UNITED NATIONS DEVELOPMENT PROGRAMME

United Nations Development Programme

Country: Egypt

PROJECT DOCUMENT1

Project Title:	PHASE-OUT OF THE USE OF HCFC-141b IN NON-DRM PU FOAM APPLICATIONS				
Award Number:	00106347	**Project Number:**	00107118		
Implementing Partner:	Egyptian Environmental Affairs Agency (EEAA)				
Start Date:	2018	**End Date:**	2025	**PAC Meeting date:**	6 December 2017

Brief Description

Through this project, Egypt will phase-out the remaining use of HCFC-141b in the foam sector. While under a separate project PU foam in domestic refrigeration is addressed, the same could not be done for commercial refrigeration because most of these companies are too small for individual consideration. Some of them have been added to HPMP-I but those served by distributors and/or importers have been grouped together to achieve economy of scale. With this action, the entire PU foam sector that is eligible for phase-out funding is thought to be addressed. Remaining companies are foreign owned and mostly have their own ODS phase-out program. Upon completion of this project, The Government of Egypt will forbid HCFC use in the foam sector. In addition, UNDP plans to phase-out the use of HCFCs in the extruded polystyrene plank manufacturing sector. A total of four producers have been identified and included in this project. The technology of choice is a blend of HFO-123ze and DME (60/40) which classifies as low GWP. As the HFO component is currently in short supply, the companies may use an HFC as interim solution.

IMPACT OF THE PROJECT ON COUNTRY'S MONTREAL PROTOCOL OBLIGATIONS:

Execution of this plan phases out the use of 125 t/y HCFC-141b at baseline conditions (2015) and thus contributes considerable to the HCFC Phase-out Management Plan (HPMP-II).

Prepared by: UNDP/NOU

Date: March 27, 2017

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Contributing Outcome (UNDAF/CPD, RPD or GPD):

UNDAF outcome 5.2:
The Government of Egypt, private sector and civil society have complied with Multilateral Environmental Agreements, adopted policies, and implemented operational measures towards a green and sustainable economy and society, including, among the others, EE, RE, low carbon cleaner technologies, SWM, POPs, ODS, and CDM

UNDP Strategic Plan outcome 1/ Output 1.3:
Solutions developed at national and sub-national levels for sustainable management of natural resources, ecosystem services, chemicals and waste

CPD Outcome 43:
The Government of Egypt, private sector and civil society have complied with Multilateral Environmental Agreements, adopted policies, and implemented operational measures towards a green and sustainable economy and society.

Project specific output:
The objective of this project is to phase out the use of HCFC 141b, 142b and RR22 in eligible PU foam application in Egypt by using non-ODS/low GWP technologies and, in this way contribute to Egypt's compliance with the Montreal Protocol HCFC phase out obligations will sharply reducing the industry's contribution to global warming.

Management Arrangement: NIM

Total resources required: USD 3,695,722.00

Total allocated resources:
- Regular _____
- Other:
  - Donor Montreal Protocol
  - Government _____

Unfunded budget: _____
In-kind Contributions _____

Agreed by (signatures)[1]:

Government	UNDP	Implementing Partner
Mr. Mohamed Shehab Abdel Wahab, Executive Officer Egyptian Environmental Affairs Agency Ministry of Environment **Signature:** Shehab Abdelwahab	**H.E. Ambassador Hany Selim,** Assistant Minister of Foreign Affairs and International Cooperation for Development, Ministry of Foreign Affairs **Signature:**	**Randa Aboul-Hosn,** Country Director UNDP **Signature:**
Date:	Date:	Date:

LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

A: ARTICLE-7 HCFC DATA (BASELINE 2015; ODS KG)

HCFC-141b	**1,172,750**	**HCFC-123**	**9,608**
HCFC-142b	**42,036**	**HCFC-124**	**2,700**
HCFC-22	**4,055,973**		

B: SECTORAL HCFC DATA (BASELINE 2015; ODS KG)

ODS Name	Total PU Foam	Domestic Refrigeration	Rest of PU Foam Sector
HCFC-141b	**1,177,600**	**566,800**	**610,800**

CURRENT YEAR BUSINESS PLAN:		Yes
ODS USE AT PARTICIPATING ENTERPRISES:	99.79	ODS t
ODS TO BE PHASED OUT:	99.79	ODS t
ODS TO BE PHASED IN:	0	ODS t
PROJECT DURATION:	30	Months
PROJECT COSTS:		
Incremental Capital Cost	899,001	US$
Contingency	68,351	US$
Incremental Operating Cost		US$
Total Project Cost	967,352	US$
EXPORT COMPONENT:		100% Egyptian Only to A5 Countries
REQUESTED GRANT:	967,352	US$
IMPLEMENTING AGENCY SUPPORT COST (7%):	67,715	US$
TOTAL COST OF PROJECT TO MULTILATERAL FUND:	1,035,067	US$
COST-EFFECTIVENESS - ACTUAL	9.69	US$/kg ODS
- THRESHOLD (low GWP**)**	9.78	US$/kg ODS
THRESHOLD (low GWP**),** SME's	10.96	
STATUS OF COUNTERPART FUNDING:	n/a	
PROJECT MONITORING MILESTONES INCLUDED:	Yes	

PROJECT OF THE GOVERNMENT OF EGYPT
PHASE-OUT OF THE REMAINING USE OF HCFC-141b IN PU FOAM APPLICATIONS

1.0 PROJECT OBJECTIVE

The objective of this project is to phase-out the use of HCFC-141b in eligible PU foam applications in Egypt by using non-ODS/low GWP technologies and, in this way contribute to Egypt's compliance with the Montreal Protocol HCFC phase-out obligations will sharply reducing the industry's contribution to global warming.

2.0 INTRODUCTION

This project is part of the phase-II HCFC Phase-out Management Program (HPMP-II) that addresses the fulfillment of Egypt's Montreal Protocol (MP) obligations for the period 2017-2025. It addresses the remaining HCFC-141b use in all remaining PU foam applications after foams in Domestic Refrigeration Manufacturing (DRM) sector have been addressed.

UNDP decided, along with individual projects for larger entities, to use a Group Phase-out Plan approach for the smaller ones, expecting technological and cost benefits through such a group approach in procurement, local works and implementation assistance. This program includes the following participants:

PARTICIPANT	PROJECT TYPE	OWNERSHIP	ACRONYM
KIRIAZI Gas Co	Individual	100% Egyptian	Kiriazi
Star Industrial factories	Individual	100% Egyptian	STAR
Beta Technical & Trading Bureau (importer)	Group	100% Egyptian	Beta

The project document does not include the usual country and sector background as this would duplicate the HPMP-II main document.

3.0 PROJECT DESCRIPTION

3.1 BACKGROUND

Apart from the domestic refrigeration manufacturing, Egyptian Foam manufacturers heavily depend on chemical and technology supply through system houses. These provide ready to use PU systems consisting of a component "A" (a fully formulated polyol system or FFS) and a component "B" (isocyanate, in this case MDI). The component A contains, apart from catalysts and stabilizers, also one or more blowing agents. The two components, when brought in contact and thoroughly mixed, create a foamed polymer with the desired product properties. A system house is able to incorporate a large range of blowing agents. Traditionally, HCFC-141b was preferred but through current phase-out efforts several non-ODS alternatives have been introduced into the market. System houses, however, do not preblend cyclopentane, the phase-out compound of choice for many larger Egyptian PU foam manufacturers. This, despite an MLF pilot project executed in Egypt showing the feasibility of such an approach.

Apart from system houses located in Egypt (4) there is also import, mostly from other Arabic countries. Most importers are large users but one functions as a distributor to smaller users and, therefore, similar to a system house.

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This project is stage II of the HPMP. The main activities implemented during stage I of the HPMP were conversion of some foam enterprises to non-HCFC based technologies; some enabling activities in the refrigeration servicing sector; and support to the project implementation and monitoring unit. UNIDO was the lead implementing agency and UNDP was the cooperating agency. Funding for the 1st Tranche (2011) and 2nd Tranche (2012) has been received and the 3rd and last tranche will be requested in 2018.

The progress in the implementation of Stage I activities are tabulated below.

UNDP		
Validation/Demonstration of Low Cost Options for the Use of Hydrocarbons as foaming agent in the Manufacture of PU Foams	The project was successfully completed with main and complementary technology reports submitted and approved by the Executive Committee. Results of the project were recommended for replication in investment PU foam related programmes globally.	Completed
Phase Out of HCFC-141b at MOG (Sandwich Panels)	Equipment installed and commissioned in 2015. IOC payment is in process. Project at MOG completed, with hand-over protocol signed for the equipment, and one remaining payment related to IOCs is in process.	Completed
Phase Out of HCFC-141b at Fresh Electric (Insulation for Water Heaters)	Project completed with equipment arrived and installed. IOC payment is in process. Project at FRESH completed, with hand-over protocol signed for the equipment, no remaining payment	Completed
Phase Out of HCFC-141b at SECC (PU Spray Foam)	Project at SECC completed, with hand-over protocol signed for the equipment, and one remaining payment related to IOCs is in process.	Completed
Phase Out of HCFC-141b at Cairo Foam (Rigid Insulation for Trucks and Panels)	Equipment installed and commissioned, including modification for the mixing head's carriage mechanism. Hand-over protocol signed, and IOC payment is in process Project at Cairo Foam completed, with hand-over protocol signed for the equipment, and one remaining payment related to IOCs is in process.	Completed
Phase Out of HCFC-141b at Reftruck (Rigid Insulation for Trucks and Panels)	Project completed with hand-over protocols signed	Completed
Phase Out of HCFC-141b at Al Fateh (Sandwich Panels)	Project completed with hand-over protocols signed	Completed
Conversion of SMEs through systems houses	Three (3) system houses (Dow-MidEast, Technocom and Obegi) now signed the MOA agreements, and completed the first milestones on technology development at each, and the second milestone on system house's conversion in case of Technocom. DOW qualified water blown (WB) technology with some customers, and preparing to run other trials based on WB, HFC and LBA	
HPMP Foam Sector Plan: Tranche 3	The last tranche will focus on complementary activities with system houses, technical support to small users as well as payment of IOCs.	

Some of the Challenges and Lessons Learned during the implementation of the projects are:

- Diversity in HCFC-141b alternatives to satisfy and meet the applicators and manufacturers needs eg Hydrocarbons; Methyl Formate; HFCs & Water-Based
  Changing and updating the project modality to avoid any barriers during implementation.

Apart from the domestic refrigeration manufacturing, Egyptian Foam manufacturers heavily depend on chemical and technology supply through system houses. These provide ready to use PU systems consisting of a component "A" (a fully formulated polyol system or FFS) and a component "B"

(isocyanate, in this case MDI). The component A contains, apart from catalysts and stabilizers, also one or more blowing agents. The two components, when brought in contact and thoroughly mixed, create a foamed polymer with the desired product properties. A system house is able to incorporate a large range of blowing agents. Traditionally, HCFC-141b was preferred but through current phase-out efforts several non-ODS alternatives have been introduced into the market. System houses, however, do not preblend cyclopentane, the phase-out compound of choice for many larger Egyptian PU foam manufacturers. This, despite an MLF pilot project executed in Egypt showing the feasibility of such an approach.

Apart from system houses located in Egypt (4) there is also import, mostly from other Arabic countries. Most importers are large users but one functions as a distributor to smaller users and, therefore, similar to a system house.

3.2 STRATEGY

Projects generally apply three different phase-out strategies:

- Individual approach
- Group projects
- TA (technical assistance)

The choice of strategy is mainly based on size but also on application.

Individual Approach – Is applied to companies with a relatively large baseline HCFC consumption. They generally have qualified technical staff and can manage sophisticated equipment and disciplined, safe operations. This approach is applied to two enterprises in this project.

Group Projects—are designed around sector-wide approaches mostly based on one, uniform ODS phase-out technology or with the assistance of supplying PU system houses. This is applied to the one participating system importer.

Technical assistance programs are geared towards downstream users consuming less than around 0.5 t/y HCFCs. They cannot adequately be dealt with within applicable thresholds. They generally operate manually, which is deemed unacceptable in view of personal exposure to chemicals of the operator. Through a UNDP pilot project for low-prices equipment and packaged systems it will be attempted to keep this group as small as possible—or even avoid it.

3.3 EXPORT

None of the included prospective recipients sell to developed countries. Export—if any—is limited to neighboring Arab countries and less than 5% of the total production.

3.4 SECOND CONVERSIONS

The project includes no second conversions.

3.5 PHASE-OUT COST STRUCTURE

The project is structured as one project with 2 individual participants and one importer/distributor. Chapter 4 shows a comparison of applicable phase-out technologies and justification for individual choices. The project costs are divided into three areas:

Technology Transfer and Oversight – this includes technology transfer and oversight, a safety audit, if applicable, and trials/commissioning. A UNDP appointed expert will monitor project progress and provide/arrange technology transfer for the recipients.

Incremental Capital Costs – all costs for technology transfer, new/retrofitted equipment, piping, tanks as well safety related costs such as gas monitors, electrical grounding, ventilation, etc.

Operating Costs – To determine operation costs, following information was collected:

- Baseline chemical prices from recipients reconciled with system house/suppliers
- Other operating costs (increased maintenance, energy)

From this information, the IOCs for each sub-project has been calculated.

4.0 TECHNOLOGY OVERVIEW

4.1 INTRODUCTION

To replace HCFCs in the production of PU insulation foams, following criteria ideally would apply:

A suitable boiling point with 25^0C being the target,
Low thermal conductivity in the vapor phase,
Non-flammable,
Low toxicity,
Zero ODP,
Low GWP,
Chemically/physically stable,
Soluble in the formulation,
Low diffusion rate,
Based on validated technology,
Commercially available,
Acceptable in processing,
Economically viable.

Nocurrent replacement technology meetsall of these criteria and compromises will be necessary. The actual choice will be impacted under others, by application, technical proficiency, plant layout and—investment as well as operating—costs. In the case of domestic refrigerators, maintaining product density and insulation value are of crucial importance and limit the choice to the technologies discussed below.

4.2 ALTERNATIVES

Following is a list of the main alternatives—validated, under validation or still under development—to replace HCFCs in rigid insulation foams. The molecular weight is mentioned as an indication of blowing efficiency and the incremental GWP as an indication how the technology performs compared to HCFC-141b on this environmental parameter:

SUBSTANCE	GWP[1]	MOLECULAR WEIGHT	INCREMENTAL GWP[2]	COMMENTS
HCFC-141b	725	117	Baseline	
CO_2	1	44	-725	Used direct/indirect (from water)
Cyclopentane	Negligible	72	-718	Extremely flammable
HFC-245fa	1,030	134	443	
HFC-365mfc	794	148	279	
HFC-134a	1,430	102	522	
Methyl formate	Negligible	60	-725	
Methylal	Negligible	76	-725	Reported for co-blowing only
Acetone	Negligible	58	-725	Used in flexible slabstock
FEA-1100	5	164[4]	-718	Limited availability
HFO-1234ze	6	114	-719	One component PU systems
HBA-2	<15	<134	>-708	Recently introduced
AFA-L1	<15	<134	>-708	Under development

[1] Unless otherwise indicated, taken from IPCC's Fourth Assessment (2007)
[2] Derived from comparing GWPs compared to the baseline on an equimolar base. It should be noted that in practice formulators may make changes such as increased water or ABA blends that impact the global warming effect

[4] Calculated from published formulations
Green = beneficial GWP effect; red = unfavorable GWP effect

These technologies are described in more detail below.

CARBON DIOXIDE - The use of carbon dioxide derived from the water/isocyanate chemical reaction is well researched. It is used as base blowing agent in almost all PU foam applications and as sole blowing agent in many foam applications that have no/ minor thermal insulation requirements. The relatively emissive nature of CO_2 in closed-cell foam is, however,a challenge. To avoid shrinkage, densities need to be relatively high which has a detrimental effect on the operating costs up and above mitigating poor insulation values. Increased use of water/CO_2 has been—and still is—an important tool in the HCFC phase-out. There is no technological barrier. However, the use of water/CO_2 alone will at this time be limited to foams such as integral skin foams (with restrictions when friability is an issue), open cell rigid foams, and spray/in situ foams for non/low thermal insulation applications.

Some chemical manufacturers have proposed enhancing water based systems through the addition of formic acid under strictly controlled conditions (the reaction of MDI with formic acid creates equal amounts of CO_2 and CO, with the latter being toxic).

Carbon dioxide can also be added directly as a physical blowing agent through the use of super-critical CO_2. The reported finer cell structure would improve the otherwise poor insulation value.

HYDROCARBONS (HCs) - There have been many HC-based/MLF-supported CFC-phase-out projects in refrigeration and in panel applications. The minimum economic size has been historically ~50 ODP t/y or US$ 400,000 US$ with (higher cost) exceptions for domestic refrigeration. Smaller projects were discouraged for reasons of cost and technological complexity. Consequently, there is hardly any use of HCs in SMEs. In addition, the technology was deemed unsafe for a multiple of applications such as spray and in situ foams. Generally, cyclopentane has been used for refrigeration applications. Fine tuning through HC blends (cyclo/iso pentane or cyclopentane/isobutane) is now standard in non-A5 countries but not widely spread in A5's. Consequently, the investment costs are the same as at the time of phasing out CFCs and the technology will continue to be too expensive for SMEs and restricted to the same applications as before. There are, however, options to fine-tune project costs and investigate other applications:

- Direct injection (lower investment)
- Centralized pre-blending through system houses (lower investment)

The MLF has initiated a study of these options with the goal to decrease the minimum economic required for the use of HCs. The outcome of the study shows the feasibility of centralized pre-blending as well as direct injection. Preblended HC systems are not (yet) available in Egypt but direct injection is in many cases an option that reduces costs and/or restricts the required safe area.

Hydrofluorocarbons (HFCs) - Current HFC use in A5 countries is relatively insignificant. The lower cost of HCFC-141b is just too compelling! These chemicals have, however, played a major role in the replacement of HCFCs in foam applications in non-A5 countries, despite their high GWP potentials, for which they are doomed to be phased out on longer term. Formulations are frequently not straightforward molecular replacements. Generally, the use of water has been maximized and sometimes other co-blowing agents have been added. Therefore, an assessment of its environmental impact has to be based on actual, validated, commercial blends.

There are currently three HFCs used in foam applications. Following table includes their main physical properties:

Parameter	HFC-134a	HFC-245fa	HFC- 365mfc
Chemical Formula	CH_2FCF_3	$CF_3CH_2CHF_2$	$CF_3CH_2CF_2CH_3$
Molecular Weight	102	134	148
Boiling point (^{0}C)	-26.2	15.3	40.2
Gas Conductivity (mWm^{0}K at 10 ^{0}C)	12.4	12.0 (20 ^{0}C)	10.6 (25 ^{0}C)
Flammable limits in Air (vol. %)	None	None	3.6-13.3
TLV or OEL (ppm)	1,000	300	Not established
GWP (100 y)	1,410	1,020	782
ODP	0	0	0

METHYL FORMATE (MF) - also called methyl-methanoate, is a low molecular weight chemical substance that can be used as a blowing agent for foams. Following data on physical properties have been reported:

Property	Methyl Formate	HCFC-141b
Appearance	Clear liquid	Clear liquid
Boiling point	31.3 ºC	32 ºC
LEL/UEL	5-23 %	7.6-17.7
Vapor pressure	586 mm Hg @ 25 ºC	593 mm Hg @ 25 ºC
Lambda, gas	10.7 mW/m.k @ 25 ºC	10.0 mW/m.k @ 25 ºC
Auto ignition	>450 ºC	>200 ºC
Specific gravity	0.982	1.24
Molecular weight	60	117
GWP	0	630
TLV (USA)	100 ppm TWA/150 ppm STEL	500 ppm TWA/500 ppm STEL

In the USA, MF is not treated as a volatile organic component (not a smog generator) and is SNAP (USEPA's Significant Mew Alternatives Program) approved. In Europe, it is compliant with the RoHS (Restriction on Hazardous Substances) and WEEE (Waste Electrical and Electronic Equipment) directives. Acute toxicity is reported low with no special hazards. The MSDS mentions R12 (extremely flammable but not explosive); R20/22 (harmful by inhalation and if swallowed) and R36/37 (irritating to eyes and respiratory system). UNDP reports show process emissions to be much lower than 100 ppm (which is the STEL and TWA). Therefore,no special precautions for MF blends in the manufacturing area are required. MF is normally sold as a system, whichwould allow restricting flammability issues to the supplier. Shipping of systems in the USA is possible without red ("flammable") tags. The ExCom reviewed the outcome of two pilot projects to assess the use of methyl formate in all potential applications and recommended that countries will include this technology in their choices of HCFC replacement technologies. However, density restrictions to about 35 kg/m^3 makes MF not suitable for DRM.

METHYLAL (ML) – Methylal's primary use is as a solvent. It is soluble in water and miscible with most common organic solvents.The use of Methylal as a co-blowing agent in conjunction with hydrocarbons and HFCs for rigid PU foam applications (domestic refrigeration, panels, pipe insulation and spray) has been described in the literature. It is claimed to improve the miscibility of pentane, promotes blending in the mixing head, foam uniformity, flow, adhesion to metal surfaces and insulation properties. The addition of a low percentage of Methylal to HFCs (245fa, 365mfc or 134a) makes it reportedly possible to prepare pre-blends with polyols of low flammability with no detrimental effect on the fire performance of the foam. Despite all literature references, public knowledge of Methylal's industrial performance as blowing agent is limited. To alleviate this, the ExCom approved a UNDP pilot project to assess its use as a possible replacement of HCFCs for MLF projects in developing countries.In

integral skin/microcellular foams ML proves to create excellent foams compared with HCFC-141b. Also ML in flexible foam works fine but in rigid foam there is an insulation penalty.

Property	Methylal	HCFC-141b
Appearance	Clear liquid	Clear liquid
Boiling point	42 ºC	32 ºC
LEL/UEL	2.2-19.9 %	7.6-17.7
Vapor pressure	400 mm Hg @ 20 ºC	593 mm Hg @ 25 ºC
Lambda, gas	Non-available	10.0 mW/m.k @ 25 ºC
Auto ignition	235 ºC	>200 ºC
Specific gravity	0.821 @ 20 ºC	1.24
Molecular weight	76.09	117
GWP	Negligible	630
TLV (USA)	1000 ppm TWA	500 ppm TWA/500 ppm STEL

EMERGING TECHNOLOGIES - Since early 2008, a flood of new blowing agents for PU foams have been proposed by major international manufacturers of halogenated compounds. Four of them are worth mentioning:

	HFO-1234ze	HBA-2	FEA-1100	AFA-L1
Chemical Formula	$CHF=CHF_3$	n/k	n/k	n/k
Molecular Weight	114	<134	161-165	<134
Boiling point (^{0}C)	-19	>15 <32	>25	>10 <30
Gas Conductivity(mWm^{0}K at 10 ^{0}C)	13	n/k	10.7	10
Flammable limits in Air (vol. %)	None	None	None	None
TLV or OEL (ppm; USA)	1,000	n/k	n/k	n/k
GWP (100 y)	6	<15	5	Negligible
ODP	0	0	0	0
Manufacturer	Honeywell	Honeywell	DuPont	Arkema

These technologies are all geared towards replacement of HFCs and sometimes called "second generation" or "unsaturated" HFCs, although the name HFOs (hydrofluoroolefins) appears to be a more distinctive description. They share low/no flammability, zero ODP and insignificant GWPs:

Most of these substances are limited commercially availableor in the process of application testing. In addition, their price, which exceed even those of HFC's, makes HFOs a not very attractive option.

4.3 DISCUSSION

Emerging technologies – based on the high prices, large quantities required (high molecular weights) and restricted commercial availability, these technologies are not considered by the companies at this point. However, a two-step implementation process in combination with HFCs would be feasible and would allow the formulation of ODS phase-out projects that meet non-ODS as well as low GWP (<150) criteria.

HFCs – EEAA has decided, where technically and economically feasible, not to pursue replacement technologies with highGWPs, effectively eliminating HFCs as HCFC replacement candidates. An option that would satisfy EEAA would be, as mentioned above, to allow two-phase projects (HCFCs > HFCs > HFOs) along with a strictly to be enforced commitment for the implementation and timing of the second step.

HCs – HCs are technically, economically and from a safety standpoint feasible for larger recipients.Direct injection and preblended systems can lower the cost effectiveness threshold and may make this technology feasible for recipients consuming more than 25 t/y HCFCs. In addition, the low related incremental operating costs may trigger willingness for some downstream users to provide counterpart financing.

H_2O/CO_2 – These systems do not meet most recipients' requirements in performance and costs. The assessment of supercritical CO_2 shows very high investment and technology acquisition costs. Apart from that, several sprayfoam manufacturers object to the extra equipment they would have to carry into the field.

MF/ML – Many participating system houses have shown high interest in this technology. Several of them have already developed laboratory formulations and assured technical support. Local supply has already been arranged at reasonable pricing. The systems under development are considered nonflammable following USDOT guidelines. However, UNDP's assessment of the technology shows weakness of this technology in some areas:

- While excellent physical properties are shown in integral skin, the need to preblend in (hazardous) MDI is a handicap. It can be overcome by separate injection but at a cost. Efforts are on the way with optimized systems based on different polyols along with changes in catalysts and stabilizer that can overcome the system stability;
- Good results in refrigeration foams onlyfor densities 35 and up. In domestic refrigeration, 32 kg/m^3 is the norm;
- Good results but complicated procedures in rigid boxfoam. This is also deemed solvable through chemical optimization.

4.4 SELECTION

For the water heaters, cyclopentane has been selected. Both companies have already experience with this substance from their refrigeration manufacturing. The selection for the group sub-project is open but methyl formate is the base for the cost calculations—in line with the other system houses.

5.0 PROJECT COSTS

5.1 CALCULATION OF INCREMENTAL CAPITAL COST

The total actual investment costs are **US$ 967,352.** This includes contingency. Details of incremental capital costs are provided in **Annexes 1 thru 3.**

5.2 CALCULATION OF INCREMENTAL OPERATING COST

The total incremental operating costs for one year are **US$.** Details are, again, provided in **Annexes 1 thru 3**.

5.3 TOTAL COSTS AND COST EFFECTIVENESS (C/E)

The total cost amounts to **US$ 967,352**.

5.4 COST EFFECTIVENESS (C/E)

The overall cost effectiveness of the project is 9.69 **US$ /kg ODS.** This compares favorably against the allowable MLF threshold of US$ 9.78 kg/ODS allowed for low GWP/rigid PU projects and US$ 10.96 kg/ODS for small/medium entities (<20 t).

No individual company exceeds the double threshold—which is allowed for individual companies in group projects.

5.5 PROPOSED MULTILATERAL FUND GRANT

Thegrant request is **US$ 967,352**.Lettersof commitment (LOCs) from individual project recipients stating their agreement areon file.

6.0 PROJECT IMPLEMENTATION AND MONITORING

The project will be implemented using UNDP's National Execution Modality. Implementation is targeted as follows:

PROJECT IMPLEMENTATION PLAN*

	ACTIVITIES PER QUARTER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MF Project approval	X														
Project Signature / Specifications		X													
System development			X	X											
Procurement			X	X											
Installation/retrofitting of equipment						X	X								
Training								X							
Testing and trials								X							
Commissioning / Project Closure										X					

*Please note that stages can overlap

MILESTONES FOR PROJECT MONITORING
(in months, measured from project approval)

TASK	MONTH
(a) Project document submitted to beneficiary	3
(b) Project document signature	6
(c) System Development	12
(d) Bids prepared and requested	9
(e) Contracts Awarded	12
(f) Equipment Delivered/Installed	21
(g) Training Testing and Trial Runs	24
(h) Commissioning / Project Completion	30
(i) HOP signature	40
(j) Project Completion Report	n/a

7.0 PROJECT IMPACT

Direct Benefits: This project will eliminate the use of 124.780HCFC-141b at baseline conditions. The project employs commercially available and environmentally acceptable technology. The Government of Egypt will assure compliance of the companies with the project conditions after completion.

Indirect Benefits: By using one phase-out technology for the entire sector, existing competitive conditions are maintained.

Environmental Impact: Cyclopentane has zero ODP and a very low GWP as the following table shows:

SUBSTANCE	GWP[1]	MOLECULAR WEIGHT	INCREMENTAL GWP[2]	COMMENTS
HCFC-141b	725	117	Baseline	
Cyclopentane	Negligible	72	-718	Extremely flammable
Methyl formate	Negligible	60	-725	
Methylal	Negligible	76	-725	Reported for co-blowing only

[1] Taken from IPCC's Fourth Assessment (2007)

[2] Derived from comparing GWPs compared to the baseline on an equimolar base

The technology complies so with MOP decision XIX/6 in view of the desire to minimize negative environmental side-effects

ANNEX-PU 1

SUB-PROJECT KIRIAZI

Name: KIRIAZI Gas Co.
Year of Foundation 2007
Address: Cairo Belbies Road – Industrial Zone – El Obour City
Contact Name: Mr. Kiriaco Stepho Kiriazi, Chairman & CEO
Tel/Fax: +202 431 30 000
Email: kiriazi@kiriazi.com
Employees: 500
Second Conversion? No
Capital 100 % Egyptian

Raw Material Consumption			
/Year	**Polyol blend** *(t/y)*	**Iso** *(t/y)*	**HCFC-141b included** *(t/y)*
2013			13.2
2014			15.4
2015			18.7
2016			18

Baseline Equipment					
Equipment	**Type**	**Manufacturer**	**Serial #**	**Year**	**Action**
Foam Dispenser	A- BASIC – 40	AFROS S.P.S		2007	Retrofit

*Retrofit is the most cost-effective option

KIRIAZI is a major manufacturer of household appliances such as cooking ranges, washing machines, fans, refrigerators, freezers, air condition and water heaters. For the manufacture of electric water heaters, it has a dedicated plant with a dedicated foaming unit. The company was founded 2007 and has 500 employees. The water heater plant is located in Obour City and manufactures electrical water heaters from 10 l up to 200 l, horizontal and vertical. The company uses already cyclopentane in its refrigerator and freezer operations and wishes to do the same for water heaters.

CALCULATION OF INCREMENTAL COSTS

ACTION	CALCULATION	COSTS (US$)
Technical Assistance and Supervision		
Safety Audit		5,000
Trials/Commissioning		5,000
Retrofit (third stream)		60,000
Encapsulation		25,000
CP Tank, piping		25,000
Relocation		10,000
Electrical adaptations		10,000
Sub-Total		**140,000**
Contingencies		15,872
Incremental operating costs		Nil
	TOTAL	**155,872**
	C/E	**US$/kg ODS**

OPERATING COSTS DETAILS

CHEMICAL	BASELINE (US$/kg)	%	NEW (US$/kg)	%	DIFFERENCE (US$/kg)	NOTES
Polyol	2.80	38	2.80	40	0.06	
Isocyanate	3,00	50	3.00	50	--	
Blowing agent	2.50	12	2.80	10	-0.02	
Price change /kg system					**0.04**	**Based on same density**

Baseline prices and formulations come from system houses. In addition, there will be a slightly higher initial density and higher maintenance costs, leading to initial higher costs that could add to as much as US$ 0.08/kg but will reduce during the first year of production with CP. The company agrees to refrain from requesting IOCs.

ANNEX-PU 2

SUB PROJECT ELECTROSTAR

Name: Star Industrial factories.
Year of Foundation 2005
Address: Badr City
Contact Name: Eng. Alaa Hosny
Tel/Fax: +201223235326
Email: alaa-hosny@electrostar.com
Employees: 110
Second Conversion? No
Capital 100 % Egyptian

Raw Material Consumption			
Year	**Polyol** *(t/Y)*	**Iso** *(t/Y)*	**HCFC-141b** *(t/Y)*
2013			n/a
2014			15
2015			25
2016			32

Baseline Equipment					
Equipment	**Type**	**Manufacturer**	**Serial #**	**Year**	**Action**
Foam Dispenser	C-16	OMS		1985	Replacement*
Foam Dispenser	FM-30	OMS		1998	Replacement*

*Replacement is the most cost-effective option

Electrostar is a major manufacturer of household appliances such as cooking ranges, washing machines, refrigerators, freezers and water heaters. For the manufacture of electric water heaters, it has a dedicated plant with a dedicated foaming unit. The company was founded 2005 and has 110 employees. The water heater plant is located in Badr City and manufactures electrical water heaters from 10 l up to 200 l, horizontal and vertical. The company uses already cyclopentane in its refrigerator and operations and is planning to do the same for freezers. It wishes to do this also for water heaters.

CALCULATION OF INCREMENTAL COSTS

ACTION	CALCULATION	COSTS (US$)
Technical Assistance and Supervision		10,000
Safety Audit		5,000
Trials/Commissioning		10,000
Dispenser replacement (3 streams)		180,000
Encapsulation		30,000
CP Tank, piping		10,000
Electrical adaptations		10,000
Sub-Total		**255,000**
Contingencies		40,874
Incremental operating costs	264,000 @ 0.10	Nil
	TOTAL	**295,874**
	C/E	**US$/kg ODS**

OPERATING COSTS DETAILS

CHEMICAL	BASELINE (US$/kg)	%	NEW (US$/kg)	%	DIFFERENCE (US$/kg)	NOTES
Polyol	2.80	38	2.80	40	0.06	
Isocyanate	3,00	50	3.00	50	--	
Blowing agent	2.50	12	2.80	10	-0.02	
Price change /kg system					**0.04**	**Based on same density**

Baseline prices and formulations come from system houses. In addition, there will be a slightly higher initial density and higher maintenance costs, leading to initial higher costs that could add to as much as US$ 0.08/kg but will reduce during the first year of production with CP. The company agrees to refrain from requesting IOCs.

ANNEX- PU 3
SUB PROJECT BETA
1. BASELINE DATA

Enterprise Name:	Beta Technical & Trading Bureau
Year founded:	
Contact/position:	Nabil Hassan/Chairman
Address:	Building 22 - 2nd floor -Plot 11008 - 1st District - Obour City
Phone/Fax:	+2 44 91 90 66
Email:	nabil@betachem.net
Ownership	100% Egyptian
Employees:	

Chemical consumption (for eligible customers only):

Year	Polyol (kg/y)	MDI (kg/y)	141b (kg/y)	Total (kg/y)
2015	284,190	370,000	81,010	735,200

2. PROJECT COSTS[1]

Following sub-project costs apply:

ENTITY	ACTION	CALCULATION	COSTS (US$)
System House	Project Management	28 x 1,000	28,000
System House	Technology Development		
System House	Trials, testing, training,	28 x2,000	56,000
System House	Contingencies		
System house	**Sub-Total**		**84,000**
Customers	HPD retrofit packages	6x 15,000	90,000
Customers	LPD retrofit packages	18 x 10,000	180,000
Customers	New Dispensers	10x 15,000	150,000
Customers	Spray/PIP Dispensers	x 5,000	
Customers	Contingencies		11,605
Customers	Incremental operating costs (1 y)		
Customers	**Sub-Total**		**431,605**
		GRAND TOTAL	**515,605**

The SH costs do not count as part of the calculation of the cost-effectiveness

3. INCREMENTAL OPERATING COSTS

To determine operation costs, following information was used:

- Baseline chemical prices from the participating system house and from FSI (methyl formate)
- Baseline formulations from participating system houses
- Replacement formulations from FSI, Purcom and calculations from an independent expert

From this information, the following average operating cost changes are calculated:

CHEMICAL	BASELINE (US$/kg)	%	NEW (US$/kg)	%	DIFFERENCE (US$/kg)	NOTES
Polyol	3.00	38	3.00	44	0.18	
Isocyanate	3,00	50	3.00	50	--	
Blowing agent	2.80	12	4.00	6	-0.10	
Price change /kg system					**0.08**	**Based on same density**

Baseline prices and formulations from system houses and replacement formulations from technology providers and UNDP developed information from the validation project). In addition, there will be phase-in costs, leading to initial higher densities and/or reject rates. This is similar to the situation when HCFC-141b was introduced and consequently it is proposed using the same based for the calculation of the phase-in costs (6% for spray, 4% for panels and 4% for PIP in the first year of operation).

This leads to a proposed base for IOCs in this project of

US$ 0.10/kg system

4. PARTICIPATING DOWNSTREAM USERS

#	End User	Founded dd/mm/yy	Application	Equipment	HCFC (t)
1	Misr El Obour		Cold store & CRM	1 HP & 1 LP	6.6
2	United Investment		Cold store & CRM	1 HP	4.2
3	Air System products company		Air Duct	Hand mixing	0.8
4	Omega Foam		Cold store & CRM	1 LP	2.12
5	Stars		Cold store & CRM	1 LP	0.53
6	Misr Foam		Cold store & CRM	1 HP	4.23
7	El Khaleej		Cold store	Hand mixing	4.23
8	Arabia for Engineering Industries		Cold store & CRM	1 LP	0.53
9	El Fayrouz		Cold store & CRM	1 HP & 1 LP	1.32
10	Egypt for trade & engineering		CRM	1 LP	0.53
11	El Shourouk for trade & engineering		CRM	Hand mixing	0.53
12	El Ashry for Ref. & AC		CRM	1 LP	0.53
13	El Kadeseya for Ref.		CRM	Hand mixing	0.53
14	Faster		Cooler	1 LP	4.23
15	Contrade Food Service		Kitchen	Hand mixing	0.53
16	Shawa for Plastics		Buoys (float)	Hand mixing	0.53
17	Euro Tech Services		Panel	2 HP & 1 LP	0.88
18	Friend Cool		CRM	Hand mixing	0.53

19	Raslan		Cold store & Panel	2 LP	5.02
20	International Invention house for Industry		Panel	1 LP	6.34
21	Comax		Cold store & CRM	1 LP	1.06
22	El Sabreen		Cooler	1 LP	1.06
23	GR Foam		Cold store & Panel	1 LP	6.03
24	El Helal for construction		Tanks & Pipes	Hand mixing	1.32
25	Pyramids Plast Factory		Cooler	2 LP	2.2
26	Atec for Engineering & Construction		Tanks & Pipes	1 LP	2.03
27	Steel Craft		CRM/Hotel facilities	1 LP	0.53
28	Basco		CRM/Hotel facilities	Hand mixing	0.36
		6HPD; 18LPD; SPD; 10 Hand mixing			49.79

UNITED NATIONS DEVELOPMENT PROGRAMME

PROJECT COVER SHEET

COUNTRY: **ARAB REPUBLIC OF EGYPT** **IMPLEMENTING AGENCY:** **UNDP**

PROJECT TITLE **HCFC PHASE-OUT IN EXTRUDED POLYSTYRENE APPLICATIONS**

NTL COORD.AGENCY: **EGYPTIAN ENVIRONMENTAL AFFAIRS AGENCY (EEAA)**

LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

A: ARTICLE-7 HCFC DATA (BASELINE 2015; ODS KG)

HCFC-141b	**1,172750**	**HCFC-123**	**9,068**
HCFC-142b	**42,036**	**HCFC-124**	**2,700**
HCFC-22	**4,055,973**		

B: SECTORAL HCFC DATA (BASELINE 2015; ODS KG)

ODS Name	Total	PU Foams (incl DRM)	XPS Foams
HCFC-141b	**1,177,600**	**1,177,600**	**--**
HCFC-22	**405,520**	**--**	**405,520**
HCFC-142b	**38,190**	**--**	**38,190**
HCFC-123	**--**	**--**	**--**
HCFC-12	**--**	**--**	**--**

CURRENT YEAR BUSINESS PLAN: Yes

ODS USE AT PARTICIPATING ENTERPRISES:	583.3	ODS t
ODS TO BE PHASED OUT:	583.3	ODS t
ODS TO BE PHASED IN:	0	ODS t
PROJECT DURATION:	24	Months
PROJECT COSTS:		
Incremental Capital Cost	1,700,000	US$
Contingency (10%)	170,000	US$
Incremental Operating Cost	816,620	US$
Total Project Cost	2,686,620	US$
LOCAL OWNERSHIP:	100% Egyptian	
EXPORT COMPONENT:	Only to Arab Countries	
REQUESTED GRANT:	2,578,370	US$
IMPLEMENTING AGENCY SUPPORT COST (7%):	180,486	US$
TOTAL COST OF PROJECT TO MULTILATERAL FUND:	2,758,856	US$
COST-EFFECTIVENESS - ACTUAL	4.42	US$/kg ODS
- THRESHOLD (weighted avg/low GWP**)**	10.28	US$/kg ODS
STATUS OF COUNTERPART FUNDING:	n/a	
PROJECT MONITORING MILESTONES INCLUDED:	Yes	

PROJECT SUMMARY

As part of the second stage of the HCFC Management Plan (HPMP-II) for Egypt. UNDP plans to phase-out the use of HCFCs in the extruded polystyrene plank manufacturing sector. A total of four producers have been identified and included in this project. The technology of choice is a blend of HFO-1234ze and DME (60/40) which classifies as low GWP. As the HFO component is currently in short supply, the companies may use an HFC as interim solution.

IMPACT OF THE PROJECT ON COUNTRY'S MONTREAL PROTOCOL OBLIGATIONS:

Execution of this plan phases out the use of 583.3 t/y HCFCs (R-22; R-142b and R; 406A) at baseline conditions (2016) and thus contributes considerable to the phase-out of HCFCs in Egypt.

Prepared by:	**UNDP/NOU**	**Date:March 27, 2017**

PROJECT OF THE GOVERNMENT OF EGYPT
HCFC PHASE-OUT IN EXTRUDED POLYSTYRENE APPLICATIONS

1.0 PROJECT OBJECTIVE

The objective of this project is to phase-out the use of HCFCs (R-22; R-142a and R-406A) in extruded polystyrene (XPS) foam applications and, in this way,contribute to Egypt's compliance with the Montreal Protocol HCFCphase-out obligations while sharply reducing the industry's contribution to global warming.

2.0 INTRODUCTION

This project is part of Egypt's HCFC Phase-out Management Program (HPMP-II) that addresses the fulfillment of Egypt's Montreal Protocol (MP) obligations for the period 2017-2025. It specifically addresses the HCFC use in remaining XPS applications. Under the CFC phase-out program, XPS sheet applications have already been converted to LPG or isobutane but only one producer of XPS (CMB, consisting of Advechem and Decomix) has been converted to HCFCs. The other enterprises were not identified at that time. While XPS foam sheet is mainly used in the food industry and as moderate thermal insulation requirements, XPS plank serves the construction industry and thermal insulation is very critical. XPS competes with PU panels in this application which is inherently more efficient—but costlier—than XPS plank.

UNDP is using a Sector Phase-out Plan approach expecting some savings through this approach in procurement, local works and implementation assistance. This program includes the following participants:

Table-1: List of Participants

PARTICIPANT	OWNERSHIP	ACRONYM
Chemicals for Modern Building	100% Egyptian	CMB
International Company for Insulation Technology	100% Egyptian	INSUTECH
Chema Foam Company	100% Egyptian	CHEMAFOAM
Spuntex Company for Engineering Textiles	100% Egyptian	MODERN PLASTICS

Notes: CMP owns XPS producers Advechem and Decomix
Spuntex owns Modern for Plastics

The project document does not include the usual country and sector background as this would duplicate the HPMP-II main document.

3.0 OPTIONS FOR HCFC REPLACEMENT IN XPS FOAMS

Extruded polystyrene foam can be categorized into sheet and boardstock applications.

In virtually all sheet applications, CFCs have been replaced by hydrocarbons—butane, isobutane, LNG or LPG, which is a sustainable technology.

In boardstock, most of the CFC replacement has been a blend of HCFC-142b and HCFC-22 in a 70-80%/30-20% ratio. The use of HCFC-22 was aimed at countering HCFC-142b's (modest) flammability. With the prices of HCFC-22 ever decreasing, many manufacturers—mainly in China—converted to HCFC-22 alone. This had its toll on product quality as the use of HCFC-22 only is prone to shrinkage.

The FTOC 2006 report offers following overview of past and expected conversions:

Table-2: Past Blowing Agents for XPS Boardstock

XPS Type	*CFC Alternatives*		
	Currently in Use (2005/2006)	*Anticipated in 2010-2015 period*	
		Developed Countries	*Developing Countries*
Sheet	Primarily hydrocarbons, HCFCs are not technically required for this end use	CO_2 (LCD), hydrocarbons, inert gases, HFC-134a, -152a	Hydrocarbons, CO_2 (LCD)
Boardstock	CO_2 (LCD) or with HC blends, hydrocarbons (Japan only), HFC-134a, HFC-152a,HCFC-22, HCFC-142b	CO_2 (LCD) or with HC blends, hydrocarbons (Japan only), HFC-134a, HFC-152a and HC blends	HCFC-142b, HCFC-22

The 2008 FTOC update reports that *"the phase-out of HCFCs in non Article 5 countries has been—and continues to be—a problem"*. North American XPS boardstock producers are scheduled to phase-outHCFC use by the end of 2009 through HFC blends, CO_2 (LCD) and hydrocarbons. The significant variety in products required to serve the North American market (thinner and wider products with different thermal resistance standards and different fire-test-response characteristics) will result in different solutions than in Europe and Japan, who have already phased out HCFCs. In Europe, this has been achieved with HFC-134a, HFC-152a and CO_2 (sometimes with a co-blowing agent or blended with an additives) while in Japan there has been significant use of hydrocarbons. Recently introduced so-called F-Gas regulations in Europe may change the scenario in that region as this regulation introduces limits on allowed GWPs.

The 2014 FTOC report reported that growth in XPS can be seen as potentially responsible for a breach of the 2013 Freeze – at least for the foams sector. However, this does not automatically mean that parties will be non-compliant with the Protocol, since there is always the potential to compensate in other sectors. Nevertheless, the significance of the XPS challenge is self-evident.

Non-Article 5 parties in North America, Europe and Japan are now actively pursuing regulatory strategies to encourage the phase-out of HFC use in the foam sector, wherever possible. In Europe, this has been enacted under the re-cast F-Gas Regulation, while in the USA, the potential to utilize the existing Significant New Alternatives Program (SNAP) is being explored as a tool for the de-selection of some blowing agent options. These regulatory initiatives could place particular pressure on the XPS industry in these regions, since universally acceptable alternatives are still to emerge.

In summary, while HCFC phase-out and HFC avoidance are being pursued in tandem, the more challenging areas are yet to be fully tackled. Much depends on future availability and cost of low-GWP blowing agents.

One encouraging factor, particularly with HFOs/HCFOs, is that the thermal performance of the foams is, as a minimum, retained and in many cases improved over the HCFCs and HFCs that they are likely to replace. The commercialization plans for these blowing agents remain on track and the next 2-3 years should confirm acceptability within the various foam sectors.Following is the current commercial/technical status on potential replacement for HCFCs:

Table-3: Status of HCFC replacements in XPS Boardstock

SUBSTANCE	COMMENTS
HFC-134a	Considered expensive; high GWP
HFC-152a	Moderately flammable and considered expensive
(Iso)butane	Highly flammable; high investment/ low operating costs
CO_2	As gas only capable to replace 30% of the blowing agent. As liquid, high investment and not fully mature
HFO-1234ze	Non-flammable; ideal boiling point; still experimental and poor in solubility—need co-blowing agent

It will be important to assess for all technologies their climate impact. Using GWP and MW data as provided by the FTOC (2006), following indicative GWP changes are to be expected for the replacement of HCFC-141b in PU foam applications:

Table-4: Indicative GWP Changes when Replacing HCFC-142b/-22

SUBSTANCE	GWP	MOLECULAR WEIGHT	INCREMENTAL GWP	COMMENTS
HCFC-142b/-22 (75/25)	2,185	97	Baseline	
HCFC-22	1,810	87	-562	Non-flammable
HFC-134a	1,430	102	-681	Non-flammable
HFC-152a	124	66	-2,101	Moderately flammable
(Iso)butane	4	58	-2,183	Flammable
CO_2 (LCD)	1	44	-2,185	Non-Flammable
HFO-1234ze	6	114	-2,178	Non-flammable

Green = favorable GWP effect; red = favorable comparable GWP effect but higher that the EU F gas limit (150)

Based on these data, it appears that HCs, CO_2 (LCD) and HFO-1234ze have by far the lowest climate impact based on GWP. HFC-152a may also be an acceptable alternative from a climate change perspective.

While HFC-134a reduces the comparable global warming effect, it will be most likely be disallowed in the future and its use is therefore discouraged—or only accepted as an interim option. A sustainableHCFC substitution program for XPS boardstock may therefore include HFC-152a, Hydrocarbons, Carbon Dioxide and HFO-1234ze.

4.0 CHOICE OF TECHNOLOGY

Trials at CMB have shown disappointing results with CO_2. All companies therefore decided against this option. They also decided against HFCs as a permanent solution but kept the way open for use as an interim option. Isobutane was rejected as being inferior in Insulation value. They selected HFO-1234ze as having by far the lowest climate impact based on GWP combined with acceptable physical properties. However, there are two issues with this choice:

- HFO-1234ze requires the use of DME to assure proper blending. As DME is (moderately) flammable, adequate safety precautions are required;

- The pricing and supply situation of HFO 1234ze is not fully assured as there is just one supplier and not yet a fully commercialized supply. Therefore, some interim use of HFCs might be needed.

The project document's budget reflects these issues by (i) including sufficient flammability safeguards, (2) providing the flexibility to use HFCs, and (3) the company assuring to EEAA that any interim use of HFCs will be limited to reasons of unacceptable pricing (>US$ 10.00/kg) and inadequate supply. EEAA accept these caveats and will monitor the companies living up to their commitment.

5.0 PROJECT DESCRIPTION

All companies use the same melting/blending/extruding process albeit in different grades of sophistication. Therefore, budgets are very similar. However, the condition of pumps and screws is very important as the DME is a very potent solvent and would maximize every leak, however small.

XPS products, being low in density and rather bulky, do not lend themselves easily to export. It is estimated that around 5% of the total production is exported—mainly to Sudan and Libya.

The project includes one second conversion. For efficiency, competitive fairness and monitoring, this company cannot be separated and dealt with later.

5.1 PHASE-OUT COST STRUCTURE

The project is structured as a group project with 4 individual sub-projects. All sub-projects share the same phase-out technology—HFO-1234ze/DME 60/40 with possible interim use of HFC-134a—and have very similar foam manufacturing technology. Chapter 3.0 shows a comparison of the applicable phase-out technologies and justification of the common choice. The project costs are divided into

Technology Transfer and Oversight – this includes technology transfer and oversight, a safety audit and trials/commissioning. An UNDP appointed expert will monitor project progress and provide technology transfer and supplier sourcing information to the recipients.

Incremental Capital Costs – include costs for new/retrofitted equipment, piping, tanks as well safety related costs such as gas monitors, electrical grounding, ventilation, etc. They amount to **US$ 1,700,000** and are detailed in **Annex-1.**

Operating Costs – To determine operation costs, current blowing agent prices were collected through EEAA and from chemical suppliers as follows:

Before:	R-142b	US$ 3.60/kg
	R-22	US$ 3.70/kg
	R-406	US$ 3.50/kg
After:	HFO-1234ze	US$ 10.00/kg
	DME	US$ 2.00/kg

The baseline formulation amounts to an average of US$ 3.60/kg. The earmarked formulation will be 60% HFO-1234ze and 40% DME which makes for a price of US$ 6.80/kg. This is US$ 3.20 higher than the baseline formulation and amounts to consolidated IOCs of **US$ 816,620**. They are detailed in **Annex-1.**

Cost Effectiveness (C/E) - The overall cost effectiveness of the project is (2,578,370/583,300 =) **US$ 4.42/kg ODS.** This compares favorably against the allowable MLF threshold of US$ 10.275/kg/ODS allowed for low GWP XPS projects. No individual company exceeds the double threshold—which is allowed for individual companies in group projects.

Proposed MLF Grant –The grant request is **US$ 2,578,370**.Lettersof commitment (LOCs) from individual project recipients stating their agreement are on file.

6.0 PROJECT IMPLEMENTATION AND MONITORING

The project will be using UNDP's National Execution Modality. Implementation is targeted as follows:

	ACTIVITIES PER QUARTER														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MF Grant Receipt	X														
Project Signature / Specifications		X													
System development			X	X											
Procurement			X	X											
Installation/retrofitting of equipment					X	X									
Training							X								
Testing and trials								X							
Commissioning / Project Closure								X							

MILESTONES FOR PROJECT MONITORING
(in months,measured from project approval)

TASK	MONTH
(a) Project document submitted to/signed by beneficiary	3
(c) System Development	9
(d) Bids prepared and requested	9
(e) Contracts Awarded	9
(f) Equipment Delivered/Installed	18
(g) Training Testing and Trial Runs	21
(h) Commissioning / Project Completion	22
(i) HOP signature	24
(j) Project Completion Report	n/a

7.0 PROJECT IMPACT

Direct Benefits: This project will eliminate the use of 583,300 kg HCFCs at baseline conditions. The project employs commercially available and environmentally acceptable technology. The Government of Egypt will assure compliance of the companies with the project conditions after completion.

Indirect Benefits: By using one phase-out technology for the entire sector, existing competitive conditions are maintained.

Environmental Impact: HFO-1234ze/DME has near to zero ODP and a very low GWP as the following table shows:

SUBSTANCE	GWP[1]	MOLECULAR WEIGHT	INCREMENTAL GWP[2]
HCFC-142b/-22 75/25	2,185	97	Baseline
HFO-1234ze	6	114	-2,178

[1] Taken from IPCC's Fourth Assessment (2007)
[2] Derived from comparing GWPs compared to the baseline on an equimolar base

The technology complies so with MOP decision XIX/6 in view of the desire to minimize negative environmental side-effects.

ANNEX-1
XPS SECTOR PHASE-OUT - BASELINE DATA AND BUDGETS

#	BASELINE	CMB	INSUTECH	CHEMA-FOAM	MODERN PLASTICS	TOTAL
1	Founded	1989/2006	1999	1987	2004	
2	Ownership	All EGY	All EGY	All EGY	All EGY	
3	Previous project	Yes/No*	No	No	No	
4	HCFC Use (2016)	73.3	300	10	200	
5	Equipment	3 extruders	2 extruders	1 extruder	1 extruder	
6	Technical Assistance	60,000	45,000	22,500	22,500	
7	Safety Audit	10,000	10,000	10,000	10,000	
8	Trials	40,000	30,000	30,000	30,000	
9	DME Storage Tank, Complete, Installed	130,000	65,000	65,000	65,000	
10	DME Feed Pumps, Complete, Installed	150,000	100,000	50,000	50,000	
11	Primary Feed Screws	120,000	80,000	40,000	40,000	
12	Secondary Screw re-engineering	--	--	--	50,000	
13	Gas Detection System	75,000	40,000	25,000	25,000	
14	Total Ventilation	45,000	30,000	15,000	15,000	
15	Local works	45,000	30,000	15,000	15,000	
16	Sub-Total	675,000	430,000	272,500	322,500	1,700,000
17	Contingencies (10%)	67,500	43,000	27,250	32,250	170,000
	IOCs****	102,620	420,000	14,000	280,000	816,620
18	Total costs (US $)	845,120	893,000	313,750	634,750	2,686,620
19	max. CE at US $ 8.22 x 1.25 (low GWP)	753,158	3,082,500	102,750	2,055,000	
20	Maximum Grant (using 2x TH rule)	1,506,315	6,165,000	205,500	4,110,000	
21	Eligible incremental costs	845,120	893,000	205,500	634,750	2,578,370

Notes:

*The CMB group owns two XPS producers: Advechem (1989), who had a project before, and Decomix (2006)

**Threshold (TH) multiplied by the sustainable growth factor (8.22 x 1.25 =) 10.275

***For Group projects, single ones can amount to two times the applicable threshold as long as the total threshold will be equal or less that the single threshold

****IOCs are based on conversion from HCFC-142b/-22/406A (US$ 3.60/kg avg) to HFO/DME 60/40.

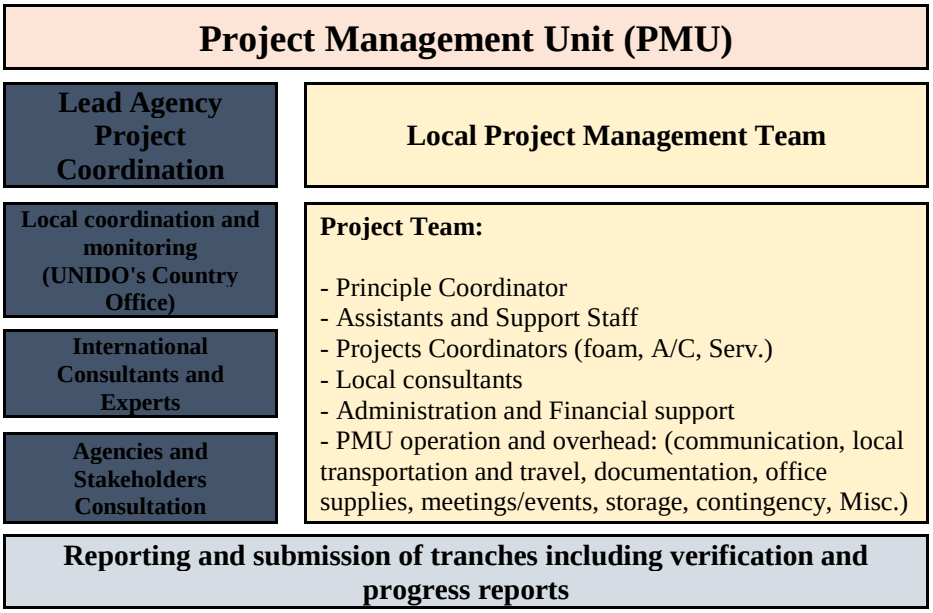
Project Management

This is a NIM executed project implemented by EEAA, NOU unit in accordance with the UNDP national implementation guidelines. UNDP NIM rules and regulations for recruitment, procurement, and award criteria will be followed for all project activities related to the contracting services, supplies and grants. The management arrangements for this projects are in line with UNDP requirements as reflected in the UNDP User guide (programme operations policies and procedures manual/POPP).

Project Implementation and monitoring unit:

The concept of Project Management Unit (PMU) has proven its effectiveness in many cases, especially for large projects like the HPMP of Egypt. It ensures full authority, flexibility and accountability in delivering targets of the HPMP without precluding the local institutional governing and monitoring roles.

As per the arrangements followed in Stage-I of the HPMP of Egypt, a dedicated Project Management Unit (**PMU)** will continue being the direct responsible unit the on-ground implementation of all HPMP activities and components. However, and given the size and diversity of projects in stage-II of the HPMP, the PMU structure will be adjusted to accommodate such multitasking and long term stage. The following figure demonstrates how the PMU will be structured for the smooth implementation of stage-II.



NOU of Egypt will continue to be main focal point for Egypt and will be supervising and monitoring the implementation of HPMP and the operation of PMU providing support as needed through the Ministry of Environment and/or other governmental bodies.

UNDP will be responsible for:

-Regular meetings are held with the NOU
- performs regular monitoring activities such as periodic field monitoring visits and spot checks.
- Ensures that resources entrusted to UNDP are utilized according to UNDP rules and procedures as per the Operations Policy and procedures manual
- Follow up with project team to ensure that financial and quarterly progress reports are submitted to UNDP on time.
- Ensure the preparations of all project budget revisions are prepared.
- Ensure annual audit and evaluations are carried out as per standard procedures.

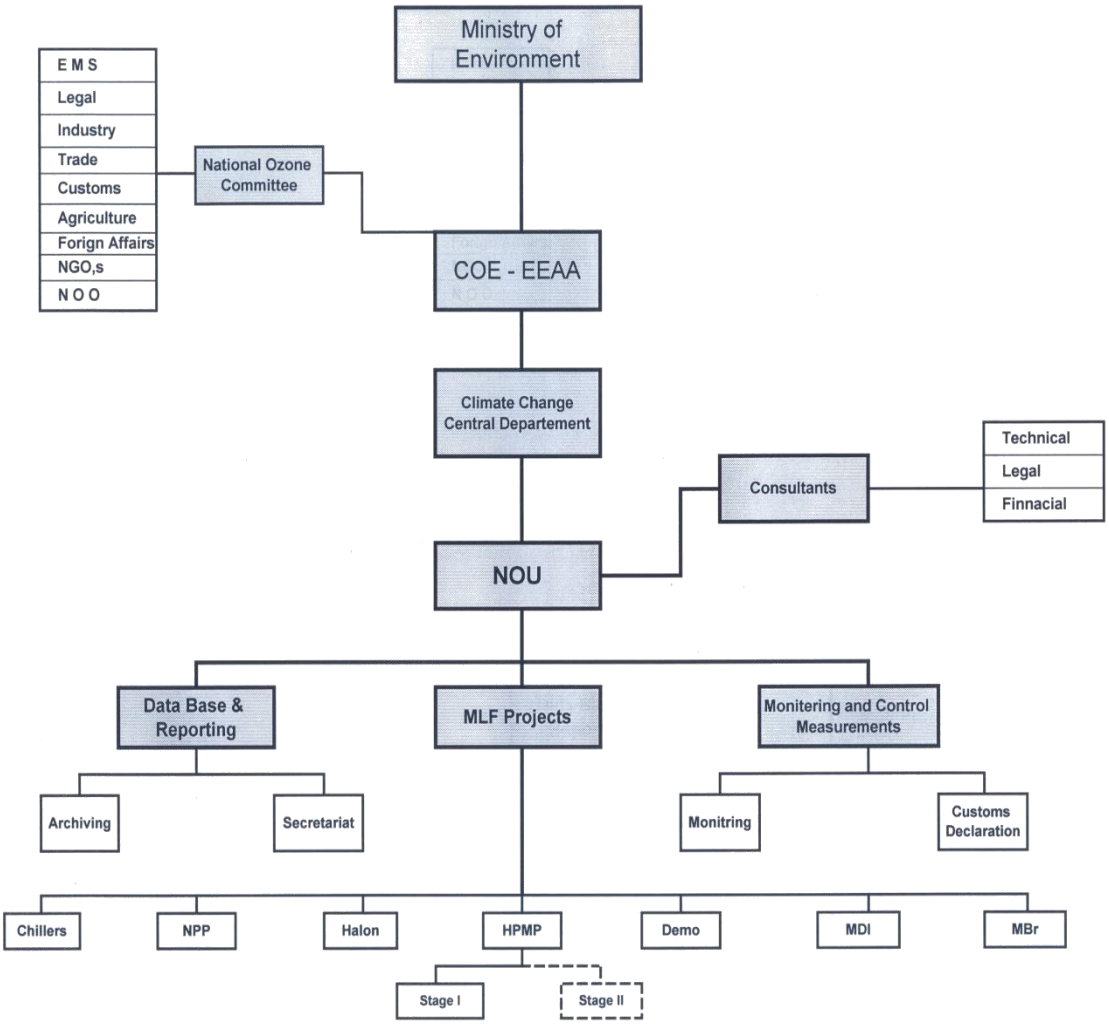
National Ozone Unite (NOU) & Egyptian Environmental Affairs Agency (EEAA)

The direct responsibility for managing and controlling the import and use of ODS rests with the NOU. The NOU as an integral part of the Ministry of State for Environmental Affairs may draw on the legal and technical expertise and resources of the Ministry to undertake its responsibilities. It cooperates with other relevant divisions and field offices of the Ministry and EEAA for carrying out activities such as field testing of imported ODS to maximize its reach.

The NOU works in close cooperation with relevant agencies, including the Egyptian Customs Authority, Ministry of Trade and Industry to regulate the importation into the country of ODS and products made from or using ODS.

The position of the NOU within the organizational structure of the Ministry of State for Environmental Affairs is illustrated in Figure below.

The Position of the National Ozone Unit of Egypt within the Ministry of State for Environmental Affairs



Intended Outcome as stated in the UNDAF/Country [or Global/Regional] Programme Results and Resource Framework:											
Outcome indicators as stated in the Country Programme [or Global/Regional] Results and Resources Framework, including baseline and targets:											
Applicable Output(s) from the UNDP Strategic Plan:											
Project title and Atlas Project Number:											
EXPECTED OUTPUTS	**OUTPUT INDICATORS[1]**	**DATA SOURCE**	**BASELINE**		**TARGETS (by frequency of data collection)**						**DATA COLLECTION METHODS & RISKS**
			Current available ODS in Egypt	**Year**	**2018**	**2019**	**2020**	**2021**	**2022**	**FINAL**	
Output 1 *Phase-out of HCFC-141b in the Polyurethane Foam*	*Identification of three factories. Two standalone factories in water heaters and one importer and distributor of 141b. to Phase out of HCFC141b in by 2025* *Instalment of new alternative technology.to phase out 141 in the three factories* *Trails of new technology completed.*	*HPMP*	1,172,750	2013	*No phase out occurred* *Technology installed and factories rehabilited* *Machine purchased.*	Trial year and measurement of 141b phased out.	Complete phase out of PU 10.98 ODP.				*Monitoring and reporting by the National and International consultants. National Steering committee meetings. Coordination meetings.*
Output 2 *Phase-out of HCFC-22 & HCFC-142b in the extruded polystyrene Foam*	*Identification of three factories. Two standalone factories in water heaters and one importer and distributor of 141b. to Phase out of HCFC141b in by 2025* *Instalment of new alternative technology.to phase out 142 b and RR 44 in the three factories* *Trails of new technology completed.*	*HPMP*	142b - 42,036 HCFC 22- 4,055,973	2017	*Activities will resume in 2019. Giving the priority to output 1*	*No phase out occurred* *Technology installed and factories rehabilited* *Machine purchased*	Trial year and measurement of 142b and HCFC 22 phased out	Monitoring of the operationt arget measruement.	*Completed phase out of 30.75 ODP.*		*Monitoring and reporting by the National and International consultants*
									Completed phase out of 142b		*Monitoring and reporting by the National and International consultants*

[1] It is recommended that projects use output indicators from the Strategic Plan IRRF, as relevant, in addition to project-specific results indicators. Indicators should be disaggregated by sex or for other targeted groups where relevant.

MONITORING AND EVALUATION

In accordance with UNDP's programming policies and procedures, the project will be monitored through the following monitoring and evaluation plans: *[Note: monitoring and evaluation plans should be adapted to project context, as needed]*

Monitoring Plan

Monitoring Activity	Purpose	Frequency	Expected Action	Partners (if joint)	Cost (if any)
Track results progress	The Country will submit a Tranche Implementation Report covering each previous calendar year; that it had achieved a significant level of implementation of activities initiated with previously approved tranches; and that the rate of disbursement of funding available from the previously approved tranche was more than 20 per cent	Every 2 years.	Slower than expected progress will be addressed by the national ozone committee.	NOU/Lead IA/ Cooperating IAs	
Monitor and Manage Risk	The National Ozone Unit (NOU) is an integral part of the Ministry of Environment under the direct responsibility of the Egyptian Environmental Affairs Agency (EEAA). The NOU will continue to have general responsibility for the implementation of the ODS programmes, including the HPMP. Under the direct supervision of the NOU. The monitoring process will be managed in close cooperation with relevant authorities with the assistance of the Lead IA and the Cooperating IAs. The project will be subject to a UNDP financial audit as part of the monitoring execercise.		Risks are identified by the national ozone committee. and actions are taken to manage risk. The risk log is actively maintained to keep track of identified risks and actions taken. Monitoring of audit findings if applicable.	NOU/Lead IA/ Cooperating IAs	
Learn	Knowledge, good practices and lessons will be captured regularly, as well as actively sourced from other projects and partners and integrated back into the project.	Annually	Relevant lessons are captured by the project team and used to inform management decisions.	UNDP/Ozone unit.	
Annual Project Quality Assurance	The quality of the project will be assessed against UNDP's quality standards to identify project strengths and weaknesses and to inform management decision making to improve the project.	Annually	Areas of strength and weakness will be reviewed by project management and used to inform decisions to improve project performance.	UNDP	

Review and Make Course Corrections	Internal review of data and evidence from all monitoring actions to inform decision making.	Annually	Performance data, risks, lessons and quality will be discussed by the project board and used to make course corrections.	UNDP	
Project Report	A progress report will be presented to the Project Board and key stakeholders, consisting of progress data showing the results achieved against pre-defined annual targets at the output level, the annual project quality rating summary, an updated risk long with mitigation measures, and any evaluation or review reports prepared over the period. A monthly progress report will be presented to the CEO/EEAA, and quarterly progress report will be presented to the National ozone committee and annual progress report will be presented to the UNDP/CO, consisting of progress data showing the results achieved against pre-defined targets at the output level, the project quality rating summary, an updated risk long with mitigation measures, and any evaluation or review reports prepared over the period.	Monthly – Quarterly - Annually		NOU/Lead IA/ Cooperating IAs	
Project Review (Project Board)	The project's governance mechanism (i.e., project board) will hold regular project reviews to assess the performance of the project and review the Multi-Year Work Plan to ensure realistic budgeting over the life of the project. In the project's final year, the Project Board shall hold an end-of project review to capture lessons learned and discuss opportunities for scaling up and to socialize project results and lessons learned with relevant audiences. The National Ozone Committee is to convene once every three months at the time determined by the Chairman of the Committee or whenever he deems. The Committee may seek the assistance it deems of experts and advisers to attend its meetings at the invitation of the Chairman of the Committee. The Chairman of the Committee presents a summary of the results of its work to the Minister of Environmental after each committee meeting.	Quarterly	Any quality concerns or slower than expected progress should be discussed by the project board and management actions agreed to address the issues identified.	NOU/Lead IA/ Cooperating IAs	

GOVERNANCE AND MANAGEMENT ARRANGEMENTS

Minister of State for Environmental Affairs issued Decree No. 80 of 8th April, 2013 for the re-establishment of the National Ozone Committee with the mandate of assisting the Egyptian Environmental Affairs Agency in the implementation of Egypt's obligations, by selecting the mechanism to regulate the import and export of quantities of ozone-depleting controlled substances to achieve schedules of gradual reduction, in order to ensure verification of compliance by Egypt with the provisions of the Montreal Protocol to protect the ozone layer.

The National Ozone Committee is to convene once every three months at the time determined by the Chairman of the Committee or whenever he deems. The Committee may seek the assistance it deems of experts and advisers to attend its meetings at the invitation of the Chairman of the Committee. The Chairman of the Committee presents a summary of the results of its work to the Minister of Environmental after each committee meeting.

Members of the National Ozone committee:

1. Chief Executive of the EEAA (Chairman)
2. The General Authority for Industrial Development - Ministry of Foreign Trade and Industry (member).
3. Foreign Trade Sector - Ministry of Foreign Trade and Industry (member).
4. Trade Agreements Sector - Ministry of Foreign Trade and Industry (member).
5. General Authority for the control of exports and imports - Ministry of Foreign Trade and Industry (member).
6. Union of Chambers of Commerce - Ministry of Foreign Trade and Industry (member).
7. Central department for customs policies in Customs Authority policies - Ministry of Finance (member).
8. Central department for Agricultural Quarantine - Ministry of Agriculture and Land Reclamation (member).
9. Department of the environment and sustainable development - Ministry of Foreign Affairs (member).
10. Consumer Protection Agency- Ministry of Supply & Internal Trade (member).
11. Egyptian Competition Authority (member).
12. Chamber of Engineering Industries - Federation of Egyptian Industries (member).
13. Environmental Management Sector - Egyptian Environmental Affairs Agency - Ministry of Environment (member).
14. Directorate General for Legal Affairs – Egyptian Environmental Affairs Agency - Ministry of Environment (member).
15. National Ozone Unit - Environmental Affairs Agency - Ministry of Environment Affairs (secretariat)
16. United Nations Development Programme (UNDP)
17. United Nations Industrial Development Organization (UNIDO)
18. Ministry of Foreign Affairs, Department of International Cooperation for Development

BILATERAL AND IMPLEMENTING AGENCIES

The Country agrees to assume overall responsibility for the management and implementation of this project and of all activities undertaken by it or on its behalf to fulfil the obligations under this project. UNIDO has agreed to be the lead implementing agency (the "Lead IA") and UNDP, United Nations Environment Programme (UN Environment) and the Government of Germany have agreed to be the cooperating implementing agencies (the "Cooperating IAs") under the lead of the Lead IA in respect of the Country's activities under this project. The Country agrees to evaluations, which might be carried out under the monitoring and evaluation work programmes of the Multilateral Fund or under the evaluation programme of the Lead IA and Cooperating IAs taking part in this project.

The Lead IA will be responsible for ensuring coordinated planning, implementation and reporting of all activities under this project. The Cooperating IAs will support the Lead IA by implementing the Plan under the overall co-ordination of the Lead IA.

LEGAL CONTEXT AND RISK MANAGEMENT

Select the relevant one from each drop down below for the relevant standard legal text:

1. Legal Context:
   - Country has signed the Standard Basic Assistance Agreement (SBAA)
2. Implementing Partner:
   - Government Entity (NIM)

Or click here for the MS Word version of the standard legal and risk management clauses

BUDGET

Award ID:	**00106347**					
Award Title:	**HPMP - Stage II**					
Project ID:	**00107118**					
Project Title:	**HPMP - Stage II**					
Executing Agency:	**Egyptian Environmental Affairs Agency**					
GEF Outcome/Atlas Activity	**Responsible Party (Implementing Agent)**	**Fund ID**	**Donor Name**	**Atlas Budgetary Account Code**	**ATLAS Budget Description**	**Total (USD)**
Activity 1: PU Foam	EEAA	63030	10009 MP	71200	International Consultant	25,000.00
				71300	Local Consultant	0.00
				71600	Travel	0.00
				72100	Contractual Services-Companies	375,000.00
				72200	Equipment	550,000.00
				74500	Miscellaneous	17,352.00
	TOTAL OUTCOME 1					**967,352.00**
Activity 2: XPS	EEAA	63030	10009 MP	71200	International Consultant	50,000.00
				71300	Local Consultant	0.00
				71600	Travel	0.00
				72100	Contractual Services-Companies	600,000.00
				72200	Equipment	1,850,000.00
				74500	Miscellaneous	78,370.00
	TOTAL OUTCOME 2					**2,578,370.00**
Activity 3: PMU	EEAA	63030	10009 MP	71200	International Consultant	75,000.00
				71300	Local Consultant	35,000.00
				71600	Travel	20,000.00
				72200	Equipment	10,000.00
				74500	Miscellaneous	5,000.00
				75700	Workshop, Training	5,000.00
	TOTAL OUTCOME 3					**150,000.00**
	TOTAL					**3,695,722.00**