NATIONS
UNIES

EP

Programme des Nations Unies pour l'environnement

Distr.
GÉNÉRALE

UNEP/OzL.Pro/ExCom/74/25
16 April 2015

FRANÇAIS
ORIGINAL : ANGLAIS

COMITÉ EXÉCUTIF DU
FONDS MULTILATÉRAL AUX FINS
D'APPLICATION DU PROTOCOLE DE MONTRÉAL
Soixante-quatorzième réunion
Montréal, 18-22 mai 2015

PROPOSITION DE PROJET : COLOMBIE

Le présent document contient les observations et la recommandation du Secrétariat du Fonds sur la proposition de projet suivante :

Mousse

- Projet de démonstration sur la validation de l'utilisation d'hydrofluoro-oléfines dans les panneaux en discontinu et la mousse projetée fabriqués dans les pays Parties visées à l'article 5, en ayant recours à des formules présentant un bon rapport coût-efficacité — PNUD

FICHE D'ÉVALUATION DU PROJET – PROJET NON PLURIANNUEL

COLOMBIE

TITRE DU PROJET		AGENCE BILATÉRALE/D'EXÉCUTION
a)	Projet de démonstration sur la validation de l'utilisation d'hydrofluoro-oléfines dans les panneaux en discontinu et la mousse projetée fabriqués dans les pays Parties visées à l'article 5, en ayant recours à des formules présentant un bon rapport coût-efficacité	PNUD

ORGANISME NATIONAL DE COORDINATION	Ministère de l'environnement Unité nationale d'ozone

DERNIÈRES DONNÉES DÉCLARÉES SUR LA CONSOMMATION DE SAO PRISES EN COMPTE DANS LE PROJET

A : DONNÉES DE L'ARTICLE 7 (TONNES PAO, 2013, EN DATE DU MOIS D'AVRIL 2015)

HCFC	176,65		

B : DONNÉES SECTORIELLES DU PROGRAMME DE PAYS (TONNES PAO, 2013, EN DATE DU MOIS D'AVRIL 2015)

HCFC-22	57,9
HCFC-123	2,1
HCFC-141b	115,1
HCFC-142b	0,6
HCFC-141b dans des polyols prémélangés importés	0,9

Consommation restante de HCFC admissible au financement (tonnes PAO)	146,63

AFFECTATIONS DANS LE PLAN D'ACTIVITÉS DE L'ANNÉE EN COURS		Financement (millions $US)	Élimination – tonnes PAO
	a)		s.o.

TITRE DU PROJET :	
SAO utilisées à l'entreprise (tonnes PAO) :	13,75
SAO à éliminer (tonnes PAO) :	0,44
SAO à introduire (tonnes PAO) :	0,00
Durée du projet (mois) :	12
Montant initial demandé ($US) :	459 450
Coût final du projet ($US) :	
Surcoût d'investissement :	339 500
Imprévus (10 %) :	33 950
Surcoût d'exploitation :	36 000
Suivi et compte rendu :	50 000
Coût total du projet :	459 450
Participation locale (%) :	100 %
Élément d'exportation (%) :	0 %
Subvention demandée ($US) :	459 450
Rapport coût-efficacité ($US/kg) :	s.o.
Coût d'appui de l'agence d'exécution ($US) :	32 162
Coût total pour le Fonds multilatéral ($US) :	491 612
Financement de contrepartie confirmé (O/N) :	O
Étapes de suivi du projet incluses (O/N) :	O

RECOMMANDATION DU SECRÉTARIAT	En attente

DESCRIPTION DU PROJET

1. Au nom du gouvernement de la Colombie, le PNUD, en qualité d'agence d'exécution désignée, a soumis à l'examen du Comité exécutif à sa 74e réunion, une demande de financement pour un projet de démonstration sur la validation de l'utilisation d'hydrofluoro-oléfines (HFO) dans les panneaux en discontinu et la mousse projetée fabriqués dans les pays Parties visées à l'article 5, en ayant recours à des formules présentant un bon rapport coût-efficacité, pour un montant de 459 450 $US, plus des coûts d'appui d'agence de 32 162 $US. Ce projet vise à donner suite à la décision 72/40[1]. La proposition initiale est jointe au document.

Objectif du projet

2. Le projet de démonstration propose ce qui suit : valider les HFO dans des formules de polyuréthane à teneur réduite en HFO pour les panneaux en discontinu et la mousse pulvérisée; optimiser le rapport coût-performance afin d'obtenir une mousse dont le rendement thermique est semblable à celui des formules à base de HCFC-141b; et réaliser une analyse de coût des différentes formules HFO/CO_2 par rapport aux formules à base de HCFC-141b.

Particularités du secteur et justification

3. Le secteur de la mousse de polyuréthane en Colombie fabrique de la mousse souple (mousse en plaques, moulée et à pellicule externe incorporée), de la mousse rigide et des élastomères microcellulaires (semelles de chaussure). Les panneaux en discontinu et la mousse pulvérisée comptent pour respectivement 33 pour cent (158 tonnes métriques (tm)) et 12,3 pour cent (59 tm) de la consommation totale de HCFC-141b dans ce pays.

4. Plusieurs Parties visées à l'article 5 ont opté pour la reconversion au cours de la première phase (2011-2015), les entreprises de mousse les plus importantes appartenant généralement aux secteurs de la réfrigération domestique et des panneaux en continu utilisant des HC. Ces pays devront s'occuper, au cours de la deuxième phase, des autres secteurs liés à la mousse (panneaux en discontinu, mousse pulvérisée et pellicule externe incorporée), composés de multiples microsociétés et petites et moyennes entreprises qui ne possèdent pas les ressources techniques et financières pour traiter en toute sécurité les substances inflammables. Ce facteur, ainsi que l'absence d'économie d'échelle, empêchent d'avoir recours à des agents de gonflage inflammables. Les HFO récemment mises au point ont présenté, pour les applications de mousse de polyuréthane rigide, un meilleur rendement thermique que les HFC à PRG élevé. Les deux principaux obstacles à l'introduction de ces substances sont toutefois les suivants : coût unitaire élevé et expérience minimale due au fait que cette technologie n'a pas été démontrée dans les conditions propres aux Parties visées à l'article 5.

Méthodologie

5. Afin d'analyser les deux molécules, HFO-1233ze(E) de Honeywell ou Arkema et HFO-1336maam(z) de DuPont, on propose de suivre les étapes suivantes : planification, mise au point des formules, tests, analyse des résultats, essais sur le terrain et reproductions technologiques/diffusion des résultats.

[1] Le Comité exécutif a décidé notamment d'examiner, à ses 75e et 76e réunions, des propositions de projets de démonstration sur des solutions de remplacement des HCFC à faible potentiel de réchauffement global (PRG) à l'intérieur du cadre établi, et a fourni des critères pour ces projets.

6. L'entreprise participante est Espumlatex[2], une société de formulation dotée de 18 réservoirs de mélange d'une capacité allant de 1 500 à 3 000 litres et d'un laboratoire de contrôle qualité certifié, où l'on peut tester les propriétés fondamentales des formules de polyuréthane (densité d'expansion libre, réactivité, conductivité thermique de la mousse, résistance à la compression, stabilité dimensionnelle et vieillissement accéléré). L'entreprise est entièrement engagée dans le processus de mise à l'essai des nouvelles solutions de remplacement des HCFC à faible PRG et possède les ressources voulues pour ce faire (laboratoire, connaissances techniques et effectifs).

Mise en œuvre du projet

7. Les activités ci-après seront exécutées :

a) Accord de travail avec Espumlatex à signer entre le PNUD et le bénéficiaire, ainsi que l'unité nationale d'ozone;

b) Élaboration d'un protocole expérimental comprenant la procédure et les conditions d'application, les propriétés à tester et la méthode d'essai;

c) Élaboration des formules et préparation des échantillons de mousse à Espumlatex, en ayant recours à un distributeur haute pression et à un moule Brett classique. Les applications de mousse pulvérisée seront réalisées à l'aide d'un injecteur Gusmer standard;

d) Acquisition d'un équipement de laboratoire conçu pour mesurer la friabilité de la mousse. Cette propriété est jugée cruciale étant donné la teneur en urée obtenue avec les formules de polyuréthane à forte teneur en eau;

e) Mise à l'essai des propriétés critiques de la mousse (immédiates et dans le temps), comme la conductivité thermique, la résistance à la compression, la stabilité dimensionnelle et la friabilité;

f) Essais sur le terrain à ABC Poliuretanos, un fabricant local de panneaux en discontinu; la réduction de 4 tm de HCFC-141b associée à ces essais sera incluse dans la deuxième phase du PGEH (Plan de gestion de l'élimination des HCFC) de la Colombie étant donné que l'élimination sera alors réalisée, et devrait être déduite du point de départ; et

g) Deux ateliers de diffusion à l'intention de l'industrie colombienne et d'Amérique latine.

8. Le projet devrait durer 12 mois.

[2] Au cours de la phase de passage du CFC-11 aux HCFC, deux projets ont été menés à Espumlatex : « Financement rétroactif de la reconversion des systèmes utilisant le CFC-11 à une technologie à base d'eau pour la fabrication de mousse souple moulée et de mousse à pellicule externe incorporée à Espumlatex-Promicolda » (COL/FOA/32/INV/49) et « Reconversion du CFC-11 au HCFC-141b et à une technologie à base d'eau pour la fabrication de diverses mousses de polyuréthane par 25 petites entreprises centrées autour de la société de formulation à Espumlatex » (COL/FOA/32/INV/48). Espumlatex a par ailleurs assuré la fonction de société de formulation locale en 2011-2013 pour un projet de démonstration de la technologie CO_2 supercritique pour la mousse pulvérisée réalisé dans le cadre d'un programme bilatéral Japon-Colombie en collaboration avec Achilles Corp.

Budget du projet

9. Le coût détaillé du projet figure au tableau 1 ci-après :

Tableau 1. Coût du projet par activité

Activité	Coût unitaire ($US)	Quantité	Fonds multilatéral ($US)	Contribution Espumlatex ($US)	Coût total ($US)
Assistance technique internationale	25 000	1	25 000		25 000
Planification	5 000	1	5 000		5 000
Élaboration de formules à la société de formulation	220 000	1	184 000	36 000	220 000
Acquisition d'un testeur de friabilité	10 000	1	10 000		10 000
Essais de mousse (uniquement en laboratoire)	57 500	1	42 500	15 000	57 500
Polyuréthane pour l'élaboration des formules et les essais	25 000	1	25 000		25 000
Essais de mousse – sur le terrain	250	40	8 000	2 000	10 000
Ateliers de diffusion de la technologie	20 000	2	40 000		40 000
Sous total, surcoût d'investissement			**339 500**	**53 000**	**392 500**
Imprévus (10 %)			33 950	5 300	39 250
Surcoût d'exploitation pour l'utilisateur final (ABC Poliuretanos)	9	4 000	36 000		36 000
Suivi et compte rendu	50 000	1	50 000		50 000
Coût total			**459 450**	**58 300**	**517 750**

OBSERVATIONS ET RECOMMANDATION DU SECRÉTARIAT

OBSERVATIONS

10. Lors de la 72e réunion, après avoir examiné l'aperçu des projets de démonstration sur les HCFC approuvés et des choix de projets supplémentaires visant à faire la démonstration de technologies de remplacement des HCFC favorables au climat et écoénergétiques[3], au titre du point 10 de l'ordre du jour, le Comité exécutif a notamment décidé d'examiner, lors de ces 75e et 76e réunions, des propositions de projets de démonstration sur des solutions de remplacement des HCFC à faible PRG à l'intérieur du cadre établi, et a fourni des critères pour ces projets (décision 72/40).

11. Lors de la 73e réunion, le Comité exécutif a examiné plus avant les projets de démonstration sur des solutions à faible PRG et les études de faisabilité sur le refroidissement urbain dans le contexte du plan d'activités général du Fonds multilatéral[4]. À l'issue des discussions, d'autres orientations ont été fournies afin d'assurer la soumission des meilleures propositions de projet de démonstration possibles[5].

12. Outre la proposition de projet contenue dans le présent document, les agences bilatérales et d'exécution ont communiqué des demandes de préparation de projets et un projet de démonstration complet en vertu de la décision 72/40. Afin d'aider le Comité exécutif à choisir les meilleures propositions de projet de démonstration soumises conformément à cette décision, le Secrétariat avait préparé une analyse de toutes les propositions, uniquement sous l'angle des concepts employés et de leur conformité

[3] UNEP/OzL.Pro/ExCom/72/40.
[4] UNEP/OzL.Pro/ExCom/73/18.
[5] Les suggestions présentées par des membres du Comité exécutif figurent au paragraphe 97 du document UNEP/OzL.Pro/ExCom/73/62.

avec les directives formulées par le Comité exécutif. Cette analyse figure dans le document concernant l'aperçu des questions soulevées pendant l'examen des projets[6].

13. Le Secrétariat n'avait donc pas examiné le projet de démonstration sur le plan technique et financier.

RECOMMANDATION

14. Le Comité exécutif pourrait souhaiter :

a) Considérer le projet de démonstration sur la validation de l'utilisation d'hydrofluoro-oléfines dans les panneaux en discontinu et la mousse projetée fabriqués dans les pays Parties visées à l'article 5, en ayant recours à des formules présentant un bon rapport coût-efficacité, dans le contexte de l'examen des propositions de projet de démonstration sur des solutions de remplacement des HCFC à faible potentiel de réchauffement global (PRG), comme cela est décrit dans le document sur l'aperçu des questions soulevées pendant l'examen des projets (UNEP/OzL.Pro/ExCom/74/13); et

b) Prier le Secrétariat de soumettre à nouveau la proposition de projet de démonstration mentionnée à l'alinéa a) ci-dessus, accompagnée de ses observations et de sa recommandation, à la 73[e] réunion, dans l'éventualité où le Comité exécutif choisirait cette proposition.

[6] UNEP/OzL.Pro/ExCom/74/13.

PROJECT COVER SHEET

COUNTRY: Colombia **IMPLEMENTING AGENCY:** UNDP

PROJECT TITLE: Demonstration project to validate the use of Hydrofluoro Olefins (HFO) for discontinuous panels and spray in Article 5 parties through the development of cost effective formulations

PROJECT IN CURRENT BUSINESS PLAN	
SECTOR	Foam
SUB-SECTOR	Rigid PU (discontinuous panels)
ODS USE IN SECTOR (2013)	479 metric tons (HCFC-141b)
ODS USE AT ENTERPRISE (2013)	125 MT of HCFC-141b in relevant sector
PROJECT DURATION	12 months
TOTAL PROJECT COST:	
Total Project Cost (including co-finance)	US $ 517,750
LOCAL OWNERSHIP	100%
EXPORT COMPONENT	0 % to non-A5
REQUESTED GRANT	US $ 459,450
COST-EFFECTIVENESS	Non applicable
IMPLEMENTING AGENCY SUPPORT COST	US $ 32,162
TOTAL COST OF PROJECT TO MULTILATERAL FUND	US $ 491,612
STATUS OF COUNTERPARTS FUNDING	Received letter of commitment
	Included
NATIONAL COORDINATING AGENCY	Ministry of Environment - National Ozone Unit

Project summary

This projects undertakes the validation of the Hydrofluoro Olefins (HFOs), a low GWP and non flammable option, for discontinuous panels and spray in the scenario of the Article 5 parties through the development of polyurethane (PU) foam formulations with reduced HFO contents that have CO_2, derived from the water-isocyanate reaction, as co-blowing agent. The aim is to optimise the cost/performance balance while achieving a similar foam thermal performance to HCFC-141b based formulations.

Impact of project on Country's Montreal Protocol Obligations

The project aims to contribute to the country obligation to reduce the HCFC consumption as per the Montreal Protocol obligation by converting the current HCFC-141b foam blowing technology to the HFO based formulations. The Colombian discontinuous panels subsector used in 2013 158 tonnes of HCFC-141b. If results were positive a significant portion of this amount could be replaced by this technology during the second stage of the HPMP. A direct impact of this project is the conversion of ABC Poliuretanos including 4 tonnes of HCFC-141b and will be included in the second stage of the HPMP. 4 tonnes of HCFC would eventually be phased-out and deducted from the starting point in Colombia.

Prepared by: Mr Miguel W. Quintero Date: March 22, 2015
Originally Reviewed by: Date:

1. BACKGROUND

1.1. PROJECT BACKGROUND

This project has been prepared as response to the Executive Committee Decision 72/40. It is part of a set of projects with the objective to validate chemical systems for use with non-HCFC blowing agents in the context of Decision XIX/6.
The developing countries will address in the short term the second phase of the HPMP (2015-2020) in the foam sector. One of the most critical subsectors that still uses HCFC-141b and accounts for a significant market portion is the manufacture of **discontinuous panels** and **spray foam** for the construction and the commercial and industrial refrigeration industries. It is characterized by a great number of small and medium sized enterprises without the sufficient knowledge and discipline to handle flammable substances. This factor along with the lack of economies of scale prevents the adoption of hydrocarbons and the introduction of high GWP alternatives such as HFCs would result in a negative climate impact.
This projects undertakes the validation of the Hydrofluoro Olefins (HFOs), a low GWP and non flammable option, for discontinuous panels and spray in the scenario of the Article 5 parties through the development of polyurethane (PU) formulations with reduced HFO contents that have CO_2, derived from the water-isocyanate reaction, as co-blowing agent. The aim is to optimise the cost/performance balance while achieving a similar foam thermal performance to HCFC-141b based formulations.
Further, the project aims to contribute to the country obligation to reduce the HCFC consumption as per the Montreal Protocol obligation by converting the current HCFC-141b foam blowing technology to the HFO based formulations. The Colombian discontinuous panels subsector used in 2013 158 tonnes of HCFC-141b. If results were positive a significant portion of this amount could be replaced by this technology during the second stage of the HPMP. A direct impact of this project is the conversion of ABC Poliuretanos that is included in the second stage HPMP.

1.2. SECTOR BACKGROUND IN COLOMBIA

Colombia became a party to the Vienna Convention and Montreal Protocol on October 16, 1990 and on March 6, 1994 respectively. Colombia also ratified the London, Copenhagen, Montreal and Beijing Amendments. The country is fully committed to the phase-out of HCFCs and willing to take the lead in assessing new HCFC phase-out technologies, particularly in the foam sector.

The Colombian PU market can be spread out in three different industrial sectors: flexible foam (flex-slab and moulded and integral skin), rigid foam and microcellular elastomers (shoe soles). HCFCs are used in rigid foam for thermal insulation and, in marginal quantities, in integral skin.

In PU rigid foam three different segments can be differentiated: domestic refrigeration (refrigerators and freezers), commercial refrigeration (mainly bottle and commercial displays) and industrial thermal insulation for the refrigeration and construction sectors (continuous and discontinuous panels, transportation and spray). While the domestic refrigeration and most of the commercial refrigeration have been converted to hydrocarbons the remaining market players still use HCFC-141b. The main suppliers are local “system houses” (Espumlatex, GMP, Olaflex, Química Industrial y Comercial) that sell two-component systems: a fully formulated polyol, which includes the blowing agent (HCFC-141b), and an isocyanate (Polymeric MDI).
A recent market survey showed that in 2013 out of a total of 1,054 tonnes of imported HCFC-141b, 479 were used in foam manufacture. Table 1 shows their distribution by application. Discontinuous panels and spray account for 33% and 12.3% of the total HCFC-141b consumption respectively.

TABLE 1. 2013 USE OF HCFC-141B IN THE COLOMBIAN FOAM MARKET		
Foam Application	HCFC-141b, kg	%
Commercial Refrigeration	125,904	26.3%
Continuous Panels	132,250	27.6%
Industrial Refrigeration & Construction (Discontinuous Panels)	157,834	33.0%
Spray	59,008	12.3%
Integral Skin	3,662	0.8%
TOTAL	478,658	100.0%

Source: Imports Declarations, Database of the Ministry of Commerce, Industry and Tourism. Personal interviews with key market players (system houses and end users)

2. PROJECT DESCRIPTION

2.1. PROJECT OBJECTIVES

The objectives of this project are:

1. To validate the use as foam blowing agents of the recently developed HFOs in blends with CO_2 for the production of discontinuous panels and spray foam in the context of an Article 5 party. The aim is to optimise the HFO/CO_2 ratio in the cell gas to get a similar thermal performance to HCFC-141b at a minimum incremental operating cost.
2. To make a cost analysis of the different HFO/CO_2 formulations versus the currently used HCFC-141b based system.

2.2. JUSTIFICATION

The Article 5 parties are in the process of preparing the second stage of the HPMPs to be implemented in the 2016-2020 period. Taking into account the priorities defined in Decision XIX/6, particularly those referred to ODP and climate change impact, the developing countries opted for converting in the first phase (2011-2015) the largest foam enterprises typically found in the domestic refrigeration and continuous panels sectors. Hydrocarbons, basically pentanes, were the substances of choice based on their favourable cost/performance balance at large size operations.

The situation is different at the second stage where the countries have to address the remaining foam sectors still using HCFCs. These sectors (discontinuous panels, spray, integral skin) are characterised by a multitude of micro, small and medium size enterprises that do not have the adequate knowledge and operating discipline to handle flammable substances in a safe manner. This factor along with the lack of economies of scale prevents the adoption of flammable blowing agents, while the introduction of high GWP alternatives such as HFCs results in high climate impact within processes which are typically less well engineered.

The recent developed unsaturated HFCs and HCFCs (commonly called HFOs), 1233zd(E) and 1336maam(z), marketed under the trademarks Forane (Arkema), Formacel (DuPont) and Solstice (Honeywell), have shown in rigid PU foam applications such as domestic refrigeration and spray a better thermal performance that the high GWP-saturated HFCs currently used in the developed countries. Their general properties are shown in table 2. They offer a unique opportunity for introducing safe non-flammable technologies that while enhancing energy efficiency will have a positive effect on climate change in terms of greenhouse emissions. Based on the physical properties of these substances (non flammability and relatively high boiling points) it is anticipated that their application does not require the retrofit of the foaming equipment currently in use. This is particularly true and important at the level of small and medium enterprises. Commercial availability has already been established for HFO-1233zd(E). Pilot scale production of HFO-1336mzzm(Z) commenced in late 2014, with full commercialisation expected in 2016. Although for these options availability is likely to be targeted mostly in markets within non-Article 5 Parties where the requirement for improved thermal efficiency is best identified, the demand to leapfrog high GWP alternatives to HCFCs could accelerate distribution to Article 5 regions. There are not legal or commercial barriers for the introduction of these products.

TABLE 2. HFO PROPERTIES			
	Formacel® 1100	***Solstice® Liquid BA***	***Forane® 1233zd***
Common name	1336mzz(Z)	1233zd(E)	1233zd(E)
Chemical Formula	Cis-CF_3-CH=CH-CF_3	Trans-ClCH=CH-CF_3	Trans-ClCH=CH-CF_3
Molecular weight	164	130.5	130.5
Boiling Point (°C)	33	19	19
GWP (100 years	2	1	<7

From the three sectors mentioned above, discontinuous panels and spray foam were chosen for the development of this project taking into consideration the high volume involved (discontinuous panels) and the application particularities (spray foam). Spray foam is produced in-situ, i.e. using portable equipment at the site being insulated, distinction that affects the safety issues related to flammable blowing agents. According to the last FTOC assessment report (2010), in 2008 around 7,300 tonnes of CFCs and HCFCs were used in the discontinuous panels subsector in the developing countries.

Two are the main barriers for the introduction of these substances:

1. Their high unitary cost that is reflected in the final cost of the PU formulation.
2. The minimum experience with these products in developing country conditions. This technology has not been demonstrated in conditions prevailing in Article 5 parties.

The main objective of this project is precisely to remove or attenuate the mentioned obstacles. The formulation science associated to the PU technology and the excellent foam thermal characteristics provided by HFOs open the door for the development of PU formulations with reduced HFO contents that have CO_2, derived from the water-isocyanate reaction, as co-blowing agent. The aim is to optimise the cost/performance balance of these substances, achieving a similar foam thermal behaviour to HCFC-141b at the lowest possible cost, and, simultaneously, to carry out a comprehensive assessment of the HFO performance at developing countries conditions. The project will be conducted at Espumlatex, a recognised local system house equipped with the required injection and testing laboratory facilities, and a field test with selected formulations will be done at ABC Poliuretanos, a typical small manufacturer of discontinuous panels. The reduction of 4 MT HCFC 141b will be included in the second stage HPMP for Colombia as the phase-out will be achieved at that time, and should be deducted from the starting point then.

2.3. METHODOLOGY

With the aim of analysing the two HFO molecules, 1233zd(E) from Honeywell or Arkema and 1336maam(z) from DuPont, in comparison with HCFC-141b, six steps are contemplated for the project development:

1. PLANNING. A statistical experimental design (DOE) will be designed having as factors (or independent variables) the type of molecule and the composition of the cell gas (mole fraction of the physical blowing agent). The responses (or dependent variables) will be the foam properties critical for this application (Lambda value, compression strength, dimensional stability, friability). A commercial HCFC-141b based formulation will be used as control.
2. FORMULATION DEVELOPMENT. The resulting formulations will be prepared at laboratory scale and injected with a conventional high-pressure dispenser. PU spray foam will be applied using a Gusmer type dispenser with an isocyanate/polyol volume ratio of one to one. Catalysis and overall blowing agent amount will be adjusted to have among formulations a similar reactivity and free-rise density. A typical Brett or Lance mould with temperature control will be used to manufacture the panels to test the foam properties. Samples for testing will be done by duplicate.
3. TESTING. The critical immediate and aged foam properties for these applications (Lambda value, compression strength, dimensional stability, friability) will be tested following ASTM or ISO standard procedures.
4. ANALYSIS OF RESULTS: foam performance and formulation cost. A detailed analysis of the resulting foam properties at different HFO levels and the associated formulation cost will be carried out. A typical HCFC-141b formulation will be used as standard.
5. FIELD TEST. A field test with selected formulations will be done at ABC Poliuretanos, a small manufacturer of discontinuous panels and spray operations with typical market characteristics.
6. TECHNOLOGY REPLICATION/DISSEMINATION OF RESULTS. One of the critical outcomes of a demonstration project is the definition of the possibility to replicate the technology in other enterprises, in other regions and in other applications. In the case of HFOs, having in mind that the main barrier for their introduction is the associated formulation cost, it is anticipated that if results are positive and an adequate cost/performance balance is achieved, there is a great potential for the technology to be replicated in other system houses in the country, in Latin America and other regions, and even in other applications such as commercial refrigeration. To assure this, it is planned to conduct two workshops, a first one at local level with the participation of the other Colombian system houses (GMP, Olaflex, Química Industrial y Comercial) and interested end users, and a second one at regional level, where regional system houses, importers and end users will be invited. It is important to note that all the Colombian and several Latin American system houses have shown interest in these products. In addition to the seminars, a detailed technical report will be written with the results of the project. Information on the performance of the HFOs at different mole fractions in the cell gas along with the associated formulation cost (incremental operation cost compared to HCFC-141b) will be delivered. It will serve as starting point for the other system houses to design/develop appropriate HFO based formulations.

2.4. INFORMATION ON PARTICIPATING COMPANIES

Espumlatex

Espumlatex was established in 1959 to serve the automotive industry in Colombia as the main supplier of PU based materials: RIM and sound insulation parts and flex moulded foam for car seats. Throughout all these years it became the leader of PU suppliers in the Andean countries with annual sales of 52 million dollars in 2008. It is certified QS9000/ISO9000, EAQF level Q1 status, ISO14000.

At the end of the eighties Espumlatex expanded its activities to formulate PU systems for the manufacture of thermal insulating and integral skin foams. Its current capacity is estimated in 500 MT per month with an annual current production of 4,000 MT of PU systems, from which 2,000 MT are dedicated to rigid foam materials. 15 % of their PU systems production is exported to Ecuador, Peru and Venezuela. Additional to PU systems they manufacture PU rigid foam sheets for insulation purpose in a process that involves the production of large foam blocks and their subsequent cutting.

The system house production facilities are equipped with 18 blending tanks with capacities that go from 1,500 to 3,000 l. They have mechanical agitation, recirculation and a direct feeding system from the raw materials drums as well as a closed pumping system for raw materials loading. The basic properties of the PU systems (free rise density, reactivity, foam thermal conductivity, compression strength, dimensional stability and accelerated aging) are tested in a certified quality control laboratory.

The consumption of chemicals for the PU systems sold for the manufacture of discontinuous panels during the last 5 years was:

Table 3. Consumption of PU chemicals for Discontinuous Panels at Espumlatex, tonnes					
Substance	**2009**	**2010**	**2011**	**2012**	**2013**
Polyol	327	381	425	423	462
HCFC-141b	82	96	107	106	115
Polymeric MDI	445	518	578	575	628
TOTAL	854	995	1,110	1,104	1,205

During the transition from CFC-11 to HCFCs the following two projects were carried out with Espumlatex:

- The project COL/FOA/32/INV/49, “Retroactive funding for the conversion from CFC-11 to water-based technology in the manufacture of flexible molded and integral skin foam at Espumlatex-Promicolda”, retroactively funded one of the Espumlatex´ divisions, Promicolda, for the conversion from CFC-11 to water and HCFC-141b based technologies in the manufacture of flexible molded and integral skin foam respectively. Promicolda is the Expumlatex´ division that manufactures the car seats and several parts based on integral skin foam for the automotive industry in the Andean Countries. The grant received by Promicolda was US$ 82,020.
- The project COL/FOA/32/INV/48, “Conversion from CFC-11 to HCFC-141b and water based technology in the manufacture of various polyurethane foam applications at 25 small enterprises centred around their systems house Espumlatex”, was an umbrella project where 25 SMEs -centred around Espumlatex as the system house- were successfully converted from CFC-11 to HCFC-141b and water based technologies. Total cost of the project was US$ 332,768. Espumlatex received funds for the project administrative expenses and a laboratory equipment (one K factor indicator not suitable to measure lambda values at different temperatures).

Espumlatex also served in 2011-2013 as the local system house host for the demonstration project on Supercritical CO_2 technology for spray foam undertaken under a Japan-Colombia bilateral with Achilles Corp.

The company is fully committed to test new HCFC alternatives of low GWP and has the required capability (laboratory facilities, technical knowledge and human resource). Its contribution to the project has been quantified in US$ 58,300 (see table 5).

3. PROJECT IMPLEMENTATION MODALITY

Project will be implemented by UNDP as an implementing agency. Relevant activity such as equipment procurement, recruitment of experts, foam testing will be arranged under the UNDP Financial Rule and Regulation.

The following activities will be executed:

- Work arrangement with local System House to be signed between UNDP and the beneficiary as well as the National Ozone Unit (NOU).
- Development of the experimental protocol which includes application procedure and conditions, properties to test, testing methods etc.
- Formulation development and foam sample preparation to be done at Espumlatex laboratory facilities using a high-pressure dispenser and a conventional Brett mould. Spray foam application will be done at Espumlatex facilities using a standard Gusmer type injector.
- Procurement of a laboratory equipment to measure foam friability. This foam property is considered critical having in mind the high urea content achieved with PU high water formulations.
- Testing of foam critical immediate and aged properties such as thermal conductivity, compression strength, dimensional stability and friability.
- Conduction of a field test at ABC Poliuretanos, a local discontinuous panels manufacturer.
- Delivery of two dissemination workshops to the Colombian and Latin American industry.

<u>Project implementation time schedule</u>

Table 4. Project Implementation Time Schedule

ACTIVITY	**2015**			**2016**	
	Q2	**Q3**	**Q4**	**Q1**	**Q2**
Approval	*				
Grant transfer to UNDP		*			
Work Arrangement between UNDP and beneficiary		*			
Detailed project planning. Development of experimental protocol		*			
Import of HFO samples		*			
Procurement & delivery of equipment to measure friability		*	*		
Formulation Development		*	*	*	
Foam testing		*	*	*	
Analysis of results: performance versus cost				*	
Field testing at a local discontinuous panels manufacturer					*
Dissemination workshops					*
Reporting & Final review					*

4. PROJECT BUDGET

The summary of the project cost is as follows:

Table 5. Project cost by activity

Activity	Unit cost, US$	Quantity	Total Cost US$	Espumlatex contribution US$	MLF US$
International technical assistance	25,000	1	25,000		25,000
Planning	5,000	1	5,000		5,000
Formulation Development in System House	220,000	1	220,000	36,000	184,000
Acquisition of Friability tester	10,000	1	10,000		10,000
Foam Testing (Laboratory tests)	57,500	1	57,500	15,000	42,500
PU material for formulation development and testing.	25,000	1	25,000		25,000
Foam testing - Field evaluation	250	40	10,000	2,000	8,000
Technology Dissemination Workshops		2	40,000		40,000
Sub total incremental capital cost			**392,500**	**53,000**	**339,500**
Contingencies			39,250	5,300	33,950
Incremental Operating Cost (IOC) at end user (ABC Poliuretanos)	9	4,000	36,000		36,000
Project monitoring & reporting	50,000	1	50,000		50,000
Total Cost			517,750	58,300	459,450

Notes:

Project management: Cost for national expert is included. The expert is expected to provide technical advices for preparation, local monitoring and reviewing of project.

Formulation Development: The formulations will be prepared at Espumlatex laboratory facilities by company personnel.

Provision of equipment: The project plans to acquire a laboratory equipment to measure foam friability according to ASTM test.

Foam testing: All the foam properties will be determined at Espumlatex laboratory facilities by company technicians.

Dissemination workshop: Cost to organize the dissemination workshops is included. Two workshops will be organized, both in Colombia, a first one for the local industry and a second one for Latin America.