UNDP Project Document

United Mexican States
Pilot project for validation of Methyl Formate in Polyurethane Shoesole Applications
(Phase-I)

Ministry of Environment and Natural Resources (SEMARNAT)
United Nations Development Programme

Mexico ratified the Vienna Convention and signed the Montreal Protocol on Substances that Deplete the Ozone Layer; including its various amendments.

The objective of this project is to develop, optimize, validate and disseminate the use of methyl formate in polyurethane shoesole applications. In case of a positive validation, the technology will be applied in a limited amount of downstream operations that cover all formulations for which it is validated. The project is designed in close cooperation with a similar project in Brazil that covers other polyurethane (PU) applications, but could not include shoesoles because of lack of know-how in this application.

The project is divided in two distinct phases:

- Phase I: development, optimization and validation of methyl formate systems at Zadro, a manufacturer of PU shoesole systems. This includes conducting a workshop for other interested system manufacturers so that they might use the technology as well
- Phase II: implementation of the technology in seven (7) shoesole manufacturers

This activity concerns phase-I only. If successful, the validated technology will contribute to the availability of low-investment options needed to implement HCFC phaseout at small and medium-sized companies.

IMPACT OF PROJECT ON COUNTRY'S MONTREAL PROTOCOL OBLIGATIONS

This project is a pilot project aimed at validating a new HCFC phaseout technology. It does not contribute directly to Mexico's Montreal Protocol obligations. However, in case Phase-II will be successful, the project will contribute 35.7 t ODS (Ozone Depleting Substances) or 3.9 t ODP (Ozone Depleting Potential) to the country's efforts to meet its HCFC phaseout obligations under the Montreal Protocol.

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Acronyms

CFC	Chlorofluorocarbons
DGCA/ UPO	General Direction of Air Quality/ Ozone Layer Protection Unit of SEMARNAT
Excom	Executive Committee
GWP	Global Warming Potencial
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
ISF	Integral Skin Foam
MLF	Multilateral Fund
ODP	Ozone Depleting Potencial
ODS	Ozone Depleting Substances
PU	Polyurethane
PUR	Polyurethane Rigid
SEMARNAT	Secretariat of Environment and Natural Resources (Mexican Ministry of Environment)
T	Tons
t/y	tons per year
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
USD	United States Dollar
MDI	Methylene bisphenyl isocyanate
ABA	Auxiliary Blowing Agent

SECTION I: Project identification

PROJECT IN CURRENT BUSINESS PLAN:	Based on ExCom Decision 55/43 (e i-iii)
SECTOR:	Foams
Sub-Sector:	Integral Skin/Shoesoles

ODS USE IN SECTOR

BASELINE:	NOT YET DETERMINED
CURRENT	3,024 T ODS/298 T ODP (AS PER GOVERNMENT REPORTING)

BASELINE ODS USE:	N/A
PROJECT IMPACT (ODP targeted):	N/A
PROJECT DURATION:	7 months
PROJECT COSTS (Phase-1 only):	US$ 291,500 (Phase I only)
LOCAL OWNERSHIP:	100 %
EXPORT COMPONENT:	0 %
REQUESTED MLF GRANT:	USD $ 291,500
IMPLEMENTING AGENCY SUPPORT COST:	USD $ 21,860 (7.5%)
TOTAL COST OF PROJECT TO MLF:	USD $ 313,360
GRANT-EFFECTIVENESS:	N/A
PROJECT MONITORING MILESTONES:	Included
NATIONAL COORDINATING AGENCY:	Secretaria de Medio Ambiente y Recursos Naturales (SEMARNAT)

Project Objectives

The objectives of this project are to:

1. Develop, optimize and validate the use of methyl formate in PU shoesole applications;
2. Apply the technology in a limited amount of downstream operations;
3. Disseminate the technology to interested "system houses"

Part I Situation Analysis

Current validated technologies for replacing HCFC-141b in foams are restricted to water/MDI, hydrocarbons and HFCs. With water non-performing in most applications, HFCs being high in GWP and hydrocarbons high in investment costs, it is important to validate other options. ExCom Decision 55/43 reflects this by promoting pilot projects aimed at validating new technologies. UNDP completed two related pilot proposals, for the validation of methyl formate (ecomate®) in all relevant foam applications. Technology validation is a global task. However, it has to be executed in a particular country and UNDP has therefore requested endorsement letters from the countries involved. Because of the global impact complete deduction from the national aggregate HCFC consumption would not be consistent with the project´s global outreach, which implies that other countries than Mexico will also benefit from the project

INFORMATION ON PARTICIPATING COMPANIES

This pilot project is designed around "Quimiuretanos Zadro S.A. de C.V." ("Zadro"), that acts as an implementing partner of the project. Contact information is as follows:

Company:	Quimiuretanos Zadro S.A. de C.V.
Contact:	Mr. Jose Luis Ordaz Perez
Address:	Prolongación Morelos 902, San Francisco del Rincón, Guanajuato, Mexico
Ph/Fx:	+52-476-743-6290/7625

Zadro was founded 1996 and is 100% Mexican owned. The company is a so-called "System House", a company that supplies preblended chemicals, in this case to the shoesole industry, which is concentrated around the Leon/San Francisco area in the State of Guanajuato. Annual sales were:

2005 USD$ 3,240,000 2006 USD$ 3,960,000 2007: USD$ 3,840,000

There are no exports. The company has a crew of 12. Base chemicals are purchased from

Name	Type of Chemical	Consumption (t)		
		2005	2006	2007
POLIOLES S.A	POLYOLS	684	836	810
BASF	ISOCYONATES	360	440	426
QUIMICA MARCAT	BLOWING AGENT 141B	36	44	42

HCFC-141b is used in ~98 % of the systems while all water-based systems make up the rest.

PROJECT DESCRIPTION

This project is divided into two phases:

- Phase-I: development, optimization, validation and dissemination of the new technology
- Phase-II: implementation at recipients covering all formulations of the new technology.

PHASE-I

PU foams are used in applications that have different formulation requirements. Around 16 main applications use currently HCFC-141b. 15 of these will be validated for the use of methyl formate as HCFC replacement through a pilot project in Brazil. Shoesoles will be covered by this project—but in close cooperation with the implementers of the Brazilian project. The use of methyl formate is patented and marketed under the name "ecomate®". Zadro will be granted a non-exclusive sub-license for Mexico. The development, optimization and validation of methyl formate as replacement technology for the use of HCFC-141b in shoesoles will in this phase involve the system house only and will consist of:

- Acquisition of an "ecomate®" license and the necessary testing/prototyping equipment;
- Development of the systems (there are different ones, depending on customer requirements);
- Optimization and Validation of all formulations;
- Dissemination of the information through a workshop.

Zadro has already prototyping equipment but lacks testing equipment needed for validation. Shoesole companies and their suppliers do not conduct currently regular testing on the properties of their foams nor do they set standards. Therefore, the acquisition of suitable testing equipment and the determination of baseline data on critical properties is a precondition for a successful validation program.

The necessary testing equipment is described in the budget explanations. The outcome of this part of the project will be a list of specific product requirements and tests to measure these. After this, optimization and validation can start in earnest. Based on the outcome of this program, the technology will be cleared for industrial application under Phase-II which will be submitted for approval at that time.

Past experience in MLF-supported CFC phaseout efforts has shown how important it is to assure commercial availability and local technical support. Therefore, the project will include a technology transfer workshop as soon as the technology is deemed transferable and will be open for any system house. While this may be not the immediate most profitable course for a commercial operation like Zadro, it is the price to be paid for MLF support.

PHASE II

After the formulations have successfully passed their evaluation, commercial application in manufacturing operations will follow. 7 companies, covering all formulations, will apply the technology in their operations. Product and process testing will be conducted by the system house.

UNDP will contribute to this evaluation by conducting safety audits that include workers exposure testing (the monitoring equipment is available from a global MLF project). Process adaptations will be made as needed to meet the pre-determined requirements

Project consistency with Mexican national priorities

1. The project is consistent with the following:
    a. Mexico's priorities for ozone layer protection as well as its compromises with Montreal Protocol to eliminate the use of HCFCs.
    b. Mexico's *National Development Plan 2007-2012,* which includes as an objective the promotion of development that is in harmony with nature and the environment, increased citizen confidence in Mexico's institutions, and support for decentralization.
    c. Mexico's *United Nations Common Country Assessment (CCA), the United Nations Development Assistance Framework (UNDAF)* situational analysis and the World Bank's *Country Assistance Strategy (CAS)* for Mexico, inclusive of their emphasis on sustainable development.
    d. Millennium Development Goals (MDG), given the positive effects on the environmental, economic and health-related MDGs.

Programatic Framework of UNDP

Millenium Development Goals

This project directly suports the progres of th. 7th Millenium Development Goal: Ensure environmental sustainability.

2008-2012 United Nations Development Assistance Framwork

Through the 2008-2012 United Nations Development Assistance Framework (UNDAF), the United Nations System in Mexico completed the process of programatic harmonization, in accordance to the United Nations reform and presented the government a joint proposal for the years 2008-2012.[1]

This Project is linked to Outcome 3.1 of the UNDAF, "Principles of sustainable development incorporated in national and regional programmes, including the promotion of equity in the use of natural resources and the distribution of environmental costs and benefits".

In addition, it has a direct effect on the following priority: "Institutional and individual capacities strengthened to stop and/or reverse environmental degradation, support natural resources conservation, encourage participatory management, natural resources governance and promote human development through policies and programmes for sustainable development".

More specifically, this direct effect is related to product 3.1.7 "Capacities strengthened to promote programmes for cleaner production, energy efficiency, waste management and sustainable and fair commerce through applied research and development, training, technical assistant and technology transfer".

[1] This document has been approved by the Mexican government and presents an articulated, coherent and strategic cooperation framework of the United Nations activities in Mexico.

UNDP's 2008-2012 Country Programme Document

The 2008-2012 Country Programme Document (CPD) of UNDP Mexico recognizes that climate change mitigation and adaptation is an urgent matter of economic survival and social development.

For this reason UNDP offers technical assistance to Mexico´s efforts to comply with its international commitments, including the goals of the Montreal Protocol, and to strengthen national and local capacities to improve it´s strategies of mitigation and adaptation to climate change.

Due the Global Warming potencial of HCFCs, their substitution is an important action for climate change mitigation.

IMPACT OF PROJECT ON COUNTRY'S MONTREAL PROTOCOL OBLIGATIONS

This project is a pilot project aimed at validating a new HCFC phaseout technology. As Phase-I does not actually phase-out ODS—it only develops and validates a new technology to do so—it does not contribute directly to Mexico's Montreal Protocol obligations.

However, in Phase-II, the project would contribute 35.7 t ODS or 3.9 t ODP to the country's efforts to meet its HCFC phaseout obligations under the Montreal Protocol.

PART II: Strategy

IDENTIFICATION OF ODS USERS IN THE FOAM INDUSTRY

The foundation and one of the challenges for a successful ODS phaseout program is a successful identification of the users. There are different ways to do this:

- **The use of customs information** – In countries that do not produce HCFCs, these substances have by definition to pass the border and are subject to customs registration and inspection. The clear problem with HCFCs for foam applications is that not all HCFCs are imported as such but frequently preblended into polyol. Inclusion of these substances in customs registration and mandatory disclosure of HCFC content is therefore a precondition for an effective identification program through customs.

  It is emphasized that identification of the importer alone is not sufficient. The importer may use distributors. Identification of distributors as well as the HCFC-containing system users is necessary. This requires convincing the importer/distributor that such identification is in their best interest and in the interest of their customers.

- **The use of trade associations** – In many countries trade associations represent the interests of producers of certain application groups. Their cooperation has been crucial, for instance in Brazil, India, Indonesia and Pakistan. Cooperation of trade associations allows the use of existing data bases and has proven particularly successful for group projects.

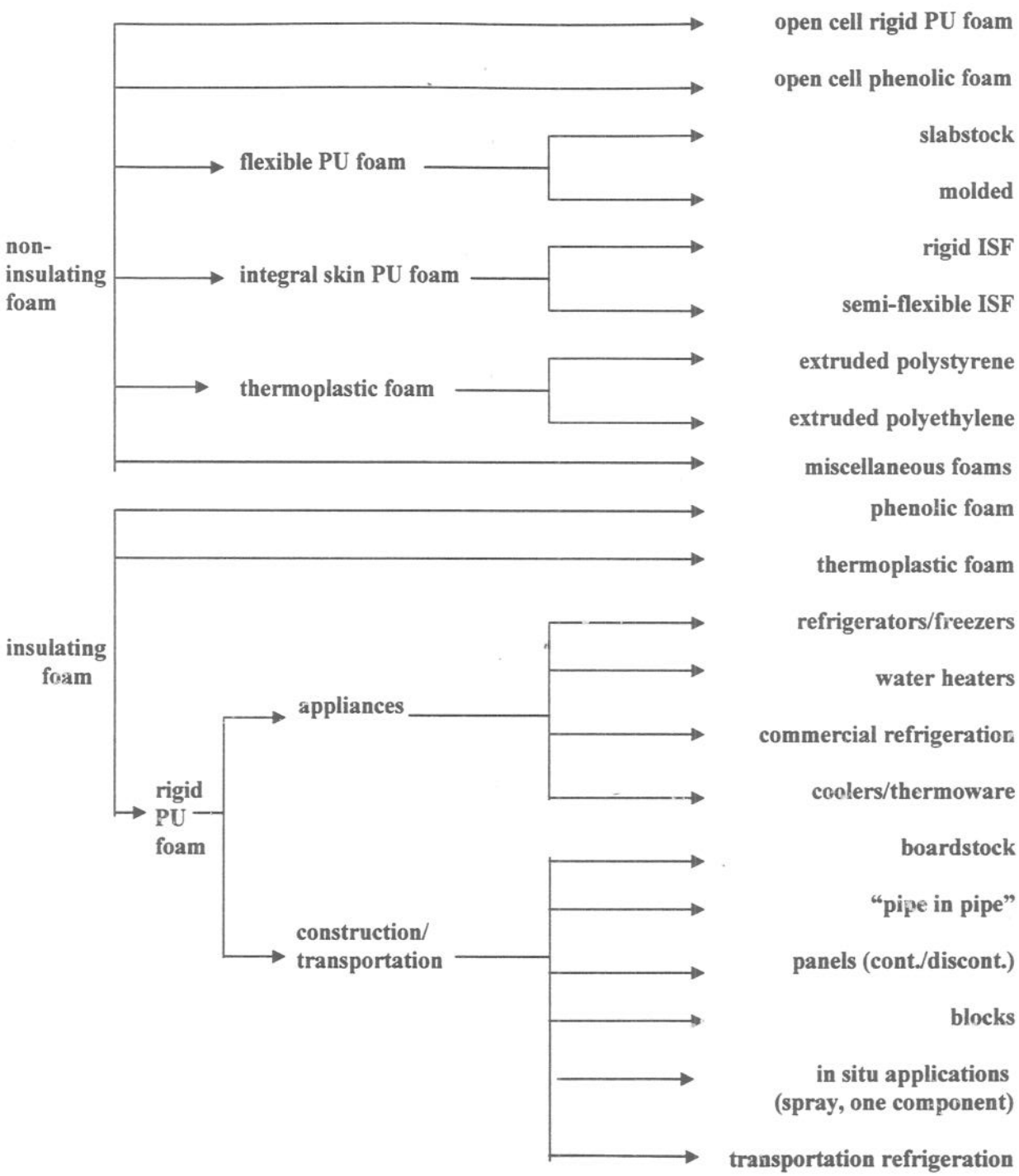
- **The use of local experts –** A person who is familiar with the local foam industry could accelerate and improve data collection. However, such a person, after "picking his/her own recollection" is dependent on the same sources as any other data collector and dependent on persistence, ingenuity and organizational skills.

- **The use of already identified users –** This is an random but very effective method of identification. Many users are not interested in identification or even actively avoid meeting with Ozone Officers, mostly because ignoring the benefits it may receive from joining the ODS phaseout program. The—positive—experience of a colleague/competitor may turn this opinion around.

- **The use of suppliers –** any foam producer needs chemicals for its production. Identifying the suppliers and their agents/distributors and enlisting their cooperation has proved to be one of the most successful tools in ODS user identification. Combined with a custom identification program and cooperation from other ODS users, it assures a virtually complete user identification.

It would be a benefit for the Ozone officer to know the different foam applications. By knowing the structure of the industry as well as the different applications the chance to finds users as well as the quality of the pre-assessment information can considerably be improved.

Foamed plastics that are produced with HCFCs can be classified on the basis of composition, chemical and physical characteristics, manufacturing process or application. They can be consolidated into **Non-Insulating Foams** and **Insulating Foams.** Insulation is understood in this context as thermal insulation. These main categories can then be further divided and subdivided into functional groups as follows:



The most prevalent use of **open cell rigid PUR foam** is for packaging applications ("pour in place" foam), mostly when small lots are involved, such as in the return of repaired items. Another application is "back-foaming" of crash panels, such as automotive dashboards.

Open cell phenolic foam is mainly used for flower arrangements.

Flexible PUR foam constitutes the largest group of non-insulating foams. Comfort applications, such as bedding and furniture, dominate in the use of **slabstock—continuous or boxfoam**—followed by lining for textiles. **Molded** foam is used in the automotive industry and, in much smaller amounts, for office furniture.

Rigid integral skin foams (ISFs) are used for recreational purposes, such as surf boards, and in imitation wood.

Semi-flexible ISFs are used in the automotive industry for arm rests and steering wheels, in office furniture and in shoe soles (micro-cellular).

Extruded polystyrene foam sheet are used for food packing applications (meat trays, egg cartons, plates, cups, etc). **Extruded polyethylene foam sheet and planks** are mostly used for packaging purposes.

Examples of **miscellaneous foams** are floor mats and one component foams, such as in spray canisters.

Closed cell **Phenolic foam** is used for building insulation.

Thermoplastic foams for thermal insulation purposes consist mostly of **extruded polystyrene insulation board** in construction applications and of **extruded polyethylene tubing** for pipe insulation.

Rigid PUR foams for thermal insulation are by far the most significant group of insulating foams. Its insulation value exceeds any other foam by a significant margin. There are numerous applications in appliances as well as construction.

In appliances, refrigerators dominate, but specifically in commercial refrigeration and small appliances, there is a diverse and frequently unexpected large use of foam. Examples are:

- Thermos bottles
- Water containers, cool boxes (fish industry)
- Boilers
- Milk containers
- Casseroles/hot pots
- Vendor carts (ice cream, drinks)
- Insulated trucks
- Mortuary coolers

Examples of applications in construction are:

- Sprayfoam (chicken/hog farms, commercial buildings, cold storage)
- Roof panels
- Cold storage structural panels
- Pipe insulation

Examples of miscellaneous applications are:

- Floatation devices (buoys, surf planks)
- Boat filling (floatation as well as insulation)
- Bus insulation (thermal, sound)

SUPERVISION ARRANGEMENTS

Decision 55/43 requires the Agencies to report accurate project cost data as well as other data relevant to the application of the technologies through "a progress report after each of the two implementation phases". UNDP suggests in addition the ExCom to consider supervision of the validation through the UNEP Foams Technical Options Committee.

TECHNICAL OPTIONS FOR HCFC REPLACEMENT IN FOAMS

Annex-1 provides an overview of all HCFC-141b replacement technologies that are currently available or proposed. Based on these data, it appears that

- Straight conversion of HCFCs to HFCs will always increase GWP
- This may be diminished by optimizing climate performance of the formulations
- Hydrocarbons (HCs), Carbon dioxide (CO2) (liquid or derived from water) and methyl formate will be options in PU foams that decrease—virtually eliminate—GWP in PU foams
- Emerging technologies such as "HBA-2", "AFA-L1" and "FEA 1100"—all identifications used for undisclosed chemicals by the developing companies will require at least two more years before commercialization

The overview concludes that PU validation may include following technologies:

- Carbon Dioxide
- Optimized Hydrocarbons
- Methyl Formate
- Optimized HCs

Methyl Formate as replacement technology for HCFC-141b

Annex-1 provides an extensive overview of the properties and use of methyl-formate, also called methyl-methanoate, or (trade name) ecomate©. Foam Supplies, Inc. (FSI) has pioneered its use in PU foams from 2000 onwards.

The application has been patented in several countries. Ecomate®, as FSI calls the product, is exclusively licensed to Purcom for Latin America, to BOC Specialty Gases for the United Kingdom and Ireland and to Australian Urethane Systems (AUS) for Australia, New Zealand and the Pacific Rim. Reportedly, AUS has also acquired the license for other countries such as India, China and several countries in the Middle-east/north Africa.

Technical and commercial claims made by FSI imply that the technology may reduce operating costs when replacing HCFC-141b, at minimum capital investment and comparable or better quality. This, of course would be of utmost interest for the MLF. However, these claims need to

be verified and validated by an independent body before the technology can be applied in MLF projects. Where insufficient data have been provided, additional information will have to be gathered.

Validation will be conducted by Purcom in Brazil, which is currently the only developing country where ecomate® is blended and in commercial use. Because Purcom is not involved in shoesoles, the validation of this application will be conducted in Mexico through Zadro.

Zadro will obtain a sub-license from Purcom or FSI and be instructed in the basic facts and formulation of ecomate in PU foam systems before developing, optimizing and validating its own shoesole systems.

PROJECT GOAL

Outcome 1: Methyl formate use in polyurethane shoesole applications demonstrated, developed, optimized, and disseminate as an alternative to the HCFC phaseout technology.

INDICATIVE LIST OF PARTICIPANTS AND BASELINE DATA

This is a condensed list of the information provided by each preliminary participant. A final list of participants will appear in the grant request for Phase-II of the project which will be prepared after—and with technology and cost input from—Phase-I. All data are subject to Government review prior to final submission:

ENTERPRISE	APPLICATION	CONSUMPTION (t/y)							
		SYSTEMS				HCFC-141b			
		2005	2006	2007	AVG	2005	2006	2007	AVG
Client-01	Shoesoles	119	87	107	104	4.0	2.9	3.5	3.5
Client-02	Shoesoles	120	130	120	124	4.0	4.3	4.0	4.1
Client-03	Shoesoles	154	160	136	150	5.1	5.3	4.5	5.0
Client-04	Shoesoles	120	130	121	124	4.0	4.3	4.0	4.1
Client-05	Shoesoles	240	220	180	213	8.0	7.3	5.9	7.1
Client-06	Shoesoles	96	100	102	99	3.2	3.3	3.4	3.3
Client-07	Shoesoles	300	240	240	260	10.0	7.9	7.9	8.6
Total Consumption		1,149	1,067	1,006	1,074	38.3	35.3	33.3	35.7

PROJECT COSTS

UNDP used cost guidance provided by the Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol (MLF) in Document 55/47 Annex III, Appendix II.

#	ACTIVITY	COSTS (US$)		
		INDIVIDUAL	SUB-TOTAL	TOTAL
PHASE-I – DEVELOPMENT/OPTIMIZATION/VALIDATION/DISSEMINATIOON				
1	Preparative work Project Preparation Technology Transfer, Training	 25,000 75,000	100,000	291,500
2	System Development (7 applications) @ 5,000 Optimization (7 applications) @ 3,000 Validation (7 applications) @ 2,000	35,000 21,000 14,000	70,000	
3	Laboratory Equipment Laboratory Safety	50,000 10,000	60,000	
4	Peer review/endorsement of next phase		10,000	
5	Technology Dissemination Workshop (s)		25,000	
6	Contingencies (10%)		26,500	

*includes license fee

PHASE-II – HCFC PILOT PHASEOUT PROJECTS COVERING ALL FORMULATIONS (these costs are tentative and not part of the current funding request)				
1	System House adaptations 1 Blender 1 Tank for MeF Safety measures Contingencies (10%)	 50,000 20,000 25,000 9,500	104,500	532,200
2	Downstream User Operations (7) 7 Retrofits @ 15,000 7 Trial Programs @ 3,000 Contingencies (10%)	 105,000 21,000 12,600	138,600	
4	Peer review/safety audits		20,000	
5	Incremental Operating Costs		269,100	

Annex-2 provides details and justifications. **UNDP was awarded a grant for phase-I of this project amounting to US$ 291,500 for Phase I.**

PART III: Management Arrangements

- All activities related to project execution will be carried out in accordance with the guidelines and regulations of the United Nations Development Programme outlines in the UNDP Mexico Management Guide for National Implementation Projects, and its later updated versions[2].
- The project will be executed and implemented through the Secretariat of Environment and Natural Resources. (SEMARNAT). The project components will be directly implemented under the realm of General Direction of Air Quality/ Ozone Layer Protection Unit (Dirección General de Calidad del Aire/ Unidad de Protección a la Capa de Ozono) of SEMARNAT. Though the responsibility for execution lies with SEMARNAT several project components will be implemented in close cooperation with other Ministries. The project success and

[2] UNDP is the only authorized to approve amendments to these rules as appropriate. The UNDP Country office in Mexico is responsible for communicating timely manner to all users of the new guidelines provisions and revisions to the rules and procedures that are generated as a result of best practices formalized by the Headquarters in New York. UNDP-Mexico reserves the right to make improvements to the Guide to facilitate the presentation and user's query. This procedure respects the integrity of the current UNDP corporate standards.

sustainability relies heavily on a close cooperation between a number of ministries and institutions as well as private sector partners.

Functions of the participants

Ministry of Foreign Affairs (SRE): The Government of the United Mexican States has designated the Technical and Scientific Cooperation Directorate of the SRE as the official counterpart to UNDP. Its principal responsibilities are:

- As the entity responsible for technical cooperation in Mexico, to act as the Mexican government's official counterpart to UNDP; specifically, and in accordance with the National Development Plan, to formalize approval of the project cooperation documents presented to UNDP by federal, state and private entities.
- If necessary, to make a written request to UNDP for reports on the project.
- To approve the annual audit plan for the project and, in accordance with UNDP norms and procedures, to convene an information and consultation meeting prior to the audit.
- If considered expedient, to attend at least one meeting a year a of the project's Executive Committee.
- As required, to participate in tripartite meetings or in any follow-up or reorientation sessions.

Ministry of Environment and Natural Resources (SEMARNAT): SEMARNAT, through its the General Direction of Air Quality/ Ozone Layer Protection Unit, is the Executing Agency responsible for supporting the Project Coordinator and chair the Executive Committee in managing the project's resources so as to achieve the planned results. Its principal responsibilities are to:

- Participate, together with UNDP, in selecting the National Consultant / Project Coordinator.
- Designate a representative to act as a permanent liaison between UNDP, the Ministry of Foreign Affairs and the Project Coordinator, both in the Executive Committee and the Technical Committee, to ensure that the necessary inputs are available to execute the project.
- Provide the technical and administrative capacity to develop the project.
- Provide the technical support for the Regulation while gradually shifting the responsibility toward the permanent government structures.
- Check the project's plan and progress.
- In a letter to UNDP, provide the name and describe the functions of the person or persons authorized to deal with UNDP concerning the project's administrative and financial matters.
- In a letter to UNDP, provide the name and describe the functions of the person or persons authorized to sign the project's budget and/or substantive revisions made to it.

United Nations Development Programme (UNDP): UNDP is the world development network established by the United Nations with a mandate to promote development in countries and to connect them to the knowledge, experience and resources needed to help people achieve a better life. Its principal responsibilities are to:

- Designate a programme officer responsible for providing substantive and operational advice and to follow up and support the project's development activities.
- Administer the financial resources agreed in the revised work plan and approved by the project's Executive Committee, and inform the Executing Agency and the Executive Committee of its origin and destination.
- As agreed with the Executive Committee, advise the project on management decision making.
- Be part of the project's Executive Committee.
- Supervise and follow up every project activity requiring UNDP administrative support.
- Use national and international contact networks to assist the project's activities and establish synergies between projects in common areas and/or in other areas that would be of assistance when discussing and analyzing the project.
- As deemed necessary, use the project's resources to prepare external evaluations and audits and to monitor them.
- Provide technical advice to the project on including activities on transversal equality of gender and strengthening civil society participation. These specialized services will be provided on the condition that the costs will be totally recovered.

Project Coordinator: these functions will be developed by the UNDP Mexico´s Environment and Energy Programme Team, in close collaboration of the national consultant.

Relevant functions:

- Follow up on progress made on the tasks outlined in the work plan.
- Prepare, and monitor compliance with work plans (annual and quarterly).
- Prepare budgets (annual and quarterly).
- Revise the project's technical and administrative documents.
- Prepare technical, financial and progress reports (quarterly, annual and final).
- Inform the Executive Committee and the Technical Committee of the project's progress, problems and possible solutions adopted and/or recommendations on how to achieve its objectives.
- Provide the technical capacity needed to develop the project.

National and international consultants: The National Consultant will prepare technical reports of progress (quarterly, annual and final) will prepare work plans (annual and quarterly) and organize the Regular meetings of the Steering Committee, to monitor project progress and identify and resolve bottlenecks. At these meetings the Implementing Agency and UNDP will provide lines of action in writing to the National Consultant. Also, the National Consultant will prepare and submit Tare a report of the status of the project, previously approved by the executive agency and the UNDP, in (s) meeting (s) tripartite. The National Consultant will organize the workshops planned in the Project work plan.

The international consultant, not contracted by the project, will prepare the report's Technical Analysis offers, if it implement, and evaluate the invoices sent by the UNDP, so that once approved by him, the UNDP can proceed with the payments.

Project Meeting. The Project Meeting is the project's supervisory and decision making body that meets at least twice a year. It consists of:

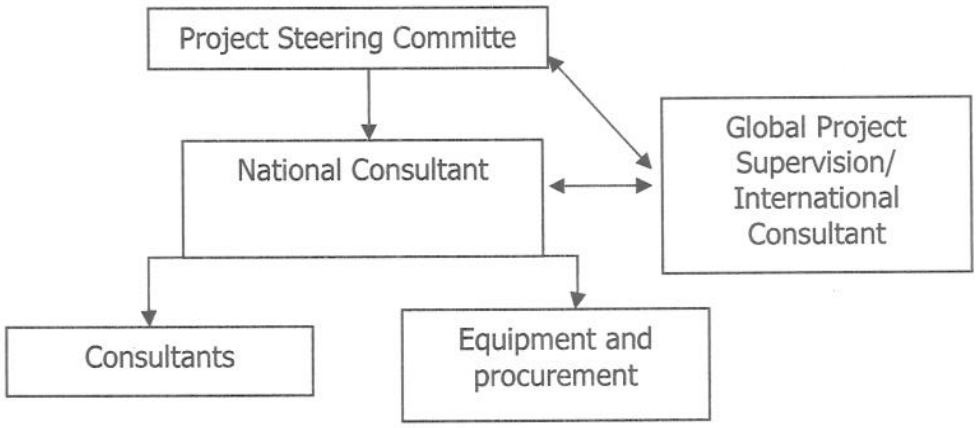
- The UNDP Programme Officer or representative.
- A representative of SEMARNAT.
- The National Consultant.

Its principal functions are to:

- Monitor compliance with the project's objectives.
- Prepare, focus on, or redesign the project's strategy.
- Approve work plan and budget revisions.
- Monitor both the budget and the prompt delivery of financial, human and technical inputs to comply with the work plan.
- Ensure satisfactory compliance with UNDP norms and procedures.
- Convene ordinary meetings to consider the Technical Committee's proposals and recommendations, as well as the progress made by the project.
- Convene, if necessary, extraordinary meetings.
- Prepare, when necessary, a substantial revision of the project document.

Structure of the project

The Project will be implemented under the UNDP National Implementation modality (NIM) and will follow standard UNDP rules and procedures for project implementation. The following diagram shows the chat for the project:



Administrative Arrangements

1. To administer the resources, UNDP will make its installed capacity available to the project, guaranteeing that its use is both transparent and prompt. The budget and work plan are provided in Annexes B and C of this document. If modifications are made to this section, they must be considered and approved by the Steering Committee, and UNDP written approval must be requested.

Any services provided to the project by UNDP will be in accordance with its internal guidelines and regulations.

2. The project will be financed by the Montreal Protocol with a total amount of **US$ 291,500 for Phase I**.

3. As an Implementing Agency, UNDP earns a fee from the Montreal Protocol upon approval of the project. The fee is used to cover costs incurred, both at Headquarters and in Country Office, in supporting project development and implementation (3%). The total fee that UNDP will receive is of US$ 8,745, at a of 3%. The cost recovery for the administration of the project will be handled under the modality of the Implementation Support Services (ISS) based on UNDP's Universal Price List.

4. If payment is made in a currency other than United States dollars, its value will be determined by applying the United Nations operational exchange rate in force on the date of payment. If, before UNDP has used the total amount deposited, there is a change in the United Nations operational exchange rate, it will be adjusted in line with the value of the balance of unused funds. If this leads to a loss in the value of that balance, UNDP shall inform the donor with a view to determining whether the donor must provide additional funds. If these additional funds are not available, UNDP may reduce, suspend or cancel its assistance to the project.

5. Activities will also have to be adjusted to the cash funds available; also in this case, if there is a deficit because of the exchange rate, UNDP has the obligation to inform the Executing Agency to determine whether it is necessary to transfer additional funds or simply to make budget changes.

6. If the event the project is suspended, reduced or cancelled, UNDP will return the unused funds at the United Nations operational exchange rate in force on the date they are returned; if there is an exchange rate loss, the deficit will be charged to the project.

7. In case of a surplus, the Steering Committee will decide how it is to be spent and what results are expected and will make the necessary work plan adjustments.

8. Because the Steering Committee will supervise and monitor the project based on a satisfactory and detailed work plan design, no unforeseen circumstances are expected that would imply administrative risks in its execution.

9. It is envisaged that, as the project proceeds, counterparts will be added as partners to implement it or as donors, and they may be either state governments or federal executive entities.

Commitments by UNDP and the Mexican government to provide support services

10. The support services required of UNDP will be provided in accordance with the conditions mentioned below.

11. The UNDP office in the country can provide the necessary support services and assistance requested, whether to prepare reports or make direct payments. In providing these services, UNDP Mexico will check whether the capacity of the designated institution has been increased to enable it to directly carry out these activities.

12. The UNDP country office , when asked to do so by the designated institution, may request support services for the programme or project, including:

- National and international technical support provided by the United Nations System.
- Project design and strategic planning.
- Project administration by making technical and financial follow-up available, with a results-based approach.
- Develop international, national and local international knowledge networks based on United Nations System experience.
- Select project personnel, assist in awarding contracts and suggest candidates (individuals or companies) for the project's substantive and administrative work.
- Acquire goods and services, in accordance with its procedures and policies.
- The acquisition of goods and services as well as contracting personnel for the project are both the responsibility of the Executing Agency. It is important to mention that the candidates for the posts of Coordinator and Administrative Assistant should be selected jointly by the Executing Agency and UNDP Mexico.

13. Should any demands or controversies arise concerning the provision of services by the UNDP office in the country, they will be dealt with according to this document's basic assistance model.

14. If there are changes in the need for support services while the project is in force, the project document will have to be revised as mutually agreed by the UNDP Resident Representative and the counterpart institution.

Audit

15. Auditing the project is an integral part of UNDP financial and administrative management within the framework of UNDP's accountability. The project will be audited to ensure that resources are administered in accordance with the financial regulations, the project document clauses and conditions, and the budget.

16. The project's budget should contemplate the resources needed to undertacke its audit and/or to establish, at the beginning of its activities, whether the internal accounting section should be responsible for rendering accounts.

Special considerations

17. Publications, research and products that are generated as part of what is proposed is owned by UNDP. All print and electronic material produced as a result of this project must bear in a visible and similar size logos of UNDP and SEMARNAT; quote the full title of the project; and give credit for the Montreal Protocol sponsorship.

18. In addition, all publications produced as a consequence of this document must include the following disclaimer:
The opinions, analyses and policy recommendations do not necessarily reflect the point of view of the United Nations Development Programme, of its Executive Board or of member states.

Security

19. It is UNDP's priority to ensure conditions of security within the project operation, and the project offices must comply with security requirements and operational standards established by the United Nations Department of Safety and Security (UNDSS).

20. The project won´t require staff for its operation. The single National Consultant will be in charge of the coordination of the procurement.

21. All project workshops and public gatherings promoted by the project will be held with external static security, ensuring safety of staff and participants.

22. Finally, UNDP regularly circulates a memo to those geographic areas that are considered at greatest risk for project staff. The project national consultant will be informed of the status of these areas. If a travel is necessary to the areas that are in a high security phase (indicated by UNDSS), the consultant will need to complete the Advanced Course on Security the Field course and must obtain the security clearance by DSS.

Learning, Knowledge Sharing and Communication Strategy

23. As a global knowledge network, UNDP promotes the sharing of experiences and lessons learned from the projects, so that they can be shared within countries and the rest of the international community to help people build a better life.

24. UNDP, in coordination with its implementation partners, will promote the systematization of experiences and dissemination of the products emerged from the project framework as a crosscutting activity in parallel to the achievement of the outcomes. These activities are included in the annual work plan of the project and a percentage of its budget shall be allocated for this purpose.

25. Results from the project will be disseminated within and beyond the project intervention zone through a number of existing information sharing networks and forums and to other countries in order to follow up on the findings spenced by this pilot project. These activities will be promoted by UNDP´s Regional Center in Panama and New Youk UNDP Headquarters as part of the second phase.

26. The project will also identify, analyze, and share lessons learned that might be beneficial for the design and implementation of similar future projects.

27. Communication and awareness-raising activities are key components of this project and are expected to support all other components by creating awareness and incentives among SMEs to participate in the project.

28. Similarly, UNDP and the Implementing partner shall participate in the promotion of these outcomes by taking advantage of the dissemination program of the United Nations, events related to the project and other common interest areas.

29. Finally, UNDP will follow a policy of access to information with respect to the project, respecting the information which the implementation partner considers confidential.

Legal Context

30. This Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement between the Government of the Republic of Mexico and the United Nations Development Programme, signed by the parties on February 23, 1961. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the government co-operating agency described in that Agreement.

31. The UNDP Resident Representative in Mexico is authorized to effect in writing the following types of revision to this Project Document, provided that he/she has verified the agreement thereto by the UNDP-GEF Unit and is assured that the other signatories to the Project Document have no objection to the proposed changes:

a) Revision of, or addition to, any of the annexes to the Project Document;
b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of the inputs already agreed to or by cost increases due to inflation;
c) Mandatory annual revisions which re-phase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility; and
d) Inclusion of additional annexes and attachments only as set out here in this Project Document

SECTION III : Total Budget and Workplan

Total Budget

	Project	Agency Fee	Total
Montreal Protocol	291,500	8,745	300,245
Co-financing	200,000		200,000
Total	491,500	8,745	500,245

Project Co-financing

Sources of Co-financing	Type of Co-financing	Amount
Project Government Contribution (SEMARNAT	In kind	5,000
Private Sector	In kind	195,000
Total co-financing		200,000

Project Budget

Award ID:	
Business Unit:	MEX10
Project Title:	Pilot project for validation of Methyl Formate in Polyurethane Shoesole Applications (Phase-I)
Project ID:	
Implementing Partner (Executing Agency)	SEMARNAT

Outcome/Atlas Activity	Responsible Party	Fund ID	Donor Name	Atlas Bud. Account Code	ATLAS Budget Description	Amount Year 1 (USD)	Total (USD)
OUTCOME 1: Methyl formate use in polyurethane shoesole applications demonstrated, developed, optimized, and disseminate as an alternative to the HCFC phaseout technology.	**SEMARNAT**	**63080**	**Montreal Protocol**	71200	International Consultants	40,000	40,000
				71300	Local consultant	6,000	6,000
				72100	Service Contracts	100,000	100,000
				74200	Communication and materials	45,000	45,000
				72200	Equipment	60,000	60,000
				71600	Travel	10,000	10,000
				74100	Professional Services (Workshops)	25,000	25,000
				74500	Miscellaneous	5,500	5,500
					Total outcome 1	**$291,500**	**$291,500**
					PROJECT TOTAL	**$291,500**	**$291,500**

Budget Comments

International Consultants	Supervision of the Global experts to the pilot results (include travel)
Local consultant	National Consultant who leads the project execution
Service Contracts	System development.
Communication and materials	Documentation of the project results and communication to global supervision committee
Equipment	Instruments, supplies and machinery needed for the project implementation
Travel	Including Zadro, local consultant, UNDP staff, etc.
Professional Services (Workshops)	Dissemination workshop
Miscellaneous	Contingencies

IMPLEMENTATION/MONITORING

Following implementation schedule applies:

TASKS	2008	2009				2010			
	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Project Start-up									
MF Project Approval	X								
Receipt of Funds			X						
Grant Signature			X						
Management activities									
-Monitoring/oversight activities in place			X						
Phase-I									
-Procurement			X						
-Installation			X						
-System development			XXX						
-System optimization			XX						
-System validation at system house			XXX						
-Peer review/detailed design of phase- II				X					
-Approval phase-II					X				
- Technology Dissemination Workshop(s)					XX				
Phase-II									
-Prepare individual Implementation plans					X				
-Procurement					X				
-Installation/start-up						XX			
-Trials						XX			
-Certificates of Technical Completion (COCs)							XX		
-Handover Protocols (HOPs)								XX	
-Completion Report (PCR)									X

MILESTONES FOR PROJECT MONITORING

TASK	MONTH*
(a) Project document submitted to beneficiaries	2
(b) Project document signatures	3
(c) Bids prepared and requested	3, 9
(d) Contracts Awarded	3, 9
(e) Equipment Delivered	4, 11
(f) Training Testing and Trial Runs	4, 12
(g) Commissioning (COC)	14
(h) HOP signatures	15
(1) Compliance Monitoring	17

* as measured from project approval

SIGNATURE PAGE

Country: Republic of Mexico

United Nations Development Programme
Project Document

Project Name: Pilot project for validation of Methyl Formate in Polyurethane Shoesole Applications (Phase-I)

UNDAF Outcome: Institutional and individual capacities strengthened to stop and/or reverse environmental degradation, support natural resources conservation, encourage participatory management, natural resources governance and promote human development through policies and programs for sustainable development.
Expected Outcome(s)/Indicator(s): Strengthening the management of public policies and citizenship for sustainable development
Expected Outputs(s) /Indicator(s): Support to adaptation of integrated environmental program
Implementing Partner: Ministry of Environment and Natural Resources (SEMARNAT)

Programme Period:_2009-2013 Programme Component: Energy & Environment Project Title: Pilot project for validation of Methyl Formate in Polyurethane Shoesole Applications (Phase-I) Project ID: Project Duration: 7 Months Management Arrangement: NEX	Total budget: 291,500 US$ Allocated resources: • Government (in-kind and cash) • Local government (in-kind and cash) • Private e Sector • Other: o Montreal Protocol 291,500 US$ o Donor _____ o Donor _____

Aproved by:	**Sign:**	**Date:**	**Name and Title:**
Ministry of Environment and Natural Resources (SEMARNAT)		24/08/09	Ms. Ana María Contreras General Director of Air Quality
Ministry of Foreign Affairs (SRE)			Mr. Maximo Romero Jiménez General Director of Scientific and Technical Cooperation
United Nations Development Programme (UNDP)		14/09/09	Mr. Magdy Martínez-Solimán Resident Representative

ANNEX-1
HCFC PHASEOUT TECHNOLOGIES IN IN FOAM APPLICATIONS

I. INTRODUCTION

HCFCs are currently used as blowing agents in polyurethane (PU) foams (predominantly rigid and integral skin) and extruded polystyrene (XPS) boardstock foams. To replace these HCFCs, following criteria would ideally 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, and
- Economically viable.

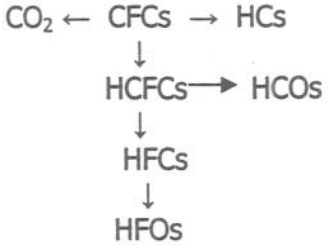
Not all replacement technologies that are currently available meet these criteria. Following assessment has been divided into the two applicable foam polymer groups: polyurethanes (PU) and (extruded) polystyrene (XPS) foams.

II PU FOAMS

CFC phaseout in rigid and integral skin foams has been mostly achieved by replacement through

- Hydrochlorofluorocarbons (HCFCs)
- Hydrocarbons (HCs)
- Carbon dioxide (CO_2), generated from water/isocyanate or directly as liquid or gas

HCFCs, in turn have already been replaced in many industrial countries by hydrofluorocarbons or HFCs which in the near future, in turn, may have to be replaced by other, non-ODS/low GWP alternatives. At the same time, suppliers are looking to reduce flammability and other safety-related issues. In the new compound, oxygen has been introduced to reduce GWP for HFCs, leading to HFOs (by some called second generation HFCs) or to reduce the flammability of HCs, leading to HCOs (esters, ethers, aldehydes and ketones). The identity of some new developments has not yet been released. But which makes the following scenario for now speculative—but compelling:



In each column, the last step is non ODP, low GWP, low toxicity and reduced or eliminated flammability.

Using GWP and molecular data as provided by the FTOC (2006), following indicative GWP changes are to be expected for available or emerging replacements of HCFC-141b in PU foam applications:

SUBSTANCE	GWP	MOLECULAR WEIGHT	INCREMENTAL GWP[2]	COMMENTS
HCFC-141b	713	117	Baseline	
CO_2	1	44	-712	Used direct/indirect (from water)
Hydrocarbons	11	70	-710	Extremely flammable
HFC-245fa	1,020	134	455	
HFC-365mfc	782	148	276	Mostly used 95% pure
HFC-134a	1,410	102	516	
Methyl formate	0[1]	60	-713	97.5% pure (supplier information)
Methylal	0[1]	76	-713	Only reported for co-blowing
Acetone	n/k	58	n/k	Only used in flexible slabstock
FEA-1100	5	n/k	~700-710	Under development
HBA-1	<15	<125	<697	Under development
HBA-2	n/k	n/k	n/k	No published data yet
AFA-L1	<15	<134	>696	

[1]Zero GWP is not possible. Negligible would be a better description
[2]It should be noted that the incremental GWP is the effect expected based on 100% HCFC 141b replacement by just one alternative on an equimolecular base. In practice this will not always be the case. Formulators may increase water, reducing in this way the GWP impact—but also decreasing the foam quality—or use a blend of physical blowing agents. In addition, replacements are not always equimolecular as solvent effects, volatility and even froth effect (HFC-134a and to a lesser extent HFC-245fa) may impact the blowing efficiency. The table therefore provides a guideline rather than an absolute assessment.

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 co-blowing agent in almost all PU foam applications and as sole blowing agent in many foam applications that have no or minor thermal insulation requirements. The exothermic reaction restricts the use, however to about 5 php and therefore to foams with densities >23 kg/m^3. While this restriction mostly applies to open-cell flexible foams which do not use HCFCs, another restriction based on the relatively emissive nature of CO_2 in closed-cell foam is more serious. To avoid shrinkage, densities need to be relatively high which has a serious detrimental effect on the operating costs up and above the poor insulation

value. Nevertheless increased use of water/CO_2 has been and still is an important tool in the HCFC phaseout in cases where HCs cannot be used for economic or technical reasons. There is no technological barrier. However, the use of water/CO_2 alone will be limited to non-insulation foams such as

- Integral skin foams (with restrictions when friability is an issue)
- Open cell rigid foams
- Spray/in situ foams for non/low thermal insulation applications

Carbon dioxide can also be added directly as a physical. This is mostly the case in flexible foam and therefore not an HCFC replacement. However, reportedly (FTOC, 2008), there is use of super-critical CO_2 in up to 10% of all sprayfoam applications in Japan. Technical details are not known. Supercritical CO2—as has been the case with LCD in CFC phaseout projects—is a demanding and expensive technology and its usefulness in A5 projects questionable.

HYDROCARBONS

There have been many HC-based/MLF-supported CFC-phaseout projects in refrigeration and in panel applications. The minimum economic size has been typically ~50 ODP t/US$ 400,000 US$ with some exceptions for domestic refrigeration. Smaller projects were discouraged. Consequently, there is no 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 and n-pentane for panels.. Fine tuning through HC blends (cyclo/iso pentane or cyclopentane/isobutane) which are now standard in non-A5 countries is 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. However, there are options to fine-tune project costs and investigate other applications:

- The introduction of HC blends that will allow lower densities (lower IOCs)
- Direct injection (lower investment)
- Low-pressure/direct injection (lower investment)
- Centralized preblending by system houses (lower investment)
- Application-specific dispensing equipment

UNDP has initiated a study of these options. After a feasibility study on each option, validation projects may be formulated with recipients that are capable and willing to participate. After completion of this preliminary study the costs of validation project can be calculated.

HFCs

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

	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	12.4	12.0 (20 ^{0}C)	10.6 (25 ^{0}C)

(mWm^0K at 10 ^0C)			
Flammable limits in Air (vol. %)	None	None	3.6-13.3
TLV or OEL (ppm; USA)	1,000	300	Not established
GWP (100 y)	1,410	1,020	782
ODP	0	0	0

Current HFC use in A5 countries is insignificant. There is some use of HFC-134a in shoesoles—most notable in Mexico. Apart from the price, its use is complicated by its low boiling point. The use of other HFCs is limited to products for export—and even then sporadic. The low cost of HCFC-141b is just too compelling! On the other hand, these chemicals have played a major role in the replacement of HCFCs in foam applications in non-A5 countries—despite high GWP potentials.

Formulations are 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. UNDP has initiated a "clima proof" study based on blends proposed by chemical suppliers of HFC-245fa and HFC-365mfc. A recently developed "functional unit" approach—a simplified life cycle test will be applied in this study.

This approach has been described in some detail in UNEP/Ozl.Pro/ExCom/55/47. It is robust enough to meet Decision XIX requirements—addressing both energy and GWP—but does not require the individualized approach of full life cycle analyses. It would not only provide for a fair assessment of optimized HFC formulations but also demonstrate the use of the "Functional Unit" approach and facilitate the Secretariat's evaluation as requested by the ExCom in decision 55/43 (h). The assessment will be a desk study. It has not to be tied to a specific country and will be universally (globally) applicable.

METHYL FORMATE (ECOMATE®)

Methyl-formate, also called methyl-methanoate, is a low molecular weight chemical substance that is used in the manufacture of formamides, formic acid, pharmaceuticals, as an insecticide and, recently, as a blowing agent for foams. While its use as blowing agent for synthetic rubbers is reported in earlier literature, Foam Supplies, Inc. (FSI) in Earth City, MO has pioneered its use as a blowing agent in PU foams from 2000 onwards. The application has been patented in several countries. Presentations by FSI have been made at major PU conferences and to Foam Technical Options Committee (FTOC 2006).

Ecomate®, as FSI calls the product, is exclusively licensed to Purcom for Latin America, to BOC Specialty Gases for the United Kingdom and Ireland and to Australian Urethane Systems (AUS) for Australia, New Zealand and the Pacific Rim. Reportedly, AUS has also acquired the license for other Asian countries such as India and China. Technical and commercial claims made by FSI imply that the technology actually would reduce operating costs when replacing HCFC-141b, at minimum capital investment and comparable or better quality. This, of course would be of utmost interest for the MLF and its Implementing Agencies. However, these claims need to be verified and validated by an independent body before the technology can be applied in MLF projects. In case insufficient data are provided, additional data will have to be developed.

Ecomate® has been mentioned in a preliminary discussion paper for the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol (UNEP/Ozl.Pro/ExCom/54/54). The information, while qualified as being provided by the supplier, is used to develop data on investment cost and operating benefits that are displayed together with data from technologies that have been extensively verified and validated in CFC phaseout projects and generates therefore the appearance of reliability. There is, however, market information that clearly contradicts this information and UNDP's conclusion—apparently shared by the FTOC—is that ecomate® technology is interesting and promising but immature, unproven in many foam applications and at this stage more expensive than HCFC-141b—and for that matter, hydrocarbons. Better, peer-reviewed data are urgently required if this technology is to be used in MLF projects.

Following data on physical properties have been taken from the FTOC-2006 and from a BOC MSDS:

Property	**Methyl Formate**	**HCFC-141b**
Appearance	Clear liquid	Clear liquid
Boiling point	31.3 °C	32 °C
LEL/UEL	5-23 %	7.6-17.7
Vapor pressure	586 mm Hg @ 25 °C	593 mm Hg @ 25 °C
Lambda, gas	10.7 mW/m.k @ 25 °C	10.0 mW/m.k @ 25 °C
Auto ignition	>450 °C	>200 °C
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

According to information from FSI, ecomate® has the following advantages compared to HCFC-141b when used in foam manufacturing (only those important under A5 conditions are listed):

- Liquid at ambient process conditions
- Zero ODP
- Zero GWP
- Lower IOCs
- Good solubility
- Low volatility
- Good system stability
- Good foam properties
- Good thermal insulation properties
- Good flammability resistance
- Safe handling

FSI does not mention actual system costs; it claims the technology being "*economically advantageous*". It relates this to being more effective—51% of HCFC-141b. Total costs are indicated as follows:

Blowing Agent	**Mol Wt**	**Factor**	**US$/Lb**	**US$/mole**
HCFC-141b	117	1.00	++	Ref

HFC-245fa	134	1.15	+++++	+350%
HFC-365/227	149	1.27	++++	+380%
cC5	70	0.60	++	- 45%
nC5	72	0.62	+	- 70%
ecomate®	**60**	**0.51**	++	- 65%

In the USA, Ecomate® is not treated as a volatile organic component (not a smog generator) and SNAP approved. In Europe it is compliant with the RoHS and WEEE 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).

The IPCS profile mentions in addition that "*vapor/air mixtures can be explosive*". FSI reports a case study that shows process emissions to be lower than 100 ppm, which is less than the STEL and TWA and therefore would require no special precautions in the manufacturing area. Ecomate® is normally sold as a system, which would restrict flammability issues to the supplier. Shipping of systems is possible without "flammable" tags.

As applications for ecomate®, FSI is mentioning

- Rigid pour and spray foams,
- Integral skin foams, and
- Flexible molded and slabstock foams.

Reportedly, Brazil is the only A5 country where ecomate® is used. The licensee for Latin America, a large system house, was contacted for more information. The company stated that they have spent much efforts in system development for ecomate® which has by now replaced about one third of their HCFC business. Current commercial applications (which indicates mature product) are in integral skin foam (steering wheels), panels (discontinuous) and commercial refrigeration (bottle coolers; refrigerator doors). Because the technology is more costly than HCFC-141b (about 10%), customers use it only when the market demands it. This is the case for international corporations such as Coca Cola and for construction on behalf of international corporations (Wall Mart, Carrefour, ...).

Following information was provided and verified through customer visits:

Health, Safety, Environment – The licensee has not developed any data in addition to what FSI provides. It has not encountered HSE problems in its manufacturing plant or at customer level. This was confirmed through the two customer visits.

Performance in Thermal Insulation Foams – The licensee has measured (through independent testing) some deterioration in insulation value. Amazingly, one of its main customers—a major bottle cooler manufacturer—did not find any increase in power consumption and the product has been approved by Coca Cola. However, the customer produces ecomate® on its only high-pressure dispenser to take advantage of increased thermal performance provided by the smaller, more regular cells. The customer mentioned as positive point that ecomate® does not attack the refrigerator liner and that it could return to its pre-HCFC-141b, liner (an operational benefit!). Adhesion to metal liners is markedly improved. A refrigerator cabinet could not be stripped from foam without leaving considerable material on the liner. This is an improvement in particular to HC-blown foams. Purcom had to considerably

reformulate by changing polyols, catalyst package and stabilizer. The amount of methyl formate that can be used is limited, which results in the need to increase water levels. The costs of ecomate® is US$ 3.00/kg compared to US$ 2.00/kg for HCFC-141b but its use is 1/3-1/2 less (the use of HCFC-141b actually reduces system costs as the price is lower than the polyol price). The resulting system costs about 10% more and produces foams that are slightly higher in density (1-2 kg/m^3). Because of the price/density impact (about 10%), companies use ecomate® only when customers demand replacement of HCFC-141b. 3They all use HCFC-141b in other cases.

Performance in Integral Skin Foams – the licensee initially faced stability problems in the polyol side of the system and inferior skin that made the application for steering wheels—which requires low friability—a problem. The reason was the addition of formic acid to counter hydrolysis. Without stabilization, the polyol system is stable for just one day. It identified two options for improvement:

- Direct injection of methyl formate
- Incorporation of methyl formate in the MDI side

As most equipment is not equipped for a third stream it concentrated on the MDI option and was able to develop a stable system providing good skin, same density BUT, a considerably decrease in viscosity of the MDI side of the system. This is no issue for high-pressure dispensing equipment but causes ratio changes on low-pressure equipment. The ecomate® use is about two third of HCFC-141b and the polyol blend had to be changed drastically.

Performance in Other Applications – There is currently no use of ecomate® in other applications. Its use is at the moment customer rather than supplier driven. Large, international, image-sensitive corporations demand ODS-free, low GWP products. Consequently, the licensee has only pursued ecomate® when and where customer pressure has been exercised and will continue to do so unless some MLF-sponsored introduction program would be initiated.

Naturally, the physical properties of ecomate®, being nothing else than the long existing and well researched chemical methyl formate, are not controversial. UNDP has compared information provided by the owner of the technology, FSI, with actual (limited) experience from customers and its LA licensee. Following are detailed comments on the advantages claimed by FSI for ecomate®:

- **Zero ODP** – true, but so area all other listed alternatives
- **Zero GWP** – true, although negligible would be a better description
- **Liquid at ambient process conditions** – true, but so are most other listed alternatives
- **Good solubility** – this claim is appears correct and is confirmed for most polyols and MDI. However, why is the MSDS mentioning "*not miscible or difficult to mix*" (MSDS)?
- **Low volatility** – the volatility is about in the middle between other alternatives, with HFC-245fa being the highest (bp 15.3 °C) and cyclopentane the lowest (bp 49 °C)
- **Good foam properties** – this statement is too broad and, as yet, unproven for major applications. Based on results from applications where intensive formulation optimization has been performed, there should be some confidence that most property issues can be resolved given time and dedication

- **Good thermal insulation properties** – this is as of yet unproven. Tests on foam insulation values in Brazil are not good but product testing will be decisive in final determination
- **Good flammability resistance** – this statement has not yet been verified. However, information provided (Utech, 2006) lacks information on comparative testing
- **Safe handling** – handling issues at the system house—where industrially pure methyl formate (97.5%) is processed needs further investigation. Information on the handling of systems indicates safe processing conditions with <22%LEL @ 30-32 °C; <100 ppm LEL
- **Good system stability** – while rigid foam systems appear to be stable, polyol/ecomate systems for ISF are instable in Brazilian tests
- **Lower IOCs** – this claim cannot be confirmed. From experience in ISF and rigid insulation foams in Brazil, 10-15% increase in system costs at current level of development can be expected compared to HCFC-141b. Compared to hydrocarbons, the difference is even larger. And, this statement even has to be qualified as preliminary because it pertains only to certain applications within the broader range of products and formulation optimization proves to be rather individually

While one cannot emphasize enough that ecomate® should be considered a highly interesting, potential financially beneficial, zero ODP and virtually zero GWP technology for MLF-sponsored HFCF phaseout projects, the information provided by the technology provider does not always match field experience and is, in addition, incomplete. UNDP intends to collect further validation information through:

- HSE testing
- Validation of ecomate® in all relevant applications

METHYLAL

METHYLAL

Methylal, also called dimethoxymethane, belongs to the acetyl family. It is a clear colorless, chloroform-like odor, flammable liquid with a relatively low boiling point. Its primary uses are as a solvent and in the manufacture of perfumes, resins, adhesives, paint strippers and protective coatings. It is soluble in three parts water and miscible with the most common organic solvents.

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

The use of Methylal as a co-blowing agent in conjunction with hydrocarbons and HFCs for rigid foam applications (domestic refrigeration, panels, pipe insulation and spray) has been described

in the literature. It is claimed that in continuous panels Methylal improves the miscibility of pentane, promotes blending in the mixing head, foam uniformity, flow, adhesion to metal surfaces and insulation properties, reducing simultaneously the size of the cells. In discontinuous panels, where most producers use non-flammable agents, the addition of a low percentage of Methylal to HFCs (245fa, 365mfc or 134a) makes it possible to prepare pre-blends with polyols of low flammability with no detrimental effect on the fire performance of the foam. Methylal reduces the cost, improves the miscibility, the foam uniformity and flow and the adhesion to metal surfaces. Co-blown with HFC-365mfc, it also improves the thermal insulation. In domestic refrigeration compared to cyclopentane alone Methylal increases the blowing rate and the compressive strength. In spray foam it reduces the cost of HFC-245fa or HFC-365mfc.

There is no known use of methylal as sole auxiliary blowing agent.

Despite all literature references, public knowledge of Methylal's industrial performance as blowing agent is quite limited. To validate its use as a possible replacement of HCFCs for MLF projects in developing countries, peer reviewed evaluations should be carried out to assess its performance in integral skin and rigid insulating foams. Following parameters should be carefully monitored:

- Fire performance in actual operating conditions (considering flammability of the pure chemical)
- Polyol miscibility, an advantage claimed in the literature
- Foam flow (taking into account the relatively high -compared to other blowing agents- boiling point)
- Foam thermal conductivity (Gas conductivity value is not reported)
- Skin formation. (A cited US patent suggests a clear benefit)
- Diffusion rate in the polyurethane matrix (in view of its high solvent power)

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. These are all geared towards replacement of HFCs and sometimes called "second generation HFS, although HFOs appears a more distinctive description. They share low/no flammability, zero ODP and insignificant GWPs:

	HBA-1	HBA-2	FEA-1100	AFA-L1
Chemical Formula	n/k	n/k	n/k	n/k
Molecular Weight	<125	n/k	161-165 (estimated)	<134
Boiling point (^{0}C)	<-15	n/k	>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 (proposed)	n/k	n/k	n/k
GWP (100 y)	0	0	0	0
ODP	6	n/k	5	Negligible

Except HBA-1, all chemicals still have to undergo substantial further toxicity testing and will therefore not appear in the market within two years. That may be too late in the A5 context where foam conversion is prioritized. As to HBA-1, this will be targeted as a replacement of HFC-134a in one component foams. There are only few OCF manufacturers in developing countries.

III XPS BOARDSTOCK

Extruded polystyrene foam can be divided into sheet and boardstock applications. In virtually all sheet applications CFCs have been replaced by hydrocarbons—butane, LNG and LPG. In boardstock, most of the replacement has been a blend of HCFC-142a and HCFC-22 in a 70-80%/30-20% ratio. The use of HCFC-22 was aimed at countering HCFC-141b's (modest) flammability. With the prices of HCFC-22 ever decreasing, many manufacturers—mainly in China—have converted to HCFC-22 alone. This has exacted an as of yet undetermined toll on the product quality as HCFC-22 escapes relatively quick from the foam, causing shrinkage and deteriorating insulation values.

The 2008 FTOC update reports that the phaseout of HCFCs in non Article 5 countries has been—and continues to be—a problem. North American XPS boardstock producers are on course to phaseout HCFC use by the end of 2009. Phaseout choices will be 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 (or CO_2/alcohol) while in Japan there has also been significant use of hydrocarbons. Recently introduced so called F-Gas regulations in Europe may change the scenario in that region.

Most XPS boardstock manufacturing in Article 5 countries appears to be in China (60,000t) and Turkey (10,000 t). There is at least one plant in Argentina and one in Egypt. This application has not been well researched by the TEAP because it was traditionally a non-A5 market. But now only in China, approximately 350 small-scale XPS plants have been installed since 2001.

Options for HCFC replacement are:

SUBSTANCE	COMMENTS
HFC-134a	Considered expensive
HFC-152a	Moderately flammable and considered expensive
(Iso)butane	Highly flammable; high investment
CO_2	As gas only capable to replace 30% of the BA. As liquid, high investment. Considered in combination with other technologies (HCs, ethanol)
HBA-1	Non-flammable, ideal boiling point, but still experimental

There may be different solutions for different baselines. In view of the fact that Chinese manufacturers are reported using only HCFC-22 as blowing agent, it is expected that 100% replacement by a hydrocarbon would be possible without (further) deterioration of quality. This would provide the Chinese market with a truly non-ODS, virtually non-GWP option. However,

the emission of hydrocarbons over an extended period is of concern, being different from XPS sheet. Therefore, as part of a validation, a thorough safety assessment will need to be performed.

Very important will be to evaluate the possible use of HBA-1. This substance appears to offer the same advantages of hydrocarbons without the fire risk and to offer improved insulation value compared with other HCFC replacements. But, with no diffusion data available, this is a very preliminary statement. UNDP is in contact with its manufacturer, Honeywell, which has in principle agreed to support a validation project. Details need to be worked out.

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:

SUBSTANCE	GWP	MOLECULAR WEIGHT	INCREMENTAL GWP	COMMENTS
HCFC-142b/-22	2,148	95	Baseline	
HCFC-22	1,780	87	-518	Used in China only (lower cost) Non flammable
HFC-134a	1,410	102	-634	Non flammable
HFC-152a	122	66	-2,063	Moderately flammable
(Iso)butane	4	58	-2,156	Flammable
CO_2 (LCD)	1	44	-2,148	Used in Japan only Non Flammable
HBA-1	6	<115	~ 2,100	In development Non flammable

Based on these data, it appears that

- HCs, CO_2 (LCD) and HBA-1 are by far the lowest GWP—indeed virtually zero ODP—options
- HFC-152a's GWP is below the EU threshold of 150. It may therefore be an acceptable alternative from a clima change perspective

The XPS boardstock program may therefore include:

- HFC-152a
- Hydrocarbons
- Carbon Dioxide (gas or liquid)
- HBA-1

ANNEX-2
DETAILED COST CALCULATIONS

#	ACTIVITY	INDIVIDUAL COSTS	EXPLANATIONS
PHASE-I – DEVELOPMENT/OPTIMIZATION/VALIDATION			
1	Preparative work Project Preparation Technology Transfer, Training	 25,000 75,000	 Partially retroactive Include license for 2 years
2	System Development Development (7 applications) @ 5,000 Optimization (7 applications) @ 3,000 Validation (7 applications) @ 2,000	 35,000 21,000 14,000	Does not include labor—just chemicals and external testing
3	Laboratory Equipment Laboratory Safety	50,000 10,000	See below For explosion proofing
4	Peer review/endorsement of next phase	20,000	
5	Contingencies (10%)	24,000	
PHASE-II – HCFC PILOT PHASEOUT PROJECTS COVERING ALL FORMULATIONS			
1	System House adaptations 1 Blender 1 Tank for MeF Safety measures Contingencies (10%)	 50,000 20,000 25,000 9,500	)))Taken from previous projects
2	Downstream user Operations (7) 7 Retrofits @ 15,000 7 Trial Programs @ 3,000 Contingencies (10%)	 105,000 21,000 12,600	)))As per MLFS template
4	Peer review/safety audits	20,000	)
5	Incremental Operating Costs	267,100	1 visit/travel/per diem/reporting See below
PHASE III – TECHNOLOGY TRANSFER TO SYSTEM HOUSES			
1	Technology transfer workshop Instructional booklets Contingencies	20,000 5,000 2,500	

Laboratory equipment	Refractometer		5,000
	Brett mold		5,000
	pH tester		5,000
	Abrasion tester		15,000
	Cell gas analyzer		20,000
	Total	**US$**	**50,000**

Incremental operating costs are based on 4.5 % increased system costs as per Purcom information. For two years this amounts to

4.5% of 1,074 t @ 3.200 x 1.74 = US$ 267,099.20 (say 276,100)

This being a pilot project, these costs are a forecast, extrapolated from experience in Brazil. A better forecast can be provided after completion of Phase-I, in the funding request for Phase-II.

ANNEX-3

TRANSMITTAL LETTER SYSTEMS HOUSE (TEMPLATE)

SUBMISSION OF A PILOT PROJECT FOR FUNDING UNDER THE MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL[3]

System house Commitments

ZADRO, represented by Mr. Jose Luis Ordaz, owner/Director having agreed to the preparation of a project for the consideration of the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol to validate the use of methyl formate as replacement of HCFC-141b in the manufacture of polyurethane foam shoesoles following and in compliance with ExCom decision 55/43 (e), makes the following commitments for the implementation of the project with the assistance and in cooperation with the United Nations Development Programme (UNDP) and with the consent of the Government of Mexico's National Ozone Unit (NOU).

ZADRO:

1. Agrees to implement the project as approved, abiding by relevant decisions relating to change in technology;

2. Is aware that a validation project does not have a secure outcome. In case the validation is successful, it will permanently convert participating customers to the use of methyl formate. In case the validation will be negative, it will undertake conversion of the participating customers to another, validated, non-ODP/low GWP technology in consent with other stakeholders and the Executive Committee for the Implementation of the Montreal Protocol;

3. Is aware and accepts that, with the view to ascertaining that equipment purchased by the Multilateral Fund is being used or is not reverted to the use of HCFCs, the NOU is mandated to monitor closely in cooperation with customs and environmental protection and/or other relevant authorities, the import and/or purchase and use of CFCs by the enterprise, including unscheduled visits to the factory. The company and the NOU may determine the number of such unscheduled visits.

4. Is aware that the implementing agency has the obligation to ensure appropriate use or refund of unused contingency funds and to keep funding requests for equipment and trials to levels essential for the conversion;

5. Will cooperate in the preparation of regular reports through UNDP and the NOU to the Multilateral Fund on the status of the project's implementation;

6. Agrees to cooperate with the implementing agency to return funds in case of identified serious funding irregularities, such as when project funds were used to purchase

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[3] *This note should be prepared on company letter head and attached as Annex I to each project document. A copy should be lodged with the NOU to be appended to its record of the Government's Note of Transmittal of the sector projects.*

non-eligible items and the implementing agency was requested by the Executive Committee to return funding to the Multilateral Fund;

7. Is aware and accepts that the implementing agency in cooperation with the NOU is required to conduct safety inspections where applicable and to prepare a report on accident resulting from conversion projects.

8. Commits to destroy or render unusable any equipment or component of equipment replaced by this project in line with the stipulations that have been drawn up in the project document.

9. Commits to provide funds for items that are included in this project but are specifically excluded from funding by the Multilateral Fund of the Montreal Protocol (MLF) as well as for items included in this project and required for a successful completion but that, while eligible, exceed the available budget and contingencies.

Name and Signature of Authorized Company Representative:

_____

Designation: Date:

_____

_____

Address: _____

_____

Telephone: Fax: _____

E-mail: _____

Name and Signature of Representative of NOU Date:

_____