

 26 November 2019

**PROJECT PROPOSAL: CUBA**

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

Refrigeration

|  |  |
| --- | --- |
| • Conversion from the use of HFC‑134a to propane (R-290) in the manufacture of chillers at Frioclima  | UNDP |

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| --- |
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**PROJECT COVER SHEET**

**Project titlE Bilateral/implementing agency**

|  |  |  |
| --- | --- | --- |
| (a) | Conversion from HFC‑134a to R‑290 (propane) in the manufacture of chillers at Frioclima | UNDP |

|  |  |
| --- | --- |
| **National co-ordinating agency** | Cubaenergía – Oficina Técnica del Ozono |

**LateSt reported consumption data for ODS addressed in project**

**A: Article-7 data (METRIC tonnes, 2018, as of July 2019)**

|  |  |  |
| --- | --- | --- |
| HFCs | mt | N/A |
| mt CO2‑eq. | N/A |

**B: COUNTRY PROGRAMME SECTORAL DATA (METRIC tonnes, 2018, as of July** **2019)**

|  |  |  |
| --- | --- | --- |
| HFCs | mt | N/A |
| mt CO2‑eq. | N/A |

|  |  |  |
| --- | --- | --- |
| **HFC consumption remaining eligible for funding** | mt | N/A |
| mt CO2‑eq. | N/A |

|  |  |  |  |
| --- | --- | --- | --- |
| **Current year Business Plan ALLOCATIONS** |  | **Funding US $** | **Phase-out (mt)** |
| (a) | 0 | 0 |

|  |
| --- |
| **PROJECT TITLE:** |
| HFC-134a used at enterprise:  | mt | 2.24 |
| mt CO2‑eq. | 3,203 |
| HFC-134a to be phased out through this project: | mt | 2.24 |
| mt CO2‑eq. | 3,203 |
| Alternatives to be phased in: | mt | 1.12 |
| mt CO2‑eq. | 3.36 |
| Project duration (months): | 24 |
| Initial amount requested (US $): |  | 175,300 |
| Final project costs (US $): |  |  |
|  | Incremental capital cost: |  | 115,000 |
|  | Contingency: |  | 5,000 |
|  | Incremental operating cost: |  | 0 |
|  | Total project cost:  |  | 120,000 |
| Local ownership (%): |  | 100 |
| Export component (%): |  | 0 |
| Requested grant (US $): |  | 120,000 |
| Cost-effectiveness (US $/kg) and (US $/t CO2-eq.) | US $/kg | 53.57 |
| US $/mt CO2‑eq. | 37.46 |
| Implementing agency support cost (US $): |  | 10,800 |
| Total cost of project to Multilateral Fund (US $): |  | 130,800 |
| Status of counterpart funding (Y/N): |  | Yes |
| Project monitoring milestones included (Y/N): |  | Yes |
| **SECRETARIAT’S RECOMMENDATION** | For individual consideration |

**PROJECT DESCRIPTION**

# On behalf of the Government of Cuba, UNDP has submitted a project proposal to convert the manufacturing of chillers at Frioclima from HFC‑134a to propane (R‑290), at a total cost of US $687,565 as originally submitted. The associated funding request from the Multilateral Fund amounts to US $175,300, plus agency supporting costs of US $12,271.

HFC consumption and enterprise background

# Frioclima[[1]](#footnote-1) is a 100 per cent locally‑owned enterprise founded in 1992 that manufactures commercial air‑cooled chillers in the capacity range of 60‑100 tonnes of refrigeration[[2]](#footnote-2) (RT), for commercial applications (e.g., supermarkets, shopping malls, hotels and other buildings), consisting of two to four independent cooling circuits. Frioclima also manufactured a small amount of water‑cooled chillers. There is currently no production of residential air-conditioners in Cuba.

# Until October 2016, Frioclima manufactured HCFC-22-based chillers; since then, the enterprise started manufacturing only HFC-134a-based chillers and, so far, has manufactured 52 chillers. Frioclima is able to manufacture 15 different types of chillers with charges ranging from 34 to 325 kg (48.6 to 464.7 mt CO2-eq.) of HFC-134a; however, only three models have been manufactured, with an average charge of 40 kg (57.2 mt CO2‑eq) of HFC-134a per cooling circuit.

# Frioclima has also an extended refrigeration service facility, separate from the manufacturing facility, that provides services to various types of refrigeration and air-conditioning (RAC) equipment operating in the country. The consumption of HFC‑134a at Frioclima, used for manufacturing chillers and for servicing RAC equipment, is presented in Table 1.

**Table 1. Consumption of HFC-134a at Frioclima**

| **Consumption**  | **2016** | **2017** | **2018** | **2019(\*)** |
| --- | --- | --- | --- | --- |
| **Metric tonnes** |
| Manufacturing | 0.75 | 2.54 | 2.24 | 2.09 |
| Servicing | 5.44 | 7.38 | 6.62 | 6.17 |
| **Total (mt)** | **6.19** | **9.93** | **8.87** | **8.27** |
| **mt CO2-eq.** |
| Manufacturing | 1,070 | 3,636 | 3,209 | 2,994 |
| Servicing | 7,779 | 10,561 | 9,471 | 8,829 |
| **Total (mt CO2-eq.)** | **8,849** | **14,197** | **12,680** | **11,823** |

(\*) Up to June 2019.

# The total consumption of HFC-134a used in the manufacturing of chillers from July 2018 to June 2019, was 3.22 mt (4,604 mt CO2-eq), representing the impact of the project as submitted; the total consumption in 2019 has been estimated at 3.37 mt (4,820 mt CO2-eq.).

# Project description

# The chiller manufacturing process at Frioclima consists of the following:

## Local manufacturing of evaporator, condenser, and metal structures (including painting);

## Assembling of the main components (both locally manufactured and imported), electric parts, compressors and control systems; and

## Refrigerant charging and performance testing of the equipment.

# Frioclima, after assessing R‑290 and HFOs as the most feasible alternative technologies for replacing HFC-134a, selected R‑290 for the following reasons: it has a very low global‑warming potential (GWP); it is currently available in the local market; its coefficient of performance (COP[[3]](#footnote-3)) and energy efficiency ratio (EER) are higher than those for HFC‑134a; and it requires approximately 50 per cent of the HFC-134a charge. Furthermore, the Government is planning to start locally producing approximately 40 mt of R‑290 per year by the end of 2020.

# Conversion to R-290 technology will entail:

## *Redesign of the product:* Redesign of the two models (Chawt-1002 and Chawt-1402) with the largest manufacturing outputs; selection of suitable compressors and expansion valves; changes in the dimensioning of the evaporator, condenser, and piping due to lower refrigerant charge required; and safety components and controls. Redesign of other models will be based on the experience gained during the implementation of the project (at no additional cost to the Multilateral Fund); and

## *Modifications to the plant:* Adjustments of equipment used to manufacture evaporators and condensers; installation of a central R-290 supply system, including refrigerant storage tanks outside the building and a stainless-steel supply line to feed the refrigerant storage tanks to the charging area; installation of a single-media R-290 charging machine; safety systems and enhanced ventilation; and replacement of R-290 leak detectors.

# The conversion of the manufacturing line (including redesign of the product) will be completed in two years. However, the project proposes staged increase in the manufacturing of R‑290‑based chillers and staged decrease in the manufacturing of HFC‑134a‑based chillers over a five‑year period, from the time plant modification would be completed.

Project costs

# The total incremental capital costs (ICCs), as originally submitted, has been estimated at US $339,200, of which US $175,300 is being requested from the Multilateral Fund and US $161,900 will be provided by the enterprise as co-financing, as shown in Table 2.

**Table 2. ICCs for the conversion to R-290 at Frioclima (US $)**

| **Description** | **Total cost** | **Co-financing** | **Requested** |
| --- | --- | --- | --- |
| **Technical support** |
| Refrigeration expert | 20,000 |   | 20,000 |
| Product redesign | 50,000 | 50,000 | 0 |
| Building of prototypes (2xUS $20,000) | 40,000 | 20,000 | 20,000 |
| Subtotal  | 110,000 | 70,000 | 40,000 |
| **New filling line** |
| Refrigerant supply system | 12,000 |   | 12,000 |
| Supply line, safety valves, accumulators | 10,000 |   | 10,000 |
| Refrigerant charging station | 50,000 |   | 50,000 |
| Installation services, including maintenance and training | 18,000 | 9,000 | 9,000 |
| R‑290 blow-off and vacuum station | 15,000 |   | 15,000 |
| Handheld leak detectors | 2,000 |   | 2,000 |
| Subtotal  | 107,000 | 9,000 | 98,000 |
| **Layout and safety** |
| Separation of charging area | 10,000 | 10,000 | 0 |
| High‑capacity ventilation system | 25,000 |   | 25,000 |
| Related infrastructure work | 20,000 | 20,000 | 0 |
| Training of technicians | 10,000 | 10,000 | 0 |
| Product certification (2xUS $5,000) | 10,000 | 10,000 | 0 |
| Final safety audit of R-290 installation | 12,000 | 12,000 | 0 |
| Machine modifications for adapted components | 20,000 | 20,000 | 0 |
| Subtotal  | 107,000 | 82,000 | 25,000 |
| **Subtotal ICC** | **324,000** | **161,000** | **163,000** |
| Contingencies (10% of equipment cost) | 15,200 | 900 | 12,300 |
| **Total ICC** | **339,200** | **161,900** | **175,300** |

# The total incremental operating costs (IOCs) for one year have been estimated at US $348,365, as shown in Table 3. However, IOCs will be fully funded by Frioclima as counterpart contribution.

**Table 3. IOCs for the conversion to R-290 at Frioclima (US $)**

| **Description** | **HFC-134a** | **R-290** | **Difference** |
| --- | --- | --- | --- |
| **IOC due to refrigerant** |  |  |  |
| Price of refrigerant (US $/kg) | 6.50 | 14.60 |  |
| Refrigerant charge per unit (kg) | 146 | 73 |  |
| IOC due to refrigerant | 949 | 1,066 | 117 |
| **IOC due to components** |  |  |  |
| Compressor (2 per unit) | 17,200 | 20,400 | 3,200 |
| Three gas detectors | 0 | 2,020 | 2,020 |
| Light signals (2 per unit) | 0 | 86 | 86 |
| ATEX[[4]](#footnote-4) control panel | 0 | 3,000 | 3,000 |
| ATEX certified ventilators (6 per unit) | 5,658 | 15,570 | 9,912 |
| IOC due to components  |  |  | 18,218 |
| **IOC per unit** |  |  | **18,335** |
| Average units manufactured (July 2018-June 2019) |  |  | 19 |
| **Total IOC**  |  |  | **348,365** |

# The total cost of the project amounts to US $687,565, for the phase-out of 3.22 mt (4,604 mt CO2‑eq.) of HFC-134a, with a cost effectiveness of US $213.53/kg (US $149.34/mt CO2-eq.). However, after deducting the counterpart funding by Frioclima, the cost‑effectiveness would be US $54.44/kg (US $38.08/mt CO2-eq.) for the Multilateral Fund.

# In addition to the phase-out of 3.22 mt (4,604 mt CO2-eq.) of HFC‑134a, it is expected that the project will generate additional reductions of indirect emissions of CO2 to the atmosphere, as the new equipment will be approximately 10 per cent more energy efficient than the HFC-134a-based models.

# The project will be implemented in no more than 24 months.

**SECRETARIAT’S COMMENTS AND RECOMMENDATION**

**COMMENTS**

# The Secretariat has reviewed the project proposal on the basis of the current policies and decisions (in particular decision 81/53(b)),[[5]](#footnote-5) and other approved projects for the conversion from CFCs, HCFCs or HFCs to flammable refrigerants. The conversion of chillers has not been covered by previously approved projects pursuant to decisions 78/3(g) and 79/45.

# Given the limited experience in the Fund with the conversion of chiller manufacturing enterprises, the Secretariat sought advice from a technical expert in reviewing the proposal.

Eligibility

# The Government of Cuba ratified the Kigali Amendment on 20 June 2019. The project for Frioclima has been submitted in line with decisions 78/3(g) and 79/45 and includes an official letter from the Government indicating that, in the event that the project is approved, any reduction of HFC‑134a consumption will be deducted from the starting point for aggregate HFC reductions that may be agreed in the future.

# Maturity of the technology, replicability, and sustainability of the project

# The Secretariat raised concerns about: the maturity of the R-290 technology in chillers in Cuba; its limited replicability in the other countries; the poor cost‑effectiveness of the conversion (i.e., US $213.53/kg (US $149.34/mt CO2-eq.) based on the total cost of the project); and the staged phase‑out of HFC‑134a over a five-year period.

# UNDP reaffirmed that the use of R‑290 in chillers is a mature technology that has being implemented on a larger scale, especially in Europe and in some Article 5 countries in Latin America. Co‑financing from the European Union that has already been secured, will provide for technical assistance to facilitate the uptake of the technology in the local market, to adopt standards and to update regulatory measures as required. In 2020, Cuba will start the procedures for the adoption of the ISO 5149 standard.[[6]](#footnote-6)

# While consumption of HFC-134a in chillers is not high as compared to other applications, their large refrigerant charge per unit and the different process followed to charge the refrigerant as compared to other large refrigerant equipment, would be of relevance to several Article 5 countries.

# UNDP also confirmed that the chiller manufacture line will be fully converted, prototypes will be developed and production of R-290-based chillers will start within the two-year period. The project will provide detailed information on the ICC and IOC during the proposed timeframe of two years, thereby complying with the requirements under decision 78/3(g). A five-year transition period is being requested to facilitate the market uptake of the R-290 technology, taking into account similar experiences in other Article 5 countries which converted from HCFC-22-based equipment to R-290.

# While the Secretariat recognized that some enterprises that successfully converted their manufacturing lines to R-290 technologies have not been able to introduce the converted equipment into the market, the five-year transition period being requested was too high. After further discussion, it was agreed to reduce it to three years, noting that Frioclima has a commitment that it will not revert to producing HFC‑134a (or other high-GWP)-based equipment. Given the relevance of the information related to the market uptake of the R-290-based chiller during the three-year transition period, it was agreed that UNDP would submit two reports providing information on the market uptake of the R-290-based chillers including challenges, and the status of the staged reduction on the manufacturing of HFC-134a chillers, one year and a half and three years after completion of the conversion.

# The Secretariat questioned the long-term sustainability of the project, noting the very high operating costs of US $18,355 per R‑290 chiller produced, making it economically unviable in comparison to the HFC-134a-based chiller currently offered on the local market. In responding, UNDP explained that the improved energy efficiency and better performance of the R‑290 chiller is expected to offset the increased operating costs within a period of approximately one year, assuming that the chiller will be continuously operating during 365 days and the cost of electricity of US $0.20/kW-hour. The Secretariat notes that this is a preliminary estimation that would need to be thoroughly assessed on the converted R‑290 chillers; furthermore, this information would be fundamental for Frioclima to determine the efficiency of the new chiller in terms of electricity use as compared to the HFC-134a chiller, and the pay‑back period for the higher investment by the end-user, which will also ascertain the long-term sustainability of the conversion.

# In view of the above, the Secretariat proposed that during the three-year transition period after the conversion of the project has been completed, an annual report should be submitted providing a comparison of the energy efficiency and the actual electricity consumption of the new R‑290 chiller and the HFC‑134a chiller. In addressing this request, UNDP proposed the submission of one (rather than three) report, and agreed to calculate the energy efficiency of the R-290 chiller in relation to the HFC-134a chiller; however, it could not commit to provide a comparison analysis on electricity consumption of the two different chillers by the end-user. The Secretariat considers that without this information the demonstration project is less attractive as it would not provide information on whether conversion to R-290 in chillers would be economically sustainable and replicable. The Secretariat also notes that several demonstration projects funded by the Multilateral Fund (e.g., Argentina, Turkey) have provided actual measurements in the use of electricity between the equipment in the baseline and the converted equipment.

# In line with decision 22/38 and subsequent decisions of the Executive Committee, UNDP confirmed that equipment to be replaced by the project will be destroyed or rendered unusable, and will recorded in the project completion report.

Issues on incremental capital costs

# The Secretariat questioned the eligibility of the installation of a new supply system (including refrigerant tanks, a supply line to feed the refrigerant tanks to the charging area), and the new automatic refrigerant charging unit, as these equipment is not in the baseline. Currently, HFC-134a is directly charged into the chiller from the refrigerant cylinder with manifolds and a scale, at the production line. In addressing this issue, UNDP confirmed the current charging operation as explained above; however, given the flammability of R‑290, a supply system, with tanks, a pump and a pipe line to feed the charging unit, has to be installed outside the building. The automatic charging station will secure interruption of the charging process in case of leaks, blockage of the charging process in case the chiller is not sufficiently evacuated, and the accurate refrigerant charged. In further discussions, and taking into account the production output of the enterprise (i.e., less than 20 chillers per year), and safety and security aspects, it was agreed to include the new supply system (i.e., refrigerant storage tanks, a pumps and a supply line to feed the refrigerant tanks to the charging area), and deduct funding equivalent to the cost of the automatic charging unit, as refrigerant charging could be safely done by minimizing the amount of refrigerant cylinders inside the production line, and installing enhanced ventilation. This resulted on a cost adjustment US $98,000 to US $50,000, on the understanding that UNDP would have flexibility to reallocate funds within the agreed ICC in case that the refrigerant filling system was more expensive than US $50,000. It was also agreed to include as part of the final report on ICC and IOC the selected methodology used to charge R‑290 in the chiller and associated costs.

# Although IOCs will be completely provided as counterpart funding by Frioclima, the Secretariat noted that the main items that account for the majority of these costs are the compressor, the ventilators and the control panel (each at an approximately US $3,000); it also noted that savings on materials associated with the reduced tube diameter of the heat exchangers were not accounted for in the calculations. Notwithstanding that IOCs are not requested from the Fund, UNDP confirmed that the final report will provide a comprehensive analysis of these costs, in line with decision 78/3(g).

# In line with existing policies and guidelines, it was agreed that the reference consumption for the project phase out be the last calendar year consumption (2.24 mt (3,203 mt CO2-eq) in 2018) rather than the initially proposed consumption between July 2018 and June 2019.

# At the conclusion of the project review, the eligible incremental costs for the conversion of chiller manufacturing at Frioclima has been agreed at US $120,000, to phase out a total of 2.24 mt (3,203 mt CO2‑eq.) of HFC-134a, at a cost effectiveness of 53.57 US $/kg (37.46 US $/mt CO2‑eq) as shown in Table 4.

**Table 4. Revised agreed costs for the conversion of chillers manufacturing at Frioclima (US $)**

| **Description** | **Requested** | **Co-financing** |
| --- | --- | --- |
| **Technical support** |   |  |
| Refrigeration expert | 20,000 |   |
| Product redesign | 0 | 50,000 |
| Building of prototypes (2xUS $20,000)) | 20,000 | 20,000 |
| Subtotal  | 40,000 | 70,000 |
| **New filling line** |   |  |
| Refrigerant supply system | 50,000 |   |
| Supply line, safety valves, accumulators |  |   |
| Refrigerant charging station |  |   |
| Installation services, including maintenance and operator training |  | 9,000 |
| HC blow-off and vac station |  |   |
| Handheld leak detectors |  |   |
| Subtotal  | 50,000 | 9,000 |
| **Layout and safety** |   |  |
| Separation of charging area | 0 | 10,000 |
| High‑capacity ventilation system | 25,000 |   |
| Related infrastructure work | 0 | 20,000 |
| Training of service team | 0 | 10,000 |
| Product certification (2xUS $5,000) | 0 | 10,000 |
| Final safety audit of R-290 installation | 0 | 12,000 |
| Machine modifications for adapted components | 0 | 20,000 |
| Subtotal  | 25,000 | 82,000 |
| **Subtotal** | **115,000** | **161,000** |
| Contingency (10% of equipment cost) | 5,000 | 900 |
| **Total cost** | **120,000** | **161,900** |

# 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. On the basis of the information available at the time of review, the Secretariat considers that the agreed costs are its best estimates of the overall incremental costs of conversion; these estimates, however, might change as more information becomes available and according to the specific characteristics of the enterprises. The Secretariat, therefore, considers that approval of the project at the levels proposed above would not constitute a precedent.

# Co-funding

# Noting that more than 70 per cent (US $510,265) of the cost would be co-funded, and upon a request by the Secretariat, UNDP provided a letter from Frioclima committing to provide the co‑funding which is already available as there are additional initiatives associated with the adoption of R‑290 technology in the enterprise. UNDP also indicated that Cuba is participating in the sustainable and climate‑friendly phase‑out of ODS initiative funded by the European Union,[[7]](#footnote-7) which has allocated approximately US $100,000 to Frioclima to convert to R‑290.

**2019–2021 business plan**

# The Secretariat notes that this project was not included in the 2019–2021 business plan of the Multilateral Fund.

**Conclusion**

# After extensively weighed the merits of the demonstration project in the light of relevant decisions on demonstration projects; the knowledge that could be acquired from the comprehensive review of the ICC and IOC that will be incurred; the potential replicability of the technology and/or the conversion of the manufacturing line in other Article 5 countries; and the knowledge on actual improvements on energy efficiency associated with the change of technology, the Secretariat decided to submit it for consideration by the Executive Committee.

# The Secretariat and UNDP had reach and agreement on all policy and costs items of the project, except for a report comparing the actual consumption of electricity between the HFC‑134a chiller and the R‑290‑based chiller, which in the views of the Secretariat is highly relevant (as reflected in the recommendation).

**RECOMMENDATION**

# The Executive Committee may wish:

## To consider the project proposal for the conversion of air-cooled chillers manufacturing from the use of HFC-134a to propane (R-290) at Frioclima;

## To further consider on whether or not to approve the project indicated in sub‑paragraph (a) above in the amount of US $120,000, plus agency support costs of US $10,800 for UNDP, on the understanding, if the project were to be approved:

### That 2.24 mt (3,203 mt CO2-eq.) of HFC-134a would be deducted from the starting point for sustained aggregate reduction in HFC once it had been established;

### That the conversion would be completed within 24 months of the transfer of funds to UNDP, that any remaining funds would be returned to the Multilateral Fund no later than one year after the date of project completion and that a comprehensive completion report would be submitted within six months of project completion with detailed information on:

1. The eligible incremental capital costs for all equipment and other components required for the conversion of the manufacturing line, including those not funded under the project;
2. Incremental operating costs, including detailed information on the price of refrigerants, compressors, electric panel, ventilators and other items, noting these costs will be fully covered by the enterprise;
3. Any potential savings that could be incurred during the conversion, in particular savings on materials associated with the reduced tube diameter of the heat exchangers, and other relevant factors that facilitated implementation (e.g. whether any purchased and/or installed equipment or supplies had gone through a competitive quote/bidding process and the details thereof); and
4. Changes in the energy efficiency of the products being manufactured and any related policies established by the Government;

### That UNDP would submit to the Executive Committee:

1. A report on the measurement of improved energy efficiency of the R‑290 chiller with regard to the HFC-134a chiller in Cuba, [including the electricity consumption,] one year after completion of the conversion;
2. A report providing information on the market uptake of the R‑290 chillers including challenges, and the status of the staged reduction on the manufacturing of HFC-134a chillers, one year and a half and three years after completion of the conversion; and

## That the enterprise Frioclima commits not to revert to the use of HFC‑134a in manufacturing after completion of the project, and will undertake efforts to stop manufacturing HFC-134a chillers in less than five years after the project proposal referred to in sub‑paragraph (a) above has been approved.

|  |  |  |  |  |
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|  |  |  |  |  |

1. Empresa Productora, Comercializadora y de Servicios de Postventa de Equipos de Climatización y Ventilación. It is the first enterprise in Cuba to obtain the ISO 9001 quality certificate. [↑](#footnote-ref-1)
2. 1 tonne of refrigeration (RT) ≈ 3.51 kW. [↑](#footnote-ref-2)
3. COP of a refrigeration equipment is defined as the heat removed from the cold reservoir (i.e., inside a refrigeration equipment) divided by the work done to remove the heat (i.e., the work done by the compressor). Higher COPs equate to lower operating costs. [↑](#footnote-ref-3)
4. Certification of equipment intended for use in potentially explosive atmospheres in the European Union. [↑](#footnote-ref-4)
5. Bilateral and implementing agencies were invited to submit project proposals for conversion to alternatives to HFCs and the promotion of new technologies, especially in sectors and regions that had not been covered by approved investment projects. [↑](#footnote-ref-5)
6. Specifies the requirements for the safety of persons and property, provides guidance for the protection of the environment, and establishes procedures for the operation, maintenance, and repair of refrigerating systems and the recovery of refrigerants. [↑](#footnote-ref-6)
7. Implemented through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and UNDP. [↑](#footnote-ref-7)