联合国 EP

联合国
环境规划署

Distr.
GENERAL

UNEP/OzL.Pro/ExCom/76/48
14 April 2016

CHINESE
ORIGINAL: ENGLISH

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

项目提案： 南非

本文件包含基金秘书处对以下项目提案的评论和建议：

<u>泡沫</u>

• 非连续面板厂从 HCFC-141b 改装为戊烷中真空辅助注射的技术和经济优势示范项目	工发组织

<u>淘汰</u>

• 氟氯烃淘汰管理计划（第一阶段第三次付款）	工发组织

项目评价表 - 多年期项目

南非

项目名称	双边/执行机构
（a） 非连续面板厂从 HCFC-141b 改装为戊烷中真空辅助注射的技术和经济优势示范项目	工发组织

国家协调机构	臭氧办公室

最新报告的项目处理的消耗臭氧层物质消费数据

A: 第 7 条数据（截至 2016 年 3 月的 2014 年 ODP 吨）

HCFCs	238.58

B: 国家方案行业数据（**截至 2016 年 3 月的 2014 年 ODP 吨**）

HCFC-22	142.36
HCFC-123	1.33
HCFC-141b	93.5
HCFC-142b	1.71
HCFC-225	1.90

有资格获得供资的 **HCFC** 消费量（**ODP** 吨）	193.34

本年度的业务计划资金分配		**供资美元**	**淘汰 ODP 吨**
	（a）	暂缺	暂缺

项目名称：	
企业使用的消耗臭氧层物质（ODP 吨）：	4.18
拟淘汰的消耗臭氧层物质（ODP 吨）：	暂缺
拟推广的消耗臭氧层物质（ODP 吨）：	暂缺
项目期限（月数）：	16
要求的初始金额（美元）：	493,366
最终项目费用（美元）：	
增量资金费用：	202,000
意外开支（10%）：	20,200
增量运营费用：	暂缺
项目总费用	222,200
当地所有权（%）：	100
出口成分（%）：	暂缺
申请的资助（美元）：	222,200
成本效益（美元/千克）：	暂缺
执行机构的支助费用（美元）：	19,998
多边基金承担的项目总费用（美元）：	242,198
配套资金状况（有 / 无）：	有
包含项目监测里程碑：（有 / 无）：	有

秘书处的建议：	单独考虑

项目说明

背景

1. 在第 75 次会议上，工发组织代表南非政府提交了非连续面板厂从 HCFC-141b 改装为戊烷中真空辅助注射的技术和经济优势示范项目，金额为 372.366 美元，外加机构支助费用按最初提交为 26.066 美元[1,2]。而且在为审议提交给第 75 次会议显示较低全球变暖潜能值（GWP）的所有项目而成立的技术联络组讨论后，执行委员会决定推迟审议提交给第 76 次会议的七个示范项目，包括南非真空辅助注射项目（75/42 决定）。

2. 工发组织代表南非政府向第 76 次会议重新提交了上述示范项目，金额为 493,366 美元，外加机构支助费用 37,002 美元。提交给第 75 和第 76 次会议的项目提案之间有费用差额，因为后者费用分摊减少，与计划的活动相关费用有微小差异。

项目目标

3. 本项目旨在评估真空辅助注射在不连续面板生产过程中使用环戊烷作为发泡剂的优势，并证明在企业生产商用制冷设备中发泡作业可增强安全。真空辅助注射技术预计将为使用标准的环戊烷提供优势，可以促成提高热效率（即较低的λ值）；更好的泡沫分布；降低泡沫密度（为 HCFC 141B 基础配方的 90％）；更短的制造时间；减少原材料投入。该技术允许在压制机周围改善安全条件原点直接萃取环戊烷和异氰酸酯蒸气，因而根据防爆分类，可使生产区从区域 1 降级到区域 2，从而降低通风和安全要求。

4. 目前，高安全相关成本是更广泛采用碳氢化合物作为发泡剂的一个关键障碍，尤其是对中小型企业（SME）。该项目提案着重研究真空辅助注射技术的安全效益和降低安全相关成本的潜力。

项目执行

5. 将在纽伦堡制冷产品厂执行本项目，该企业表示承诺利用其一种生产程序来进行该示范项目。它还同意当真空辅助注射技术证明成功时，淘汰 38.04 公吨 HCFC141B。在淘汰管理计划的第一阶段，纽伦堡制冷产品厂获得了资金，从使用 HCFC¬141b 转换为甲酸甲酯。

6. 在企业层面，环戊烷转换将包括提供环戊烷预混合多元醇；更换或改造计量仪；改造压制机为真空注塑技术；使用易燃发泡剂的安全考虑；包括产品试验及测试和培训的技术援助；安全报告和认证。

7. 该项目预计在 24 个月内完成。

项目费用

8. 表 1 提供项目成本的汇总

[1] UNEP/OzL.Pro/ExCom/75/66。
[2] 编制本项目的供资在第 74 次会议得到批准，金额为 40,000 美元，外加机构支助费用 2.800 美元，其谅解是：批准该供资并不意味着批准该项目或提交的金额（ 74/33 号决定）。

表 1. 拟议项目费用

费用成分	估计费用（美元）
生产	
改造高压发泡机	80,000
改装真空辅助注射压制机*	80,000
侧型材装置（60 和 80mm）	20,000
预混合装置	84,000
戊烷水箱及配件	20,000
氮气供应系统	2,000
工厂安全	
通风和排气系统	90,000
气体传感器、报警、监控系统	50,000
安全审计/安全检查和认证	2,000
技术转让/培训	25,000
安装调试和试验	75,000
小计	**528,000**
意外开支	52,800
小计	**580,800**
增量运营费用	（87,434）
费用	**493,366**

***** 真空单元（35,000 美元个），真空设备厂（24,000 美元）及真空模或侧型材（21,000 美元）

秘书处的评论和建议

评论号

9. 秘书处指出，对该提案做了更改，为按 72/40 决定批准此项目提供额外理由。特别是重新提交的提案侧重调研真空辅助注射的技术和潜力对减少有关安全资金费用的安全效益。真空辅助注射系统将需要更多的前期资金投入；然而，由于提高了安全和最终产品质量而具有节约潜力。

10. 为了便于参考，秘书处和开发计划署提交给第 75 和 76 次会议关于示范项目的讨论结果概述如下：

(a) 南非氟氯烃淘汰管理计划第一阶段，已获准供资在该国完全淘汰 HCFC-141b。因此，该国政府在 2016 年 1 月对进出口纯 HCFC 141B 或混合化学品成分实施禁令，此外，纽伦堡制冷产品厂已经获得供资来淘汰其 HCFC 141b 消耗量。因此，转换纽伦堡制冷产品厂为环戊烷的相关费用将没有资格获得供资。依此，秘书处强调，只有相关真空辅助注射技术示范费用将有资获得供资。工发组织调整该项目费用为 222.200 美元，去除了转换为环戊烷的相关费用；

(b) 秘书处指出，拟议的技术独立于所使用的发泡剂，似乎构成了技术升级，按照 18/25（a）号决定，将没有资格。工发组织强调该项目采用真空辅助注射将展示一种新技术，这将提高环戊烷发泡技术，并能减少暴露于危险气体（例如，异氰酸酯），并增强易燃发泡剂的封闭；

(c) 秘书处指出，真空辅助注射技术似乎将被若干企业至少用于一个第 5 条国家的各种应用。

(d) 按照关于所有示范项目的优选短执行时间的 72/40（b）（i）e 号决定，工发组织修订了项目时间表，以使该项目预期在核准后 16 个月可以完成。

修订后的项目提案作为本文件附件一。

<u>结论</u>

11. 本项目可以促进从 HCFC-141b 转换为环戊烷，降低了安全相关费用，降低泡沫密度，因此降低了运营成本。工发组织调整了相关采用环戊烷技术的项目费用；据此，项目总费用将为 222.200 美元，外加机构支助费用 19.998 美元。

建议

12. 执行委员会不妨考虑：

(a) 南非的非连续面板厂从 HCFC-141b 改装为戊烷中真空辅助注射的技术和经济优势示范项目，纳入其讨论全球低变暖潜能值（在项目审查过程中认定问题概述的文件中描述的氟氯烃替代品）的示范项目提案的范畴（UNEP / OzL.Pro/ ExCom/76/12）；

(a) 批准南非的非连续面板厂从 HCFC-141b 改装为戊烷中真空辅助注射的技术和经济优势示范项目，供资水平为 222.200 美元，外加机构支助费用 19.998 美元；和

(b) 敦促南非政府和工发组织在 16 个月内按计划完成项目，并在项目完成后立即提交一份综合最终报告，。

项目评价表 - 多年期项目

南非

（I）项目名称	机构	核准会议	控制衡量率
氟氯烃淘汰计划（第一阶段）	工发组织（牵头）	第 67	到 2020 年 35%

（II） 最新第 7 条数据（附件三 I 类）	年份: 2014	239.0 （ODP 吨）

（III）最新国家方案行业数据（ODP 吨）									年份: 2014
化学品	气雾剂	泡沫	消防	冷冻藏		溶剂	加工剂	实验室使用	总行业消费量
				制造业	维修				
HCFC-123					1.3				1.3
HCFC-124									
HCFC-141b		93.5							93.5
进口预混合多元醇中 HCFC-141b									
HCFC-142b		1.7							1.7
HCFC-22					142.4				142.4
HCFC-225					1.9				1.9

（IV） 消费数据 （ODP 吨）			
2009 - 2010 年基准:	369.70	持续总削减起点:	369.70
有资格获得供资的消费量（ODP 吨）			
已核准:	176.72	剩余:	192.98

（V）业务计划		2016 年	2017 年	2018 年	合计
工发组织	淘汰消耗臭氧层物质（ODP 吨）	35.2	13.5	4.8	53.6
	供资（美元）	1,393,498	534,585	191,273	2,119,356

（VI） 项目数据			2012 年	2013 年	2014 年	2015 年	2016 年	2017 年	2018 年	2019 年	2020 年	合计
《蒙特利尔议定书》消费限量			暂缺	369.7	369.7	332.7	332.7	332.7	332.7	332.73	240.31	暂缺
最高允许消费量（ODP 吨）			暂缺	369.7	369.7	332.7	332.7	332.7	270.2	270.20	240.31	暂缺
商定的供资（美元）	工发组织	项目费用	1,960,229	2,592,620	0	1,302,335	499,612	0	6,533,556	0	0	6,533,556
		支助费用	137,216	181,483	0	91,164	34,973	0	457,349	0	0	457,556
执行委员会核准的供资（美元）		项目费用	1,960,229	2,592,620	0	1,302,335	0.0	0.0	0.0	0	0	4,552,849
		支助费用	137,216	181,483	0	91,164	0.0	0.0	0.0	0	0	318,699
要求本次会议核准的供资总额（美元）		项目费用	0	0	0	0	**1,302,335***	0	0	0	0	1,302,335
		支助费用	0	0	0	0	**91,164***	0	0	0	0	91,164

* 原计划的 2015 年第三次付款，但仅提交给第 76 次会议

秘书处的建议:	供一揽子核准

项目说明

13. 工发组织作为牵头的执行机构，已代表南非政府向执行委员会第七十六次会议提交了氟氯烃淘汰管理计划第一阶段第三次付款[3]的供资申请额为 1,302,335 美元， 外加工发组织的机构支助费用 91,164 美元。提案包涵关于执行氟氯烃淘汰管理计划第二次付款的执行进度报告，以及2016-2017 年期间付款的执行计划。

氟氯烃消费报告

氟氯烃消费

14. 南非政府报告的 2014 年消费量为 238.58 ODP 吨，并提供了 2015 年初步消费水平 3500 公吨（MT）。2011 - 2015 年氟氯烃消费量如表 1 所示。

表 1：南非氟氯烃消费量（2011-2014 年 第 7 条数据，2015 年为估计数）

HCFC	2011 年	2012 年	2013 年	2014 年	2015 年	基准
公吨						
HCFC-22	3,169.79	3,030.58	3,027.19	2,560.60		3,833.90
HCFC-123	40.18	113.19	97.39	67.20		12.80
HCFC-124	-1.91	-1.31	-0.08	0		-30.80
HCFC-141b	1,112.90	1,553.98	1,081.90	850.00		1,455.00
HCFC-142b	51.83	81.56	21.40	15.30		-12.90
HCFC-225	9.50	6.90	0.00	27.20		0.00
合计 （公吨）	**4,382.28**	**4,784.91**	**4,227.78**	**3,520.30**	**˜3,500.00**	**5,258.00**
ODP 吨						
HCFC-22	174.34	166.68	166.50	140.83		210.90
HCFC-123	0.80	2.26	1.95	1.34		0.30
HCFC-124	-0.04	-0.02	-0.00	0		-0.70
HCFC-141b	122.42	170.93	119.00	93.5		160.10
HCFC-142b	3.37	5.30	1.39	0.10		-0.80
HCFC-225	0.66	0.48	0.00	1.90		0.00
合计）（**ODP 吨**）	**301.55**	**345.64**	**288.84**	**238.58**		**369.70**

15. 在 2012 年高峰期后， 2013 年和 2014 年氟氯烃消费量减少到氟氯烃基准消费量的 35％，除其他外，是因为执行了淘汰管理计划活动，增加了与利益相关方的合作，引进和推广替代品，以及当地货币贬值对进口和经济增长产生了消极影响。

国家方案执行情况报告

16. 南非政府报告了 2014 年国家计划执行报告的氟氯烃行业消费数据，基本上与第 7 条报告的数据一致， HCFC-22 和 HCFC142b 消费量有小差异，因为混合物包含的这些物质的消费量可能未计入根据蒙特利尔议定书第 7 条报告的消费量。正在验证这种微小差异。 2015 年国家计划报告将在 2016 年 5 月 1 日前提交。

[3] 原计划 2015 年的第三次付款，但仅提交给第 76 次会议

<u>氟氯烃淘汰管理计划第二次付款执行进度报告</u>

控制氟氯烃供给和需求的其他法律文书

17. 氟氯烃淘汰管理计划第一阶段确立的主要监管措施概要如下表 2 所示。

表 2：列入更新的南非消耗臭氧层物质监管的主要监管措施

措施	日期
分配所有氢氟碳化合物的进口许可证的配额制度	2013年1月1日
禁止进口含有HCFC-22或任何含HCFC的制冷剂或混物的任何新的或使用过的制冷和空调系统或设备，	2014年9月1日
禁止在构建、装配或安装任何新的制冷或空调系统或设备时， 使用纯泡沫或混制冷剂成分的HCFC-22，	2014年9月1日
购买制冷剂需要许可/认证	2015年1月1日
禁止进口纯或混合化学品成分的HCFC141B	2016年1月1日

聚氨酯泡沫制造业活动

18. 正在将下列两个泡沫厂家转换为环戊烷发泡剂技术：

(a) *家用冰箱和冰柜（31.7 ODP 吨）*：转换项目已经完成。2015 年 12 月新工厂开始无 HCFC 制造；和

(b) *Aerothane 应用（泡沫块）（7.2 ODP 吨）*：已采购泡沫设备，正在安装用易燃发泡剂进行操作的安全设备。项目计划于 2016 年中期完成。

19. 一个系统厂房和使用基于甲酸甲酯的多元醇操作的六个聚氨酯发泡下游用户的转换已经完成，由此淘汰了 400 吨（44 ODP 吨）HCFC141B。由于该国当前的经济形势，第二个家系统厂房的转换已被推迟，这已经影响到了企业为其转换所需的共同出资水平的能力。

20. 一直保持着聚氨酯泡沫生产商的数据库，已经向中小型企业（SME）提供技术援助，以识别和评估 HCFC141B 合适的低全球变暖潜能值替代品。

21. 关于两个非符合资格的企业淘汰 HCFC141B，惠而浦（Whirlpool）已完成转换为环戊烷，促成淘汰 69 ODP 吨 HCFC141B， 而布博（Bumbo）仍使用库存的 HCFC141B。布博尚未通报替代 HCFC141B 的替代技术。

制冷维修行业

22. 已经编写了海关手册，95 名海关官员在 7 个海关点接受了培训。每个培训地点提供至少一个制冷剂识别仪，并向合规性监控单位提供了额外识别仪，该单位在海关场地之外进行检查。

23. 还举办了利益相关者会议，研究采用和执行已颁布的氟氯烃控制措施。目前正在与行业伙伴谈判原计划在 2014 年 9 月 1 日前建立的氟氯烃和其他制冷剂强制性回收和再利用的措施。预计将在 2017 年上半年建立。

项目实施和监控单位（PMU）

24. 淘汰管理计划的活动由国家臭氧机构执行和监测，该单位位于环境事务部（DEA），得到比勒陀利亚工发组织办公室的支持。

资金发放水平

25. 截止 2016 年 3 月，在迄今核准的 4,552,849 美元中，已发放 2,920,698 美元（64%）。余额 1,632,151 美元将在 2016 年发放。

表 2. 南非氟氯烃淘汰管理计划的第一阶段的财务报告（美元）

机构	第一次付款		第二次付款		核准总额	
	核准	发放	核准		核准	发放
工发组织	1,960,219	1,795,539	2,592,620	1,125,159	4,552,849	2,920,698
发放率（%）		92%		43%		64%

氟氯烃淘汰管理计划第三次付款执行计划

26. 将执行以下活动：

(a) 控制氟氯烃供应和需求的其他法律文书（没有申请资金）：继续与税务局（SARS）和国际贸易与海关合作，解决税则所要求的修改和完善监测及报告；

(b) *淘汰泡沫塑料行业使用的 HCFC-141b 的投资项目（622.437 美元）*：完成将 Aerothane（7.2 ODP 吨）转化为环戊烷和将湖科技（系统厂房）转化为甲酸甲酯；将剩下的聚氨酯泡沫下游用户完全转换甲酸甲酯系统；

(c) *制冷维修行业（514.020 美元）*：开展一个回收和再循环的可行性研究，在两个地点执行回收和再循环示范活动；与行业利益相关者和其他政府部门磋商，确立培训课程；更新与维修相关的实践规范和法规；执行少量项目来示范使用低全球变暖潜能值的技术，如二氧化碳和氨的不同应用；和

(d) *非投资活动（包括监控）（165.878 美元）*：继续培训南非其他陆路口岸海关官员；继续进行涉及泡沫和制冷维修行业的信息传播和宣传活动；增加行业参观执行项目和潜在新项目的次数。

秘书处的评论和建议

评论

氟氯烃消费报告

27. 在第 71 次会议上，南非政府通报，由于报告混合物所含氟氯烃的进出口的海关税则的缺陷，有必要对 2008 年相应报告的消费量进行数据修正。因此该国政府同意向臭氧秘书处提交正式请求，修改 2014 年 6 月报告的氟氯烃消费量。要求基金秘书处一旦获知修改的基准数据，即更新

协定附录 2-A，以包括最高允许消费量的数字，并将所产生的最大允许消费量（71/30[4]决定）的水平变化通知执行委员会。

28. 讨论完此事，工发组织通知秘书处，南非政府修订了 2011 年氟氯烃消费量（从 379.26 改为 301.45 ODP 吨）和 2012 年氟氯烃消费量（从 461.71 改为 345.64 吨）。然而，它决定不修改前几年的氟氯烃消费量。因此，将不需要更改协议，因为 HCFC 基线没有变化。

<u>核查报告</u>

29. 在发出本文件之时， 2013 年、2014 年和 2015 年氟氯烃消费量的核查报告仍在进行。因此，按照 72/19 决定，只有在秘书处审阅核查报告并证实南非政府遵照了蒙特利尔议定书和该国政府与执行委员会之间的协议之后，批准的第三次付款资金才会转给执行机构。

<u>氟氯烃淘汰管理计划的第二次付款执行进度报告</u>

法律框架

30. 南非政府按照蒙特利尔议定书的目标，已经颁布了 2016 年氟氯烃进口配额 332.7 ODP 吨，包括按照最近确立的禁令，HCFC141B 零进口配额。

聚氨酯发泡制造业

31. 关于仍在进行的聚氨酯泡沫塑料行业转换，工发组织解释说，在企业 Aerothane（单个项目）案例中，由于企业的管理变革和吸引设备供应商参加小型招标过程的困难，出现了延误。在湖科技（系统厂房）案例中，由于该国目前的经济形势，企业在提供所需的共同融资时面临困难。此外，工发组织表示，如果企业决定不参加氟氯烃淘汰管理计划，未动用资金可以重新分配，向中小企业提供更多的援助。秘书处要求工发组织先验报告以供考虑，因为氟氯烃淘汰管理计划可能会有重大改变。

32. 聚氨酯泡沫下游用户一直面临着引进甲酸甲酯的技术困难。关于开发多元醇配方，正在通过系统厂房提供协助，工发组织还任命了一名当地专家提供技术支持和促进转换过程。工发组织预计正在进行的转换将在 2016 年底前完成；企业目前使用 HCFC141B 库存，因为他们不能再进口原浆或多元醇所含的。

制冷维修行业

33. 在解释有关制冷维修行业执行活动进展有限的原因时，工发组织解释说，优先重视法规和聚氨酯发泡转换。已与高等教育部和制冷空调协会的代表讨论了关于更新现有的自愿性技术人员认证计划。正在计划扩大该计划的规模，以对该行业产生重大影响。

34. 在提供关于在制冷行业计划中示范项目的更多详情时，工发组织解释说，目前选择制冷系统的主要标准是安装的价格，所使用的大多数氟氯烃替代品是 HFC 混合物。项目目标是促进非消耗臭氧层物质，低全球变暖潜能值的制冷系统，并证明其运作可节省能源和费用。选择的替代品是超市制冷 CO2 系统或 CO2 和氨级联系统。预计这两类系统可比常规的 HCFC-22 或 R-404A 系统大大提高节能效率（10 至 50％），这意味着给用户带来节约。

[4] UNEP/OzL.Pro/ExCom/71/64， 附件 IX， 第 15 页，有条件一揽子批准。

35. 关于氟氯烃替代品渗入市场上的状况，工发组织通报，各类非消耗臭氧层物质的制冷剂进入南非，取决于客户需求，实际成本和应用。在气候和清洁空气联盟的支持下，正在进行详细调查，完成之后，将可提供关于替代品的更详细信息。

结论

36. 秘书处指出，南非政府于 2016 年 1 月 1 日建立了一整套法规来控制氟氯烃进口，包括禁止进口 HCFC-141b，无论原浆或作为混合化学品成分。南非在 2013 年、2014 年和 2015 年报告的氟氯烃消费量表明，该国遵照了蒙特利尔议定书和政府与执行委员会之间的协定。利用多边基金的援助，聚氨酯泡沫塑料制造行业到低全球变暖潜能值技术的几项转换已经完成（一个企业、一个系统厂房和六个下游用户），估计促成淘汰 80 ODP 吨 HCFC 141B。海关官员接受了培训，制冷剂识别仪已经分发。在第三次付款期间将开始制冷维修行业的实务活动，包括在超市的制冷维修行业中示范低全球变暖潜能值的替代品。

建议

37. 基金秘书处建议，执行委员会关注南非的氟氯烃淘汰管理计划第一阶段第二次付款的执行进度报告；还建议一揽子核准南非的氟氯烃淘汰管理计划第一阶段第三次付款和相应的 2016 年 2017 年的付款执行计划，供资数额如下表所示。其谅解是，只有在秘书处审查核查报告并证实南非政府遵照了蒙特利尔议定书和该国政府与执行委员会之间的协定之后，核准的资金才会转给工发组织：

	项目名称	项目供资（美元）	支助费用（美元）	执行机构
（a）	氟氯烃淘汰管理计划 （第一阶段第三次付款）	1,302,335	91,164	工发组织

Annex I

PROJECT COVER SHEET

COUNTRY: **South-Africa**

IMPLEMENTING AGENCY: UNIDO

PROJECT TITLE: Demonstration project on the technical and economic advantages of the Vacuum Assisted Injection in discontinuous panel's plant retrofitted from 141b to pentane

PROJECT IN CURRENT BUSINESS PLAN	Yes
SECTOR	Foams and commercial refrigeration
SUB-SECTOR	PU Discontinuous Sandwich Panel
ODS USE IN SECTOR (Average of 2009-10)	N/A
ODS USE AT ENTERPRISES (2015)	N/A
PROJECT IMPACT	N/A
PROJECT DURATION	16 months
TOTAL PROJECT COST:	
Incremental Capital Cost	US$ 202,000
Contingency	US$ 20,200
Incremental Operating Cost	N/A
Total Project Cost	US$ 222,200
LOCAL OWNERSHIP	100%
EXPORT COMPONENT	Nil
REQUESTED GRANT	US$ 222,200
COST-EFFECTIVENESS	N/A
IMPLEMENTING AGENCY SUPPORT COST (7%)	US$ 19,998
TOTAL COST OF PROJECT TO MULTILATERAL FUND	US$ 242,198
STATUS OF COUNTERPART FUNDING	
PROJECT MONITORING MILESTONES	Included
NATIONAL COORDINATING/ MONITORING AGENCY	Ozone Office

Project summary
Dalucon Co. agreed to host the project for conversion of the most important segment of their products, insulated trucks and other transport containers to Vacuum Assisted Injection (VAI)/Cyclopentane technology. The chosen technology is a novel method for the high quality discontinuous production of sandwich panels. These panels for refrigerated trucks, reefers, walk-in refrigerators and industrial cold stores will be manufactured using the industrially proven VAI technology. This technology will enhance Cyclopentane blowing technology, which is a definitive alternative under the Montreal Protocol and additionally has a positive impact on climate, in compliance with MOP Decision XIX/6.
Impact of project on global Montreal Protocol programms

If successfully validated, the optimized technology will contribute to availability of cost-effective options that are urgently needed to implement HCFC phase-out, particularly for applications where the size of products and high thermal insulation performance are crucial.

Prepared by: UNIDO — Date: 07 September 2015
Reviewed by: Mr. Kimmo J. Sahramaa — Date: 18 September 2015

Revision 24 March 2016

Changes in the document, since last submission, are yellow shaded and include:

- Paragraph on Improvement of Safety Conditions, including illustrative technical drawing
- Relevant alterations in this regard, to respective paragraphs, (Objectives, Methodology and Description of the process expectations) and
- Respective cost implications as following:
  - Savings on Plant Safety, namely ventilation and gas detection
  - Additional costs on testing of improvement of safety conditions, which include:
    - Verification of pentane concentration near the press in the conditions without and with VAI
    - Report on the findings and results, conclusions and recommendations.

1 BACKGROUND AND JUSTIFICATION

In 2007, the Parties to the Montreal Protocol agreed to accelerate the phase-out of the hydrochlorofluorocarbons (HCFCs) as the main ozone depleting substances largely because of the substantive climate benefits of the phase-out. In the following years, Parties operating under the Montreal Protocol's Article 5 (mostly developing countries) have formulated their HCFC Phase-out Management Plans (HPMPs) for implementation under financial assistance from the Multilateral Fund for the implementation of the Montreal Protocol (MLF).

The Executive Committee in decision 72/40 agreed to consider proposals for demonstration projects for low-GWP alternatives and invited bilateral and implementing agencies to submit demonstration project proposals for the conversion of HCFCs to low-global warming potential (GWP) technologies in order to identify all the steps required and to assess their associated costs.

In particular, Par (b)(i)a. of the Decision 72/40 indicates that project proposals should propose options to increase significantly in current know-how in terms of a low-GWP alternative technology, concept or approach or its application and practice in an Article 5 country, representing a significant technological step forward.

The use of the vacuum assisted technology for the application of alternatives to HCFCs fully fits the actual ExCom decision on Demonstration project proposals as defined in ExCom Decision 72/40.

The Executive Committee of Multilateral Fund for the Implementation of the Montreal Protocol approved at its 74th meeting held in Montreal, Canada in May 2015, the preparation of the demonstration project for foam and refrigeration sectors. The project was approved for UNIDO implementation in the republic of South Africa.

2 OBJECTIVE

- Demonstrate benefits from the application of the vacuum assisted injection in replacement of HCFC-141b with pentane in term of insulation properties in the panel's sector
- Demonstrate the easy applicability of the technology and, consequently, the replicability of the results
- Demonstrate that lower cost structure can be obtained by means of shorter foaming time, lower foam density, lower thermal conductivity
- Demonstrate the advantages in terms of safety against explosion and environmental and health sustainability for the operators
- Objectively analyze, if the incremental capital cost could be reduced overall in similar future projects by means of using Vacuum Assistance applied in the foaming process automatically used also for suction of flammable and harmful gaseous substances. Thus, providing means of reducing the cost of exhaust ventilation system in the hydrocarbon based plant conversions.

3 METHODOLOGY

Intention of this demonstration project is to provide means for the evaluation of sandwich panels manufactured with new technology in comparison and in regards to;

- Thermal transmittance
  - Measurement of lambda values (thermal conductivity W/mK)

    - Ageing of lambda value
- Mechanical resistance of the panels and its core material
    - Shear strength and shear modulus
    - Compressive strength
    - Cross panel tensile strength
    - Bending moment and wrinkling stress
- Foam density distribution through the foam matrix in various positions of the panels
- Reclassification of the dangerous area from zone 1 to zone 2 i.e. less critical, according to ATEX regulation
    - Measurement of the presence of pentane vapors in the area near the press

All tests above will be conducted according to EN 14509 (Self-supporting double skin metal faced insulating panels - Factory made products – Specifications)

3.1 Description of process expectations

Quality of PU panel relies, in most of the application, on the insulation property. Considering the PU physical properties, insulation of final products can be influenced by the: a) thermal conductivity of the blowing agent b) thermal conductivity polymer matrix and c) overall foam structure, its uniformity and homogeneity. These factors of thermal conductivity then determine the thickness of the foam insulation.

Therefore, one of the critical points in the retrofitting from 141b to blowing agents with higher thermal conductivity value , is the losses in insulation properties.

Aim of this demonstration project is to evaluate the advantages of Vacuum Assisted Injection (VAI) in discontinuous panel production process, when using Cyclopentane as foam blowing agent instead of HCFC-141b and to demonstrate higher safety of foaming operations through downgrading of one area (around the press) according to ATEX regulations..

The Vacuum injection technology will give advantages to a standard pentane converted plant in term of:

- Decreased lambda value
- Better overall foam structure/ foam distribution
- Decreased demolding time of 30%
- Increased safety. Reclassification/downgrade of safety zone, from zone 1 to zone 2 (according to ATEX)

The above is expected to generate substantial technical improvements in the final products as well as reduction of operation costs (reduction of time for manufacturing as well as reduction of raw materials inputs).

The project results will be extremely relevant for those sectors where insulation property of final products is crucial and thickness of panels cannot be increased (e.g. panels for refrigerated trucks, refrigerated containers, etc.)

3.2 Detailed description of Methodology

In the selection of the most suitable partner for the application of the vacuum assisted technology, priority was given a company, which is eligible and willing for the pentane conversion.

Dalucon is willing and eligible beneficiary which was selected and the project will include the implementation of:

1- Pentane conversion of the plant
2- Retrofitting kit to vacuum injection technology of the existing presses

The pentane conversion will include: Provision of Cyclopentane preblended polyol, Dosing unit (retrofit or substitute the existing one), Safeties for the use of flammable blowing agent (safety control panel, gas sensors, ventilators…), engineering services for the pentane conversion, safety report and White book and certification (TUV or similar).

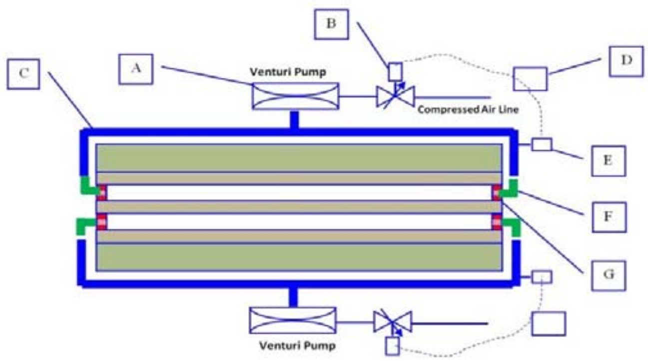
1- *Retrofitting kit to vacuum injection technology*

The retrofitting kit to vacuum injection technology will include three main components: vacuum unit, vacuum plant and vacuum molds, (as explained below).

VACUUM UNIT

System where the vacuum is generated and controlled.

This includes vacuum pumps, control valves, sensors, control hardware and software. The unit can control the level of vacuum in the cavity, the duration of the process and can store different recipes according to different kind of panel models, with optimized parameters.



VACUUM PLANT

This part is to connect the vacuum up to the cavities where PU foam is injected. Objective is to keep the normal movement of the press and the press platens and reduce costs of retrofitting.

VACUUM MOULDS (SIDE MOULDS OR PROFILES)

Molds are to define the shape of the panel, especially its external shape and dimensions. The scope of supply considers a complete additional set of molds designed to create the vacuum inside the press cavity.

Each side mold will be equipped with connections for connecting the cavity to the vacuum plant, vacuum distribution in the whole cavity and a dedicated injection holes able to maintain the vacuum level even at the insertion of the injection head.

4 COMPANY BACKGROUND

Dalucon Refrigeration Products (DRP) is a family owned business, originally founded by Aldo Martinelli in 1991 with combined company knowledge between its members of over 50 years. Their core focus is on quality and delivery time and therefore DRP has set a benchmark for all of its products that competitors find hard to match. DRP remains a successful business employing over 110 staff members and are situated in Centurion, with over 10,000 m² of manufacturing space available; 800m² office space; 3000 m² storage, assembly and stock area. DRP is situated in Highway Business Park, Centurion, Gauteng – a gateway between Johannesburg and Pretoria, which forms a natural extension to the rest of South Africa.

Address:

P.O. Box 7827
Centurion
0046
Tel: 012 661 8480/1/2
Fax: 012 661 0354
Website: www.dalucon.co.za
Members: A. Martinelli, M. Martinelli, S. Martinelli
Reg No: 2006-089100-23
Vat No: 444 0126 730

4.1 PRODUCTION PROCESS

The raw materials, including polyol blend with HCFC-141b as a pre-blend from the local system house, and isocyanate is being procured in 1,000 liter IBC containers. The polyol-blend, once received, is shifted to the polyol tank of 1,000 liters through pneumatic pump. This tank is kept in the temperature-controlled storage room. The blend of poly and HCFC-141b is taken to the day tank of the foaming machine. Iso is taken in similar process from the tank of 1,000 liter to the Iso day tank of the foaming machine. The plant has 3 foaming lines and 3 units 2 +2 Manni presses. The chemical is poured discontinuously in the panel in the desired quantity to achieve the required foam parameters. The production process is to a large extent automated.

The production cycle is as follows:

- Warehouse and storage for metal coils
- Cutting and profiling to length of the metal sheets
- Assembly of the panels
- Movement to the foaming tables of the press
- Foaming
- Extraction and transport to the warehouse for shipment

The chemical composition of various chemical uses in the manufacturing PU sandwich panels is provided in the table below:

Description	HCFC 141b	Polyol	Isocyanate
%age mixing ratio	11.90%	36.71%	51.39%

The higher than normal content of HCFC-141b is found and proven to provide the optimum thermal transmittance for the panels and enhanced PU mixture flowability, which is required, in particular in the transport vehicle use of insulated sandwich panels.

The description of the foaming machine, press and storage tanks are provided below.

Baseline Equipment

Sr. #	Type of Equipment	Model	No.	Design Capacity	Manufacturer Type	Commissioning Year
Foaming Line 1						
1	Polyol Preblend Storage Tank	Dalucon Stainless Steel	2	1000 liter	Dalucon	2006
2	Isocyanate Storage Tank	Dalucon Stainless Steel	2	1000 liter	Dalucon	2006
1	Polyol Day Tank	Cannon, Italy	1	200 liter	Cannon, Italy	2006
2	Isocyanate Day Tank	Cannon, Italy	1	200 liter	Cannon, Italy	2006
3	PU Foaming Machine with mixing heads	Cannon A-100 Basic, Italy	1	100 kg/min	Cannon, Italy	2006
4	Manni 2+2 Press	Manni/Cannon, Italy	1	9.5x1.45 meter	Cannon, Italy	2006
Foaming Line 1 (mainly for the refrigerated truck panels) is subject for the conversion and demo project						
Foaming Line 2 for longer panels						
1	Polyol Day Tank	Cannon, Italy	1	350 liter	Cannon, Italy	2012
2	Isocyanate Day Tank	Cannon, Italy	1	350 liter	Cannon, Italy	2012
3	PU Foaming Machine with mixing heads	Cannon A-200 CMPT, Italy	1	200 kg/min	Cannon, Italy	2012
4	Manni 2+2 Press	Manni/Cannon, Italy	1	13.5x1.45 meter	Cannon, Italy	2012
Foaming line 3						
1	Polyol Day Tank	Cannon, Italy	1	350 liter	Cannon, Italy	2015
2	Isocyanate Day Tank	Cannon, Italy	1	350 liter	Cannon, Italy	2015
3	PU Foaming Machine with L-14 mixing head	Cannon A-100 Basic, Italy	1	100 kg/min	Cannon, Italy	2012
4	Manni 2+2 Press	Manni/Cannon, Italy	1	13.5x1.45 meter	Cannon, Italy	2015

The Cannon A-100 will be converted to cyclopentane. Further, the electrical system of the hydraulic control of the presses needs to be adapted to ATEX requirement.

Few photographs taken at the plant is provided below:

4.2 ANNUAL PRODUCTION PROFILE IN 2014

Panel thickness mm	Capacity m2 / 8 hrs	Share of production %	PU m3	PU kgs	PU total kg/a	HCFC-141b kg	HCFC-141b Total / a
40	500	10,0	2,0	83,2	20800,0	9,9	2475
50	500	5,0	1,3	52,0	13000,0	6,2	1547
60	450	30,0	8,1	337,0	84240,0	40,1	10025
80	400	30,0	9,6	399,4	99840,0	47,5	11881
100	380	20,0	7,6	316,2	79040,0	37,6	9406
125	350	5,0	2,2	91,0	22750,0	10,8	2707
		100,0	30,7	1278,7	319670,0	152,2	38041

5 TECHNOLOGY OPTION FOR VACUUM ASSISTED INJECTION TECHNOLOGY (VAI)

5.1 Overview of alternatives to HCFC-141b for PU foam application

HCFC-141b has mainly been used as a blowing agent in various formulations in the manufacturing of PU foam for the production of PU sandwich panels for various sizes and thickness in South-Africa.

Factors that influence the technology selection include consideration of the following major features for PU foam.

- Mechanical properties
- Density
- Insulation properties
- Costs

5.2 Alternate Technologies Considered

In accordance with the 2014 report of the rigid and flexible foams technical options committee, there are a number of alternatives that are available to replace the use of HCFC 141b in rigid polyurethane foam. Several foaming technologies including the following are used as alternate technology.

- Cyclopentane
- HFC-245fa
- HFC-365mfc/227ea
- HFC-134a
- Methyl formate
- CO_2 (Water)
- u-HFC
- Liquid unsaturated HFC/HCFC (HFOs) as emerging technology

The below table provides an overview of the blowing agents that has been used in various sub-sectors of foam sector.

Sector	*HCFCs*	*HFCs*	*HCs*	*HCOs*	*HFOs*	*CO2-based*
PU Appliances	HCFC-141b HCFC-22	HFC-245fa HFC-365mfc/227ea	cyclo-pentane cyclo/iso-pentane	Methyl Formate	HFO-1233zd(E) HFO-1336mzzm(Z)	CO2 (water)*
PU Board	HCFC-141b	HFC-365mfc/227ea	n-pentane cyclo/iso pentane		HFO-1233zd(E) HFO-1336mzzm(Z)	
PU Panel	HCFC-141b	HFC-245fa HFC-365mfc/227ea	n-pentane /iso pentane		HFO-1233zd(E) HFO-1336mzzm(Z)	CO2 (water)*
PU Spray	HCFC-141b	HFC-245fa HFC-365mfc/227ea			HFO-1233zd(E) HFO-1336mzzm(Z)	CO2 (water)* Super-critical CO2

Sector	*HCFCs*	*HFCs*	*HCs*	*HCOs*	*HFOs*	*CO2-based*
PU In-situ / Block	HCFC-141b	HFC-245fa HFC-365mfc/227ea	n-pentane cyclo/iso pentane		HFO-1233zd(E) HFO-1336mzzm(Z)	CO2 (water)*
PU Integral Skin	HCFC-141b HCFC-22	HFC-245fa HFC-134a		Methyl Formate Methylal		CO2 (water)*
XPS Board	HCFC-142b HCFC-22	HFC-134a HFC-152a		DME	HFO-1234ze(E)	CO2 CO2/ethanol
Phenolic	HCFC-141b	HFC-245fa HFC-365mfc/227ea	n-pentane cyclo/iso pentane		HFO-1233zd(E) HFO-1336mzzm(Z)	

*CO_2 (water) blown foams rely on the generation of CO_2 from reaction of isocyanate with water in the PU system itself.

The pros & cons for commercially available options as well as emerging options as highlighted in the UNEP 2014 report of the rigid and flexible foams technical options committee for the manufacturing of PU foam are provided in the below tables:

Commercially Available Options

Option	**Pros**	**Cons**	**Comments**
Cyclopentane & n-Pentane	Low GWP	High flammable	High incremental capital cost, may be uneconomic for SMEs
	Low operating costs		
	Good foam properties		
HFC-245fa, HFC-365mfc/227ea, HFC-134a	Non-flammable	High GWP	Low incremental Capital Cost
	Good foam properties	High Operating Cost	Improved insulation (cf. HC)
CO2 (water)	Low GWP	Moderate foam properties -high thermal conductivity-	Low incremental Capital Cost
	Non-flammable		
Methyl Formate/Methylal	Low GWP	Moderate foam properties -high thermal conductivity-	Moderate incremental capital cost (corrosion protection recommended)
	Flammable although blends with polyols may not be flammable		

Emerging Options

Option	**Pros**	**Cons**	**Comments**
Liquid Unsaturated HFC/HCFC (HFOs)	Low GWP	High operating costs	First expected commercialization in 2013
	Non-flammable	Moderate operating costs	Trials in progress
			Low incremental capital cost

The Indicative assessment of criteria for commercially available options as well as emerging alternatives in PU foam is provided in the table below:

Assessment of criteria for commercially available options

	c-pentane	**i-pentane n-pentane**	**HFC-245fa**	**HFC365mfc/ 227ea**	**CO_2 (water)**	**Methyl Formate**
Proof of performance	+	++	++	++	++	+
Flammability	---	---	++	+(+)	+++	--
Other Health & Safety	0	0	+	+	-	0
Global Warming	+++	+++	--	---	++	++
Other Environmental	-	-	0	0	++	-
Cost Effectiveness (C)	--	---	++	++	++	0
Cost Effectiveness (O)	++	+++	--	--	+	+
Process Versatility	++	++	+	++	+	+

Assessment of criteria for Emerging Technology options

	HFO-1234ze(E)	**HFO-1336mzzm(Z)**	**HFO-1233zd(E)**
	Gaseous	liquid	Liquid
Proof of performance	0	+	+
Flammability	++	+++	+++
Other Health & Safety	+	+	+
Global Warming	+++	+++	+++
Other Environmental	+	+	+
Cost Effectiveness (C)	++	++	++
Cost Effectiveness (O)	--	--	--
Process Versatility	+	+	+

IOC comparison between major alternatives

IOC	**HCFC-141b**			**HFO-1233zd**			**c-pentane / vacuum**			**Water-blown / Formic Acid**		
	Formula	%	Cost/kg	Formula	%	Cost/kg	Formula	%	Cost/kg	Formula	%	Cost/kg
Polyol	100	36,71%	2,70	100	38,17%	2,70	100	37,88%	2,70	100	37,95%	2,70
B.A	32,42	11,90%	2,70	22	8,40%	13,00	9	3,41%	2,68	3,5	1,33%	2,70
MDI	140	51,39%	2,50	140	53,44%	2,50	155	58,71%	2,50	160	60,72%	2,50
Total	**272,42**	**100,00%**	**2,60**	**262**	**100,00%**	**3,46**	**264**	**100,00%**	**2,58**	**263,5**	**100,00%**	**2,58**
Thermal conductivity mW/mK			**23**			**21**			**23**			**31**
Foam density			42			42			37,8			
Equivalent cost USD			**2,60**			**3,16**			**2,32**			**3,48**
Total PU consumption 2015	319670	38,04	830253	319670		1009300	287703		742819	319670		1110996
IOC / year USD						**179047**			**-87434**			**280744**

5.3 Selection of alternative technology for the VAI

The technology chosen has been Cyclopentane due to the following:

- Experience has been gained and training, technology options costs are lower
- Cyclopentane is a well-established technology with zero ODP and is a low GWP

- The existing (VAI) foam formulations in the manufacture of domestic refrigerators and sandwich panels are based on the utilization of c-pentane as core foaming agent

6 Activities required for conversion

6.1 Modification of production process

The following modification and replacements in the existing process is assumed to implement the conversion.

- Retrofit of existing foam dispenser where applicable
- Replacement of pre-mixing unit,
- Modification of Press
- Hydrocarbon tank and accessories (piping and pumps, ventilation).
- Buffer tank for polyol, however, at Dalucon, it will not be required, since the storage tank of polyol blend will act as buffer tank
- Nitrogen supply system

- The following features need to be introduced

  - Ventilation system
  - Safety system controls
  - Adaptation of foaming equipment controls (software) and electrical equipment in order to comply with ATEX or equivalent safety regulations
  - Suitability of pressure equipment to comply with the regulations
  - Control of emissions of the equipment used which includes magnetic joints on electrical motors and EX parts for all equipment in contact with the liquid
  - Safety verification by the supplier or independent entity like TUV.

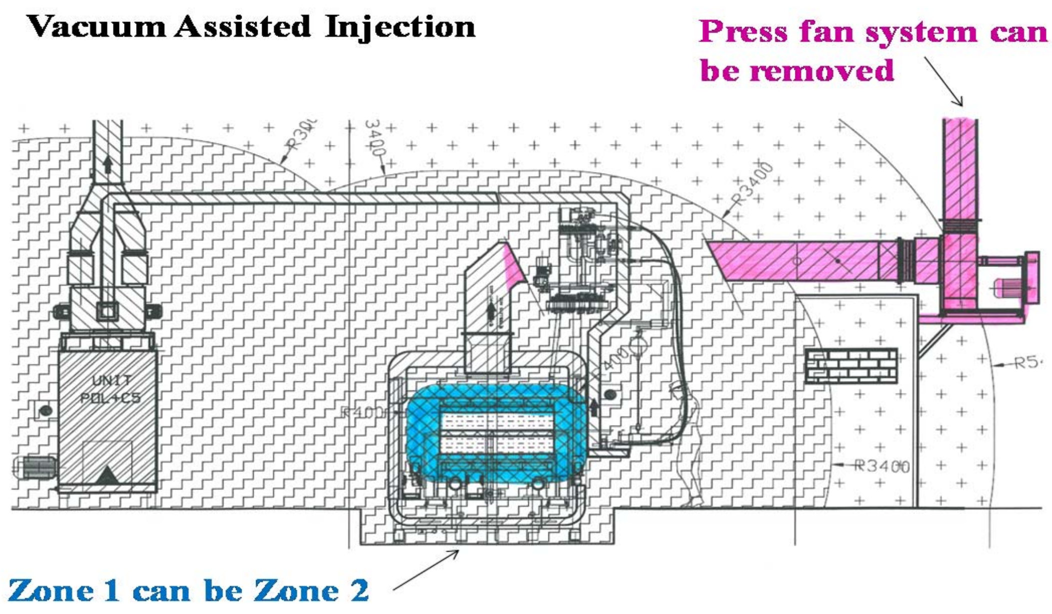
6.2 Improvement of safety conditions

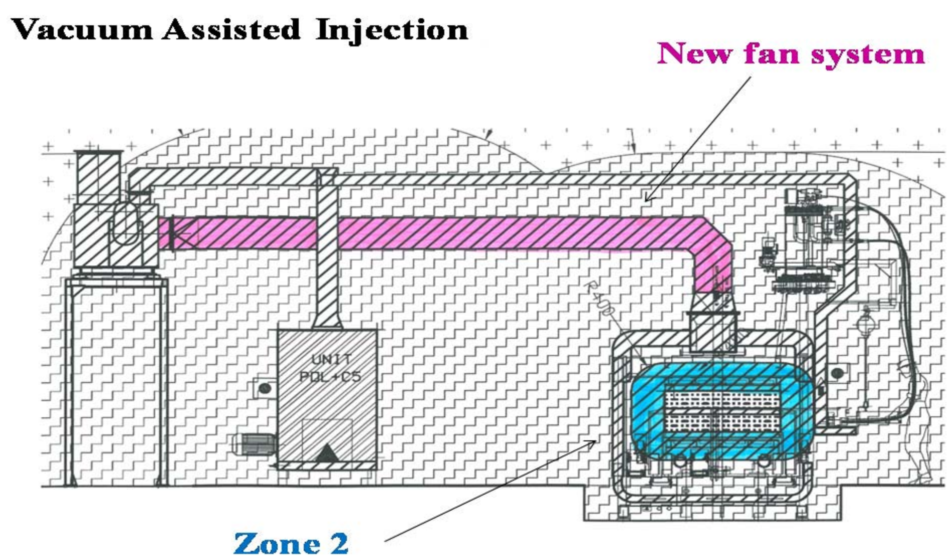
Another important aim of the project is to demonstrate that using the Vacuum Assisted Technology, all the vapours (pentane as well as isocyanate) are extracted directly from the source at their origin, while frothing, by the vacuum itself and, therefore vapours and fumes, they could not be released into the atmosphere around the press with the following consequences:

- Avoid the presence in the atmosphere around the press, of the blowing agent (hydrocarbon) and isocyanate vapors thus also, consequently, allow safe and healthy working conditions for the operators

- Downgrading of the area from zone 1 to zone 2 and, consequently, reduction of the ventilation needed, as shown in the following layouts. The new function of fan system is dual as mentioned above, for health and safety. However safety aspect now becomes as secondary as safety reclassification results in no permanent presence of blowing agent.

Savings in the safety costs are solely related to VAI.


Vacuum Assisted Injection
Press fan system can be removed
UNIT
PDL+C5
R3400
R3400
Zone 1 can be Zone 2


Vacuum Assisted Injection
New fan system
UNIT
PDL+C5
Zone 2

The training of the beneficiary staff for the adaptation of new technology is covered in this project. Further, the trials and testing of the product is also covered. Once the plant is put in commercial operation, the safety verification by the safety certifier shall be carried out and is being covered in the cost of the project.

After the successful completion of testing and commercial production, the removed equipment will be destroyed.

7 PROJECT COST

7.1 Project Cost as per MP Guideline decision 55/47

The conversion plan and costs are following the guidelines of decision 55/47 to the extent possible.

7.2 Incremental capital cost

The foaming line 1 shall be converted to the use of Cyclopentane from HCFC-141b with VAI technology. Funds are requested to cover the modification, provision of the VAI Kit and retrofit of existing A-100 foaming machine and the provision of necessary equipment, accessories as well as technology transfer, training, trials and commissioning. The ICC calculation is based on Appendix-I of the above referenced guidelines. These guidelines are based on 2008 market costs.
While calculating the incremental capital cost for each plant, the cost provided for 2008 basis has to be adjusted according to the inflation rate as a matter of acceptance of principles of market economy, as also manufacturers of equipment adjust to inflation.
The ICC of this project is calculated using only the base cost figures as provided in the guideline 55/47.

All cost in US$

	Guidelines Decision 55/47 US$	Counterpart cost sharing	Project cost US$
Retrofit of High pressure foaming machine (Cannon A-100 Basic; Ref. note in the Baseline Equipment table; p.5 above)	100 000	80 000	
Modification of press for VAI (cost break down detailed below)*	80 000	-	80 000
Set of side profiles (60 and 80 mm)	20 000	-	20 000
Premixing unit	84 000	84 000	
Hydrocarbon tank and accessories including polyol-pentane drum pump	55 000	20 000	
Buffer tank for pentane-polyol tank 1,000 liters	100 000		
Nitrogen supply system	15 000	2 000	
Plant Safety			
Ventilation and exhaust system (fans, piping, ductworks, grounding, electrical boards/connection) complete	115 000	90 000	0

Gas sensors, alarm, monitoring system for entire plant	57 000	50 000	0
Fire protection/control system for the plant	10 000		0
Lightning protection and grounding	15 000		0
Antistatic floor	5 000		0
Safety Audit / Safety Inspection and certification	20 000	18 000	2 000
Stand by electric generator	15 000	15 000	0
Civil work / Plant modifications	25 000	25 000	0
Technology transfer / training	25 000		25 000
Installation, commissioning, start up and trials **	75 000		75 000
Total	816 000	326 000	202 000
Contingency	81 600		20 200
Grand Total	**897 600**	**326 000**	**222 200**
IOC			N.a.
Total project cost US$			**222 200**

*Cost break down for Modification of press for VAI, which is described as three component retrofitting kit (Chapter 3.2 ; p. 3 above).

VACUUM UNIT	35,000
VACUUM PLANT	24,000
VACUUM MOULDS (SIDE MOULDS OR PROFILES)	21,000
Total	80,000

****Trials and commissioning include testing mentioned in the methodological chapter (3):**

- Positioning and installation of equipment U$ 25,000
- Commissioning U$ 20,000
- Start up of equipment an U$ 10,000
- Testing of physical properties of panels U$ 5000
  Thermal transmittance
    - Measurement of lambda values (thermal conductivity W/mK)
    - Ageing of lambda value
  Mechanical resistance of the panels and its core material
    - Shear strength and shear modulus
    - Compressive strength
    - Cross panel tensile strength
    - Bending moment and wrinkling stress
- Foam density distribution through the foam matrix in various positions of the panels
- Improvement of safety conditions
  Verification of pentane concentration near the press in the conditions without and with VAI
  U$ 10,000

Report on the findings and results, conclusions and recommendations. U$ 5,000

7.3 Incremental operating cost

IOC is not included in this project budget, since this demo cannot contribute to the HCFC 141b phase out in the Country. However it is calculated below as an example to illustrate important financial advantage of this Vacuum Assisted Injection (VAI) technology.

In calculating the Incremental Operating Costs it has been assumed that:

- The use of Cyclo-Pentane is only about 28.6% of the use of HCFC 141b.
- The conversion of technology to VAI / Cyclo-pentane system shall reduce the density of the foam to 90% of present HCFC-141b based formulations.

Incremental operating cost related to the conversion of the foaming technology was calculated based on the formulations as applicable at Dalucon. Current prices are as follows:

- HCFC-141b: US$ 2.70/kg
- Polyol: US$ 2.70/ kg
- Isocyanate: US$ 2.50/ kg
- Cyclo-Pentane: US$ 2,68/kg

Chemicals	**R-141b system**			**VAI/Cyclo-pentane system**		
	Amount Kg	**Price US$/kg**	**Cost US$**	**Amount Kg**	**Price US$/kg**	**Cost US$**
Polyol	0.367	2.70	0.99	0.379	2.70	1.02
Isocyanate	0.514	2.50	1.28	0.587	2.50	1.47
Blowing agent	0.119	2.70	0.32	0.034	2.68	0.09
Total	**1.000**		**2.60**			**2.58**
				Difference per kg		**-0.02**

The IOC is calculated based on 1 year as provided in the table below

	Before conversion	**Year I**
Foam production [kg]	319,670	287,703
Total annual cost of chemicals used	830,253	742,819
Cost difference per annum - Total IOC, US$		-87,434

7.4 Valuation of costing

- Plant safety costs in this demonstration project are solely related to VAI and they are necessary to:

  a) validate the difference between atmospheric pentane blowing and VAI and also

  b) facilitate plant safety certification.

- Additional savings at both, ICC and IOC are very likely, on the account of increased safety and higher quality of the end products as in comparison with HCFC 141b blowing as well as cyclopentane atmospheric (non-vacuum) blowing.

- For example saving on extraction fan will result also in IOC saving for electricity.
- Downgrade of around press safety zone will result in additional IOC saving for electricity since importance and capacity of reaming fan(s) is reduced due to non-permanent presence of cyclopentane.
- Reduced number of equipment (ventilation and detection) will result in reduced IOC for maintenance cost.
- Also reduction in IOC for insurance should be considered.
- Potential higher price of end products due to increased quality yet lower weight should add to overall savings/ revenue.
- Also modification of the process for the case of the use of pre-blended polyol will be associated with obvious savings.
- These additional cost benefits could be quantified only after implementation of this demo project.

8 GLOBAL WARMING IMPACT ON THE ENVIRONMENT

8.1 Project Impact on the Environment

The project impact on the environment was studied for both the chemicals i.e. HCFC 141b and Cyclopentane. The CO_2 emission before conversion (using HCFC 141-b as blowing agent with Global Warming Potential of 713) is expected as 27,123 metric ton per year whereas after conversion to Cyclopentane with GWP 25, it is estimated 245 metric ton per year. The net impact on the environment is positive. The CO_2 emission is expected to be reduced by 26,878 MT after implementing the new technology. The net effect is provided in the table below:

Name of Industry	**Substance**	**GWP**	**Phase out amount MT/ year**	**Total equivalent warming impact CO2 eq. MT/ year**
Before Conversion				
Total CO_2 emission in M tonnes	HCFC 141b	713	38.04	27,123
After Conversion				
Total CO_2 emission in M tonnes	Cyclopentane	25	9.81	245
Net Impact				-26,878

9 PROJECT IMPLEMENTATION MODALITIES

9.1 Implementation structure

The National Ozone Unit reporting to the Department of Environmental Affairs, Government of South-Africa is responsible for the overall project, coordination, assessment and monitoring. The National Ozone Unit (NOU) cleared the Letter of Commitments with Dalucon DRP. NOU will clear Agreement on Implementation Procedures with the counterpart and other partners of this project (if any), to ensure that project objectives are met. Terms of Reference (TOR) for the implementation of this demonstration project will be prepared by

UNIDO in close collaboration with his technology originator and provider(s) of equipment and Dalucon (recipient company). Main objective of this Plan is to ensure project successful implementation and provision of process replication to other companies in South-Africa and other Article 5 countries.

UNIDO as the implementing agency is responsible for the financial management of the respective grant. UNIDO will also assist the Dalucon in equipment procurement, technical information update, monitoring the progress of implementation, and reporting to the ExCom. The counterpart/enterprise is responsible to achieve the project objective by providing financial and personnel resources required for smooth project implementation. Financial management will be administered by UNIDO following UNIDO's Financial Rules and Regulation.

9.2 Working arrangement for implementation

After the approval of the project by the Executive Committee, the working arrangement will be signed by the above parties, where the roles and responsibilities of each party are detailed.

9.3 Modification of production process

Procurement of equipment required for the production line modification will be done through a single source purchase, however according to respective regulation stipulated by UNIDO's Financial Rules and Regulations. Smaller equipment and parts may be procured locally, if local procurement is found to be more economical. Local procurement will also be done based on UNIDO's Financial Rules and Regulations. This applies also for contracting with contractors for provision of technical services. Terms of references and technical specifications for the procurement of contracts and equipment will be prepared by UNIDO in consultation and agreement with the enterprise and the NOU.

9.4 Project monitoring

Project monitoring is done by the executing and implementing agencies through regular missions to the project site and continuous communications through e-mails and telephone/skype discussion. Occasional visits and communication by the NOU are also to be done to ensure adequate project implementation.

9.5 Project completion

Project completion report will be submitted by UNIDO within 6 months after project completion. Necessary data and information for the preparation of the project completion report is to be provided by the enterprise/NOU.

9.6 Timetable for implementation

Milestone	**2016**				**2017**				**2018**			
	Q1	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
Approval												
Working arrangement												
Preparation of TORs												
Bidding & contract award												
Equipment Delivery												
Modification of line												
Staff training												
Safety certificate												
Project completion												

In conformity with the Montreal Protocol Executive Committee's decision 23/7 on standard components on monitoring and evaluation, milestones for project monitoring are proposed as follows:

Sr. #	Milestone	Months
1	Project approval	-
2	Start of implementation	1
4	TOR prepared	3
5	Bids prepared and requested	5
6	Contracts awarded	8
7	Equipment delivered	13
8	Commissioning and trial runs	16
9	De-commissioning/destruction of redundant baseline equipment	18
10	Submission of project completion report	18-24