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联 合 国
环 境 规 划 署

Distr.
GENERAL

UNEP/OzL.Pro/ExCom/56/23
11 October 2008

CHINESE
ORIGINAL: ENGLISH

执行蒙特利尔议定书
多边基金执行委员会
第五十六次会议
2008 年 11 月 8 日至 12 日，多哈

项目提案：巴西

本文件由基金秘书处就以下项目提案提出的评论和建议构成：

泡沫塑料

- 聚氨酸泡沫塑料制造业中将甲酸甲酯确认为一种发泡剂的试验项目（第一阶段） 开发计划署

淘汰

- 国家氟氯化碳淘汰计划（第七次付款） 开发计划署

项目评价表－非多年期项目
巴西

项目名称 **双边/执行机构**

(a) 聚氨酸泡沫塑料制造业中将甲酸甲酯确认为一种发泡剂的试验项目（第一阶段）	开发计划署

国家协调机构	环境部，MMA/PROZON

最新报告的项目所涉消耗臭氧层物质的消费数据
A: 第 7 条数据（ODP 吨，2007 年，截至 2008 年 9 月）

氟氯烃化合物	1,545.2		

B: 国家方案行业数据（ODP 吨，2007 年，截至 2008 年 9 月）

消耗臭氧层物质				
氟氯烃化合物				

仍符合供资条件的氟氯化碳消费量（ODP 吨）	0.0

本年度业务计划		供资 百万美元	淘汰 ODP 吨
	(a)	根据第 55/43（e）号决定	暂缺

项目名称：	
企业所使用的消耗臭氧层物质 （ODP 吨）：	
将淘汰的消耗臭氧层物质（ODP 吨）：	暂缺
将逐步采用的消耗臭氧层物质 （ODP 吨）：	暂缺
项目的期限 （月)：	7
最初申请数额 （美元）：	368,500
最终项目费用（美元）：	368,500
增支资本费用：	335,000
应急费用 （10 %）：	33,500
增支业务费用：	
项目费用总额：	368,500
当地所有权 （%）：	100%
出口部分 （%）：	0%
申请的赠款 （美元）：	368,500
成本效益值 （美元/公斤）：	暂缺
执行机构支助费用 （美元）：	27,638
项目向多边基金申请的总费用 （美元）：	396,138
对应资金是否已确认 （是/否）：	暂缺
是否包括了项目监测阶段目标（是/否）：	是

秘书处建议	单独审议

项目说明

1. 开发计划署代表巴西政府向执行委员会第五十六次会议提交了一项巴西聚氨酸泡沫塑料制造业中将甲酸甲酯确认为一种发泡剂的试验项目（第一阶段）。试验项目第一阶段的总费用为 368,500 美元，外加 27,638 美元的机构支助费用。

2. 该项目提议，首次开发、优化和确认用于聚氨酸泡沫塑料用途的甲酸甲酯（第一阶段），然后将该技术（如经过了确认）适用于涉及若干不同用途的一些下游泡沫塑料工厂，并转让至相关的系统厂商（第二阶段）。

3. 甲酸甲酯是用于制造药物和杀虫剂等其他化学品和产品的一种化学物质。尽管以前的文件报告其被用作发泡剂来制造合成橡胶，但美国的泡沫塑料供应公司却于 2000 年率先使用其来制造聚氨酸泡沫塑料。此种用途已作为 Ecomate®获得了专利权，并由以下公司获得了独占许可证：拉丁美洲的 Purcom、联合王国和爱尔兰的 BOC 特种气体公司，以及澳大利亚驻澳大利亚、新西兰和环太平洋国家的澳大利亚聚氨脂公司（澳大利亚的公司还获得了中东和北非国家，以及中国和印度这些国家的许可证）。

4. 据估计，第一阶段的总费用为 368,500 美元，详细分列情况见下表。第二阶段的初步费用估计值为 1,916,000 美元。

说明	**美元**
项目编制	30,000
技术转让和培训	25,000
系统开发（7 项用途，每一项 5,000 美元）	35,000
优化（15 项用途，每一项 3,000 美元）	45,000
确认（15 项用途，每一项 2,000 美元）	30,000
实验室设备	115,000
实验室安全	10,000
同行审议/下一阶段的筹备工作	20,000
技术传播讲习班	25,000
应急费用（10%）	33,500
总计	**368,500**

5. 鉴于这是在泡沫塑料用途方面展示氟氯烃替代技术的首个试验项目，本文件附上了关于开发计划署编制的项目的简述。

秘书处的评论和建议

评论

6. 秘书处根据提交至第五十五次会议的关于氟氯烃淘汰供资方面有关费用因素的订正

分析的政策文件，以及执行委员会通过的第 55/43 号决定，和同样由开发计划署提交至第五十六次会议的墨西哥补充性确认项目审查了该项目。

7. 执行委员会第五十五次会议审议的氟氯烃的费用文件指出，使选定的第 5 条国家的系统厂商及时确认被用于氟氯烃化合物淘汰项目的新技术或经重大修改的技术具有重要意义，因为调查项目可直接得到确认工作的指导。秘书处注意到开发计划署提交的以下提案涉及此类方式：

(a) Prucom（巴西的甲酸甲酯许可方）已同意向根据多边基金规则有资格获得供资的所有区域系统厂商提供非独占从属许可证；

(b) 一经认为技术具有可转让性，将尽快向相关系统厂商提供技术传播讲习班；

(c) Purcom 将会与其他地区的领有许可证者取得联系，并提出一种类似的方法。

8. 秘书处就开发计划署处理的项目提出了以下几个问题：

(a) 未表明巴西、联合王国和爱尔兰拥有甲酸甲酯技术独占许可证的三家公司是否可以相互分享在不同泡沫塑料用途中进行技术确认的成果。这对于巴西（涵盖拉丁美洲和加勒比地区）以及涵盖环太平洋国家、中东和北非国家的澳大利亚的系统厂商而言尤为有益。秘书处还建议开发计划署考虑邀请其他技术许可方参与项目，并推动将每一经确认的用途中的技术转让至这些许可方；

开发计划署在答复中表明，虽然对秘书处的提议非常感兴趣，但在第五十五次会议通过第 55/43 号决定至向第五十六次会议提交该试验项目这一非常有限的期间内，无法解决这些问题。但于 2008 年 10 月初在得克萨斯圣安东尼奥市举行的 2008 年聚氨酸技术大会上，开发计划署与 Ecomate 技术的专利持有者举行了一次会议，开始讨论秘书处提议的精神。会议引起了澳大利亚聚氨脂公司在环太平洋地区推广类似方法的巨大兴趣。此外，澳大利亚公司还将出席将结束试验项目第一阶段的信息传播讲习班，并在随后就其将如何开展合作（这些公司之间的合作似乎已势在必得）做出最终决定。

(b) 目前和今后的甲酸甲酯生产量是否可以满足需求，是否能确保该技术在提议所载的多数泡沫塑料用途中得到确认，并实现成本-效益；

开发计划署指出，甲酸甲酯是一种化学商品，市场上有大量可用于原料和溶剂用途的甲酸甲酯。其作为发泡剂的用途将不会对其供应情况产生任何影响。纯度要求会需要采取一项额外的蒸馏步骤。

(c) 根据该项目，Purcom 已确认和优化了整皮泡沫塑料（方向盘）、仪表板（不连续式），以及商业制冷（冰酒套）行业的甲酸甲酯技术， 并将其用于了商业用途。秘书处询问，这些用途方面的技术确认工作是否已得到了独立泡沫

塑料专家的证实，还问道秘书处（第 5 条国家）如何从这些用途方面的技术确认工作中获益；

开发计划署报告，仅由海关人员和最终用户通过内部方法对一些整皮用途中的甲酸甲酯使用情况进行了确认，不应将此视为一个正式的证实过程。但方向盘用途除外，因为该用途已通过了大众汽车磨损测试。由于此项用途由 Purcom 独家开发，因此不将其归入共有领域，根据开发计划署协商，应将其视为多边基金所有。在整皮用途领域开展的技术确认工作需要另外提供 33,000 美元，用于增加设备（即，磨损测试装置）和开展测试。

9. 根据提议，由基金秘书处通过一名独立的合格专家核查在适用该技术方面获得的各项成果，并由环境规划署泡沫塑料技术备选方法委员会监督上述核查工作。秘书处注意到开发计划署对独立专家开展的技术核查工作表示关切。但其指出，它没有核查任何技术的专门知识、预算或任务。因此秘书处建议，在核查过程中，开发计划署应与泡沫塑料技术备选办法委员会保持相互交流，以有利于审查工作。开发计划署表示，泡沫塑料技术备选办法委员会、开发计划署和 Purcom 于 2008 年 10 月举行了一次会议，期间 Purcom 向泡沫塑料技术备选办法委员会简述了其目前的进展情况，开发计划署对提交至第五十六次会议的试验项目提案做出了解释。开发计划署还表示，泡沫塑料技术备选办法委员会在原则上愿意开展一项同行审议，并将与开发计划署和/或秘书处取得联系，共同确定详细情况。

10. 秘书处和开发计划署就以下方面的几点内容进行了讨论：即巴西的氟氯烃消费量，以及其行业分布情况，包括系统厂商关于向地区系统厂商发放从属许可证的承诺，以及将通过本项目所获的成果推广至其他系统厂商的方式。开发计划署报告，其已与 Purcom 签订了协定，向拉丁美洲和加勒比地区的其他系统厂商提供非独占从属许可证。但是，开发计划署认为应保留此类总许可证与从属许可证协定方面的详情。开发计划署还指出将会邀请以下国家的系统厂商出席讲习班：阿根廷（3 个）、智利（3 个） 、哥伦比亚（5 个）以及墨西哥（8 个）。开发署还收到了印度系统厂商出席讲习班的申请。如果开发计划署能够成功说服其他许可证持有者（特别是澳大利亚）在其领域遵循类似的转让政策，则举行一次讲习班可能尚不充分。

11. 秘书处和开发计划署还讨论了与费用相关的问题，包括向技术转让和培训提供 25,000 美元的申请，因为 Purcom 拥有使用甲酸甲酯技术的专属许可证。关于试验室设备方面（包括两台泡沫注入机，总费用 70,000 美元）的申请，注意到该公司已开始开展此项业务，并且在向所有类型的泡沫塑料用途提供系统方面，其为巴西的最大系统厂商，因此该设备是基准的一部分。开发计划署表示，必须对 Purcom 进行使用确认设备方面的培训。需要就开发计划署国际专家制定的实际确认方案开展交流，开发计划署专家也必须对确认工作提供指导，以确保其符合泡沫塑料技术备选办法委员会的确认要求。开发计划署还报告，确认所需的设备并非公司基准的一部分。

建议

12. 注意到通过其第 55/43（e）号决定，执行委员会作为一项紧急事项邀请双边和各执行机构编制并提交有限数量的具有具体时限的项目提案，这些项目提案涉及有关的系统厂商和/或化学品供应商根据秘书处评论开发、优化和确认使用无氟氯烃发泡剂的化学系统，谨建议执行委员会：

(a) 考虑核准巴西聚氨酸制造业中将甲酸甲酯确认为一种发泡剂的试验项目（第一阶段），经费为 368,500 美元，外加提供给开发计划署的 27,638 美元的机构支助费用；以及

(b) 核准向整皮产品制造业中将甲酸甲酯确认为一种发泡剂的工作另外提供 33,000 美元，外加 2,475 美元的机构支助费用。

项目评价表 – **多年期**项目

巴西

(一) 项目名称	机构
CFC phase out plan	Germany, UNDP

(二) 最新第7条数据 (ODP吨)			年: **2007**	
CFC: 318.1	CTC: 50.3	Halons: 1.6	MB: 100.4	TCA: 0

(三) 最新国家方案行业数据 **(ODP吨)**						**Year: 2007**							
物质	气雾剂	**泡沫塑料**	**哈龙**	**制冷**		**溶剂**	**加工剂**	计量吸入器	实验室用途	**甲基溴**		**烟草磨里**	总计
				生产	维修					检疫和装运**前消毒**处理	**非**检疫和装运**前消毒**处理		
CFC								279.3					279.3
CTC							50.3						50.3
Halons			1.6										1.6
Methyl Bromide										100.4			100.4
TCA													0

(四) 项目数据			**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Total**
蒙特利尔议定书的消费限量		CFC	10,525.8	10,525.8	10,525.8	10,525.8	10,525.8	5,262.9	5,262.9	1,578.9	1,578.9	1,578.9	0.	
最大允许消费量 (ODP吨)		CFC	9,276.	9,276.	8,280.	6,967.	5,020.	3,070.	2,050.	1,000.	424.	74.	0.	
项目费用 (美元)	Germany	项目费用			577,137.	1,062,863.	1,000,000.	1,000,000.	243,600.					3,883,600.
		支助费用			51,942.	95,658.	90,000.	90,000.	21,924.					349,524.
	UNDP	项目费用			7,860,000.		5,420,000.	4,270,000.	2,856,400.	1,190,000.	870,000.	250,000.	100,000.	22,816,400.
		支助费用			687,700.		473,000.	369,500.	242,276.	92,300.	63,500.	12,500.	5,000.	1,945,776.
原则核准资金总额 (美元)		项目费用			8,437,137.	1,062,863.	6,420,000.	5,270,000.	3,100,000.	1,190,000.	870,000.	250,000.	100,000.	26,700,000.
		支助费用			739,642.	95,658.	563,000.	459,500.	264,200.	92,300.	63,500.	12,500.	5,000.	2,295,300.
执行委员会发放资金总额 (美元)		项目费用			8,437,137.	6,420,000.	1,062,863.	6,826,400.	2,733,600.	870,000.	0.	0.	0.	26,350,000.
		支助费用			762,727.8	563,000.	95,658.	584,776.	231,224.	63,500.	0.	0.	0.	2,300,885.8
本年申请资金总额 (美元)		项目费用										250,000.		250,000.
		支助费用										12,500.		12,500.

(五) 秘书处的建议：	一揽子核准

项目说明

13. 开发计划署代表巴西政府向执行委员会第五十六次会议提交了一份向国家氟氯化碳淘汰计划提供第七次付款的供资申请，以供其审议，费用总额为 250,000 美元，外加 12,500 美元的支助费用。提交申请的同时还提交了一份关于迄今该计划执行情况的报告，以及一份关于 2007 年的核查报告。该计划的目标是在巴西 2002 年 8,280 ODP 吨这一基准水平之上，在 2010 年之前全部淘汰氟氯化碳消费量。

背景

14. 在牵头执行机构开发计划署，以及合作机构德国政府的援助下，正在执行该计划的制冷技师和海关官员培训方案部分。德国政府在发放第五次付款之后收到了最后一次拨款。2002 年 7 月，执行委员会第三十七次会议核准了巴西的国家氟氯化碳淘汰计划，供资总额为 2,670 万美元。迄今，已核准的前六次付款的总额共计为 26,350,000 美元，外加 2,300,885.80 美元的支助费用。

对消费量的核查

15. 提交的核查报告证实了 2007 年巴西报告的其氟氯化碳的消费量（318.1 ODP 吨），与其根据第 7 条报告的数据相当。核查报告还介绍了国家淘汰计划中各项活动的执行情况。

16. 在核准前一次付款时，执行委员会请开发计划署在提交第七次付款申请时报告向所有消耗臭氧层物质普及配额制度的进展情况。根据该要求，核查人员指出，当时仅针对 CFC-12 设立了配额制度。根据 2000 年 9 月颁布并于 2001 年 1 月生效的一部条例，禁止使用附件 A 和 B 提及的所有物质，一些物质除外。一个例外的情况是预先界定的 CFC-12 进口限额的表格。其他例外情况涉及某些灭火器用途、加工剂、医疗用途及其他用途，所有这些用途方面的进口均需特定的进口许可证。因此，可视为针对附件 A 和 B 下的消耗臭氧层制定了配额制度。没有报告附件 C 和 E 中物质方面的制度情况。报告向 IBAMA 和负责执行环境政策的国家机构提供了更多建议，以增强出口管制和检查。

2007 年取得的成就

项目监测、宣传和政府活动

17. 执行和监测机构通过诸如以下活动继续监测和执行该计划的各项次级项目：与顾问签订合同、组织采购，以及监督财政和预算的执行情况。继续开展公共宣传活动，以散播关于国家各类氟氯化碳淘汰计划的信息，包括在《蒙特利尔议定书》20 周年庆典之际开展的特殊举措。还颁布了一项新条例，第 2799 号 GM/MS 行政命令，其中设立了一条“卫生部 2008 年 1 月 1 日起实施的购买不含氟氯化碳的计量吸入器的标准”。

强制执行

18. 2008 年制定了一项题为“控制非法贩运”的新活动，目前正处在执行的筹备阶段。

制冷维修行业

19. 2007 年，4,208 名技师接受了制冷良好做法方面的培训。根据 CFC-12 回收项目，配置了 296 台回收机器，以及 25 台汽车空调回收和再循环设备，和 60 个配有回收袋的工具包。在同一时期还设立了两家再利用中心。此外，根据 CFC-12 回收和能效次级项目，还与六家电力公司签订了最后处理替换的氟氯化碳冰箱的协定。

20. 根据报告，2008 年又取得了重大进展，其中包括迄今对另外 3,808 名技师进行了培训，并再次配置了 1,144 台回收机器。

泡沫塑料制造行业

21. 在 20 家软质聚氨酸泡沫塑料企业完成转换以后，该次级项目的最后一部分完成。

计量吸入器和溶剂行业

22. 为确认潜在的计量吸入器生产商、进口商和出口商，确认含氟氯化碳的计量吸入器，并确认和列举该国现有的不含氟氯化碳的计量吸入器，开展了三项调查。针对健康专家和协会举行了一次关于消耗臭氧对健康的影响的宣传讨论会，并就即将禁止生产或进口含各类氟氯化碳的计量吸入器的问题开展了一次公共协商。

23. 根据提交前一次付款申请时的报告所述，已无需在溶剂行业开展各项活动，随后会将此领域的经费划拨至其他活动。

24. 提交的多年期协定数据表明，迄今（包括 2008 年期间）的支出金额共达 24,358,959 美元，占核准经费总额的 91.1%。下表提供了关于支出情况的一个概览。此外，下表列出了 2007 年报告年度所有主要活动群体的支助情况，和迄今为止 2008 年所有付款的总花费情况，以及该数据与整个计划的预测如何联系。最后，还提供了今后几年的数据。这充分说明，该项目的进展情况良好，即将完成，并需对相关的支出做出较小的调整。

	支出（美元）				
	2007 年	2008 年	迄今的总费用	占总体预算费用的百分比	2009 年的的计划费用
立法	26,773	117,807	274,985	38.66%	436,315
良好做法	535,268	700,406	3,211,426	83.15%	650,973
制冷维修 – 投资	6,853,164	2,070,590	13,939,230	95.54%	651,000
制冷制造	0	0	52,079	100.00%	0
泡沫塑料	320,000	599,351	4,552,065	105.32%	61,090
溶剂	2,977	0	6,838	100.00%	0
计量吸入器	10,987	106,748	122,870	61.44%	77,130
项目管理股	556,100	488,596	2,199,466	73.44%	405,534
总计	8,305,269	4,083,498	24,358,959	91.10%	2,282,042

2009 年执行计划

25. 计划在项目监测、宣传和政府活动领域开展一些活动。执行和监测单位将继续提供技术和业务支助，管理该计划的各项活动。还计划继续开展公共宣传运动，以向相关行为者提供关于国家氟氯化碳淘汰计划的信息，并同时侧重回收和再循环工作。计划的政策活动将包括加强对含各类氟氯化碳混合物的进出口管制；增强 IBAMA 的技术登记册；并将氟氯化碳淘汰计划，以及今后的氟氯烃淘汰计划纳入政府的《气候变化国家计划》。在执行次级项目方面，将继续向海关官员进行新活动方面的培训，以打击非法贸易，并改善消耗臭氧层物质进/出口许可证制度。

26. 在制冷维修方面，将计划开展以下活动：对以前配置的回收机器的使用情况进行监督；将向冷风机行业配置另外 3,000 个工具包和回收袋，以及 5 台回收设备；还将确认 114 家再循环中心，并为其安装设备。正式启动剩余的 3 家 CFC-12 再利用中心，同时对两个现有的中心进行监测，并举行地方和地区讲习班，宣传中心的各项活动。向另外 6,000 名制冷技师进行制冷良好做法方面的培训。

27. 在计量吸入器行业，将继续开展关于向无氟氯化碳计量吸入器过渡的宣传运动，并强制执行各项既定条例。将开展的活动包括：针对各州和各市开展一次关于过渡的讲习班，在专门的医疗杂志刊登关于该专题的内容，详细阐述培训和宣传材料，并颁布一项在 2011 年 1 月 1 日之前禁止生产和进口含氟氯化碳的计量吸入器的决议。

秘书处的评论和建议

评论

28. 秘书处要求阐述要求在 2011 年 1 月之前淘汰计量吸入器生产的立法，并表明 2010 年各类氟氯化碳和计量吸入器的潜在使用情况。开发计划署指出，2008 年和 2009 年仅针对计量吸入器行业保留了 CFC-12 消费量，以及在制冷维修行业不能进口 CFC-12。2010 年，计量吸入器制造商将继续利用其库存来生产氟氯化碳计量吸入器，但不允许有新的进口。

29. 巴西国家氟氯化碳淘汰计划的执行情况进展顺利。在协定中，该国接受大幅削减其氟氯化碳消费量，将其降至《蒙特利尔议定书》规定的消费限额（1,578.9 ODP 吨）以下，即 2007 年 1,000 ODP 吨、2008 年为 424 ODP 吨，2009 年为 74 ODP 吨。经核查，2007 年的消费量为 318.1 ODP 吨，因此已明显低于 2008 年的最大允许消费量。

30. 如今，国家氟氯化碳淘汰计划在巴西已得到了大规模地实施。其方法的涵盖范围较为广泛，不仅涉及海关人员和制冷技师培训和相关的投资支助等已充分开展的各项活动，还涵盖回收报废冰箱等较不普遍的活动。国家氟氯化碳淘汰计划非常独特，因为其将供资和活动与能效工作结合在了一起，即处理冰箱，以及用功效更强的新冰箱来替换冰箱。因此在各执行机构的积极支助下，该国可产生多种惠益，并可确保淘汰和投资的可持续性。

31. 多年来，巴西国家氟氯化碳淘汰计划一直是报告方面的典范，因为其使得可及早根据其目标监测总体进展情况。通过多年期一览表，多数淘汰计划也同时引入了此类监测。在报告年度和 2008 年第一个月，支出费用占到了供资金额的 50%以上，与头四年相比，执行活动出现了大幅增加，头四年的情况以前一直是秘书处关切的一个问题。

建议

32. 基金秘书处建议按下表所列供资额一揽子核准巴西国家氟氯化碳淘汰计划的第七次付款和相关支助费用。

	项目名称	项目供资（美元）	支助费用（美元）	执行机构
(a)	国家氟氯化碳淘汰计划（第七次付款）	250,000	12,500	开发计划署

- - - - -

COUNTRY:	**Brazil**	**IMPLEMENTING AGENCY: UNDP**
PROJECT TITLE:	**Pilot project for validation of Methyl Formate as a blowing agent in the manufacture of polyurethane foam (Phase-I)**	
PROJECT IN CURRENT BUSINESS PLAN:		**Based on ExCom Decision 55/43(e i-iii)**
SECTOR:		**Foams**
Sub-Sector:		**All sub-sectors (except shoe soles)**
ODS USE IN SECTOR		
Baseline:		**Not yet determined**
Current (2007):		**6,403 t (HCFC 141b imported** as per Government reporting**)**
BASELINE ODS USE:		**N/A**
PROJECT IMPACT (ODP targeted):		**N/A**
PROJECT DURATION:		**7 months**
PROJECT COSTS:		**US$ 368,500 (Phase-I only)**
LOCAL OWNERSHIP:		**100 %**
EXPORT COMPONENT:		**0 %**
REQUESTED MLF GRANT:		**US$ 368,500**
IMPLEMENTING AGENCY SUPPORT COST:		**US$ 27,638 (7.5 %)**
TOTAL COST OF PROJECT TO MLF:		**US$ 396,138**
COST-EFFECTIVENESS:		**N/A**
PROJECT MONITORING MILESTONES:		**Included**
NTL. COORDINATING AGENCY:		**Ministry of Environment - MMA/PROZON**

PROJECT SUMMARY

Brazil became a Party to the Vienna Convention and Montreal Protocol on 19 March, 1990. Brazil also ratified the London, Copenhagen, Montreal and Beijing Amendments. The country is fully committed to the phaseout of HCFCs and willing to take the lead in assessing new HCFC phaseout technologies

The objective of this project is to develop, optimize, validate and disseminate the use of methyl formate in PU foam applications. The project is divided in two distinct phases:

Phase-I: development, optimization and validation and technology dissemination
Phase-II: implementation in 15 downstream enterprises covering all relevant applications

At this stage funding only for Phase-I is requested. The costs Phase-II are included as a preliminary indicative estimate. The Phase-II costs will be updated after completion of Phase-I and submitted for approval in 2009.

IMPACT OF PROJECT ON COUNTRY’S MONTREAL PROTOCOL OBLIGATIONS

This project is a pilot project aimed to validate a new HCFC phase-out technology and will contribute indirectly to Brazil’s Montreal Protocol obligations. If successfully validated, the technology will contribute to availability of cost-effective options that are urgently needed to implement HCFC phase-out, particularly at SMEs.

Prepared by: Bert Veenendaal **Date: October 2008**

PROJECT OF THE GOVERNMENT OF BRAZIL

PILOT PROJECT FOR VALIDATION OF METHYL FORMATE AS A BLOWING AGENT IN THE MANUFACTURE OF POLYURETHANE FOAM

1. PROJECT OBJECTIVES

The objectives of this project are to:

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

2. INTRODUCTION

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 reflect this by promoting pilot projects aimed to validate 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. However, because of the global impact complete deduction from the national aggregate HCFC consumption would not be fair.

3. INFORMATION ON PARTICIPATING COMPANIES

This pilot project is designed around Purcom Quimica LTDA ("Purcom"). Contact information is as follows:

Company: Purcom Quimica LTDA

Contact:	Mr. Gerson Silva, Technical Director
Address:	Rua Aeroporto 83/115, 06419 260 Barueri, SP, Brazil
Ph/Fx:	+5511-416-18902/+5511-416-84683
Email:	gerzon@purcom.com.br

Purcom was founded May 2002 and is 100 Brazilian owned. The company is the largest independent system house in Brazil and specializes in tailor-made PU systems covering virtually all applications except shoesoles. Annual sales have developed as follows (rounded):

2005 US$ 10,000,000   2006 US$ 14,000,000   2007: US$ 26,000,000

Export amounts to less than 3% (Argentina, Chile, Colombia and Mexico). The company employs about 50. Base chemicals are purchased from Air products, Bayer, Dow, Evonic, and Huntsman. The company processes following auxiliary blowing agents (2007):

• HCFC-141b	70 %	940 t	all rigid and integral skin applications
• Methyl Formate	15 %	200 t	steering wheels, bottle coolers
• Methylene Chloride	10 %	130 t	packaging foams
• HFCs	5 %	65 t	specialty applications

Methyl formate systems are sold under the name "ecomate®" and based on a license from FSI, USA. Purcom has developed these systems further and applied so far for 4 patents on new applications.

Purcom has identified companies covering 15 applications that address virtually all HCFC-consuming PU applications in Brazil. **Annex-3** lists the applications involved, and preliminary estimates of chemical consumption of PU systems as well as the HCFC-141b they contain. Verification of data and more information will be collected during the preparation of phase II.

4. PROJECT DESCRIPTION

The project is divided into two phases:

- Phase-I: development, optimization, validation, technology dissemination
- Phase-II: implementation at recipients covering all applications

4.1 PHASE-I

PU foams are used in applications that have different formulation requirements. Around 16 applications use currently HCFC-141b and 15 of these are produced by Purcom (shoesoles, will be a separate pilot project in Mexico). Development, optimization and validation of methyl formate as replacement technology for HCFC-141b will involve the systems house only. Purcom has already developed the technology for 8 applications (ref. **Annex-3**). It commercialized their use in three applications—steering wheels, discontinuous panels and bottle coolers. However, testing programs were hampered by insufficient testing equipment. Phase-I therefore will consist of:

- Acquisition of the necessary testing/prototyping equipment;
- Development of the remaining 7 applications;
- Optimization and Validation of all formulations except steering wheels on prototyping equipment that can simulate process conditions;
- Dissemination of the experience gained through a workshop.

Changing the blowing agent, which is an essential element in the formulation, requires the determination of baseline values for critical properties. While some, such as density, are general in nature, others are specific such as the following list shows:

Foam type	Application	Status	Critical Properties	Action
Integral Skin	Steering wheels	Partially proven	Friability, surface Skin adhesion	No action
	Shoe soles	Not developed	Surface	Validation
	Structural (rigid)	Developed	Surface	Validation
	Semi-flexible	Developed	Surface	Validation
Rigid Insulation	Domestic refrigeration	Not developed	Insulation, adhesion	Validation
	Commercial refrigeration	Developed	Insulation, adhesion	Validation
	Water heaters	Developed	Insulation, adhesion	Validation
	Trucks	Not developed	Insulation, adhesion	Validation
	Panels-continuous	Not developed	Insulation, adhesion	Validation
	Panels-discontinuous	Developed	Insulation, adhesion	Validation
	Spray	Not developed	Insulation, adhesion	Validation
	Blocks	Not developed	Insulation	Validation
	Thermoware	Not developed	Insulation, adhesion	Validation
	Pipe-in-pipe	Not developed	Insulation, adhesion	Validation
Flexible Foams	Hyper-soft molded	Developed	Appearance, touch	Validation
	Hyper-soft slabstock	Developed	Appearance, touch	Validation
	Low resilience	Developed	Resilience curve	Validation

Companies and their suppliers do not conduct 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. In addition, prototyping equipment is required to limit burdensome and costly downstream production testing to a minimum. The outcome of this part of the project will be a list of application-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 then be technically cleared for industrial application under Phase-II as well for dissemination to interested system houses. Past experience has shown how important it is to assure commercial availability and local technical support. In this project, following action is proposed to achieve this goal to the extent possible:

- UNDP has requested—and Purcom, as exclusive licensee for "ecomate®" technology in the regional area, has agreed to—offering non-exclusive sub-licenses to all regional system houses in good standing (= meeting MLF participation financial and eligibility criteria);
- Technology dissemination workshops will be conducted for interested systems houses as soon as the technology is deemed transferable;
- UNDP has contacted licensees in other A5 regions and proposed the same approach. The response was a tentative "yes". These companies will attend the dissemination workshops and then decide on a definite commitment.

While this may be not the immediate most profitable course for a system house with an exclusive license, it is the price to be paid for MLF support. It should be emphasized that, while other system houses can be briefed at no cost in MEF technology, they remain independent in their choice of phaseout technologies.

7.2 PHASE-II

After the formulation for a particular application has successfully passed its evaluation, UNDP will apply for approval of the second project phase, which is application in a manufacturing context.
15 companies, covering all applications, will apply the technology in their operations. Product and process testing will be conducted at downstream level by the system house. UNDP will contribute to this evaluation by conducting safety audits that includes workers exposure testing. Process adaptations will be made as needed to meet requirements as indicated in the previous table.

7.4 Supervision Arrangements

1. Decision 55/43 requires 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

8. TECHNICAL OPTIONS FOR HCFC REPLACEMENT IN PU FOAMS

8.1 GENERAL OVERVIEW

Annex-2 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
- HCs, CO_2 (LCD 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 will require at least two more years before commercialization

It follows that PU validation may include following technologies:
- Carbon Dioxide
- Hydrocarbons
- Methyl Formate

8.2 METHYL FORMATE AS REPLACEMENT TECHNOLOGY FOR HCFC-141b

Annex-2 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 MENA countries.

Technical and commercial claims made by FSI imply that the technology actually 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 data will have to be developed.
Reportedly, Brazil is the only A5 country where ecomate® is blended. The licensee for Latin America, Purcom, stated that it has spent much effort in system development for ecomate® which has by now replaced about 15% of their HCFC consumption. Current commercial applications (which indicate mature product) are in integral skin foam (steering wheels), panels (discontinuous) and commercial refrigeration (bottle coolers). Because the technology is more costly than HCFC-141b (Purcom indicates ~10%), customers use it only when the market demands it. This is the case for international corporations and for construction on behalf of international corporations

9. PROJECT COSTS

Cost forecasts for pilot projects are very difficult to prepare as such projects, by nature, are unpredictable. UNDP has as much as possible used the guidance provided by the Secretariat in Document 55/47 Annex III, Appendix II. Deviations from this document are explained.

One uncertainty is the flammability of methyl formate. The MSDS mention the substance to be "extremely flammable" respectively "explosive in vapor/air mixes". On the other side, a study shows that emissions from the actual foam process are <100 ppm and therefore below applicable explosion limits.

UNDP considers the process at the system house (prototyping, blending) hazardous and requiring adequate safeguards but the use of pre-blended systems non-flammable. That implies that from the 15 applications only 3 (all continuous operations that direct meter the blowing agent) are deemed to require safeguards. Consequently, the Secretariat's template for flammable blowing agents is used in four cases and the one for non-flammable substances 12 cases. This has a beneficial impact on the budget and leads to the following summarized cost expectations:

#	ACTIVITY	COSTS (US$)		
		INDIVIDUAL	SUB-TOTAL	TOTAL

PHASE-I – DEVELOPMENT/OPTIMIZATION/VALIDATION/DISSEMINATION				
1	Preparative work Project Preparation Technology Transfer, Training	30,000 25,000	55,000	368,500
2	System Development (7 applications) @ 5,000 Optimization (15 applications) @ 3,000 Validation (15 applications) @ 2,000	35,000 45,000 30,000	110,000	
3	Laboratory Equipment Laboratory Safety	115,000 10,000	125,000	
4	Peer review/preparation of next phase		20,000	
5	Technology Dissemination Workshops		25,000	
6	Contingencies (10%)		33,500	

PHASE-II – HCFC PILOT PHASEOUT PROJECT COVERING ALL APPLICATIONS (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	104,000	
2	Continuous Operations (12) 12 Retrofits @ 15,000 12 Trial Programs @ 3,000 Contingencies (10%)	 180,000 36,000 21,600	237,600	
3	Discontinuous Operations (3) 3 ex proof metering systems @ 15,000 3 ventilation units @ 25,000 3 sensor systems @ 15,000 3 grounding programs @ 5,000 Contingencies	 45,000 75,000 45,000 15,000 18,000	198,000	
4	Peer review/safety audits		50,000	
5	Incremental Operating Costs		1,326,400	1,916,000

Annex-6 provides details and justifications.

UNDP requests at this stage a grant for the first phase of this project amounting to

US$ 368,500

10. ANNEXES

Annex 1: Implementation/Monitoring Plan
Annex 2: Overview of PU Applications
Annex 3: Overview of HCFC Replacement Technologies in Foams
Annex 4: Participating Enterprises
Annex 5: Detailed Cost Calculations
Annex 6: Transmittal Letter

ANNEX-1

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	X	XX							
-System optimization		XX							
-System validation at system house		X	XX						
-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

ANNEX-2

IDENTIFICATION OF ODS USERS
IN
THE FOAM INDUSTRY

Foundation and at the same time one of the largest challenges for a successful ODS phaseout program is a successful identification program of the users. There are different avenues to do so:

- **The use of customs information –** In countries that do not produce CFCs, these substances have to pass by definition the border and are subject to customs registration and inspection. The problem with CFCs for foam applications is that not all CFCs are imported as such but frequently preblended into polyol. Inclusion of these substances in customs registration and mandatory disclosure of CFC 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 CFC-containing system users is required. This requires convincing the importer/distributor that such identification is in the best interest of itself and its 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.

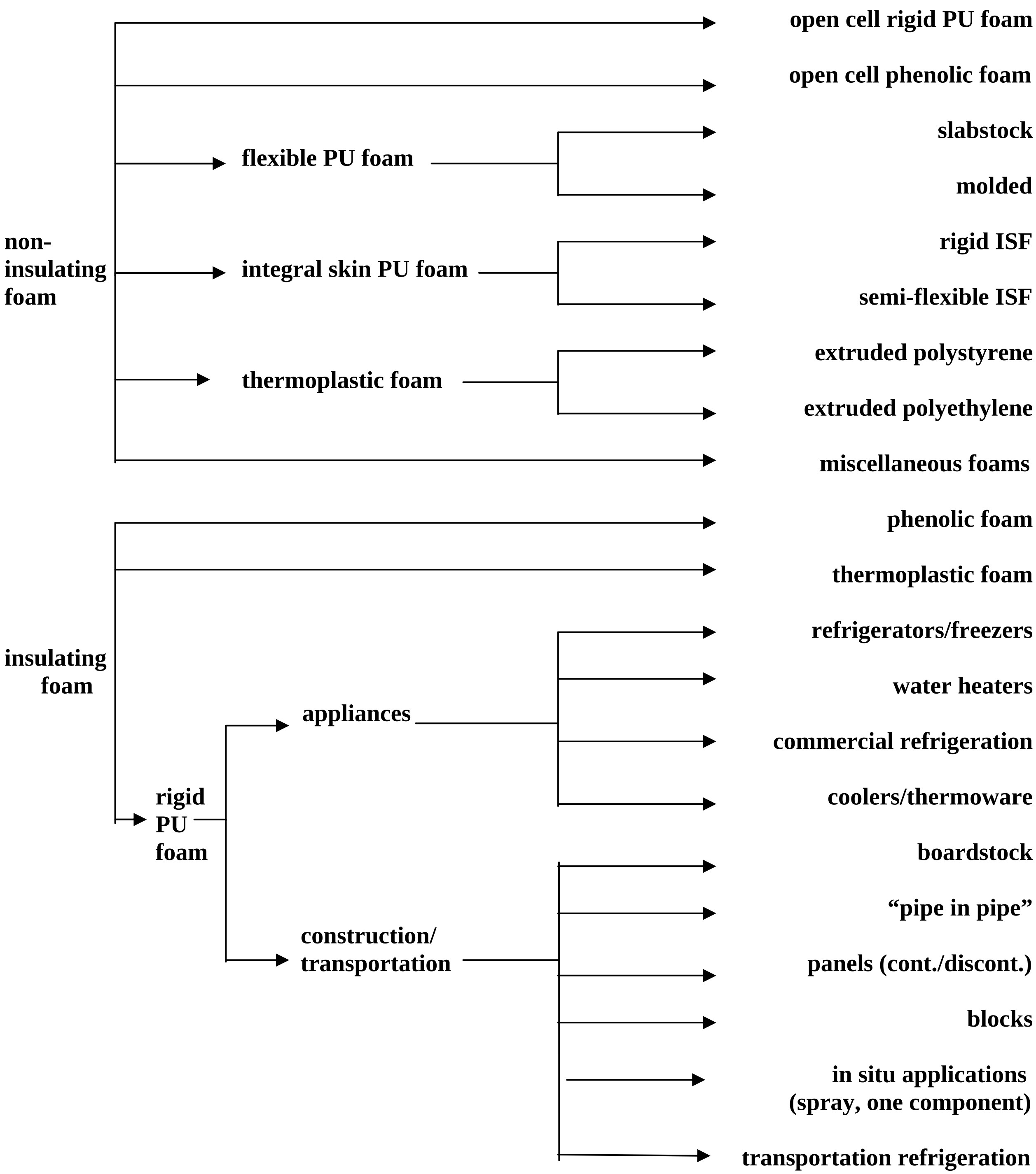
- **The use of local experts –** A person who is familiar with the local foam industry could accelerate and improve data collection. However, such person, after "picking his own recollection" is dependent on the same sources as any other data collector and dependent on persistence, ingenuity and organizational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

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

- **The use of suppliers –** any foam producer needs chemicals for its production. Identifying the suppliers and their agents/distributors and enlisting their cooperation has proven 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 virtually assures a virtually complete user identification.

IT WILL 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 BE IMPROVED CONSIDERABLY.

Foamed plastics that are produced with CFCs 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 involves, 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 is used for food packing applications (meat trays, egg cartons, plates, cups, etc). **Extruded polyethylene foam sheet and plank** is 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)

ANNEX-3

HCFC PHASEOUT TECHNOLOGIES
IN
IN FOAM APPLICATIONS

I. INTRODUCTION

HCFCs are currently used in A2 countries 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:

CO_2 ← CFCs → HCs
↓ ↓
HCFCs HCOs
↓
HFCs
↓
HFOs

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 (mWm^{0}K at 10 ^{0}C)	12.4	12.0 (20 ^{0}C)	10.6 (25 ^{0}C)
Flammable limits in Air (vol. %)	None	None	3.6-13.3
TLV or OEL (ppm; 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.

Here 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-4

PARTICIPANTS AND BASELINE DATA TEMPLATE

APPLICATION	ENTERPRISE	CONSUMPTION (t/y)					
		SYSTEMS			HCFC-141b		
		2005	2006	2007	2005	2006	2007
FLEXIBLE FOAMS (FPF)							
Hyper-soft Slabstock	Client 1	16	20	24	2.4	3.0	3.6
Hyper-soft Molding	Client 2	7	7	7	1.1	1,1	1.1
Low Resilience Slabstock	Client 3	120	120	120	7.2	7.2	7.2
INTEGRAL SKIN FOAMS (ISF)							
Rigid ISF	Client 4	150	160	165	16.5	17.6	14.0
Flexible ISF	Client 5	120	142	150	14.0	17.0	18.0
RIGID INSULATION FOAMS (RPF)							
Domestic Refrigeration	Client 6	94	100	110	14.0	15.0	16.0
Commercial Refrigeration	Client 7	1,000	1.100	1,200	150.0	165.0	180.0
Water Heaters	Client 8	30	32	35	4.5	4.8	5.2
Panels, Continuous	Client 9	900	1,000	1,200	125.0	130.0	160.0
Panels, Discontinuous	Client 10	150	150	168	20.8	22.2	23.0
Trucks	Client 11	180	200	280	25.0	27.8	39.0
Blocks	Client 12	30	30	36	4.2	4.2	5.0
Pipe-in-Pipe	Client 13	120	150	180	16.8	21.0	25.0
Thermoware	Client 14	90	100	110	13.5	15.0	16.5
Spray	Client 15	400	420	450	60.0	63.0	71.0
TOTAL		**3,407**	**3,731**	**4,235**	**413.0**	**513.9**	**584.6**

ANNEX-5

DETAILED COST CALCULATIONS FOR PHASE-1

#	ACTIVITY	COSTS (US$)	EXPLANATIONS
1	Preparative work Project Preparation Technology Transfer, Training	 30,000 25,000	 Partially retroactive for UNDP-funded preparation/TTT
2	System Development Development (7 applications) @ 5,000 Optimization (16 applications) @ 3,000 Validation (16 applications) @ 2,000	 35,000 48,000 33,000	 Does not included labor—just chemicals and external testing
3	Laboratory Equipment Laboratory Safety	140,000 10,000	See below For explosion proofing
4	Technology Dissemination Workshop	25,000	
5	Peer review/endorsement of next phase	20,000	
6	Contingencies (10%)	36,500	

ESTIMATED COST CALCULATIONS For PHASE II

(to be recalculated after technology validation)

1	System House adaptations 1 Blender 1 Tank for MeF Safety measures Contingencies (10%)	 50,000 20,000 25,000 15,000	)))Taken from previous projects)
2	Continuous Operations (12) 12 Retrofits @ 15,000 12 Trial Programs @ 3,000 Contingencies (10%)	 180,000 36,000 21,600	))As per MLFS template)
3	Discontinuous Operations (3) 3 ex proof metering systems @ 15,000 3 ventilation units @ 25,000 3 sensor systems @ 15,000 3 grounding programs @ 5,000 Contingencies	 45,000 75,000 45,000 15,000 18,000	)))From previous projects))
4	Peer review/safety audits	50,000	10 days/15 visits/travel/per diem
5	Incremental Operating Costs	1,326,400	See below

Laboratory equipment

K-factor tester	US$	10,000
Refractometer		5,000
Brett mold		5,000
HP laboratory dispenser		50,000
Sprayfoam/PIP dispenser		20,000
pH tester		5,000
Abrasion tester		25,000
Cell gas analyzer		20,000
Total	**US$**	**140,000**

Incremental operating costs are based on 10% increased polyol system costs, which amounts to ~5% increase in total chemical costs as per Purcom information. For 2 years/net present value base, this amounts to 10% of 4,235 t @ 3,600 x 1.74 = **US$ 1,326,400.**

ANNEX-6

TRANSMITTAL LETTER

SUBMISSION OF A PILOT PROJECT FOR FUNDING UNDER THE MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL[1]

Systems House Commitments

PURCOM, represented by Mr. Gerson Silva, 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 foams 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 Brazil's National Ozone Unit (NOU).

PURCOM:

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 participate in the permanent conversion of participating customers to the use of methyl formate;

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 importation and or purchase and use of HCFCs by the enterprise, including unscheduled visits to the factory. The enterprise 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 of 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 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.

[1] *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.*

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 Enterprise Representative:

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Designation: Date:

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Address: ____

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Telephone: Fax: ______________________________

E-mail: ____

Name and Signature of Representative of NOU Date:

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