee, it is possible that the manufacturer may require additional equipment, such as gas supply pump, additional ultrasound welding, lockring tool, additional leak detector, to improve the efficiency of the manufacturing process. Those will be co-funded by the manufacturer.

22. The IOC of the project was discussed. Given that the energy efficiency improvement will be submitted later, it was agreed that the IOC for the project will not be requested in the current proposal.

23. At the 94th meeting, the contact group considering the HFC cost guidelines agreed that the previously agreed cost-effectiveness threshold of US \$13.76 per kilogram would continue to be used for the domestic refrigeration sector.⁵ Based on this, the eligible funding for the project is calculated as US \$352,985 at US \$13.76/kg to phase out 25.65 mt of HFC-134a. The enterprise agrees to provide co-funding for the remaining project cost.

24. The total project costs were agreed at US \$352,985 for the conversion of two manufacturing lines to phase out 25.65 mt (36,684 CO₂-eq tonnes) of HFC-134a, at a cost-effectiveness of US \$13.76/kg (US \$9.62/CO₂-eq tonne). Considering that the third manufacturing line is under planning and will adopt the R-600a technology, the overall cost-effectiveness of the conversion project will be further improved in the future.

Project climate impact

25. While the Secretariat is not able to provide an estimate of the avoided emissions from the implementation of the project at this meeting,⁶ it has used the Multilateral Fund Climate Impact Indicator (MCII) to estimate the climate benefit resulting from the manufacture of the converted products at the enterprise for one year, calculated at 71,127 CO₂-eq tonnes. This includes 36,670 CO₂-eq tonnes of direct impact and 34,457 CO₂-eq tonnes of indirect impact. The direct impact reflects the climate benefit of domestic refrigerators manufactured in one year, calculated over the equipment lifetime (estimated at 15 years). The indirect impact assumes a 10 per cent reduction in electricity consumption of the equipment and calculates its lifetime energy savings due to the implementation of an energy efficiency project to be submitted to a future meeting and implemented during the conversion process. Additionally, the enterprise uses 0.77 mt of HFC-134a annually to service domestic refrigerators in operation. Following the conversion, this servicing demand will be replaced by R-600a, avoiding emissions of an additional

⁵ Paragraph 278 of document UNEP/OzL.Pro/ExCom/94/67.

⁶ As further discussed in document UNEP/OzL.Pro/ExCom/95/31, the Secretariat has updated the MCII to include HFCs and is working on a methodology to estimate the climate benefits from the implementation of HFC phase-down projects.

1,094 CO₂-eq tonnes. In total, the annual climate benefit from the conversion project amounts to 72,220 CO₂-eq tonnes each year.

2024-2026 business plan

26. This project is included in the 2024–2026 business plan of the Multilateral Fund at US \$428,000, including agency support costs. The total agreed costs of US \$377,694 including agency support costs, is US \$50,306 below the amount in the business plan.

RECOMMENDATION

27. The Executive Committee may wish to consider approving the project proposal for the conversion of two production lines at one enterprise (MANAR) manufacturing domestic refrigeration equipment from HFC-134a to R-600a in the amount of US \$352,985, plus agency support costs of US \$24,709 for UNIDO, on the understanding:

- (a) That, the enterprise, MANAR, has committed not to use HFCs in manufacturing of domestic refrigeration equipment after the conversion is completed, including the remaining production line that has not been included in the present project;
- (b) That the Government of Morocco would establish a ban on the manufacturing and import of HFC-134a-based domestic refrigeration equipment once the conversion project at MANAR is completed;
- (c) That 36,684 CO₂-eq tonnes of HFCs (25.65 mt of HFC-134a) would be deducted from the starting point for sustained aggregate reductions in HFC consumption once it has been established, and that this deduction would be undertaken in accordance with the methodology agreed under the HFC cost guidelines currently under discussion; and
- (d) That the present project would be integrated into stage I of the Kigali HFC implementation plan for Morocco, once the plan had been fully formulated and submitted for consideration by the Executive Committee.