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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Ninety-ninth Meeting
Montreal, 7–11 December 2026
Item 9(d) of the provisional agenda¹

PROJECT PROPOSAL: ANGOLA

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

Energy efficiency

- | | | |
|---|------|-----------------------------|
| <ul style="list-style-type: none">• Pilot project to maintain and/or enhance the energy efficiency of replacement technologies and equipment in the context of HFC phase-down (non-investment activity): Demonstration of an R-290/R-744 cascade system as a replacement for R-404A in a cold chamber at Angoalissar (decision 91/65) | UNDP | Individual
consideration |
|---|------|-----------------------------|

¹ UNEP/OzL.Pro/ExCom/99/1

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT**Angola**

PROJECT TITLE	AGENCY
Pilot project to maintain and/or enhance the energy efficiency of replacement technologies and equipment in the context of HFC phase-down (non-investment activity): Demonstration of an R-290/R-744 cascade system as a replacement for R-404A in a cold chamber at Angoalissar	UNDP

PROJECT OBJECTIVE
The project aims to demonstrate propane/CO ₂ (R-290/R-744) cascade refrigeration systems as a viable replacement for R-404A in small- to medium-sized cold chambers and to promote this technology in Angola. It seeks to reduce operating costs and energy consumption while phasing out R-404A. The project will also strengthen the beneficiary's capacity to install and maintain R-290/R-744 cascade systems safely, addressing flammability and high-pressure challenges, and to establish a real case example that helps remove national barriers to adoption.

NATIONAL COORDINATING AGENCY	National ozone unit, Ministry of Environment
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ARTICLE 7 DATA (Annex F)	Year: 2025	596.63 mt	1,228,481 CO ₂ -eq tonnes
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PROJECT DETAILS		
HFC consumption in servicing sector in 2025 (country programme data)	mt	596.51
	CO ₂ -eq tonnes	1,228,466
Project duration	months	36
Grant amount requested from the Multilateral Fund	US \$	360,000
Grant amount agreed	US \$	300,000
Project support costs for UNDP	US \$	21,000
Total cost of project to Multilateral Fund	US \$	321,000
Co-financing	US \$	180,000
Total project cost, including co-financing	US \$	480,000
Energy-efficiency savings to be achieved through the project	kWh/year	7,600
Counterpart funding		Yes
Project monitoring milestones included		Yes
Minimum energy performance standards for relevant applications are established		No
Minimum energy performance standards for relevant applications are enforced		No

SECRETARIAT'S RECOMMENDATION	Individual consideration
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PROJECT DESCRIPTION

Summary of the proposal as submitted

1. On behalf of the Government of Angola, UNDP as the designated implementing agency has submitted, in line with decision 91/65, a request to demonstrate an R-290/R-744 cascade system as a replacement for R-404A in a cold chamber at Angoalissar, in the amount of US \$360,000, plus agency support costs of US \$25,200, as originally submitted.²

Background

2. Angola ratified the Kigali Amendment on 16 November 2020, and stage I of the Kigali HFC implementation plan (KIP) was approved at the 97th meeting,³ with the country committing to reducing its HFC consumption by 10 per cent of the baseline by 2030. At the 98th meeting, the Executive Committee approved a request for funding for additional activities to strengthen energy efficiency in the refrigeration and air-conditioning (RAC) servicing sector and to promote the use of energy-efficient, low-global-warming-potential (GWP) refrigerants in line with decision 89/6(b),⁴ as well as funding for the preparation of a project to enhance energy efficiency in the industrial refrigeration sector under decision 91/65.

Status of implementation of other activities related to energy efficiency

3. The project approved for additional activities to maintain energy efficiency in the refrigeration servicing sector, in line with decision 89/6, includes: enhanced coordination among energy efficiency policymakers and other relevant stakeholders to ensure appropriate consideration of low-GWP refrigerants during the development of minimum energy performance standards (MEPS) and labelling systems; training of technicians on how to maintain or improve energy performance, and of customs officers on the monitoring and inspection of low-GWP RAC equipment and energy efficiency classifications; and informing consumers and end users, importers and retailers on the advantages of using energy-efficient, low-GWP RAC technologies. The project contributes to the overall objectives of both the HCFC phase-out management plan (HPMP), the KIP and helps the country sustain the reductions achieved in HCFCs while adopting more energy-efficient, low-GWP RAC technologies. As of September 2026, the project is being set up and is expected to initiate activities by the end of 2026.

4. Under stage III of the HPMP, the Government conducted awareness raising campaign targeting technicians, stakeholders, end users and the public on HCFC phase-out including energy efficiency.

Policy, regulatory and institutional framework

5. The Ministry of Environment is the national body responsible for the implementation of the Montreal Protocol in Angola, under which the national ozone unit (NOU) was established to coordinate Montreal Protocol related activities. The Electricity Sector Regulatory Institute (IRSE) is the public body responsible for managing electrical energy and energy efficiency in the public system. The National Institution of Quality Infrastructures (INIQ) is responsible for development of standards.

Minimum energy performance standards

6. Angola has no mandatory MEPS or formally implemented energy labelling for most appliances. Energy efficiency efforts are supported under Angola Energia 2025, which prioritizes sustainability, reduced energy consumption, renewable energy diversification, and encourages adoption of ISO 50001 for energy management and CO₂ emission reduction. As part of the Southern African Development Community

² As per the letter of 27 August 2026 from the Ministry of the Environment of Angola to UNDP.

³ Decision 97/56

⁴ Decision 98/26(a)(i)

(SADC), Angola participates in the regional energy-efficient lighting and appliances initiative, which aims to harmonize MEPS in the region to prevent importing obsolete, energy-intensive appliances.

7. Cold chambers (walk-in cold rooms and freezers) are generally excluded from MEPS as they are custom-engineered systems. The demonstration project will work with the relevant bodies in Angola to develop a roadmap for cold-chamber energy efficiency regulations, including public procurement guidelines requiring a minimum energy efficiency for government-funded cold chambers; voluntary certification and labelling based on monitored performance; favourable import licensing for higher-efficiency components; incentives for certified efficient installations; and adoption of ISO standards with energy efficiency criteria for cold storage design.

HFC consumption and sector background

8. The HFC consumption baseline for Angola has been established at 3,878,000 CO₂-eq tonnes. As reported in the country programme (CP) data, total HFC use in 2025 was 1,228,481 CO₂-eq tonnes, which is 68 per cent below the baseline. Table 1 presents HFC consumption in the country in 2021–2025.

Table 1. 2021–2025 HFC consumption in Angola (Article 7 data)

Substances	2021	2022	2023	2024	2025
Metric tonnes (mt)					
All HFCs	350.85	2,609.56	6,044.65	1,722.96	596.63
R-404A	84.74	557.56	853.17	284.00	85.20
CO₂-eq tonnes					
All HFCs	757,864	6,040,225	13,218,297	3,877,981	1,228,481
R-404A	332,316	2,186,527	3,345,793	1,113,734	334,120

9. HFC consumption decreased substantially in 2021 due to restrictions enacted during the COVID-19 pandemic, followed by a substantial increase in 2022 and 2023 given the COVID-19 recovery and increased demand for HFC imports to service additional RAC equipment. The particularly high consumption in 2023 may also attribute to stockpiling by importers in advance of the 2024 consumption freeze. The reduced consumption in 2024 and 2025 reflects the combined effect of enforcement of licensing and quota system, possible economic slowdown and the use of HFCs stockpiled in previous years.

10. The commercial and industrial refrigeration sector is the largest overall user of HFCs in Angola. It covers the centralized systems (large, multi-compressor racks serving supermarkets, hypermarkets, and large food retail facilities); condensing units (medium-sized systems for smaller commercial applications); and chillers (industrial process cooling and large-scale air conditioning), used primarily in food and beverage processing, meat and poultry plants, fish and seafood processing; cold storage facilities, distribution centres and logistics hubs. The highest consumed refrigerant in the sector is R-404A due to its high GWP value and consumption volume (64 per cent in CO₂-eq tonnes in baseline years), followed by HFC-134a and R-507A. The phase-out in the sector poses challenges due to the limited availability of cost-effective low-GWP alternatives, technical capacity to install such systems, lack of performance data to attract potential investors and high up-front capital investment.

Project overview

Project objectives and coordination with stage I of the Kigali HFC implementation plan

11. The pilot project aims to demonstrate R-290/R-744 cascade refrigeration systems as a viable replacement for R-404A in small to medium-sized cold chambers and to promote this technology in Angola. It seeks to reduce operating costs through lower energy consumption and improved refrigerant leakage while phasing out R-404A; will build capacity to design, install, and maintain R-290/R-744 cascade systems safely

(addressing flammability and high-pressure challenges) and establish a real case example to help remove national barriers to adoption.

12. The demonstration of the R-290/R-744 cascade refrigeration system will be implemented in coordination with stage I of the KIP to generate local performance data under Angola's hot climate and remove barriers related to flammability and high pressure. It builds technical capacity for engineers and technicians to safely install and handle flammable and high-pressure systems, with guidance developed and integrated into national RAC training curricula. The project also complements the enabling framework and energy-efficiency activities planned under the HPMP and KIP, phases out R-404A at the beneficiary company, provides a replicable model for the introduction of R-290/R-744 technology, and supports a wider market transformation to low-GWP technologies in commercial and industrial refrigeration in Angola as well as the country's compliance with the Montreal Protocol. Its outcomes will inform the development of strategies for stage II of the KIP.

Project beneficiary

13. The beneficiary, Angoalissar Comércio e Indústria Limitada (Angoalissar), is a wholly locally owned company founded in 1992. It operates in the food cold storage sector and currently runs several R-404A-based freezing chambers, with total HFC consumption of 1,743 CO₂-eq tonnes in 2025. The cold chamber selected for demonstration measures 8×6×4 cubic metres, currently operates at –18°C with an R-404A charge of 11 kg, and stores approximately 70 tonnes of frozen raw meat, poultry, fish, and seafood.

Proposed activities as submitted

14. The project will include a technical assessment of the selected R-404A cold chamber to establish pre-project reference conditions; design of the new R-290/R-744 cascade system; replacement of the existing R-404A system with the R-290/R-744 cascade system; training of technicians to design, install, and operate the new system; a financial analysis of the existing and replacement systems to identify project benefits; and a workshop to disseminate the project outcomes. The planned activities and costs proposed for project implementation are as follows:

- (a) *Equipment and conversion process (US \$380,000)*: Cost of two-stage R-290/R-744 cascade refrigeration system (US \$260,000); physical structure adaptation and civil works (US \$60,000); assembling, installation and commissioning (US \$30,000); and contingencies (US \$30,000);
- (b) *Technical assistance by an international expert (US \$30,000)*: Recruiting an expert to conduct a safety audit of the proposed R-290/R-744 cascade installation, covering design review, risk assessment, and compliance with applicable safety standards for flammable and high-pressure refrigerants; and
- (c) *Capacity building and development of standards and guidelines (US \$130,000)*: Developing capacity-building frameworks for energy-efficient cold storage technologies (US \$45,000), conducting a validation and completion workshop (US \$30,000), development and adoption of technical standards and safety guidelines for energy-efficient cold storage technologies (US \$45,000), and contingencies (US \$10,000).

Cost of the pilot project as submitted

15. The total project cost is estimated at US \$540,000, of which US \$360,000 is requested from the Multilateral Fund and US \$180,000 will be co-financed by Angoalissar. The project is expected to be completed within 36 months of approval, between December 2026 and December 2029. The cost breakdown of the project is presented in table 2.

Table 2. Proposed costs for demonstrating an R-290/R-744 cascade refrigeration system as a replacement for R-404A in a cold chamber (US \$)

Description of activities	MLF Funding	Co-funding	Total
Equipment			
Two stage R-290/R-744 cascade refrigeration system	260,000	0	260,000
Physical structure adaptation (civil works)	0	60,000	60,000
Assembling, installation and commissioning	30,000	0	30,000
Contingencies	30,000	0	30,000
<i>Subtotal</i>	<i>320,000</i>	<i>60,000</i>	<i>380,000</i>
Technical Assistance			
International expert for design and safety audit	30,000	0	30,000
Development of capacity-building frameworks for energy-efficient cold storage technologies	0	45,000	45,000
Validation and completion workshop	0	30,000	30,000
Development and adoption of technical standards, safety guidelines for energy-efficient cold storage technologies	0	45,000	45,000
Contingencies	10,000	0	10,000
<i>Subtotal</i>	<i>40,000</i>	<i>120,000</i>	<i>160,000</i>
Total	360,000	180,000	540,000

SECRETARIAT'S COMMENTS AND RECOMMENDATIONS

COMMENTS

16. The Secretariat has reviewed the project proposal in light of decisions 89/6, 91/65 and 95/87 and taking account activities implemented under stage I of the country's KIP.

Eligibility under decisions 89/6, 91/65, and 95/87

17. This proposal has been submitted prior to the 100th meeting of the Executive Committee meeting the eligibility criteria of decision 95/87(d). The Government of Angola has committed to the conditions referred to in decision 91/65(b)(iv)b. to e. and 91/65(b)(v), since the project is intended to be nationally replicated and the Government of Angola has confirmed that the NOU would coordinate with the Ministry of the Environment along with INIQ and IRSE to facilitate consideration of refrigerant transition when developing energy-efficiency standards; that if Angola were to mobilize funding from sources other than the Multilateral Fund for energy-efficiency components when phasing down HFCs, the project would not result in the duplication of activities among those funded by the Multilateral Fund and those funded from other sources; the information on project progress, results and key learning would be made available, as appropriate; the date of completion of the project would be set as no more than 36 months after the date of approval by the Executive Committee and a detailed project report would be submitted to the Executive Committee within six months of the date of completion of the project.

Minimum energy performance standards

18. Angola will develop and implement MEPS and energy labelling for RAC equipment to improve energy efficiency under the project approved under decision 89/6 at the 98th meeting. While the currently proposed project does not include MEPS development for cold chambers, it will provide valuable inputs to assess and calculate energy-efficiency for various RAC equipment, as the fundamental principles and methodologies for calculating energy efficiency are broadly applicable across different RAC equipment and capacity ranges. Knowledge and technical expertise developed under decision 89/6 are therefore expected to support and inform energy-efficiency performance assessment in larger refrigeration systems, including cold chambers.

Technical and cost-related issues

19. Regarding the development and adoption of technical standards and safety guidelines for energy-efficient cold storage technologies, UNDP clarified that the project will produce a roadmap for the introduction of necessary standards and guidelines to address safety issues related to working with R-290 and R-744 as refrigerants, including identifying gaps, assessing adaptable international standards, recommending a national adoption pathway, and engaging government officials to align with national priorities. Actual development of national regulatory instruments will be handled in a different project. Nevertheless, the demonstration project will develop technical guides for operating and maintaining the R-290/R-744 cascade system to be integrated into the training curriculum for technicians. National capacity to install, operate, and maintain an R-290/R-744 cascade system will be built through the proposed demonstration project. Training for engineers and technicians will be implemented throughout the project. Synergies will be developed with Angola's KIP regarding training for the sector.

20. Regarding the conversion of the R-404A system, UNDP clarified that the project would retrofit the refrigeration system of the existing chamber only, and the physical facility will remain unchanged. However, an additional high-temperature loop will be added to reject heat to the atmosphere. The cascade system will be specifically designed and configured for the site, including specialized R-744 components, R-290 safety provisions, controls, monitoring, leak detection, and other associated equipment.

Selection of replacement technology

21. Several low-GWP technologies were considered when selecting the alternative technologies, including the R-717/R-744 system. The R-290/R-744 technology was selected for its low GWP, component compatibility with existing R-404A systems, and safety considerations. The cascade system comprises a high-temperature R-290 circuit and a low-temperature R-744 circuit operating exclusively at subcritical pressure with a heat exchanger to connect the two loops. The system is expected to reduce electricity consumption by 20 to 30 per cent compared with the baseline R-404A system. The demonstration project will be the first R-290/R-744 cascade refrigeration system to be installed and operated in Angola.

Selection of beneficiary

22. Angoalissar was selected through a consultation process. As Angola's largest food importer and fast-moving consumer goods distributor, Angoalissar maintains extensive cold chain refrigeration operations to handle, store, and distribute large volumes of frozen and chilled goods, including large-scale temperature-controlled warehouses, floor-mounted cold rooms, and specialized frozen-food storage. It operates 41 freezing cold chambers. The company has built a robust, self-sustaining cold chain in a region with limited and unstable grid access, often relying on massive on-site diesel generators to keep large-scale cold storage running continuously. Angoalissar is committed to implementing the project and represents high potential for replication of the demonstrated technology.

23. An agreement with Angoalissar was reached during project development. Angoalissar has committed to co-finance any costs that exceed the approved amount or are not covered under the project, to support the full implementation of the conversion process, including testing and technician training, and to allow installation visits by other potential equipment owners for replication.

Monitoring of energy efficiency

24. Regarding the monitoring of energy efficiency, UNDP explained that the beneficiary will measure the baseline of the existing R-404A system and monitor the replacement systems. The baseline R-404A measurements will be taken under representative operating conditions, including electricity consumption, chamber temperature, compressor operation, and ambient conditions. For the replacement system, the project costs include energy metering, sensors, and a telemetry/digitalization system to continuously record

electricity consumption and key operating parameters. Data will be collected and analysed by the technical team, and results will be compared to assess energy savings and the percentage reduction in electricity consumption. The comparison will be based on total kWh before and after replacement, taking into account relevant operating conditions, including ambient temperature, chamber temperature, operating schedules, and refrigeration load, to provide a meaningful assessment of the energy-efficiency improvement.

Calculation of costs

25. The Secretariat noted that a detailed cost breakdown for the equipment of the R-290/R-744 cascade system was not provided in the original submission (in total US \$260,000 as submitted). UNDP explained that reliable individual costs for some components were difficult to provide because the system specifications would only be determined during the design process. To strengthen the cost analysis, UNDP obtained a detailed cost breakdown for a refrigeration installation that uses a similar R-290/R-744 cascade arrangement implemented by Eletrofrio Brasil at ETP Curitiba in Brazil in 2021, as a reference. Following discussions, and taking into account Angola's implementation environment, the equipment cost was agreed at US \$230,000 with no contingency funding. Costs for assembly, installation and commissioning, and technical assistance activities are maintained as requested.

26. The agreed cost of the pilot project to demonstrate an R-290/R-744 cascade system as a replacement for R-404A in a cold chamber at Angoalissar in Angola amounts to US \$480,000, including a Multilateral Fund grant of US \$300,000 and co-funding by the beneficiary of US \$180,000, as shown in table 3.

Table 3. The agreed costs for demonstration of an R-290/R-744 cascade system as a replacement for R-404A in a cold chamber (US \$)

Description of activities	MLF funding as requested	MLF funding as agreed	Co-funding
Equipment			
Two stage R-290/R-744 cascade refrigeration system	260,000	230,000	0
Physical structure adaptation (civil works)	0	0	60,000
Assembling, installation and commissioning	30,000	30,000	0
Contingencies	30,000	0	0
<i>Subtotal</i>	<i>320,000</i>	<i>260,000</i>	<i>60,000</i>
Technical Assistance			
International expert for design and safety audit	30,000	30,000	0
Development of capacity-building frameworks for energy-efficient cold storage technologies	0	0	45,000
Validation and completion training workshop	0	0	30,000
A road map for the development and adoption of technical standards, safety guidelines for energy-efficient cold storage technologies	0	0	45,000
Contingencies	10,000	10,000	0
<i>Subtotal</i>	<i>40,000</i>	<i>40,000</i>	<i>120,000</i>
Total	360,000	300,000	180,000

Energy-efficiency enhancements and estimated savings

27. Based on currently available information, the existing system has an estimated annual electricity consumption of approximately 38,000 kWh/year. Based on published literature for comparable refrigeration applications, energy savings from the replacement system are estimated at 20 to 30 per cent. The preliminary estimated savings from energy efficiency enhancement would therefore be approximately 7,600 to 11,400 kWh/year.

28. Actual annual energy savings will be established through the project's monitoring and measurement mechanism, using measured baseline and post-installation data under actual operating conditions. Once the

system is designed, installed, and monitored, the project will have the data needed to calculate actual annual savings and the resulting simple payback period.

Sustainability, replicability and assessment of risks

29. The project is designed for long-term sustainability and replication. Commercial and industrial refrigeration represents the largest source of HFC consumption in the country, so the successful demonstration, testing, and promotion of alternative solutions in this sector could facilitate their broader adoption across a wide range of applications. Angoalissar has committed to phasing out R-404A in the selected cold chamber and to replicating the technology, where feasible, subject to demonstrated energy efficiency benefits. The Government will also promote replication by other companies in Angola and the region in coordination with the KIP. Financial sustainability is supported by Angoalissar's substantial co-financing, which mitigates the risk of high initial capital investment. Flammability risks will be addressed through technical support from international experts to ensure design and installation comply with international safety standards (EN 378, ISO 5149), supplemented by a site-specific risk assessment covering ventilation, ignition sources, and emergency procedures. The lack of national technical standards has been identified as a critical barrier to replication and will be addressed through a roadmap for developing and adopting technical standards and safety guidelines, along with training and capacity-building activities to equip local technicians. The project will also ensure coordination with activities under the approved project under decision 89/6 to ensure synergy.

30. The project will strengthen the beneficiary's technical capacity to install and maintain low-GWP systems safely and is expected to serve as a replicable model for similar refrigeration systems in Angola and other Article 5 countries. The beneficiary company has committed to phasing out its consumption by replicating the technology based on the outcomes of the demonstration.

RECOMMENDATION

31. The Executive Committee may wish to consider:

- (a) Approving the project to demonstrate an R-290/R-744 cascade system as a replacement for R-404A in a cold chamber at Angoalissar, in the amount of US \$300,000, plus agency support costs of US \$21,000 for UNDP;
- (b) Noting:
 - (i) That the Government of Angola has committed to the conditions referred to in decision 91/65(b)(iv)b. to b(iv)d.; and
 - (ii) That the project will be operationally completed no later than 31 December 2029 and a detailed project report will be submitted to the Executive Committee within six months of the date of completion of the project, including a detailed description of the activities undertaken to disseminate the results of the technology demonstration and to promote the adoption of the selected energy-efficient alternative technologies.