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环境规划署

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执行蒙特利尔议定书
多边基金执行委员会
第七十六次会议
2016 年 5 月 9 日至 13 日，蒙特利尔

# 项目提案：马尔代夫

本文件包含秘书处关于以下项目 提案的评论和建议：

制冷

- 渔业行业不含氟氯烃的低全球升温潜能值制冷替代品示范项目 开发计划署

# 项目评价表——非多年期项目

## 马尔代夫

| 项目名称 | 双边/执行机构 |
|---|---|
| (a) 渔业行业不含氟氯烃的低全球升温潜能值制冷替代品示范项目 | 开发计划署 |

| 国家协调机构 | 国家臭氧机构 |
|---|---|

最新报告的消耗臭氧层物质消耗数据，在项目中提及

**A:** 第 7 条数据（ODP 吨，2014 年，截至 2016 年 4 月）

| | |
|---|---|
| 氟氯烃 | 3.32 |

**B:** 国家方案行业数据（ODP 吨，2015 年，截至 2016 年 4 月）

| | |
|---|---|
| HCFC-22 | 2.45 |

| 仍可获得资助的氟氯烃消耗（ODP 吨） | 0 |
|---|---|

| 本年度商业计划拨款 | | 供资（美元） | 淘汰（ODP 吨） |
|---|---|---|---|
| | （a) | 321,000 | 0.6 |

| 项目名称： | |
|---|---|
| 企业使用的消耗臭氧层物质（ODP 吨） | 不详 |
| 淘汰的消耗臭氧层物质（ODP 吨） | 不详 |
| 逐步使用的消耗臭氧层物质（ODP 吨） | 0 |
| 项目期限（月）： | 24 |
| 最初申请金额（美元）： | 144 000 |
| 最终项目费用（美元）： | |
| 资本费用增量： | 141 000 |
| 意外开支（10%）： | 0 |
| 业务费用增量： | 0 |
| 项目费用共计： | 141 000 |
| 地方所有权（%）： | 100 |
| 出口组成部分（%）： | 0 |
| 所申请赠款（美元）： | 141 000 |
| 成本效益（美元/公斤）： | 不详 |
| 执行机构支助费用（美元）： | 12 690 |
| 多边基金项目费用共计（美元）： | 153 690 |
| 对应基金状态（有/无）： | 无 |
| 包含的项目监测进度指标（有/无）： | 有 |

| 秘书处的建议 | 个别审议 |
|---|---|

# 项目说明

1. 开发计划署作为指定执行机构，代表马尔代夫政府向第七十六次会议提交了为渔业行业的不含氟氯烃的低全球升温潜能值制冷替代品示范项目供资的申请，原提议的金额为为 144 000 美元，外加 12 960 美元的机构支助费用。[1]

项目目标

2. 马尔代夫的氟氯烃消耗基准是 76.4 公吨，其中渔业行业的消耗量约占 20%。马尔代夫正寻求加快淘汰氟氯烃，以期到 2020 年完全消除氟氯烃消耗，而且必须将包括渔业设备在内的 HCFC-22 制冷设备转换为使用替代品。由于渔业行业缺少低全球升温潜能值的制冷剂来改造 HCFC-22 制冷设备，所以马尔代夫一些渔船转而使用了 R-438（全球升温潜能值为 2,265）制冷剂作为临时解决方案。

3. 在此基础上，示范项目的目的是确定低全球升温潜能值的氟氯烃替代技术，以供渔业行业制冷剂消耗量为 150 公斤至 200 公斤的制冷设备使用。[2] 示范的受益企业将在项目执行过程中遴选。

项目实施

4. 示范项目将研究和分析海运制冷设备和陆上储备和加工用途中使用的现有技术备选方案；它将就低全球升温潜能值备选方案的无需改造设备的制冷剂的可行性，以及替代备选方案进行技术评估；测试替代品的性能[3]，包括优化无需改造设备的或替代系统；以及示范如何使用选出的替代品。

5. 该项目提议将三艘渔船使用 HCFC-22 的制冷设备转型为使用低全球升温潜能值技术，评估其性能，并评价所选技术的适合性。根据评价，将在淘汰氟氯烃期间向渔业界推广适合的技术。该项目将消除渔船所使用的 0.6 公吨的 HCFC-22。

项目预算

6. 如表 1 所示，项目总费用的估计数为 146 000 美元。

[1] 编制本项目的供资在第七十四次会议上获得核准，金额为 15,000 美元，外加 1,050 美元的机构支助费用，但有一项谅解，即这一核准并不意味着核准提交时的该项目或其资金数额（第 74/26 号决定）。

[2] 在第七十五次会议上，在核准逐步淘汰氟氯烃管理计划第三期款项时，要求开发计划署继续协助该国政府确定用于渔业行业的低全球变暖潜能值的替代品（第 75/62 号决定）。

[3] 测试参数尤其包括冷却能力、能源效率、氢氟烯烃与压缩机油和其他组成部分的兼容性、泄露率以及降低泄露率的措施、更换机油和其他操作问题。

表 1. 三系统转型项目费用估计数（美元）

| 描述 | 费用 |
|---|---|
| 压缩机和油费用 | 18 000 |
| 电力安全装置 | 900 |
| 蒸发设备和冷凝器 | 3 000 |
| 管道和配件 | 600 |
| 制冷剂费用（估计数） | 18 000 |
| 劳动力和杂项费用 | 10 500 |
| 项目实施技术支持 | 35 000 |
| 调查成果宣传国家讲习班 | 10 000 |
| 技术咨询顾问（性能评价、改进手册、最大程度减少制冷剂泄露的良好做法） | 30 000 |
| 项目管理和协调 | 20 000 |
| 费用共计 | 146 000 |

7. 该项目将由国家臭氧机构在开发计划署的协助下进行管理和协调。考虑到低全球升温潜能值的制冷剂的供应情况（例如氢氟烯烃），该项目预计在两年内完成。

## 秘书处的评论和建议

### 评论

8. 该项目提供了机会，可检验在渔业行业的 HCFC-22 设备中使用低全球升温潜能值制冷剂的适合性。它将提高在技术适用、转换系统的操作和维修及其性能方面的专门技能，这意味着在技术层面前进了一步。如果事实证明低全球升温潜能值制冷剂适合使用，则可在马尔代夫的其他渔船上和存在此类消耗的其他第 5 条国家使用。从示范项目收集到的信息将通过讲习班、网络会议以及区域和国际会议和展览会进行宣传。

9. 尽管该示范将在渔船上进行，但合适性评价将涵盖海运船舶和陆上制冷设备。根据现有的研究和分析，所选技术有可能是氢氟烯烃或氢氟烯烃混合物。不过，如果出现了更好的低全球升温潜能值的技术，也会将这些技术纳入其中。

10. 渔业行业所采用低全球升温潜能值制冷剂方面的潜在风险和障碍，与氢氟烯烃的供应情况、技术设计和改型后制冷系统正常运作方面的挑战有关。为了尽可能减少这些风险，执行小组将与氢氟烯烃的供应商和技术专家切实的予以落实，以协助设计和转型进程。

11. 根据第 74/21 号决定(c)段，秘书处建议开发计划署考虑将示范项目费用合理化的可能性。开发计划署在就这项建议作出答复时强调，该项目的费用适中，因为只有少量制冷剂和少数设备需要远程采购和运输。此外，有待测试的制冷剂价格（30 美元/公斤到 85 美元/公斤不等）以及运输费用很高。马尔代夫国家臭氧机构管理投资项目的能力有限，因此需要额外资源进行项目管理和协调。鉴此，开发计划署同意减除 5 000 美元，因此费用总计 141 000 美元，外加机构支助费用。本文件附件一载有经修订的项目提案。

结论

12. 示范项目与马尔代夫淘汰氟氯烃管理计划拟定的淘汰活动有关。如证明成功，该项目将提供一种技术解决方案，可代替渔船制冷系统使用的 HCFC-22。该技术尚未在任何国家经过测试，它将提供一种渔业界可以采用的、可行的低全球升温潜能值的替代办法。

## 建议

13. 执行委员会不妨考虑：

(a) 在讨论关于项目审查期间所查明问题概览的文件（UNEP/OzL.Pro/ExCom/76/12）所述氟氯烃全球升温潜能值代用品的示范项目提案时，审议马尔代夫渔业行业不含氟氯烃的低全球升温潜能值制冷技术示范项目；

(b) 依照第 72/40 号决定，核准马尔代夫渔业行业不含氟氯烃的低全球升温潜能值制冷技术示范项目，金额为 141 000 美元，外加给开发计划署的 12 690 美元的机构支助费用；以及

(c) 敦促马尔代夫政府和开发计划署按计划在两年内完成该项目，并在项目完成之后立即提交一份全面的最终报告。

# 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. |