UNITED NATIONS

EP

United Nations Environment Programme

Distr.
GENERAL

UNEP/OzL.Pro/ExCom/76/40
13 April 2016

ORIGINAL: ENGLISH

EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Seventy-sixth Meeting
Montreal, 9-13 May 2016

PROJECT PROPOSAL: MALDIVES

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

Refrigeration

- Demonstration project for HCFC-free low-GWP alternatives in refrigeration in the fisheries sector — UNDP

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

MALDIVES

PROJECT TITLE(S)	BILATERAL/IMPLEMENTING AGENCY
(a) Demonstration project for HCFC free low-GWP alternatives in refrigeration in the fisheries sector	UNDP

NATIONAL CO-ORDINATING AGENCY	National ozone unit

LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

A: ARTICLE-7 DATA (ODP TONNES, 2014, AS OF APRIL 2016)

HCFCs	3.32

B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, 2015, AS OF APRIL 2016)

HCFC-22	2.45

HCFC consumption remaining eligible for funding (ODP tonnes)	0

CURRENT YEAR BUSINESS PLAN ALLOCATIONS		Funding US $	Phase-out ODP tonnes
	(a)	321,000	0.6

PROJECT TITLE:	
ODS use at enterprise (ODP tonnes):	n/a
ODS to be phased out (ODP tonnes):	n/a
ODS to be phased in (ODP tonnes):	0
Project duration (months):	24
Initial amount requested (US $):	144,000
Final project costs (US $):	
Incremental capital cost:	141,000
Contingency (10 %):	0
Incremental operating cost:	0
Total project cost:	141,000
Local ownership (%):	100
Export component (%):	0
Requested grant (US $):	141,000
Cost-effectiveness (US $/kg):	n/a
Implementing agency support cost (US $):	12,690
Total cost of project to Multilateral Fund (US $):	153,690
Status of counterpart funding (Y/N):	N
Project monitoring milestones included (Y/N):	Y

SECRETARIAT'S RECOMMENDATION	Individual consideration

PROJECT DESCRIPTION

1. On behalf of the Government of Maldives, UNDP, as the designated implementing agency, has submitted to the 76th meeting a request for funding for a demonstration project for HCFC-free low-global-warming potential (GWP) alternatives in refrigeration in the fisheries sector, at the amount of US $144,000 plus agency support costs of US $12,960, as originally submitted[1].

Project objective

2. Maldives has an HCFC consumption baseline of 76.4 metric tonnes (mt), of which approximately 20 per cent is consumed in the fisheries sector. Maldives is pursuing accelerated HCFC phase-out to completely eliminate HCFC consumption by 2020, and must convert its HCFC-22-based refrigeration equipment, including that in the fisheries industry, to alternatives. Due to lack of low-GWP refrigerants for retrofitting HCFC-22-based refrigeration equipment in the fishery industry, Maldives has converted some fishing vessels to R-438 (GWP=2,265) refrigerant as an interim solution.

3. On this basis, the demonstration project intends to identify low-GWP alternative technologies to HCFCs for use in refrigeration equipment with a charge of 150 kg to 200 kg of refrigerant in the fisheries sector[2]. The beneficiary enterprise for demonstration will be selected during project implementation.

Project implementation

4. The demonstration project will research and analyse existing technology options used in both sea-borne refrigeration equipment and in land storage and processing applications; it will undertake a technical assessment of low-GWP options in terms of their feasibility as drop-in refrigerants as well as replacement options; test the performance[3] of substitutes including optimization of drop-in or replacement systems; and demonstrate the use of the selected substitutes.

5. The project proposes to convert the HCFC-22-based refrigeration equipment in three fishing vessels to low-GWP technologies, assess its performance, and evaluate the suitability of the selected technology. Based on the evaluation, suitable technologies will be disseminated to the fishing industry during HCFC phase-out. The project will eliminate the use of 0.6 mt of HCFC-22 in fishing vessels.

Project budget

6. The total project cost has been estimated at US $146,000, as shown in Table 1.

[1] Funding for the preparation of this project was approved in the amount of US $15,000, plus agency support costs of US $1,050, on the understanding that its approval did not denote approval of the project or its level of funding when submitted (decision 74/26).

[2] At the 75th meeting, when approving the third tranche of the HCFC phase-out management plan (HPMP), UNDP was requested to continue assisting the Government in identifying low-GWP alternatives for the fisheries sector (decision 75/62).

[3] The testing parameters would include *inter alia* cooling capacity, energy efficiency, compatibility of HFO with compressor oil and other components, leakage rates and measures for reducing them, change of oil and other operational issues.

Table 1. Estimated project costs for the conversion of three systems (US $)

Description	Cost
Compressor and oil costs	18,000
Electrical safety devices	900
Evaporator and condensers	3,000
Pipes and accessories	600
Refrigerant cost (estimated)	18,000
Labour and miscellaneous costs	10,500
Technical support for project implementation	35,000
National workshop on dissemination of findings	10,000
Technical consultant (evaluation of performance, retrofit manual, good practices for minimizing refrigerant leakage)	30,000
Project management and coordination	20,000
Total cost	146,000

7. The project will be managed and coordinated by the national ozone unit (NOU) under the assistance of UNDP. The project is expected to be completed in 24 months, taking into consideration of the availability of the low-GWP refrigerants (e.g., HFOs).

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

8. The project offers an opportunity to examine the suitability of introducing low-GWP refrigerants in HCFC-22 based equipment in the fisheries sector. It will increase know-how in the application of the technology, the operation and maintenance of the converted system, and its performance, representing a technological step forward. If the low-GWP refrigerants are found to be suitable they could be used in other fishing vessels in Maldives and in other Article 5 countries where such consumption exist. Information collected from the demonstration project will be disseminated through workshops, network meetings and regional and international conferences and fairs.

9. Although the demonstration will be conducted on fishing vessels, the evaluation of suitability will cover both sea-borne vessels and refrigeration equipment on land. Based on existing research and analysis, the technologies selected are likely to be HFOs or HFO blends. However if better low-GWP technologies emerge, they will also be included.

10. The potential risk and barriers associated with the introduction of low-GWP refrigerants in fisheries are related to the availability of HFOs, challenges in technical design and smooth operation of the converted refrigeration system. To minimize these risks, the implementation team will closely follow up with suppliers on HFO availability and with technical experts to assist in the design and conversion process.

11. In light of decision 74/21(c)), the Secretariat suggested that UNDP consider possibilities to rationalize the costs of the demonstration project. In responding to this suggestion, UNDP emphasized that the project costs were moderate given that only a small quantity of refrigerant and a few equipment will be procured and delivered through a long distance. Moreover, the prices of refrigerants to be tested are very high (ranging from US $30/kg to US $85/kg) as well as shipping costs. The NOU in Maldives has limited capability in managing the investment project, and, therefore additional resources would be needed for project management and coordination. On this basis UNDP agreed to deduct US $5,000, resulting in a total cost of US $141,000 plus agency support costs. The revised project proposal is contained as Annex I to the present document.

Conclusion

12. The demonstration project has been linked with the phase-out activities proposed in the HPMP for Maldives. If proven successful, the project will provide a technology solution to replace HCFC-22 used in refrigeration systems in fishing vessels. The technology has never been tested in any country and will provide a viable low-GWP alternative for use in the fisheries industry.

RECOMMENDATION

13. The Executive Committee may wish to consider:

(a) The demonstration project for HCFC-free low-GWP technologies in refrigeration in the fisheries sector in Maldives, in the context of its discussion on proposals for demonstration projects for low-GWP alternatives to HCFCs as described in the document on the Overview of issues identified during project review (UNEP/OzL.Pro/ExCom/76/12);

(b) Approving the demonstration project for HCFC-free low-GWP technologies in refrigeration in the fisheries sector in Maldives in the amount of US $141,000 plus agency support costs of US $12,690 for UNDP in line with decision 72/40; and

(c) Urging the Government of Maldives and UNDP to complete the project as planned in 24 months, and submitting a comprehensive final report soon after project completion.

Annex I

MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL ON SUBSTANCES THAT DEPLETE THE OZONE LAYER

PROJECT COVER SHEET - NON-MULTI-YEAR INVESTMENT PROJECTS

COUNTRY: Maldives

PROJECT TITLE:	**IMPLEMENTING AGENCY:**
Demonstration Project for HCFC free low GWP alternatives in refrigeration in fisheries sector in Maldives	UNDP

PROJECT DATA			
Sector:	Refrigeration		
Sub-sector:	Fisheries refrigeration applications		
ODS use in sector (2015 metric tonnes):			**44.8**
Project impact (metric tonnes):			**10**
Project duration:			24 months
Project Costs:	Incremental Capital Costs(including contingencies):	US$	**141,000**
	Incremental Operating Costs:	US$	0
	Total Costs:	US$	**141,000**
Local ownership:			100%
Exports to non-A5 countries:			0%
Request grant		**US$**	**141,000**
Counterpart fund		**US$**	**NA**
Cost-effectiveness (US$/kg-ODS):			
Implementing agency support costs:		**US$**	**12,690**
Total Cost to Multilateral Fund:		**US$**	**153,690**
Status of counterpart funding (Yes/No):			Yes
Project monitoring milestones included (Yes/No):			Yes

***Preliminary data based on ongoing surveys*

PROJECT SUMMARY

This demonstration project, upon successful completion, will identify and establish suitability of HCFC free low GWP alternatives in fisheries applications in Maldives. Currently, the fishing industry and particularly, fishing vessels use HCFC-22 for refrigeration and freezing applications during sea borne fishing operations. These vessels due to maintenance conditions as well as rough sea conditions experience significant loss of refrigerants while at sea. This results in higher levels of consumption of HCFC-22 in the country.

The project will identify low GWP alternatives that can be used in these vessels in place of HCFC-22, processes for replacing HCFC-22 based refrigeration equipment used in fishing vessels, good practices that can be adopted for reducing refrigerant consumption and policies that can help in reducing HCFC-22 use in fishing vessels.

If successful, the demonstration project will contribute towards reduction in HCFC-22 consumption in existing fishing vessels and long term reduction in HCFC-22 consumption in fishing industry. The experiences and knowledge gained in this project would be helpful for countries that use HCFC-22 in fishing industry applications.

Prepared by: UNDP in consultation with National Ozone Unit and industry **Date:** March 2016

PROJECT OF THE GOVERNMENT OF [COUNTRY]

Demonstration Project for HCFC free low GWP alternatives in refrigeration in Fisheries sector in Maldives

Objective

The main objective of the project is to demonstrate low-GWP HCFC free alternative for use by fishing industry in Maldives. The project results can be used in other countries that have similar HCFC use in fishing industry and thus help the countries addressing challenges in fishing industry, particularly sea-borne vessels' HCFC refrigerant use.

Sector Background

Maldives is a small island country and consumes HCFC-22 in refrigeration and air-conditioning applications. As per survey report of HPMP, about 76 MT of HCFC-22 was consumed in Maldives in the year 2008. The consumption of HCFC-22 in the year 2015 is about 45 MT. The main reason for decrease in consumption is national activities and regulations that has reduced supply and use of HCFC-22. Of this total consumption, fisheries sector applications consume about 15-20% of the total consumption.

Fisheries sector is an important sector for Maldives economy. This sector is the second largest contributor to Maldives' economy and employs a very significant population of Maldives. The fish catch of Maldives is stored and processed and exported to different countries across the globe. HCFC-22 is consumed in fisheries sector in a range of applications and predominantly in fishing vessels, processing and storage applications. Many of these equipment still have an economic life, though old and need continued use of HCFCs for their operations. Given that fishing vessels operate in sea and many times under rough sea / weather conditions, it is difficult to control leakage and adopt servicing practices as in other equipment like refrigeration equipment using HCFCs in land.

Under HPMP Stage-I, targeted projects addressing consumption of HCFCs in fishing vessels were implemented. Due to technological constraints and given the need for compliance of the country, they had to adopt ODS free alternatives which have GWP as retrofit / drop-in substitutes. Fishing industry has agreed with the Government of Maldives to continue their efforts to convert to low GWP alternatives that are technically feasible and economically viable, as and when such alternatives are available in the market. The need for identifying and promoting usage of low GWP alternatives in fishing industry was also emphasized by several Excom members (refer para 242 and 243 of the 75 Excom report).

It is noted that availability of HCFC free low-GWP alternative technologies that can substitute HCFCs are available in refrigeration applications. It must also be noted that many of these options cannot be direct drop-in substitutes and/or retrofit options with minimum changes in the existing equipment. Depending upon the type of use, the specific option for existing fishing vessels would need to be chosen and adopted.

In this proposed project, demonstration of low-GWP alternatives for retrofitting equipment using HCFCs is proposed to be undertaken. Replacement options for fishing vessels which are HCFC free would also be considered for demonstration projects. Technical information on retrofit and replacement technologies would be provided for the benefit of industry. This will not only assist Maldives in adoption of such technologies and promote their low GWP low carbon growth policy, but also help other countries which have a significant consumption of HCFCs in fishing industry – mainly in refrigeration applications, switch over to low GWP alternatives.

In different reports and meetings, the issue of non-availability of such drop-in substitutes for refrigeration applications in fisheries industry has been highlighted. Thus this project is expected to have a significant impact on (a) HCFC phase-out in the country with low-GWP alternatives and (b) scaled up adoption of HCFC free alternatives in countries with large fishing industry consuming HCFCs including Maldives (e.g., Fiji, PICs)

Alternative Technology

The following factors need to be considered for selection of the alternative technology for replacement / retrofitting in existing fishing industry applications:

Technical factors
- Functionality in end-product
- Proven and mature technology
- Energy efficiency

Commercial factors
- Cost-effectiveness
- Reliable availability

Health and safety factors
- Low risk for occupational health
- Low risk for physical safety (flammability, etc.)

Environmental factors
- Direct ozone impacts
- Direct and indirect climate impacts

Some of the zero-ODP alternatives to HCFC-22 currently available for refrigeration applications are given below.

Substance	GWP	Application
R-407C	1774	Medium / High-temp applications
R-424A	2440	Medium / High – temp applications
R-438A	2268	Low / Medium / High – temp applications
R-417A	2346	Medium temp ref. applications
R-422D	2729	Low/Medium/High temp applications – ref.
HFC-32	675	Low/Medium temperature
HFOs	<10	Low/Medium/High temp applications – ref.

Source: Industry research reports. Rows marked in red color relate to alternatives that are having a GWP of greater than 1000.

As per the TEAP report that made an assessment of low GWP options in different applications (2014), the following options can be used in refrigeration applications. It must be noted that these options include a range of refrigerants that can be "potentially used" not necessarily actually in use due to a range of technical and commercial considerations.

Status	Refrigerants
Limited trials	**HC-600a, HFC-1234yf, HFC-1234ze(E),** "L-40"
Potentially feasible	R-444B "L-41" "DR-5" R-450A "XP-10" HFC-32

Source: Executive Committee document no. 74/49

They are either at stage where they "are potentially feasible" or "have undergone limited trials". It must be noted that these alternatives are not strictly "drop-in" substitutes and would need modification in equipment at varying scales.

This aspect needs to be studied. The options shown in green color are low GWP options but are flammable. The options not in green have a GWP ranging from 290 to 716.

Project Background

The project primarily aims at undertaking detailed technical assessment of the available low GWP options in terms of their feasibility in being used in HCFC-22 based refrigeration equipment in fishing industry – primarily as drop-in substitutes and as alternatives and demonstration of use of these alternatives by the industry. As explained earlier, given the limited information available on actual performance of different technical options, the project will include both detailed research and analysis of existing options available and designing project interventions for testing performance of substitutes that are drop-ins or "near" drop-ins involving soft optimization.

Project Description

The primary objective of the project would be to identify low GWP substitutes to HCFC-22 in the existing refrigeration equipment using HCFC-22. The equipment capacity would be in the range of 100 kgs to 150 kgs per unit in terms of HCFC-22 initial charge.

Research and analysis of alternative technologies

The research and analysis activities on alternative technologies would cover the said equipment. As mentioned above, the primarily focus will be on sea-borne vessels. It will, however, also cover storage and processing applications.

It is known that in Maldives, the storage and processing applications for land based applications have alternatives such as ammonia and HFCs in use depending upon the nature of use. All attempts would be made to identify possible low GWP options that could substitute HFCs, if feasible.

Identification of technical options

Based on the above research and analysis, drop-in substitutes / substitutes with minimum retrofit of existing equipment by the industry for the identified applications. This would take into consideration technical feasibility, economic viability particularly timing of commercial availability and safety in operations. As of now with the available information, the options that are likely to be available are HFOs or low GWP HFO blends.

Demonstration of technical options

Demonstration of use of low GWP alternatives in identified users in these applications that would include drop-in as well as replacement options. The specific number of units for demonstration would be decided by NOU in close consultation with fishing industry. For the purposes of estimation, it is proposed to undertake demonstration of technologies at 3 units or equivalent.

The equivalent quantity of refrigerant that would be replaced in the system is expected to be about 200 kg per unit of HCFC-22. Based on cost equivalent of equipment, the estimated incremental costs for materials is estimated to be about USD 17,000 per equipment. An overview of estimated cost break-down is given below.

Items	**USD**
Compressor and oil costs	6,000
Electrical safety devices	300
Evaporator and condensers	1,000
Pipes and accessories	200
Refrigerant cost (estimated)	6,000
Labour and miscellaneous costs	3,500
Sub-total	**17,000**
Unit costs for 3 units estimated at USD 17,000 per unit	**51,000**
Technical support for project implementation	35,000
Sub-total	**86,000**

Source: Best estimates based on industry data

Outreach and dissemination activities

The findings of the above demonstration project would be documented and disseminated to countries in the region. UNEP CAP program would be used as one of the platforms for dissemination of this information. In addition, global / sub-regional meetings will also be used for dissemination of information.

The estimated total cost information outreach activities for dissemination of the findings of the survey are given below.

Items	**USD**
National workshop on dissemination of findings	10,000
Technical consultant – manual on technical performance documentation, retrofit manual and good practices for minimising refrigerant leakage	30,000
Total	**40,000**

Equipment using HCFC free low GWP technologies will not be procured. Information on such technologies will be collected by the technical expert during the research phase and during manual development phase. This will be shared with industry, Government and other national stakeholders in Maldives.

Summary

The conversion will be carried out in close consultation with NOU and the industry personnel. Technical consultants would provide technical backstopping and guidance for project implementation.

Project Costs and Financing

The total funding request from MLF amounts to US$ 146,000 including project management and coordination support. Details are provided in Annex-I. The project envisages co-financing from industry and Government personnel which is in-kind (i.e., time and resources spent for the project). The estimated amount relating to this is not included in the proposal. Annex 2 presents a summary of how this project conforms with conditions specified in decision 72/40.

Implementation

Project Monitoring Milestones

The project milestones and timelines from the date of receipt of funds is given in the table below. The estimated period over which the project would be completed is 30 months i.e., 10 quarters.

MILESTONE/QUARTERS	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Start-up of project activities	X							
Technology research and analysis	X	X						
Technology choice and retrofit options using low GWP technologies		X	X	X	X			
Compilation of findings of demonstration project and information dissemination				X	X	X	X	X
Project Monitoring and management	X	X	X	X	X	X	X	X

Management

The project will be under the overall management and coordination of the National Ozone Unit, Government of Maldives. UNDP will be the implementing agency for the project, which will provide international coordination and technical assistance as needed.

The project would employ Performance-based Payment (PBP) mechanism in its implementation. Under the PBP mechanism, The project activities would be assessed on achievement of different milestones and payments would be made against those milestones.

The procurement shall be organized fully in line with procedures followed by Government, so that the goods and services procured are high quality, most reasonable price and suitable for the purposes of the project activity. The detailed arrangement on procurement will be defined in the contract between Government of Maldives and UNDP. After testing, the equipment will be (please mention the purpose of use).

Verification

1) **Periodical Performance Verification.** Before each payment, NOU of Maldives and UNDP will review the progress of activities based on documents and site visits/site visit reports. Upon satisfactory completion of the project.

2) **Technical Assessment.** Before the last installment of payment, NOU and UNDP will invite subject specialist expert(s) to verify the project performance and outcomes.

Impact

The successful implementation of this demonstration project will provide information on performance of a low GWP and cost-effective alternative for fisheries industry. The results of the project would also be shared with other countries across the globe with similar operating conditions.

Annex 1
Funding request from MLF for the project

	Item	Value in USD
1	Technical consultant research and analysis of alternative technologies	35,000
2	Procurement of equipment for retrofit options	51,000
3	Information dissemination and capacity building for retrofit	40,000
4	Project Management and Coordination	15,000
	Total	**141,000**

Annex 2
Check on conformance with decision 72/40 on demonstration project

MFS criteria	Remarks relating to the project
In terms of a low-GWP alternative technology, concept or approach or its application and practice in an Article 5 country, representing a significant technological step forward;	Yes – the project promotes the technology options are low GWP which are new to the market and have a potential to replace HCFC-22 and high GWP impact refrigerants. Fisheries sector is urgently looking for such options so that they can avoid high GWP refrigerants to the extent feasible when they adopt low GWP options.
The technology, concept or approach had to be concretely described, linked to other activities in a country and have the potential to be replicated in the medium future in a significant amount of activities in the same sub-sector;	Replication potential exists in Maldives and other countries with HCFC-22 consumption in fishing industry. The project results will facilitate adoption of these technologies in different countries – as a result of market factors and technical performance.
For conversion projects, an eligible company willing to undertake conversion of the manufacturing process to the new technology had been identified and had indicated whether it was in a position to cease using HCFCs after the conversion;	Not applicable – testing at site. Products are available and are proposed to be procured through international competitive bidding.
The project proposals should prioritize the refrigeration and air-conditioning sector, not excluding other sectors;	Yes – refrigeration sector
They should aim for a relatively short implementation period in order to maximize opportunities for the results to be utilized for activities funded by the Multilateral Fund as part of their stage II HCFC phase-out management plans (HPMPs);	Timeframe for implementation is driven by time for completing different steps. From a period of about 12 months, the test results would be available. Total implementation timeframe for the project is estimated to be 24 months.
The project proposals should promote energy efficiency improvements, where relevant, and address other environmental impacts;	Energy efficiency performance of the product will be reviewed. However, the main purpose of this project is to demonstrate low GWP HCFC free technologies that could serve as retrofit options.