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

PROJECT PROPOSAL: BANGLADESH

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

Refrigeration

- Demonstration for the conversion of domestic refrigerator manufacturing facility from HFC-134a to isobutane as a refrigerant and conversion of compressor manufacturing facility from HFC-134a-based compressors to isobutane-based compressors at Walton Hitech Industries Limited (“Walton”)

UNDP

BANGLADESH

PROJECT TITLE(S)
BILATERAL/IMPLEMENTING AGENCY

| | |
|---|------|
| (a) Demonstration for the conversion of domestic refrigerator manufacturing facility from HFC-134a to isobutane as a refrigerant at Walton Hitech Industries Limited (“Walton”) | UNDP |
| (b) Demonstration for the conversion of compressor manufacturing facility from HFC-134a-based compressors to isobutane-based compressors at Walton Hitech Industries Limited (“Walton”) | UNDP |

| | |
|--------------------------------------|-----|
| NATIONAL CO-ORDINATING AGENCY | N/A |
|--------------------------------------|-----|

LATEST REPORTED CONSUMPTION DATA FOR HFC ADDRESSED IN PROJECT
A: ARTICLE-7 DATA (METRIC TONNES, 2016, AS OF JUNE 2017)

| | |
|------------------|-----|
| Annex F, Group I | N/A |
|------------------|-----|

B: COUNTRY PROGRAMME SECTORAL DATA (METRIC TONNES (MT), 2016, AS OF JUNE 2017)

| | |
|----------|-----|
| HFC-134a | N/A |
|----------|-----|

| | |
|--|-----|
| HFC consumption remaining eligible for funding (CO₂-equivalent tonnes) | N/A |
|--|-----|

| CURRENT YEAR BUSINESS PLAN ALLOCATIONS | | Funding US \$ million | Phase-out (mt) |
|--|-----|-----------------------|----------------|
| | (a) | N/A | N/A |

| PROJECT TITLE: | Walton | |
|---|---------------------------------------|-------------------------------------|
| Project component | Refrigerator manufacturing conversion | Compressor manufacturing conversion |
| HFC used by the enterprise: | HFC-134a | HFC-134a (indirect) |
| HFC to be phased-out (mt): | 197.3 | 197.3 |
| Project duration (months): | 24 | 24 |
| Initial amount requested (US \$): | 2,362,058 | 2,574,450 |
| Final project costs (US \$): | | |
| Incremental capital cost: | 1,382,618 | 2,078,120 |
| Contingency (10 %): | 138,262 | 207,812 |
| Incremental operating cost: | 1,160,678 | N/A |
| Servicing sector | 160,000 | N/A |
| Total project cost: | 1,320,678 | 2,285,932 |
| Local ownership (%): | 100 | 100 |
| Export component (%): | 0 | 0 |
| Requested grant (US \$): | 1,320,678 | 1,810,932 |
| Cost-effectiveness (US \$/kg): | Manufacturing | 5.88 |
| | Servicing | 4.8 |
| Implementing agency support cost (US \$): | 92,447 | 126,765 |
| Total cost of project to Multilateral Fund (US \$): | 1,413,125 | 1,937,697 |
| Status of counterpart funding (Y/N): | N/A | Confirmed by UNDP |
| Project monitoring milestones included (Y/N): | Y | Y |

| | |
|-------------------------------------|------------------------------|
| SECRETARIAT’S RECOMMENDATION | For individual consideration |
|-------------------------------------|------------------------------|

PROJECT DESCRIPTION

1. On behalf of the Government of Bangladesh, UNDP has submitted to the 79th meeting a request for funding the conversion of three domestic refrigerator manufacturing lines from HFC-134a to isobutane as a refrigerant, at a total cost of US \$2,362,058, plus agency support costs of US \$165,344, and the conversion of a compressor manufacturing facility from HFC-134a-based compressors to isobutane-based compressors at Walton Hi-tech Industries Limited (“Walton”), at a total cost of US \$2,574,450, plus agency support costs of US \$180,212.

2. The submission was accompanied by a letter dated 14 May 2017 from the Government of Bangladesh committing to the ratification of the Kigali Amendment and agreeing that no further funding would be available from the Fund until the instrument of ratification had been received by the depositary at the Headquarters of the United Nations in New York; and that any amount of HFC reduced as a result of the project would be deducted from the starting point, in line with decision 78/3(g). The Secretariat also notes with appreciation that this proposal was submitted without preparation funding.

HFC consumption in Bangladesh

3. Table 1 presents a summary of HFC consumption in Bangladesh as provided in the project proposal. The country also received funds to conduct a survey on ODS alternatives, the report of which has been submitted to the 79th meeting.

Table 1. HFC consumption in Bangladesh in 2015 (metric tonnes (mt))

| Sectors | HFC-134a | R-404A | R-410A | R-407C | HFC-227ea | HFC-32 | Total |
|--|---------------|--------------|--------------|-------------|-------------|-------------|---------------|
| Domestic refrigerator manufacturing | 205.80 | | | | | | 205.80 |
| Commercial refrigerator manufacturing | 119.70 | 3.50 | | | | | 123.20 |
| Industrial refrigerator manufacturing | | | 0.50 | | | | 0.50 |
| Transportation refrigeration | 3.18 | | 0.50 | | | | 3.68 |
| Residential air-conditioner (AC) manufacturing | 2.00 | | 2.00 | | | 0.90 | 4.90 |
| Commercial AC manufacturing | 3.00 | | 1.43 | | | | 4.43 |
| Industrial AC manufacturing | | 0.50 | 4.00 | 1.10 | | | 5.60 |
| Mobile AC | 7.79 | 0.35 | | | | | 8.14 |
| Aerosol | 140.10 | | | | | | 140.10 |
| Fire Extinguishers | | | | | 1.00 | | 1.00 |
| Service sector (for all applications) | 284.91 | 11.15 | 12.83 | 1.95 | 1.50 | 1.00 | 313.34 |
| Total | 766.48 | 15.50 | 21.26 | 3.05 | 2.50 | 1.90 | 810.68 |
| % in mt | 94.5% | 1.9% | 2.7% | 0.4% | 0.3% | 0.2% | 100.0% |
| Total CO ₂ -eq tonnes | 1,096,059 | 60,785 | 44,255 | 5,401 | 8,050 | 1,282 | 1,215,833 |
| % in CO ₂ -eq tonnes | 90.1% | 5.0% | 3.6% | 0.4% | 0.7% | 0.1% | 100.0% |

4. The consumption of HFC-134a constitutes 94.5 per cent of the total consumption of HFCs in metric tonnes, and 90.1 per cent in CO₂-equivalent tonnes in 2015. HFC-134a in domestic refrigerator manufacturing constitutes about 26.9 per cent of the total HFC-134a consumption in the country.

Domestic refrigerator manufacturing sector

5. In Bangladesh, domestic refrigerators are both locally produced and imported. Local production is done by four domestic refrigerator manufacturers using mainly HFC-134a as a refrigerant, with a total production of about 2.5 million units in 2016. In the same period, approximately 200,000 units were imported from China, India, Indonesia and Thailand. Demand for refrigeration and air-conditioning (RAC) products is increasing due to growth in the economy of the country.

Company profile

6. Walton is the largest manufacturer of domestic refrigerators in Bangladesh with a total production of 2.2 million units in 2016, representing 88 per cent of the total market, and mainly uses HFC-134a as a refrigerant. Approximately 150,000 units of refrigerators were exported (Bhutan, Myanmar, Nepal and countries in Africa and the Middle East). The company's HFC-134a consumption in 2016 was 197.30 mt. The company also has a production line of compressors with a cooling capacity range of 85 to 205 watts used in the domestic refrigerator industry, with a total production of 2.25 million compressors in 2016, representing 70 per cent of the total market. It is estimated that the company would be producing 4.5 million compressors by 2021-2022 annually for both the domestic market and for exports.

7. In 2015, Walton completed the conversion of one production line from HFC-134a to isobutane as a demonstration project with funding support from the United States of America (US \$550,000), plus US \$790,000 provided by the enterprise. The project included conversion of assembly line comprising of investments in refrigerant storage, charging and supply system, gas charging and ultrasonic welding units, replacement of vacuum pumps with explosion-proof units and helium detection system, safety system including exhaust blower, gas detection and alarm system and explosion proof motors, modification of testing equipment and explosion proof research and development testing rooms, and training. All compressors used in the conversion were imported as the project did not include compressor manufacturing conversion. In 2016, Walton produced 650,000 refrigerators on this converted line with refrigerant charge ranging from 39 grams to 60 grams per unit reducing HFC-134a consumption by 65 mt. Lessons learned from this conversion to isobutane technology encouraged Walton to move forward to convert the entire manufacturing facility to hydrocarbons.

8. At the 62nd meeting, the Executive Committee approved US \$1,146,074 for the conversion of the insulation foam component to replace 183.6 mt (20.2 ODP tonnes) of HCFC-141b to cyclopentane for domestic refrigeration manufacturing at Walton. The project was successfully completed by 2014. At the time of the approval of the project, the capacity of the enterprise was about 283,000 units/year.

Project overview and funding request

Technology selection

9. The project proposal provides a review of the technology options available in terms of their technical and economic feasibility, and environmental performance. The enterprise evaluated propane-butane mixture and pure isobutane and concluded that isobutane alone is the better option. Furthermore, it is readily available and cost-effective and has been used in the production line that was converted with funding assistance from the United States of America.

Production conversion activities foreseen

10. The conversion of the production lines from HFC-134a to isobutane as a refrigerant for manufacturing domestic refrigerators includes: modification or replacement of the equipment in the production process for refrigerators, installation of safety devices in areas where refrigerant is handled and product re-design including introduction of safety feature to handle flammable refrigerants changes in

product components including heat exchanger and compressor; and support for the service infrastructure for handling installation and maintenance. The new product will have an average refrigerant charge of 40 to 90 grams of isobutane per unit instead of an average of 126 grams of HFC-134a. Financial assistance for the conversion of the lines are requested for refrigerant supply and storage, vacuum pumps, refrigerant charging equipment, leak detection equipment, safety infrastructure and assembly line testing equipment, vacuum pumps, charging machines, manifold for service centre for equipping service infrastructure for handling hydrocarbon refrigerants, modification of drier filter production line for use with isobutane, changing fin press die for frost free refrigerator production and technical assistance/consultancy for product redesign, training costs and civil works necessary for conversion. The incremental operating costs (IOC) for the production of 1.62 million refrigerators is estimated at US \$3,018,600 (i.e., US \$1.83 per unit). These costs have not been requested. Table 2 summarises the investment costs requested for the project.

Table 2: Estimated costs for conversion of three domestic refrigerator manufacturing lines at Walton

| Description | Cost (US \$) |
|---|---------------------|
| Product design, testing and certification | 240,000 |
| Refrigerant charging and supply system | 130,000 |
| Assembly line modifications | 1,068,000 |
| Safety systems | 203,000 |
| Service centers equipment support | 150,000 |
| Technical assistance and training | 160,000 |
| Shipping and insurance | 116,325 |
| Civil construction | 80,000 |
| Contingencies | 214,733 |
| Total | 2,362,058 |
| Operating costs | - |
| Total fund requested | 2,362,058 |

11. The conversion of the compressor line to manufacture fixed speed compressors for refrigerators using isobutane as the refrigerant includes: product redesign, modifications in tool, die, moulds and machining operations for design changes in parts and components to ensure energy efficient performance of the compressors; safety systems and training and testing needed for assessing its reliable performance. The total estimated cost of the project is US \$3,574,450; of this amount, US \$1,000,000 is co-financed by Walton. Table 3 presents the summary of the costs requested by the company.

Table 3: Estimated project costs for conversion of compressor manufacturing facility at Walton

| Description | Cost (US \$) |
|---|---------------------|
| Costs of plant equipment modification | 2,260,000 |
| Product redesign, prototype development and testing | 500,000 |
| Safety system for testing and verification | 250,000 |
| Training | 20,000 |
| Installation and commissioning | 169,500 |
| Civil construction and other miscellaneous | 50,000 |
| Contingency | 324,950 |
| Total | 3,574,450 |
| Co-financing | 1,000,000 |
| Total fund requested | 2,574,450 |

12. The total costs for refrigerator manufacturing conversion and compressor conversion as submitted is summarized in Table 4.

Table 4. Estimated costs for conversion of three domestic refrigerator manufacturing lines and one compressor line at Walton

| Particulars | US \$ | HFC-134a phase-out (mt) | Cost – effectiveness (US \$/kg) |
|----------------------------|------------------|----------------------------|---------------------------------|
| Refrigerator manufacturing | 2,362,058 | 197.30 | 11.97 |
| Compressor manufacturing | 2,574,450 | | NA |
| Total | 4,936,508 | 197.30 | NA |

13. The project is expected to result in direct emissions reduction of about 282,000 tonnes of CO₂- equivalent tonnes with the reduction of 197.3 mt of HFC-134a. No estimates of indirect emission savings associated with energy efficiency were provided.

14. The project will be implemented over a period of 24 months.

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

Eligibility

15. This project has been submitted in line with decision 78/3(g). It included an official letter from the Government with the commitment required in the decision as mentioned in paragraph 2.

16. The Secretariat reviewed the project proposal based on the current policies and decisions of the Multilateral Fund and the review of similar conversion projects for CFC phase-out so far approved (i.e., conversion of refrigerant component from CFC-12 to isobutane, and conversion of compressors from HCFC-22 to propane involving product and manufacturing process redesign). The Secretariat's comments on the project proposals are presented below.

Conversion of refrigerator assembly line to isobutane

17. Noting that one production line had already converted to isobutane technology, the Secretariat requested clarification on the need for product redesign, prototype development and certification; the requests for components for assembly line modification; the need for additional safety infrastructure; the need for modification of the filter drier manufacturing process and fin press die for producing evaporators; and the need for technical assistance and training component.

18. Following a discussion on the above, UNDP explained that the requested modifications were necessary to implement the conversion projects, and agreed to adjust costs of equipment required for ultrasonic welding machines in the production lines, rationalised the number of vacuum pumps and their unit costs, and adjusted the costs required for safety systems. UNDP also agreed to remove the component relating to filter drier manufacturing based on consultation with the company, and reduce the costs for technical assistance, product redesign, testing and certification.

19. The incremental operating cost had been estimated at US \$1.863/unit on an average, including US \$2.00/compressor. However, financial assistance is requested for converting the compressor manufacturing line to isobutane. This would result in incremental savings of US \$0.137/unit, or US \$221,940 for a total production of 1,620,000 units in 2016.

20. The funding component also included assistance to service centres equipment infrastructure. As this activity is related to servicing, UNDP agreed to consider deducting an additional 33.33 mt of HFC-134a (47,662 CO₂-equivalent tonnes) calculated at US \$4.8/kg in line with 74/50(c). The agreed costs of the conversion of the domestic refrigerator manufacturing lines are shown in Table 5.

Table 5. Agreed costs for conversion of domestic refrigerator manufacturing lines at Walton

| Particulars | Proposed cost (US \$) | Agreed cost (US \$) |
|--|--------------------------|------------------------|
| Refrigerator manufacturing | | |
| Product design, testing and certification | 240,000 | 96,000 |
| Refrigerant charging and supply system | 130,000 | 130,000 |
| Assembly line modifications | 1,068,000 | 671,000 |
| Safety systems | 203,000 | 158,000 |
| Technical assistance | 160,000 | 70,000 |
| Shipping and insurance | 116,325 | 71,925 |
| Civil construction | 80,000 | 60,000 |
| Service sector equipment support | 150,000 | 0 |
| Total funding request (excluding contingency) | 2,147,325 | 1,256,925 |
| Contingency | 214,733 | 125,693 |
| Total incremental capital cost | 2,362,058 | 1,382,618 |
| Incremental operating savings | * | (221,940) |
| Total incremental cost | 2,362,058 | 1,160,678 |
| HFC-134a consumption (mt) | 197.3 | 197.3 |
| CE (US \$/kg) | 11.97 | 5.88 |
| Servicing sector | | |
| Technical assistance | | 150,000 |
| Training of technicians | | 10,000 |
| Total | | 160,000 |
| HFC-134a consumption (US \$4.8/kg) (mt) | | 33.33 |
| Total HFC-134a phased-out (mt) | | 230.63 |
| CO₂-eq tonnes of HFC-134a phased-out | | 329,801 |
| Total cost of the project | | 1,320,678 |

*Incremental operating costs were not requested in the original project proposal.

Conversion project for compressors

21. The Secretariat has limited experience in projects related to the conversion of compressor manufacturing from HFC-134a to isobutane for domestic refrigerators; however, it reviewed this project in light of the demonstration projects approved for compressor conversion to hydrocarbon refrigerant in air-conditioning, noting similarities between these projects.

22. The proposed conversion is for producing fixed-speed isobutane-based compressors while the compressors currently used for the isobutane-based refrigerators produced by the enterprise are inverter-based models which are imported. UNDP explained that the choice of fixed-speed compressor model was to provide a cost advantage while introducing the new refrigerators using isobutane in the market, noting that inverter-type refrigerators cost more. The enterprise is committed to adopting a variable speed compressor model at a future date when product acceptance is achieved, costs are more favorable, and energy efficiency becomes a more important driver rather than product cost for the end-user. This conversion will be done at the company's cost.

23. The Secretariat requested clarification on the costs associated with changes in the manufacturing facility, and the costs associated with product redesign, testing facilities and training; in particular, the cost for motor line conversion at US \$975,000 and other modifications in machining equipment and fixtures.

24. Further to discussion with UNDP it was agreed to reduce the costs for the components to US \$925,000, resulting in a co-finance of US \$475,000 by Walton. UNDP further agreed to the reduction of the costs for redesign, testing and prototype development, and to reduce the costs for installation and commissioning. The agreed costs for conversion of the compressor manufacturing facility are shown in Table 6.

Table 6. Agreed costs for conversion of compressor manufacturing at Walton

| Particulars | Proposed cost (US \$) | Agreed cost (US \$) |
|---|--------------------------|------------------------|
| Costs of plant equipment modification | 2,260,000 | 1,400,000 |
| Product redesign, prototype development and testing | 500,000 | 250,000 |
| Safety system for testing and verification | 250,000 | 250,000 |
| Training | 20,000 | 20,000 |
| Installation and commissioning | 169,500 | 108,120 |
| Civil construction and other miscellaneous | 50,000 | 50,000 |
| Total incremental cost (excluding contingency) | 3,249,500 | 2,078,120 |
| Contingency | 324,950 | 207,812 |
| Total funding for conversion | 3,574,450 | 2,285,932 |
| Costs for co-finance by Walton | 1,000,000 | 475,000 |
| Funding request to MLF | 2,574,450 | 1,810,932 |

Agreed level of funding

25. Based on the review of the Secretariat, and discussions and clarifications provided by UNDP, the proposed incremental costs for conversion for the refrigerator manufacturing component of Bangladesh amounts to US \$3,131,610 to phase-out 230.63 mt (329,801 CO₂-equivalent tonnes) of HFC-134a as shown in Table 7, 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.

Table 7. Agreed incremental costs for conversion of refrigerator and compressor manufacturing components

| Particulars | US \$ | HFC-134a phase-out (mt) | Cost – effectiveness (US \$/kg) |
|----------------------------|------------------|----------------------------|---------------------------------|
| Refrigerator manufacturing | 1,160,678 | 197.30 | 5.88 |
| Compressor manufacturing | 1,810,932 | | NA |
| Service sector component* | 160,000 | 33.33 | 4.80 |
| Total | 3,131,610 | 230.63 | |

*Decision 74/50 paragraph (c).

26. The enterprise has committed that it will stop using HFC-134a in producing domestic refrigerators upon project completion by December 2019, leading to a reduction of more than 90 per cent of the HFC-134a used in domestic refrigerator manufacturing in the country.

2017-2019 Business plan

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

Recommendation

28. The Executive Committee may wish to consider the projects for the conversion of domestic refrigerator manufacturing facility from HFC-134a to isobutane as a refrigerant, and the conversion of compressor manufacturing facility from HFC-134a-based compressors to isobutane-based compressors at

Walton Hitech Industries Limited in the context of its discussion of the proposals for HFC-related projects described in the document on Overview of issues identified during project review (UNEP/OzL.Pro/ExCom/79/19).
