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环 境 规 划 署

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执行蒙特利尔议定书
多边基金执行委员会
第五十一次会议
2007 年 3 月 19 日至 23 日，蒙特利尔

九个第 5 条国家氟氯烃调查（开发计划署的介绍）

摘要和初步结论

氯氟烃国家调查：

阿根廷
巴西
哥伦比亚
印度
印度尼西亚
伊朗伊斯兰共和国
黎巴嫩
墨西哥
委内瑞拉

选定国家的氯氟烃调查

摘要和初步结论

做法和筹备

1. 多边基金执行委员会第四十五次会议核准了由开发计划署开展的活动，开发计划署准备在选定的国家进行有限的氯氟烃使用情形调查，目标是使执行委员会今后能够为这些国家确定国家氯氟烃总消费量，根据这些消费量提供项目和活动资金。所选 12 个国家是：

拉丁美洲：	阿根廷、巴西、哥伦比亚、墨西哥、委内瑞拉
中东：	黎巴嫩、阿拉伯叙利亚共和国
南亚：	印度、伊朗伊斯兰共和国、斯里兰卡
东南亚：	印度尼西亚、马来西亚

2. 为确保在这个全球项目中有效协调调查活动，并为了更好地处理跨区域问题，开发计划署计划通过一个三阶段进程开展这些活动：

- 在国家一级收集数据和进行调查
- 汇编和分析调查数据
- 介绍和报告调查数据

3. 国家一级收集数据和进行调查的工作由地方顾问实体（个人或公司/机构）与国家政府协商进行。汇编和分析调查数据的工作由开发计划署任命的国际专家进行。介绍和报告调查数据的工作是与国家政府协商进行的，国家政府还保证与氯氟烃供应和消费行业等本国利益攸关方进行国家一级的协商，获得他们的认证。

报告格式

4. 为了统一和确保完整性，制订了以下报告格式：

执行摘要

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<u>调查方法</u>

5. 工作方法是，先拟定一项案头研究报告，确认信息来源。然后再对这些来源进行调查，与氯氟烃及氯氟烃相关化学产品和设备的各生产厂家/供应商/进口商进行互动。与行业协会也进行了接触。通过这样做，努力确定并量化用于气雾剂、泡沫塑料、溶剂和消防等用途以及任何其他用途的氯氟烃目前的所有产量和消费量。尽可能收集了接受资助资格数据，但是，由于多数信息都是供应商提供的，而供应商认为自己无权公布机密性客户信息，所以，这些数据不完整，调查报告没有非常详细地介绍这些数据。

6. 虽然调查工作将提供关于每个行业和每种物质目前氯氟烃使用情形的信息，但受到相当重视的是，根据现有国内总产值预测和每个行业和每种物质的具体因素，计算增长量。

7. 本国专家根据蒙特利尔议定书事务股商定的格式，将这些数据和有关预测、结论和建议纳入一项详细报告。此后，报告由负责该区域的国际专家审查，然后通过蒙特利尔议

定书事务股转交各国政府，供其评论、在制订政策时参考、作最后认证和核可，然后才提交多边基金秘书处。

现状

8. 由于在安排有能力的本国专家方面遇到了问题，所以没有及时完成所有调查，不能向执行委员会第五十一次会议提交所有调查报告。在 12 个国家中，9 个国家（阿根廷、巴西、哥伦比亚、墨西哥、委内瑞拉、伊朗伊斯兰共和国、黎巴嫩、印度和印度尼西亚）完成了整个进程。1 个国家（马来西亚）正处于认证的最后阶段，两个国家（斯里兰卡、阿拉伯叙利亚共和国）仍然在收集国家数据。因此，关于调查结果的分析是初步分析。

9. 此外，分析是一个费时的进程，经常需要与当地国家臭氧机构或本国专家协商，以获得进一步的信息或认证。这也意味着，一些调查报告可能尚未最后定稿。鉴于开发计划署将最后定稿看得比分析还重要，应将本摘要视为"先睹"，而不是最后的解释。摘要是根据向多边基金秘书处提交的 9 份调查报告的抽样分析提出的。一旦收到尚待提交的报告，就将完成数据审查/分析。

机构框架

10. 即使在大幅度删节之后，现行机构框架有时仍然很复杂，这显示参与者在管理各类氟氯化碳方面取得了进展，在稍作修改之后，可以将这种框架用于氯氟烃管理。各参与国已准备承担起管制和管理任务。

11. 尤其是，现行许可证制度可以轻易地移植到氯氟烃方面。

供应假设

12. 所有参与者都详细叙述了其氯氟烃供应假设，并根据环境规划署以下公式，计算了 1996-2005 年（多数计算的都是这个时期）氯氟烃消费量：

消费量＝生产量＋进口量－出口量

13. 整体而言，数据与以前提交臭氧秘书处的报告相符。如果不符，例如委内瑞拉的数据，则作出了解释。将对较小的出入进行后续调查，例如巴西的数据。一个令人关切的问题是，若干国家的 HCFC-123 消费量较低。可用于分析的时间较短，在这段时期内不能解决这个问题，因此，对这个问题也要进行后续调查。

行业氯氟烃消费

14. 一些国家仅仅按行业列出以“消费量＝生产量＋进口量－出口量”公式得出的消费量，而另一些国家则进行了彻底的由下而上的调查，然后将这种调查与由上而下的调查调节。毫无疑问，这增加了对数据的信心，虽然并非总是能够完全调节 － 由于库存效应，

也不可能总能完全调节。按行业列出消费量就可以根据过去的增长信息，对增长格局分析进行微调，增加对增长预测的信心。

15. 此外，按物质分类也很有趣。这显示淘汰氟氯化碳政策造成的影响。各技术和经济评估小组主席表示，正常的使用格局是 25-30％的 HCFC-141b。下表显示调查的发现（2005 年，占总氯氟烃用量的百分比）：

9 国抽样	HCFC 22	HCFC 141b	其他类 HCFC 和混合物	2005 共计 (公吨)
共计	65 %	32.4%	2.5%	52,246

16. 但是，存在着很大的差异，这显示过去氟氯化碳淘汰战略造成的影响。阿根廷强调通过在制冷和泡沫塑料方面使用碳氢化合物，以可持续方式进行替代，其报告的使用量仅为 13％，而巴西的碳氢化合物所占分量较小，报告的使用量为 30％。哥伦比亚没有碳氢化合物项目，没有传统的聚胺脂泡沫塑料系统出口，其报告的 HCFC-141b 使用量竟然达到 47％。

17. 开发计划署表示，某些报告领域需要进一步核查。例如，消防用途、冷风机以及某些气雾剂用途。可以在完成尚未完成的调查过程中进行这种核查，也可以在此后执行淘汰氯氟烃战略的过程中进行这种核查 － 似乎所有国家都倾向于第二种做法。

分析

目前的使用情形和无约束增长假设

18. 最后完成的调查使用了“由上而下”的方法，有些调查则使用了“由下而上”的方法，量化目前的氯氟烃使用情形。最理想的是针对 1996-2005 年期进行这种调查，以便确定将采用的增长格局 － 在确定这种格局时还要利用现有的国内总产值预测和今后的具体里程碑（例如，蒙特利尔议定书 2010 年禁止使用氟氯化碳的规定、具体国家先导淘汰数据或地方生产对淘汰工作的影响），以估计在无约束情况下 2015 年的氯氟烃需求量。下表将这些估计数与报告的 2005 年氯氟烃消费量进行对照（吨）：

国家	2005 年实际消费量	2015 (无约束情况下的) 预计消费量	增长系数
阿根廷	3,579	7,950	2.22
巴西	12,555	26,368	2.10
哥伦比亚	1,821	3,744	2.06
墨西哥	14,525	32,905	2.27
委内瑞拉	2,313	4,137	1.79
拉丁美洲共计	**34,793**	**75,104**	**2.16**
黎巴嫩	336	692	2.06
中东共计	**336**	**692**	**2.06**
印度	11.027	27,103	2.46
印度尼西亚	3,976	9,662	2.31
伊朗伊斯兰共和国	2,114	4,889	2.31
南亚/东南亚共计	**17,117**	**41,654**	**2.43**
总计	**52,246**	**117,450**	**2.25**

19. 调查结果按区域分列（南亚/东南亚合并为一区）。结果显示，南亚/东南亚的增长势头略高于拉丁美洲，而中东的抽样样本太少，不能得出结论。

20. 在拉丁美洲区域,委内瑞拉呈现了非典型的增长势头,中东的黎巴嫩也是这样 — 不过其统计意义较小，两国的这种情形可能与目前的政治局势有关。这些结论是暂时性的，以后在列入马来西亚、斯里兰卡和阿拉伯叙利亚共和国数据后，将使结论在统计上更具有意义。但是，该表明确显示无约束假设可以产生多么巨大的增长。

对 2016 年冻结氯氟烃目标的影响

21. 显然，对 2016 年冻结氯氟烃消费目标切实性的主要影响是无约束情况下的增长幅度。但是，一项不太明显但更加重要的因素是惯性，这种惯性阻碍各种用途的维修突然发生变化。除哥伦比亚和墨西哥外，所有国家都报告了维修在氯氟烃总消费量中的比重：

国家	2005 年氯氟烃消费量		
	维修	**总消费量**	**占总消费量百分比**
阿根廷	2,155	3,579	60
巴西	6,657	12,555	53
印度	2,204	11,027	20
印度尼西亚	1,755	3,976	44
伊朗伊斯兰共和国	351	2,114	17
黎巴嫩	230	336	68
委内瑞拉	1,776	2,313	77

22. 较老旧设备原注入氯氟烃的泄漏量接近 100%，因此，任何显示维修消费量低于氯氟烃总使用量 50%的数据都是可疑的，需要重新认证（印度、印度尼西亚、伊朗伊斯兰共和国）。这个信息很重要，因为虽然可以（在存在技术能力的前提下）强行规定在制造活

动中使用氯氟烃替代物质，但在制造活动发生变化之后，维修活动会有相当长时间的滞后现象，因为市场上存在"老旧"设备（中国国家环境保护总局/德国技术合作署最近在一项介绍中强调了这一事实）。

23. 得出的结论是，量化调查数据显示

- 氯氟烃使用量增长幅度
- 由于维修活动使用量超过氯氟烃总使用量的 50%，"惯性"妨碍变化
- 结果是，必须采取行动，减缓增长，否则，可能无法达到《蒙特利尔议定书》的冻结目标

<u>供应和价格</u>

24. 没有一个参与者提到对供应的关切。关于价格，所有参与者都提到，在过去 10 年里，氯氟烃价格下降幅度相当大，而且预期，如果价格上涨，涨幅也会在总通货膨胀幅度之内。很难进行价格对比，因为提到的价格是否包括税/关税、是散装价还是再包装价、是批发价还是最终用户价等问题并非总是很清楚。一般而言，氯氟烃价格似乎低于其替代的氟氯化碳的价格，即使在仍然生产氟氯化碳的国家也是这样。这说明各国政府及其国家臭氧机构非常严肃地执行了淘汰氟氯化碳的任务。

<u>技术和环境影响</u>

25. 提到的技术通常都是氟氯化碳转换过程中使用过的技术。一些国家提到需要重新评价技术的成本。其他国家则提到目前的化学和设备成本，这些成本或转换造成的成本效应太高，阻碍进行转换投资。

26. 几乎所有国家都提到希望利用与其他公约的增效作用，主要是与气候变化公约的增效作用。

<u>挑战和机遇</u>

27. 各国几乎一致认为，主要挑战是如何改变目前的无约束增长格局，使其成为管理的限制格局，以实现冻结目标。

28. 一些国家提到需要修订《蒙特利尔议定书》，其他国家则提到，现行供资和接受资助资格政策是一项障碍。

29. 生产 HCFC-22 的参与者对购买清洁发展机制积分、以支付其他第 5 条国家 HCFC-22 制造厂家销毁副产品 HFC-23 的费用表示不满。他们认为，这是一项补贴措施，是其价格体现的生产成本中的一个因素。

可能采取的履约措施

30. 若干国家提到，执行淘汰方案的必要第一步骤是，必须制订分阶段的淘汰氯氟烃政策（一项"战略"）。其他国家则提到以下已经很明显的步骤：

- 将氟氯化碳维修用途中已经采用的最佳做法运用到氯氟烃（和氢氟碳化物）维修用途中
- 在清洗冰箱电路时不使用 HCFC-141b
- 将锁定的制造活动转换为产生零消耗臭氧层物质的办法（最常提到的领域是泡沫塑料）
- 执行老旧制冷和空调设备替换方案（节省能源和减少消耗臭氧层物质！）
- 为突出的新淘汰技术和做法开展试点项目

31. 各项提议都是泛泛的提议，不是详细的投资提案。

32. 若干国家表示，需要而且它们愿意考虑开展一个加速淘汰氯氟烃方案。

结论

33. 各国对通过调查获得的信息感到满意，认为筹备关于氯氟烃使用情形和增长格局的调查是管理氯氟烃使用情况的重要第一步。

34. 各国普遍认为，“不行动”假设不是可行的办法，将破坏 2016 年冻结消费目标。

35. 各国广泛承诺，将加速开展淘汰氯氟烃进程，但这需要采取后续行动，例如执行国家战略，以便能够加速开展这个进程。

36. 各国有强烈的意愿，考虑将淘汰氯氟烃的活动与清洁发展机制方案结合起来。

37. 各国多次提到，必须调整现行多边基金政策，甚至修订《蒙特利尔议定书》。

38. 在这方面，各技术和经济评估小组主席 2006 年 7 月 8 日在 “斯德哥尔摩集团”讲习班上作的介绍很有趣。当时提出了以下问题：

- 第 5 条国家如何在不出现重大混乱的情况下淘汰氯氟烃？
- 如何获取技术和资金？
- 如何计入能源效率因素？

- 存在哪些相关财政和环境成本？
- 加速淘汰氯氟烃有哪些成本？
- 如何处理氯氟烃不受欢迎的副产品（HFC-23、氟氯化碳）？

39. 调查为处理其中一些问题提供了部分依据。开发计划署制订了一个数学模型，用以预测不同淘汰假设的成本。讨论该模型会超越关于调查活动的这份介绍文件的范围，但据认为，这种讨论将有助于制订财政上能够承担而且环境上有效力的战略。

40. 开发计划署认为，多边基金可以发挥重大作用，协助第 5（1）条国家拟定和执行各项战略，以便遵守《议定书》规定的各项时限，甚至提前达到目标。

41. 为了为第 5（1）条国家制订全面的氯氟烃管理政策，建议在下述领域进一步开展筹备活动：

- 拟定提议，调整多边基金关于消耗臭氧层物质效应相同但仅产生 5-11％消耗臭氧潜能值影响的淘汰氯氟烃项目的供资政策和准则
- 筹备更多的具体国家氯氟烃调查
- 拟定国家氯氟烃管理战略
- 制定试点项目，以认证新技术/改良技术
- 完善开发计划署淘汰成本模型
- 处理具体行业问题（清洗、HCFC-141b 在消防中的使用……）
- 探索共同供资的机会
- 为具体机会制定项目

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SURVEY OF HCFCs IN ARGENTINA

FINAL REPORT

Oficina Programa Ozono (OPROZ)
Secretaria de Ambiente y Desarrollo Sustentable
and
United Nations Development Programme (UNDP)

February 17, 2007

EXECUTIVE SUMMARY

Argentina acceded to the Vienna Convention in January 1990 and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in September 1990. Subsequently, Argentina ratified the London Amendment, in December 1992, the Copenhagen Amendment in April 1995, the Montreal Amendment in January 2001 and the Beijing Amendment in June 2006.

As the annual calculated consumption in Argentina of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, Argentina was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

Argentina's Country Programme, incorporating the national strategy and action plan for controlling the use of Ozone Depleting substances, was approved at the 13th Meeting of the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol in July 1994. Since 1994 until to date, Argentina has been generally in compliance with the Montreal Protocol control schedule for Annex-A, B and E substances, through a combination of projects and programs featuring technology transfer investments, technical assistance, training & capacity building, information dissemination and awareness-raising and institution of a proactive regulatory framework. In compliance with Article-4B of the Montreal Protocol incorporated through the Montreal Amendment, Argentina has established a licensing system for import and export of Annex-A, -B, -C and -E controlled substances, which includes recovery, recycling and reclamation. All importers and exporters of these substances are required to register and obtain licenses which are issued based on annual quotas for substances with control measures and are subject to reporting requirements for all ODS, including HCFCs.

Hydrofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore their use has to be controlled and eventually phased-out. In accordance with the control schedule of the Montreal Protocol for Article-5 countries, production and consumption of HCFCs will be subject to a freeze at 2015 levels from 01 January 2016 and are required to be completely eliminated by 2040. HCFCs are used in Argentina in the Aerosols, Foams, Firefighting, Refrigeration & Air Conditioning and Solvents sectors. The predominant HCFC used is HCFC-22 mainly in the Refrigeration & Air Conditioning Sector (more than 95%). There is also significant use of HCFC-141b, predominantly in foam applications and, to a lesser extent, as a cleaning agent.

"As per decision 45/6 (i), the survey provides information on current consumption by sector and substance, as well as consumption projections up to 2015. This information will allow the MLF Secretariat – if requested by the Executive Committee – to propose funding policies and procedures for the next few years, including the possible establishment of an eligible national aggregate level of HCFC consumption."

Due to the economical crisis in 2001/2002, growth in demand for consumer and commercial products and related consumption of HCFCs in Argentina stagnated However, after recovery, the consumption of HCFCs has increased from 1,892 t in 2001 to 3,575 t in 2005, signifying an average annual growth of about 17.5%.

At a conservative annual growth rate in demand forecasted for the period 2006 - 2015, it is estimated that the consumption of HCFCs in Argentina is likely to exceed 7,950 ton in 2015.

Because of a significant increase in supermarkets and more affluent living conditions, the main growth is predicted in commercial refrigeration and air conditioning.

Argentina realizes that bending the current significant growth into a no-growth one in 2016 followed by phased reduction cannot be achieved without addressing use patterns early on. This implies that actions to control/reduce consumption of HCFCs to ensure compliance with the 2016 freeze would need to be initiated well in advance of that date.
Challenges and constraints for such actions include sustained and cost-effective availability of environment-friendly substitutes for HCFCs and access to technology and funding to facilitate transition without undue burden on the economic health of the country and on the consumers and industry.

Argentina expects that the international community will recognize management of HCFCs as a crucial activity to be undertaken at the earliest, supported with adequate technical and financial assistance from the Multilateral Fund.

To move this forward, Argentina proposes the approval of funding to prepare a comprehensive strategy for management of HCFCs as a follow-up to this HCFC survey. Such strategy could be developed within nine months from acceptance of a pertinent proposal and might be used to develop more general guidelines and funding criteria for future national strategies.

The primary outcome of such strategy could be to propose short/medium-term interventions for reducing HCFC demand in industry sectors where alternatives are currently available (e.g. Aerosols, Foams and Solvents Sectors), through investment projects on the basis of a sectoral approach, with the objective to eliminate HCFC use in these sectors within an agreed time-frame (e.g., 5-7 years). The reference consumption for these sectors could be the consumption reported for 2005.

Additional outcomes of such strategy would be the identification of viable alternatives for HCFC use in other sectors (mainly Foams, Refrigeration and Air Conditioning) and the feasibility of their adoption, as well as the application of good practices in service applications. A proposed timeframe for moving this process forward could be:

Mch 2007	ExCom Decision to approve funding for preparation of a pilot project for the development of a strategy for accelerated phaseout of HCFCs and the development of guidelines for future strategies/project proposals
Mch – Dec 2007	Preparation/submission of a strategy
Dec 2007 - Dec 2015	Implementation of approved strategy to bend the HCFC growth trend to a stabilized consumption through components such as investment projects, policy and management support, support for technical assistance, training, capacity-building and awareness
Jan 2016 - Dec 2040	Phased reduction of the use of HCFCs to essential uses only

Experience gained, lessons learnt, as well as infrastructures created during implementation of ongoing sectoral/national phase-out plans for CFCs and other ODS can be applied in approval and implementation of such a strategy.

Besides having an ozone depleting potential (ODP), HCFCs additionally have a global warming impact due to their relatively high global warming potentials (GWP). Argentina has ratified the Kyoto Protocol in 2001. There may be potential to develop selected HCFC phaseout projects along with carbon credit components thus generating co-funding on a bilateral level. The development of pertinent pilot projects could be a part of the mentioned strategy.

SURVEY OF HCFCs IN ARGENTINA

CONTENTS

LIST OF ABBREVIATIONS

AFIP	Administratión Federal de Ingresos Públicos (Tax/Customs Authority)
ATOC	UNEP Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride Technical Options Committee
CDM	Clean Development Mechanism
CFCs	Chlorofluorocarbons
CNACC	Climate Change Unit
CP	Country Programme
CTC	Carbon Tetra Chloride
Dacs	Disposable Cans (used for refrigerants – DuPont: Dispose-A-Can^{R})
DNA	Designated National Authority
ExCom	Executive Committee of the Multilateral Fund
FIASA	Frio Industrias Argentinas SA
FTOC	UNEP Foams Technical Options Committee
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IA	Implementing Agency
MAC	Mobile Air Conditioning
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MP	Montreal Protocol
MT or t	Metric Tons
NOU	National Ozone Unit
OAMDL	Oficina Argentina del Mecanismo para un Desarollo Limpio
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
OEM	Original Equipment Manufacturer
OPROZ	Oficina Programa Ozono (National Ozone Unit in Argentina)
R&R	Recovery and Recycling
SAyDS	Secretary of Environment and Sustainable Development
SMEs	Small and Medium-sized Enterprises
STOC	UNEP Solvents, Coatings and Adhesives Technical Options Committee
TEAP	UNEP Technology and Economic Assessment Panel
TR	Tons of Refrigeration
UCC	Climate Change Unit
UNDP	United Nations Development Programme
UNDP-MPU	United Nations Development Programme, Montreal Protocol Unit
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
WB	World Bank
XPS Foam	Extruded Polystyrene Foam
Y	Year

1. INTRODUCTION

1.1 BACKGROUND

Argentina acceded to the Vienna Convention in January 1990. It ratified the Montreal Protocol on Substances that deplete the Ozone Layer in September 1990. It has also ratified the Montreal Protocol's London Amendment (December 1992), the Copenhagen Amendment (April 1995), the Montreal Amendment (January 2001) and the Beijing Amendment (June 2006).

Argentina is classified as a party operating under Paragraph-1, Article-5 (annual calculated consumption of controlled substances listed in Annex-A at accession was less than 0.3 kg per capita) and qualifies therefore for technical and financial assistance, including transfer of technology, through the Multilateral Fund for the implementation of the Montreal Protocol (MLF), the protocol's financial support mechanism .

Argentina's Country Programme was approved at the 13th Meeting of the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol in July 1994. This program sets out the national strategy and an action plan for controlling the use of Ozone Depleting substances. Argentina has been consistently in compliance with the Montreal Protocol control schedule for Annex-A, B and E substances. This has been achieved through a combination of projects and programs featuring technology transfer, investments, technical assistance, training & capacity building, information dissemination and awareness-raising and institution of a proactive regulatory framework.

In compliance with Article-4B of the Montreal Protocol incorporated through the Montreal Amendment, Argentina has established a licensing system for import and export of Annex-A, -B, -C and -E controlled substances, which includes recovery, recycling and reclamation. All importers and exporters of these substances are required to register and obtain licenses which are issued based on annual quotas and are subject to reporting requirements. Matching the licensing system with maximum allowances under the MP assures that Argentina is—and will remain—in compliance.

Over the period 1996-2006, many ODS phaseout projects were completed covering mainly refrigeration and foams but also in other sectors. For example, CFC-11 consumption in foams dropped from 800 t in 2000 to only 100 t in 2005. The only significant remaining CFC consumption is the servicing sector, mainly consisting of CFC-12. In 2004, OPROZ initiated a management and control program for this sector that includes training and equipment for technicians in order to impose good environmental practices through recovery, recycling and reclamation.

While there are many refrigerant importers, there is only one producer of CFC-11/12/HCFC-22 in Argentina. More details are provided under the supply scenario.

1.2 APPROACH AND PREPARATION

The Executive Committee of the MLF approved at its 45th Meeting a project prepared by UNDP which aims to conduct a survey of HCFC use in selected countries with the objective of establishing an eligible national aggregate level of HCFC consumption in the future against which proposals would be funded (Decision 45/6).

In order to speed up the administrative process, UNDP selected to implement this project through its Montreal Protocol Unit (MPU) in close cooperation with the National Ozone Units (NOUs) and UNDP's Country Offices in the selected countries, from which Argentina is one. For each country, in consultation with the NOUs, national experts have been recruited to conduct and analyze the actual survey and to prepare a report following a template issued by UNDP. These reports have been edited by international experts before being forwarded to UNDP-MPU. MPU, after conducting its own review, submitted the reports to the National Ozone Units with the request for comments by an as broad as possible cross-section of stake holders. After taking these comments into consideration, MPU prepared final versions of the national reports for submission to the MLF.

1.3 SURVEY METHODOLOGY

The National Expert was directed to prepare initially a desk study with the aim to

- locate sources of information,
- identify the different applications for HCFCs,
- identify the stakeholders, such as importers, exporters and associations, and
- determine the scope of work for the final survey.

For the sake of uniformity and completeness, MPU provided a template for this study.

After editing and acceptance of the desk study by MPU, a final survey was conducted, again, following an MPU-provided template. Activities for this survey included

- interaction with the various identified stakeholders to identify and categorize all current users of HCFCs
- collection of baseline information following formats provided by MPU
- classification of this information as below:
  - historical consumption data (determined from production + import – export)
  - segregation of these data by sector
  - segregation of these data by users (or, for smaller users, groups of users)
  - segregation of these data by users that received/did not receive prior MLF assistance

The national expert incorporated these data along with related forecasts, conclusions and recommendations into a final report, for which MPU provided a detailed template. This report was reviewed, completed and edited by the international expert responsible for the Latin America region and then forwarded through UNDP-MPU to OPROZ.

After conducting its own review, OPROZ arranged a workshop for the main national stakeholders to present the outcome of the survey. Opinions voiced during this workshop as well as any other comments and opinions by the Government of Argentina have been reflected in the final version of the report that herewith is presented to the Executive Committee.

The survey resulted in a list of importers, distributors and HCFC-consuming enterprises. The Government however asked these lists to be treated on a confidential basis as it involves commercial information that may be sensitive to some of the parties concerned. For this reason, requests for more detailed information should be sent to the National Ozone Unit. While the survey has identified a substantial amount of individual HCFC users, not all suppliers were willing to disclose individual customers, additional individual users will be identified over the next years in case this survey will evolve into a sector-based HCFC management plan.

The following table provides the numbers of enterprises that were identified in the survey per category/sector:

Table 2 - Stakeholders identified in the HCFC Survey in Argentina

HCFC Stakeholders		Amount of Enterprises
Producers/Importers		7
Distributors		15
Chambers/Associations		5
HCFC-Consuming Enterprises		
	HCFC-141b	32
	HCFC-22	66*
Total	**All HCFC Stakeholders**	**125**

* service providers not included (>5,000)

2. OBSERVATIONS

2.1 INSTITUTIONAL FRAMEWORK

2.1.1 Institutional Arrangements

The National Ozone Unit, OPROZ (Oficina Programa Ozono) is the designated national authority (DNA) charged with coordination of the MP compliance actions. It is an Intergovernmental Agency from the Secretary of Environmental and Sustainable Development, the Ministry of Foreign Affairs and the Secretariat of Industry. The Secretary of Environment is charged with the management of the unit. The Secretariat reports directly to the Cabinet Chief. Where synergies with climate issues exist, the DNA will be the Argentinean office for CDMs (OAMDL - Oficina Argentina del Mecanismo para un Desarollo Limpio).

2.1.2 Policies

In the 13th meeting of the ExCom, July 1994 Argentina's Country Programme was presented and approved. This program contains:

a. description and analysis of consumption, exports and imports of ODS
b. industrial structure
c. institutional structure for the CP development
d. general policy
e. official strategy for eliminating the ODS consumption
f. action plan
g. participation of the different government sectors
h. schedule of reduction and elimination of ODS consumption
i. global cost of the CP implementation
j. proposals for industrial re-conversion projects

This program has been the base for subsequent policies and regulations to enforce adherence to the Montreal protocol and its amendments

2.1.3 Regulations

Argentina became Party to Vienna Convention on September 23rd 1989 and subscribed the Montreal Protocol on Substances which Deplete the Ozone Layer on May 10th 1990. It has also signed the London, Copenhagen, Montreal and Beijing Amendments. All those international obligations were enforced through different national laws.

In 1996 the **265/96** Decree created the National Ozone Unit (OPROZ, "Oficina PRograma OZono") located at the Environment and Sustainable Development Secretariat, and is in charge of coordinating all the activities related to the Montreal Protocol together with other governmental institutions and industries. OPROZ is composed by representatives of the Ministry of Foreign Affairs, International Trade and Worship, the Secretariat of Industry from the Ministry of Economy, and the Environment and Sustainable Development Secretariat. OPROZ has established several Consultative Groups (GRUCO) covering halon, methyl bromide and CFC issues. These GRUCOs are consultative bodies that give advice on the establishment of strategies for the reduction of consumption of those ODSs. They are composed by representatives of trade associations, ODSs importers, governmental institutions and chambers.

In 1991, Law **24.040** was enacted. It establishes restrictions to production, trade, import and export operations for Annex-A substances. Among its articles there are some punitive regulations including fines, closures of enterprises in case of non compliance, among others. It includes a ban for the use of Annex A (from the Montreal Protocol) substances in the aerosol manufacture, establishing exceptions related to MDIs and special uses in the electronic industry.

Resolution SAyDS **620/2002** authorizes the use of 1301, 1211 and 2402 halons for critical uses.

Resolution SAyDS **296/2003** was passed in order to enlarge the list of substances included in Law 24.040. The Resolution includes Annexes B, C and E of Montreal Protocol like methyl chloroform, carbon tetrachloride and another series of CFCs; HCFC, HBFC and methyl bromide.

Regarding Montreal Protocol Statements, Decree **1609/2004** created a Licensing System for imports and exports of new, recycled and reclaimed ODSs. The national authority in this area/ system is the Environment and Sustainable Development Secretariat. It includes an ODS Importers and Exporters Registry (RIESAO). Substances included in this regulation are the ones listed in the Annexes A, B, C and E of the Montreal Protocol, however it excludes any substances or mixtures which are in a manufactured product, such as a refrigerator, other than a container used for transportation or storage of that substances. It is complemented by Resolution **953/04** which enforces the system previously mentioned. It includes definitions, the explanation of the procedure that must be followed by importers and exporters and a schedule for the distribution of ODSs import quotas.

Minding these two norms, OPROZ issues ODS import quotas for substances with control measures every year through a binding norm which is published in the National Official Journal. Resolutions 17/05, 1253/05 and 646/06 were issued for quota issuances for 2005 thru 2007.

The Halon Bank was created by Resolution **954/2004**. It is operated by the INTI (National Institute of Industrial Technology). It describes the requirements and procedures for being an operator of the bank, and making use of it.

Resolution **505/2006** states the obligation for all laboratories who manufacture MDIs to inform to OPROZ, at the beginning of each calendar year, their consumption of CFCs together with all the data required in Decision XIV/5 of the Fourteenth Meeting of Parties.

Environmental issues have a special place in Argentina's legislation. Its Constitution has a specific article devoted to the protection of the environment (Art. No 41 .also called "The Environmental Clause"). This rule includes the concept of Sustainable Development.

According to Art. 75 inc 22), International Treaties have a special hierarchy. They are above national rules, however in order to enforce them, a law passed by the National Congress. Vienna Convention -1985- (Law 23724/89), Montreal Protocol -1987- (Law 23778/90) and London (Law 24167/92), Copenhagen (Law 24418/95), Montreal (Law 25389/01) and Beijing (Law 26106) Amendments have been approved through this system.

Argentina's CFC consumption schedule under MP is:	2003/2004	4,692 t/y (base level)
	2005/2006	2,346 t/y
	20077/2009	704 t/y
	2010	0 t/y

Total CFCs consumption in 2005 was 1,676 t, almost 30% under target.

Argentina became Party to the United Nations Framework Convention on Climate Change (UNFCCC) in 1994. Adherence is enforced through Law 24.295 and by Decree N° 2213/2002. The Secretary of Environment and Sustainable Development (SAyDS) was appointed as the National Implementation Authority of the law.

The Climate Change Unit (UCC) created by Resolution 56/03 under the jurisdiction of the SAyDS is in charge of proposing political guiding measures; identification of sector areas with priority needs in the implementation of mitigation activities; determination of national goals regarding emissions reduction; definition of guidelines and strategies for mitigation activities in each sector and to coordinate the drafting of the National Communications.

By Resolution 579/03 from the Social Development Ministry, the Permanent Secretary of the Argentinean Office for CDMs is included in this UCC.

The UCC is assisted by the National Adviser Commission on Climate Change (CNACC) which is integrated by members of the national and provincial Governments, private sector, academics from private and public universities, as well as experts on UNFCCC .

2.2 HCFC SUPPLY SCENARIO

2.2.1 Production

Argentina produces CFCs and HCFCs. While the production of HCFCs is limited to HCFC-22 and constitutes currently only 10% of the total consumption, theoretical capacity is 3,000MT.

The first CFC production was started by DuPont in 1958 with a capacity of about 8,000 t/y. In the 70's production of HCFC-22, was added. This plant was closed in 1992. From that date thru September 1999, DuPont continued producing CFC-12 and CFC-11 from intermediates imported from DuPont Brazil. HCFC-22 was imported from other DuPont plants in the USA and Europe. When DuPont Brazil stopped its CFC's production in September 1999 the Argentinean operation was closed as well.

In 1988, FIASA (Frio Industrias Argentinas SA) started commercial production of CFC's in Villa Mercedes/San Luis. Initially FIASA was a joint venture between Liquid Carbonic, La Fluorhidrica and Tecunion. The current owner, PAMCOR, acquired full ownership in 1997. The capacity of the plant is 8,600 MT but production has never exceeded 60% of capacity. In 2003 FIASA signed an agreement with the Government of Argentina that includes following maximum CFC production schedule:

2003/2004 :	3,020	t/y	
2005/2006 :	1,647	t/y	
2007/2009 :	686	t/y	
2010:	412	t/y	(15% of base production level for essential use)

In 1995, FIASA added the production of HCFC-22 with a name plate capacity of 3,000 t/y and continues this to date. The company provided following historical production data:

YEAR	PRODUCTION (t)	REMARKS
1995	250	
1996	250	
1997	250	
1998	250	
1999	250	
2000	100	
2001	100	
2002	Negligible	Production problems/not competitively priced
2003	Negligible	
2004	564	Increase because of decline in CFC production (one crew operates both production lines)
2005	347	

The figures show that never more than 20% of the capacity has been used. This is partly related to one crew operating both the CFC and the HCFC production lines. Considering the condition of the Villa Mercedes plant, FIASA's ability to produce HCFC-22 at competitive quality and costs appears limited.

2.2.2 Exports

Only HCFC-22 is exported. FIASA is the main exporter. DuPont exports very small volumes. Bordering countries are the main destination:

YEAR	HCFC-22 EXPORT (t)	DESTINATION COUNTRIES (t)				
		BRAZIL	CHILE	URUGUAY	PARAGUAY	OTHERS
1997	293	0	158	117	9	9
1998	395	0	209	130	40	16
1999	490	147	157	137	39	10
2000	1,227	888	172	147	20	0
2001	881	573	132	159	17	0
2002	957	785	57	86	29	0
2003	611	422	24	110	55	0
2004	864	631	17	138	78	0
2005	602	494	0	84	24	0

Source: AFIP- Customs

2.2.3 Imports

Up to 1998, Customs in Argentina reported HCFCs under one code (29.03.49.12). In addition, any HCFCs in blends with other chemicals—such as polyols—were not reported as HCFCs.

YEAR	HCFC-22	HCFC-141b	HCFC-142b	HCFC-123	HCFC-124	TOTAL
1995	1,750	15				**1,765**
1996	1,901	55				**1,956**
1997	1,964	163				**2,127**
1998	2,090	120				**2,210**
1999	2,201	210	0	70	0	**2,481**
2000	1,956	150	0	38	0	**2,144**
2001	2,278	134	0	8	0	**2,420**
2002	1,624	72	0	8	0	**1,704**
2003	2,969	160	1	12	1	**3,143**
2004	2,464	370	6	16	2	**2,858**
2005	3,259	460*	58**	34	23**	**3,834**

Source: AFIP-Customs

Notes: * 160 t HCFC-141b included from imported premixed polyol
** Pure and included in ternary blends to be used in retrofitted CFC-12 equipment

No segregated import information per country is available and for 1995-1998 there is no segregated information at all. Main supply countries for HCFCs to Argentina are Europe (the Netherlands), the USA and lately China and India. Increased imports from the latter two is related to favorable pricing but, in the case of China, also to DuPont, recently importing from its plant in China rather than from the USA. Following are the available segregated import data:

YEAR	HCFCs (t)	ORIGINATING COUNTRIES (t)				
		EUROPE	USA	CHINA	INDIA	OTHERS
1999	2,201	1188	903	0	0	110
2000	1,956	1076	821	0	0	59
2001	2,420	1670	605	73	0	72
2002	1,704	852	426	136	256	34
2003	3,142	943	723	157	1257	62
2004	2,856	1200	485	570	428	173
2005	3,674	1466	183	990	660	375

Source: AFIP-Customs

2.2.4 Distribution and supply chain

HCFC-22

A/C manufacturers are supplied directly by importers (mainly DuPont). All the other final users are supplied by importers or big distributors (spare parts shops). Following is a list of HCFC-22 importers:

Year	Total (t)	DuPont	Fiasa	York	Giacomino	Atofina	Praxair	Others
2001	1750	1120	100	70	190	150	80	40
2002	1266	700	200	60	100	100	40	66
2003	2358	1500	350	100	100	100	100	108
2004	2164	1500	300	100	100	--	100	64
2005	3259	1600	859	200	110	--	150	340*

Source: AFIP-Customs

2005 showed the emergence of new importers—partly for own use. Reason was low priced direct offers from China and India. This explains the increase in the "Others" category. In Argentina, most final users purchase refrigerants and other parts in shops that are called "distributors". There are more than 150 in the country, but only 15 of them are substantial in size. Smaller ones are frequently supplied by the larger ones. Each of the larger ones distributes around 100/150 t of refrigerants per year. Annexes 1 and 2 provide a more detailed list of the major distributors.

HCFC-141b

Importers include, beside the conventional HCFC ones, major PU chemical suppliers and their distributors:

Year	Total(MT)	DuPont	Giacomino	Tecunion	BASF	Ecopur	QuimCau	Others
2005	460	42	17	57	76	70*	90*	108

Source: AFIP-Custom

* not pure, included in the Polyol

HCFC-142b

Only Giacomino imports HCFC-142b in its pure form. 2005 imports totaled 13 t. An additional 45 t were imported through ternary blends by DuPont, Giacomino and Praxair.

The 160 t HCFC-141b contained in imported polyol blends in 2005 originate from Brazil (60 t) and Spain (100 t). It is not identified in Brazil's HCFC survey—most likely because customs treat this as a system rather than by components.

HCFC-123

Importers are DuPont and Quimex. For 2005 they imported as follows:

Year	Total (MT)	DuPont	Quimex
2005	29	11	18

HCFC-124

Less than one ton was imported in 2005 in its pure form by DuPont who is also the sole importer for blends. HCFC-124 is used to replace CFC-12 by the following ternary blends: R-401a; R 401b and R-409a

2.2.5 HCFC Pricing

Prices for HCFCs have decreased over the years. This is particularly the case with HCFC-22. There are several reasons for this decline:

- Global demand is down, because important markets such as Europe and the USA are applying regulatory restrictions, (partially) changing to HFCs, and
- Additional production capacities are coming on stream in China and India

Compared to the HFCs and HFC blends, there is a large price difference in favor of HCFCs. This is a big impediment in the introduction of such blends—even if it technically would make sense. For instance, R-404A would be the technically correct and logical refrigerant for low temperature applications in commercial refrigeration (previously R-502), but lower costs dictates the use of technically inferior HCFC-22.

Local current prices of HCFCs and HFCs are as follows (distributor level/in US$/kg):

PACKING	HCFC-22	HCFC-141b	HCFC 123	R-404A	R-407C	R-410A
DACS	2.70	2.50	13.00	10.00	10.00	13.00
Bulk	2.50					

*Dacs: <u>D</u>isposa<u>b</u>le <u>C</u>an<u>s</u> *Source: DuPont , FIASA*
Note: In comparison: the price for CFC-12 is ~US$ 8.00/kg and HCFC-134a ~ US$ 5.00/kg

2.3 HCFC CONSUMPTION

The total annual volume of HCFCs consumed in Argentina in the period 1996-2001 was ~2,000 t/y. During the severe economical crisis in 2001/2002, the consumption decreased to around 1,700 t/y. In 2003, growth resumed and in 2005, the consumption was almost 3,600 t.

Following HCFCs are in use in Argentina:
- HCFC-22,
- HCFC-141b,
- HCFC-142b,
- HCFC-123, and
- HCFC-124.

HCFC-22, with almost 85% of the consumption, is the most important component. Second is HCFC-141b with 13 %. Others are used in low volume but serve important niche applications. Until 1999 HCFC-141b and HCFC-123 shared one Custom Code. The following table shows HCFC consumption in tons from 1995 to 2005 (source AFIP-Custom, OPROZ, Importers):

YEAR	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
1995	1,800	0	0	0	0	1,800
1996	1,849	50		0	0	1,899
1997	1,937	163		0	0	2,100
1998	1,959	120		0	0	2,079
1999	1,711	210	70	0	0	1,991
2000	1,828	150	38	0	0	2,016
2001	1,750	134	8	0	0	1,892
2002	1,266	72	8	0		1,346
2003	2,358	160	12	0	1	2,531
2004	2,164	370	16	6	3	2,559
2005	3,004	460*	34	58	23	3,579

* 300 t were imported pure and 160 t premixed with polyol (Ecopur/Plasfi; Quimica del Caucho/Bayer)

HCFC consumption is mainly concentrated in foam, refrigeration and air conditioning applications as the following table shows:

HCFC	CONSUMPTION BY SECTOR (t)						TOTAL
	Air Cond'ning	Refr'tion	Foam	Aerosol	Solvent	Fire Fighting	
22	1,920	1,034	8	40	0	2	**3,004**
141b	0	0	423	0	37	0	**460**
123	10	0	0	0	0	24	**34**
142b	0	45	0	0	13	0	**58**
124	1	22	0	0	0	0	**23**
TOTAL	**1,931**	**1,101**	**431**	**40**	**50**	**26**	**3,579**

2.3.1 Aerosol Sector

Potential use of HCFCs in this sector is as a propellant. However, for cost and policy reasons, most propellants in this sector are hydrocarbons. The only known application of HCFCs: is the use of a blend of HCFC-22 and dimethylether (80/20) as a propellant in the production of “artificial snow” for use in parties. The flammability of hydrocarbons is an issue in this case. Annual volume of HCFC-22 in this aerosol application is 40MT.

2.3.2 Foam Sector

Potential use of HCFCs in this sector is as a blowing agent. Because of Argentina’s policy in the replacement of CFCs to use non-ODS technologies to the extent possible, all larger users have converted to the use of hydrocarbons. Smaller users, however, use prevalent HCFC-141b because of lower conversion cost. The use of HCFC-141b started in 1996/1997 through the implementation of UNDP/UNIDO projects for the replacement of CFC-11 in PU rigid foams. More than 130 enterprises received assistance by the MLF in the last 10 years, and the consumption of HCFC-141 reached almost 500 t in 2005. There is one company who uses a blend of CFC-12/HCFC-22 (70/30) for the manufacturing of XPS foam boards. The volume of HCFC-22 consumed in 2005 was 8t. As part of the Foam Sector CFC Phaseout Plan, the consumption of CFC-12 (20 t/y) will be phased out in early 2007 through interim replacement by HCFC-142b/HCFC-22 (75/25).

2.3.3 Firefighting Sector

The technically most suitable replacement for Halon-1211 in portable fire extinguishers would be HFC-236fa. However, because of the very high price of this product there are several HCFC-123 based products in the market. HCFC-123 is considered a health hazard in concentrations exceeding 50 ppm. When an extinguisher is used, and HCFC-123 is released, the concentration is high for only a very short period and its use is therefore permitted. Ventilation of the room after use of an extinguisher is highly recommended.

Following fire extinguishing brands in the market contain HCFC-123:

Halotron I: Imported by Matafuegos Donny from American Pacific USA, Halotron I is a ternary blend with the following composition: 93% HCFC-123, 4% HFC-14 and 3% Argon.

Haloclean: Quimex Sudamericana SA imports HCFC-123 from China and then refills in drums and then markets the product under the name Haloclean.

Nafion I: imported in very small volumes. The composition is: 82% HCFC-22, 5% HCFC-123 and 3% terpene.

Total 2005 HCFC-123 use in firefighting applications was 24 t.

2.3.4 Refrigeration & Air Conditioning Sector

The use of HCFCs in foams as insulator in the refrigeration industry is covered under 2.3.2.

In the **Refrigeration Sector**, all companies are “assemblers/installers”. In 2005, 300t HCFC-22 was used for the “first charge” and 734t for servicing. Total volume in this sector was 1,034t. There is no use of HCFC-22 in Domestic Refrigeration. All companies use isobutane (R-600a) or HFC-134a.

In the **Air Conditioning Sector**, the only HCFC-22 used for manufacturing applications are the Domestic Air Conditioning Manufacturers (5 companies). All other AC installations are assembled and installed by medium/small companies called “installers”. These companies purchase all components (compressors, valves, pipes, refrigerants, etc) from distributors. In 2005, 300 t HCFC-22 was used in the manufacture of domestic ACs. For the “first charge” in ACs from “installers, 250 t was used. For servicing of the entire AC segment, 1,370 t was used. The total volume of HCFC-22 for all AC applications was 1,920 t. Regarding chillers, HCFC-123 is the only HCFC used in this sector. Volume in 2005 in this segment was 10 t.

2.3.5 Solvents Sector

HCFCs as solvents are used in cleaning applications, with cleaning of electronic parts being one of the largest and most critical ones. There is also considerable use of HCFC-141b for the flushing of refrigerant circuits, while HCFC-141b and -142b are used in the formulation of cleaning agents.

In 2005, 37 t HCFC-141b and 13 t HCFC-142b were used in solvent applications.

2.3.6 Feedstock/Process Agents

There are no feedstock or process agent applications for HCFCs in Argentina.

2.3.7 Summary and Conclusions

Consumption of HCFC is Argentina for the year 2005 is as follows:

SUBSTANCE	PRODUCTION	EXPORT	IMPORT	CONSUMPTION
HCFC-22	347	602	3,259	3004
HCFC-123	0	0	34	34
HCFC-124	0	0	23	23
HCFC141b	0	0	460	460
HCFC-142B		0	58	58
TOTAL	**347**	**602**	**3,834**	**3,579**

The use of HCFCs in Argentina can also be divided into:

USE	APPLICATION	SECTOR(S)	AMOUNT (t)
Primary Use	Manufacturing	Aerosols, RAC, Foams	1,281
	Extinguishers/Cleaning Aids/Solvents	Cross Sectors	143
Secondary Use	RAC Servicing	RAC	2,155
Total			**3,579**

HCFCs are used for their original applications as well—in dramatically increased amounts—for CFC replacement. Because of the size of individual users and the limitations of technologies, it has not been economically and/or technically possible to replace in all cases CFCs by non-ODS substances—even when financed by the MLF.

Pricing constitutes a major issue in the use of all HCFCs. In the case of HCFC-141b, investment costs are also an impediment in cases where replacement by hydrocarbons are considered.

While the use of HCFCs in the servicing sector can be reduced through “best practices” approaches that are essentially the same as the currently used ones for servicing with CFCs, complete phaseout of its use can only be achieved through prior phaseout of the use in primary applications.

3. ANALYSIS

3.1 DEMAND FORECASTS

To estimate future HCFC demand, we have to consider two factors:

1. The economic growth in the country and, specifically, in the commercial refrigeration and air conditioning sectors

2. Introduction rate of HFCs blends for the replacement of HCFCs

Growth factors

The last three years, economic growth in Argentina was ~8%/y. Forecasts for 2006/7 are 7%, and expectations for 2008/2010 are in the order of 5-6%. Economic growth is the basic assumption for all HCFC consumption forecasts, upon which special factors are imposed.

For HCFC-22, growth is expected to be in line with general economic growth. No difference is made between first charge and service, as service follows new equipment growth with only minor delay.

The same criteria are adopted for HCFC-123.

For HCFC-141b, 10% growth in 2006/2007 and 8% in 2009/2010 is expected because of a trend to better thermal insulation.

For HCFC-142b and HCFC-124, 15% growth in 2006/7 and 20% in 2008/2010 is expected because in 2007 FIASA has to decrease the CFC-12 production from 1,647MT to 686MT. The reduced availability and the high price of CFC-12 would be an important factor for an expected increased use of ternary blends such as R-401A, R-401B, R-406A and R-409A.

HFCs blends introduction

As mentioned before, the introduction rate of HFC blends for the replacement of HCFCs is strongly related to the prices evolution of both substances. At the present, HFC blends are 4-5 times more expensive than HCFCs prices, and only the R-404A has some application in commercial refrigeration.

It is interesting to compare the introduction of HCFC alternatives to the CFC-12 experience in the most important sectors:

- **Mobil Air Conditioning:** in Argentina, all car manufacturers are subsidiaries of global manufacturers and the decision for the use of HFC-134a was corporate and simultaneous for virtually all companies
- **Domestic Refrigeration**: local manufacturers received assistance under the MLF for their CFC conversion and choose therefore HFC-134a or HCs
- **Aftermarket:** until 2005, the majority used R-12, but CFC-12 availability and price motivated the use of ternary blends

However, the HFC blends penetration cannot be compared with the CFC-12 experience:

- The majority of the OEM's are local companies, in some cases connected through agreements with global enterprises, but not necessarily so dependent that they have to adopt the same policy.
- More important, there is uncertainty about the evolution of the HCFC-22 price. According to DuPont Argentina, if the carbon credit system under the Kyoto Protocol, that allegedly would allow developing countries to reap carbon credits from byproducts in the production of HCFC-22, will continue, its price will decrease dramatically.
- Finally, MLF support is currently far from assured
- Regarding HFC blends, a gradual price decrease can be expected

While no economic forecasts for the period 2010-2015 are available, it is expected that the growth rate of HCFC-22—based on expected price reduction—will be around 10%/y; for HCFC-123 will be 5%/y; HCFC-141b remains at 8%/y and HCFC-142b/124 will continue to be 20%/y.

Taking into account the factors above mentioned, the percentage of growth until 2015 for each HCFC can be summarized as follows:

SUBSTANCE	2006-2007	2008-2010	2011-2015
HCFC-22	7%	5%	10%
HCFC-123	7%	5%	5%
HCFC-141b	10%	8%	8%
HCFC-142b/HCFC-124	15%	20%	20%

Considering the real 2005 volume of each HCFC, and using the growth for the different periods, the estimated 2015 consumption in metric tons is as follows:

	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
2005 actual	3,004	460	34	58	23	**3,579**
2015 forecast	6,400	1,030	60	330	130	**7,950**

It follows that, with unconstrained growth, the use of HCFCs in Argentina will increase by almost 10%/y to more than double the 2005 consumption by 2015. This is in line with TEAP predictions for global demand development in developing countries (article 5.1 signatories to the Montreal protocol)

3.2 AVAILABILITY SCENARIOS AND PRICES

3.2.1 Availability Scenarios

Global production and use scenarios have been subject of several TEAP reports (2003 HCFC Task Force Report; 2005 Report on HCFC Demand, Banks and Emissions; 2005 Supplementary Report). The 2003 report predicted an HCFC-22 production capacity shortfall beyond 2005. However, sharp increase of production capacity in China—currently 368,000 t/y with a 75% utilization rate—has avoided this. For other major HCFCs (141b; 142b) no shortfalls were identified.

Argentina one of the three countries in Latin America with a local production source for the by now largest and most critical ODS substance, HCFC-22, with a production capacity of 3,000 t/y—essentially 100% of its 2005 demand. However, the current technical condition of the plant is such that continuation of the production at a competitive cost and quality level is not assured and capacity use over the ten years of production (1995 onward) has never been more than 20%.

Nevertheless, HCFC-22 prices have dropped over the same period from US$ 5.00/kg to US$ 2.50/kg (bulk)—another sign that the supply situation is very relaxed.

Based on the situation as described, Argentina does not expect any availability issues for HCFCs over the period 2006-2015

3.2.2 Price Trends

Price development of major HCFCs over the last ten years has been as follows (US$/kg):

YEAR	HCFC-22	HCFC-141b	HCFC-142b	HCFC-123	HCFC-124
1995	5.00	4.00	n/a	10.00*	**
2005	2.50	2.20	4.00	5.00	**

Notes: * 1998—no earlier data available
** Only imported in blends/no breakdown available

Interesting is that over the same period the price of CFC-12 increased from US$ 3.00/kg to US$ 8.00/kg and CFC-11 from US$ 2.50/kg to US$ 5.00/kg. Prices for ternary HCFC blends, on the other side dropped to levels that are now comparable with CFC-12 (R-401: US$ 8.00/kg and R406 US$ 6.00/kg).

Predictions of price levels for the future can only be made with a high level of uncertainty but, based on the relaxed supply scenario for all HCFCs and the mature and generic production status of these products, a price development following general inflation appears likely.

While HCFCs ternary blends can now compete with CFCs, this is—and most likely will not be in the foreseeable future—the case for scenarios including HFCs, which are around US$ 10.00-13.00/kg. Therefore,

Without intervention, no increased use of HFCs can be expected

3.3 TECHNOLOGY

Many of the available CFC phaseout technologies that apply non-ODS options apply for the phaseout of HCFCs as well. The Government of Argentina has always preferred the use of sustainable—non-ODS/low-GWP options. Based on policy, it preferred

- Water-, additive- of LCD based-options in flexible foam applications
- hydrocarbons or water-based options in rigid foams
- hydrocarbons in refrigeration applications

For reasons of technical and commercial maturity as well on investment and operating costs it was not always possible to apply this policy. Nevertheless, Argentina has an above average of non-ODs/low-GWP conversions to show. For instance, while internationally HCFC-141b—used predominantly for rigid foam applications—constitutes 25-30% of all HCFC use, in Argentina this is only 15 %. Use of hydrocarbons and liquid carbon dioxide—all zero ODP/low GWP technologies have been chosen wherever possible.

These technologies have been, particularly in the mid to late nineties, expensive and many companies have gone through long and sometimes bitter learning experiences. At the same time, these technologies have developed and matured. Overly restrictive safety restrictions have been adjusted based on widespread actual applications, equipment requirements have been optimized for different applications, lower priced low-pressure technology has adjusted to the new requirements and world-wide competition—including many article 5(1) countries has lead to significantly lower equipment prices. As a result, conversion projects today are significantly lower priced that they would be, say 10 years ago.

Therefore, as a matter of priority, new technical and financial parameters have to be set for existing technologies before applying them to HCFC phaseout projects

As before, Argentina will prefer options that combine zero ODP with favorable GWP properties. This implies that, while HFCs will be part of the solution, their overall environmental impact—GWP as well as energy requirements and end of life issues—need to be assessed. Such assessments have global significance and are not part of this survey. They should, however, be considered for the HCFC-management strategy that Argentina hopes to develop as a follow-up to this document.

As for now, Argentina expects to reduce the use of HCFCs by

- increasing the use of hydrocarbons in foam and refrigeration applications using optimized technologies and some novel blowing agents
- promoting the use of HFC-based ternary blends in RAC service, solvent and chiller applications
- changing to HFC technology in those aerosol applications that do not allow for the safe use of hydrocarbons

A discussion of all these technologies and how they could be applied in the specific Argentinean context would exceed the scope of this survey.

3.4 ENVIRONMENTAL IMPACT

PARAMETERS	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
Volume (t)	6,400	1,030	60	330	130	7,950
ODP	0.055	0.11	0.02	0.065	0.22	
ODP tons	352	113	1	21	3	490
GWP	1,780	713	76	2,270	599	

Source: 2005 IPPC/TEAP Special report

One should also take into account that

- HFCs are very energy efficient in insulation applications
- HCs are effective in refrigeration applications (better than HFC-134a)
- Argentina ratified in 2001 the Kyoto protocol and is therefore committed to options that combine zero ODP with favorable GWP properties and low energy impact

These issues should be considered when preparing an HCFC management plan.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

In the early 2000s, developed countries implemented HCFC-based technologies such as binary/ternary blends for refrigerants as well as liquid HFCs for foams. These can be technically applied in the Argentinean context as well.

It will, however, pose a cost issue. For instance, HCFC-22 costs US$ 2.50/kg (bulk). Replacing it by HFC blends will cost US$ 10.00-13.00/kg—a price increase 4.5 times! Even when in some cases energy efficiencies can be claimed, these will not close the price gap. The same is the case when replacing HCFC-141b with liquid HFCs.

While the use of HFCs faces challenges based on operational costs, using HCs will face challenges based on investment costs and related to the enforcement of safety in SME settings. Simplification and economizing the technology may be required to overcome this.

There are opportunities as well. If the simplification of HC technology would be successful, there may be operational savings. The simultaneous introduction of good operational practices may decrease the use of HFCs and limit the cost increase—at least in service applications.

3.6 POTENTIAL COMPLIANCE MEASURES

To identify potential compliance measures it will be useful to revisit the ExCom decision relevant to this survey. The Executive Committee of the MLF approved at its 45^{th} Meeting a project prepared by UNDP which aims to conduct a survey of HCFC use in selected countries with the objective of **establishing an eligible national aggregate level of HCFC consumption in the future against which proposals would be funded** (Decision 45/6).

This is a relatively narrowly focused objective but one which would lead to potential investment projects. To conduct these Argentina as well as the MLF would need a strategy that contains:

- A forecast of unconstrained consumption through 2015 (included in this document)
- A model how this unconstrained consumption scenario can bent into a no-growth one followed by phased reduction towards a no-use scenario by 2040
- A list of concrete, sequential actions required to support such a model
- An estimate of costs to implement these actions
- A financial Plan outlining total costs, cost for the MLF, GEF, bilateral funding (carbon credits) other co-financing, etc.
- Criteria against which projects to implement those actions can be approved
- A critical review of applicable technologies that meet pertinent criteria
- A list of pilot projects—if any—required to validate novel technological approaches

Argentina is in the position to prepare such a strategy on relatively short notice. Assuming this survey will be accepted by the ExCom in its meeting in March 2007 and funding for the preparation of a strategy would be approved at the same meeting, it would be possible to complete such a strategy for the December 2007 ExCom meeting with an interim report for the July 2007 meeting . The strategy could be used as a “pilot” one, e.g. as a base to develop formal, financial and technical criteria against which future HCFC phaseout projects could be approved.

An important part of the strategy will be the sequencing of projects with priorities for projects that offer sustainability by offering low operating costs—or even operating benefits.

While the use of HCFCs in the servicing sector can be reduced through “best practice” approaches that are essentially the same as the currently used ones for servicing with CFCs, complete phaseout of its use can only be achieved through prior phaseout of the use in primary (manufacturing) applications.

The initial phase of such a strategy (2008-2012) would be to "bend the trend". Priority projects for this phase would be those who offer low operating costs—or even benefits. "Best Practices" and foam/refrigeration manufacturing projects—if based on HCs—would qualify as such. in addition , any pilot projects required to validate new technical approaches would be formulated and implemented.

The second phase (2012-2015), aimed at "holding the trend", could address follow-up projects on novel technical approaches and projects that have become more cost-effective because of changed cost patterns. At the same time, regulatory measures to assure compliance with the freeze would be formulated

The third and last phase (2016 – 2040) would be based on enforcing the freeze and working towards complete phaseout of HCFCs. The regulatory umbrella will allow more co-financing and less emphasis on containment of operating costs. Companies will have to participate now or face enforcement later.

3.7 SUMMARY AND CONCLUSIONS

In summary, the use of HCFCs in Argentina can be divided into:

USE	APPLICATION	SECTOR(S)	AMOUNT (t)
Primary Use	Manufacturing	Aerosols, RAC, Foams	1,281
	Extinguishers/Cleaning Aids/Solvents	Cross Sectors	143
Secondary Use	RAC Servicing	RAC	2,155
Total			**3,579**

HCFCs are used in historical applications as well—in dramatically increased amounts—for CFC replacement. Because of the size of individual users and the limitations of technologies, it has not been possible to replace in all cases CFCs by non-ODS substances—even when financed by the MLF.

Considering the real 2005 volume of each HCFC, and using the growth for the different periods, the estimated 2015 consumption in metric tons is as follows:

	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
2005 actual	3'004	460	34	58	23	**3,579**
2015 forecast	6,400	1,030	60	330	130	**7,950**

Pricing constitutes a major issue in favor of the use of HCFCs. In the case of HCFC-141b, investment costs are also an impediment, specifically in cases where replacement by hydrocarbons are considered. The high operating costs of non-ODP technologies based on HFCs are another factor.

There are currently no supply problems with HCFCs nor are any expected in the period through 2015. Prices have come down for virtually all HCFCs in the last ten years and are currently relatively stable.

Current alternatives are by enlarge the same as those for ODS-free CFC replacement . exceptions are recently developed liquid HFCs for foams and HFC binary and ternary blends for refrigeration

While the use of HCFCs in the servicing sector can be reduced through “best practices” approaches that are essentially the same as the currently used ones for servicing with CFCs, complete phaseout of its use can only be achieved through prior phaseout of the use in primary applications.

Argentina offers to prepare a HCFC management strategy before December 2007.. The strategy could be used as a “pilot” one, e.g. as a base to develop formal, financial and technical criteria against which future HCFC phaseout projects could be approved.

An important part of the strategy will be the sequencing of projects with priorities for projects that offer sustainability by offering low operating costs—or even operating benefits.

The initial phase of a strategy (2008-2012) would be to **“bend the trend”**. Priority projects for this phase would be those who offer low operating costs—or even benefits. “Best Practices” and foam/refrigeration manufacturing projects—if based on HCs—would qualify as such. In addition, any pilot projects required to validate new technical approaches would be formulated and implemented. In this period, the upwards trend should be bend towards a flat one.

The second phase (2012-2015) would be to “**keep the trend”**. Follow-up projects on validated novel technical approaches as well as projects that are based on technologies that have become more cost-effective because of changed cost patterns. At the same time, regulatory measures to assure compliance with the freeze would be formulated.

The third and last phase (2016 – 2040) would be to “**end the trend”.** It would be based on enforcing the freeze while working towards complete phaseout of HCFCs. A regulatory umbrella will allow less emphasis on containment of operating costs. Co-financing will be emphasized. The word will be to participate now or face enforcement later.

SURVEY OF HCFCs IN BRAZIL

FINAL REPORT

National Ozone Unit, Ministry of Environment
Government of Brazil

United Nations Development Program, UNDP

January 22, 2007

EXECUTIVE SUMMARY

Brazil is a party to the Vienna Convention for the Protection of the Ozone Layer, the Montreal Protocol on Substances that Deplete the Ozone Layer as well as to all amendments to this Protocol,

As the annual calculated consumption in Brazil of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, it was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified a special phaseout schedule as well as for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

The first control actions on Ozone Depleting Substances (ODS) took place through a nation-wide effort by the National Secretary of Sanitary Surveillance of the Ministry of Health, with the issuance of Regulation SNVS no. 01 of August 10, 1988, that issued instructions for packaging labels of aerosols which didn't contain CFC and, soon after, with Regulation no. 534, of September 19, 1988 that prohibited production and sales of cosmetics, hygiene products, perfumes and household sanitary products in the form of aerosols with CFC-based propellants.

The first Brazilian law that obligated producers, importers, exporters and users of substances under Annexes A, B and C of the Montreal protocol to register with IBAMA was the “Portaria nº 4”, from January 11, 1993. Since then, several regulations were issued aiming to control production, trade and consumption of ODS. Currently, based on Law 10.165/2000, Resolution CONAMA 267/2000 and the Normative Instruction IBAMA 37/2004, the Brazilian Government regulates and controls all production, trade and consumption of substances controlled under the Montreal Protocol.

Another Government initiative was the preparation of the Brazilian Country Programme on the Elimination of Substances that Destroy the Ozone Layer (CP). This program was first released July 1994 and then updated in 1999 (CPU). The CP defines ODS phaseout actions and related scientific, technological and economic projects. It focuses on industrial conversion projects and the analysis of all producer and users segments, defining strategies to eliminate production and consumption of ODS.

The CP projects also actions by the Government to establish policies to reduce ODS such as production quota for all local producers and gradually imposed limitations and bans on the importation of ODS by the imposition of higher federal and/or state taxes.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol. Their use has to be controlled and eventually phased-out in accordance with the control schedule of the Montreal Protocol for Article-5 countries. Production and consumption of HCFCs will be subject to a freeze at 2015 levels from January 1, 2016 and are required to be completely eliminated by 2040. HCFCs are used in the Aerosol, Foam, Firefighting, Refrigeration & Air Conditioning, Refrigeration Service, Process Agent (Feedstock) and Solvents sectors. The predominant HCFC used is HCFC-22, mainly in the Refrigeration & Air Conditioning Sector (more than 95%), including charging of new equipment (10/15%) and Refrigeration Service (85-90%). There is also significant use of HCFC-141b, predominantly in foam applications (85/90%) and, to a lesser extent, as a cleaning agent (estimated 10%) and for contact sprays (up to 5%).

Brazil consumed in the last ten years almost 85,500 t HCFCs (Hydrochlorofluorocarbons), mostly as refrigerant and foaming agent. HCFC-22, R-401A and HCFC-141b are the most important substances. At present, the largest consumption in Brazil is in Air Conditioning (25%), Commercial Refrigeration (50%), Foam (20%) and solvent applications (5%). Uses in feedstock are statistically insignificant and no use could be identified in firefighting applications. The use of HCFCs has increased substantially due to a ban on CFCs for primary applications and the preference for HCFCs as replacement. For instance, HCFC-22 costs today about US$ 3.50/kg and is a major component in HCFC-containing blends that are used in the retrofit of refrigeration equipment to replace R12. HCFC-141b, used to replace CFC-11 in foams, costs currently around US$ 3.80/kg.

The 2005 consumption of HCFC by sector can be summarized as follows:

2005 HCFC Consumption by Sector (t/y)

Sector \ Substance	HCFC-22	HCFC-141b	HCFC Blends	Total
RAC	**7,938**	**0**	**840**	**8,778**
Foams	**0**	**3,383**	**0**	**3,383**
Solvents	**0**	**376**	**0**	**376**
Aerosols	**4**	**0**	**0**	**4**
Process Agents	**14**	**0**	**0**	**14**
Total	**7,956**	**3,759**	**840**	**12,555**

The use of HCFCs in Brazil is growing above average. Reasons are general growth in comfort and energy efficiency applications as well as the relatively low price and ease of application. Unconstrained development in the use of HCFCs would lead to considerable growth:

Development over the past of 5 years and Forecast for 2015

Substance	Year	Consumption (t)
All HCFCs	2005	12,555
	2010	18,100
	2015	26,368

This moderate scenario (a high one and a low one have been calculated as well) is well below TEAP predictions. Reason might be that there is currently in Brazil more pressure from the supply industry to change to HFC ternary blends as there is elsewhere. However, after 2007, when no new CFCs can be imported except for permitted uses, the use of ternary HCFC blends will most likely increase and, in this way the use of HCFCs in general.
At present there are no restrictions on the use of HCFCs and an unconstrained growth scenario would therefore apply. Brazil realizes that bending the current growth into a no-growth one in 2016 followed by phased reduction cannot be achieved without addressing use patterns early on. This implies that actions to control/reduce consumption of HCFCs to ensure compliance with the 2016 freeze would need to be initiated well in advance of that date.

The Government of Brazil would be in favor of developing accelerated schedules towards “freeze” of HCFC consumption followed by steps towards an equally advanced gradual phase out. For this, the support of the Multilateral Fund is a necessity. To do so, current support programs will have to be adjusted to fit the specifics of HCFCs being lower in ODP and frequently second phaseout steps.

Brazil has identified potential for initial accelerated phaseout of HCFCs in the following areas:

- Best practices programs for HCFCs in RAC service
- Retrofit programs with conversion to alternatives and energy optimization for large CR installations
- Elimination of the use of HCFC-141b used as a solvent for refrigeration circuit flushing
- A conversion program for foam manufacturers to non-ODS technologies
- Equipment replacement programs aiming at protecting the ozone layer **and** climate, benefiting from energy savings and partnerships for innovative financing including the MLF and other funding sources. Collection of ODS containing equipment and final destination logistics also will be required.

However, as a matter of priority— a detailed Strategy will have to be developed which will look into scenarios for the country taking into considerations technologies, cost and legal framework required, SURVEY OF HCFCs IN BRAZIL

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List of Abbreviations

ABRAVA	Associacao Brasileira de Refrigeracao , Ar Condicionado , Ventilicao e Aquecimento/ Brazilian Association for HVAC
ABRAS	AssociacaoBrasileira de Supermercados/Brazilian Association of Supermarkets
ABRIPUR	Associacao Brasileira de Espumacao/Brazilian Foam Association
Alice Web	External Trade Information System of the Ministry of Development, Commerce and External Trade (also called (SISCOMEX)
CFC	Chlorofluorocarbons
CR	Commercial Refrigeration
CTC	Carbon Tetra Chloride
DR	Domestic Refrigeration
ExCom	Executive Committee of the Multilateral Fund
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
HFC	Hydrofluorocarbons
HCFCs	Hydrochlorofluorocarbons
IA	Implementing Agency
IBAMA	Instituto Brasileiro de meio Ambiente e dos Recursos Naturais Renováveis (Brazilian Institute of Environment and Renewable Natural Resources)
LPG	Liquid Petroleum Gases
LNG	Liquid Natural Gases
MAC	Mobile Air Conditioning
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MMA	Ministerio do Meio Ambiente/ Ministry of Environment
MP	Montreal Protocol
MT/mt/t/tonnes	Metric Tons
OEM	Original Equipment Manufacturer
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
RAC	Refrigeration and Air Conditioning
R&R	Recovery and Recycling
SISCOMEX	External Trade Information System of the Ministry of Development, Commerce and External Trade (also called Alice Web)
SMEs	Small and Medium-sized Enterprises
TR	Tons of Refrigeration
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services

1. INTRODUCTION

1.1 BACKGROUND

The first restrictive actions on Ozone Depleting Substances (ODS) took place through a nation-wide effort by the National Secretary of Sanitary Surveillance of the Ministry of Health, with the issuance of Regulation SNVS no. 01 of 10.08.88, that defined instructions for packaging labels of aerosols which didn't contain CFC and, soon after, with the Regulation no. 534, of 19.09.88 that prohibited throughout the Country the production and the commercialization of cosmetics, hygiene products, perfumes and household sanitary products in the form of aerosols with CFC-based propellants.-

Brazil signed the Vienna Convention and the Montreal Protocol on March 19th, 1990 (Decree nº 99.280 from July 7, 1990). Subsequently, it signed the London, Copenhagen, Montreal and Beijing amendments:

Table 1 – Ratification Dates for MP Amendments

Instrument	Entry into Force	Ratification by Brazil
London Amendment (1990)	August 10, 1992	October 1, 1992 (At)
Copenhagen Amendment (1992)	June 14,1994	June 25, 1997 (R)
Montreal Amendment (1997)	November 10, 1999	June 30, 2004 (R)
Beijing Amendment (1999)	February 25, 2002	June 30, 2004 (R)

Source:: www.unep.org/ozone R: Ratification; At: Acceptance; Ac: Accession;

As an Article 5(1) country, Brazil will have until 2010 to eliminate production and consumption of Annex-A group 1 and 2 of Annex B substances. However, Brazil decided on an earlier deadline to eliminate CFCs. CONAMA (the National Council of Environment) Resolution 267 established 2007 for a ban on the importation of CFCs (except for permitted usages).

CFCs are not anymore produced in Brazil. In 1995, after closing of the plant of Hoechst do Brazil, the Brazilian market stayed only with one manufacturer of HCFC (DuPont do Brasil) which ended its activities in August 1999. It is estimated that during these years some 12,500 t HCFCs were produced in this plant (in the same period, about 21,000 t HCFCs were imported).

On January 11, 1993 IBAMA issued Ordinance no. 04, stipulating that all producers, importers, exporters, dealers and/or users of ODS must register with the Institute. IBAMA counted more than 600 initial registrations. With Ordinance IBAMA no. 29 dated May 2, 1995, an improved registration system was enacted that applies to each company that handles more than one t/y ODS annually. In this way, the commitment to supply annually Brazilian statistical data to the Protocol Secretariat was facilitated.

Another Government initiative was the issuance of the Brazilian Program of Elimination of Substances that Destroys the Ozone layer – CP – July 1994 (and updated in 1999). The CP contains several actions of normative nature and provides scientifically, technological and economical focus on industrial conversion projects, the analysis of all producer and user segments and defined strategies to eliminate the production and consumption of ODS.

The CP requires the Government to establish policies that define quotas of ODS use for all local manufacturing companies. Besides that, they stipulate strategies to a gradual limitation and make imports of ODS less attractive by increasing pertinent federal/state taxes.

External trade in ODS was already controlled in Brazil even before the licensing systems under the MP went into force. This control consisted of registering exported and imported ODS containing goods, products, etc. In 1993, before approval of any Montreal Amendments, Brazil had already imposed a licensing system that was intended for annexes A and B of the MP. As the system includes all products, goods, etc, HCFCs—Annex C substances—have also been registered in view of external trade (importation and exportation). However, there are currently no other control measures pertaining to HCFCs.

1.2 APPROACH AND PREPARATION

The Executive Committee of the MLF approved at its 45th Meeting a project prepared by UNDP which aims to conduct a survey of HCFC use in selected countries with the objective of establishing an eligible national aggregate level of HCFC consumption in the future against which proposals would be funded (Decision 45/6).

In order to speed up the administrative process, UNDP selected to implement it through its Montreal Protocol Unit (MPU) in close cooperation with the National Ozone Units and UNDP's Country Offices in the selected countries, from which Brazil is one. For each country, in consultation with the NOUs, national experts have been recruited to conduct and analyze the actual survey and to prepare a report following a template issued by UNDP. These reports have been edited by two international experts before being forwarded to UNDP-MPU. MPU, after conducting its own review, submitted the reports to the National Ozone Units with the request for comments by an as broad as possible cross-section of stake holders. After taking these comments into consideration, MPU prepared final versions of the national reports for submission to the MLF.

1.3 SURVEY METHODOLOGY

The work methodology has been to initially prepare a desk study that identifies information sources. These sources were then surveyed and interaction was initiated with the various suppliers/importers of HCFC-related chemical products and equipment and/or their representatives and industrial associations. In this way, it was attempted to identify and quantify all current use of HCFCs in the Foam and RAC sector as well as solvents and firefighting applications and any other use of HCFCs, keeping continuous contact and updating lists of all these users, with the objective to classify the data as follows:

- Consumption of HCFC by sector:
    - Aerosols
    - Foams
    - Firefighting Applications
    - Refrigeration & Air Conditioning Applications
    - Solvents
    - Process Agents
- HCFC users separated by sector
- HCFC user that received assistance under the Montreal Protocol Program
- If known, HCFC users that did not receive assistance under the Montreal Protocol Program

The national expert incorporated these data along with related forecasts, conclusions and recommendations into a detailed report following MPU's detailed template. This report was reviewed, completed and edited by the international expert responsible for the Latin America region and then forwarded to the MMA for review and decision on policy issues before being submitted to UNDP-MPU for a final review and submission to the MLF.

As per decision 45/6(i), the survey provides information on current consumption by sector and substance, as well as the forecasted projections thru 2015. This information will allow the MLF Secretariat–if requested by the Executive Committee–to propose funding policies and procedures for the next years, including the possible establishment of an "eligible national aggregate level of HCFC consumption."

The survey resulted in a list of importers, distributors and HCFC-consuming enterprises. The Government however asked these lists to be treated on a confidential basis as it involves commercial information that may be sensitive to some of the parties concerned. For this reason, requests for more detailed information should be sent to the National Ozone Unit. While the survey has identified a substantial amount of individual HCFC users, not all suppliers were willing to disclose individual customers, additional individual users will be identified over the next years in case this survey will evolve into a sector-based HCFC management plan.

The thousands of refrigeration technicians and small shops, mainly in the informal sector were not listed in this survey. The list even though tailored to CFC users, has been identified in the CFC phaseout plan, as part of the training activities. The following table provides the numbers of enterprises that were identified in the survey per category/sector:

Table 2 - Stakeholders identified in the HCFC Survey in Brazil

HCFC Stakeholders		Amount of Enterprises
Importers		7
Distributors		280
HCFC-Consuming Enterprises		
	HCFC-141b	153
	HCFC-22	265
Total	**All HCFCs**	**418**

* service providers not included(over 30,000)

2. OBSERVATIONS

2.1 INTRODUCTION

Apart form import/export registrations, Brazil has not yet adopted any control policies on HCFCs and an unconstrained growth scenario would therefore apply. Brazil realizes, however, that bending the current growth into a no-growth scenario by 2016 cannot be achieved without some form of control and has stated during the 18th meeting of the Parties to the Montreal Protocol (MOP) its commitment to actions to control/reduce consumption of HCFCs to ensure compliance with the 2016 freeze. Taking stock of current use and growth patterns is needed to plan any concrete actions. The survey serves this purpose.

2.2 INSTITUTIONAL FRAMEWORK

2.2.1 Institutional Arrangements

To coordinate actions to protect the ozone layer, PROZON—an Inter-ministerial Executive Committee composed of seven ministries—was created in September, 1995. Under coordination of the Ministry of Environment (MMA), PROZON is in charge of coordinating following activities:

- actions related to the implementation of the Brazilian Country Program (CP);
- arranging updates of this Program while considering scientific and technological developments, economic aspects and compliance with the Montreal Protocol;
- proposing policies to guide/harmonize/coordinate actions related to the ozone layers' protection;
- coordinating allocations of financial resources necessary to carry out the CP;
- actions by the MLF's Implementing Agencies in the execution of the CP;
- making the CP well known and promote society's participation in its development.

For the implementation of Country Program, the Brazilian Government has been having the support of the four Implementing Agencies of the Montreal Protocol: UNDP United Nations Development Program, UNEP - United Nations Environment Program, UNIDO - United Nations Industrial Development Organization and the World Bank.

Among the government entities that support the carrying out of the current obligations to the Montreal Protocol stand out the most: the National Institute of Space Researches - INPE, linked to MCT - plus the Federal Environment Agency IBAMA, which centralized the file of all the producing companies, importers, exporters, users and merchants of SDO, in order to make up a database.

The development and execution of the Country Program, as well as its revision, has been accomplished with the intense participation of the private sector represented by the respective associations, the government, state environment agencies, NGO's and Universities, as listed below:

- National Council of Environment - CONAMA
- Brazilian Institute of Environment and Natural Renewable Resources - IBAMA
- State of Sao Paulo Environment Agency - CETESB
- Automotive Manufacturers Association - ANFAVEA
- Brazilian Refrigeration, Air Conditioning, Ventilation and Heating Association -ABRAVA
- National Association of Electronic Products Manufacturers- ELETROS
- Brazilian Electrical and Electronic Industry Association - ABINEE
- Brazilian Association of Chemical Industries - ABIQUIM
- Brazilian Association of Gas Industries - ABRAPAR
- Brazilian Association of Machine and Compressor Industries - ABIMAQ
- Brazilian Association of Aerosol Industries - ABA
- Brazilian Association of Supermarkets - ABRAS

National Trade Union of the Automotive Parts Industry – SINDIPEÇAS

- CENCUS A. B. NILSEN
- Brazilian Pharmaceutical Industry Association - ABIFARMA
- National Industrial Learning Service - SENAI
- Small and Medium Size Company Service Support - SEBRAE
- National Industry Confederation - CNI

At the 37th Meeting of the ExCom, the Brazilian National CFC Phaseout Plan (NPP) was approved. An amount of up to US$ 26.7 million was made available for an array of measures that should lead to full elimination of the use of CFCs except for recognized uses considered essential by the government, such as manufacture of metered dose inhalers for asthma. This program is still under implementation.

2.2.2 Policies

Current policies in Brazil are focusing on the control of emissions from CFCs. Since 2001, there is the NPOP – National Phase out Plan. This plan has the purpose to control the emissions of CFCs to atmosphere and do the recycle of this one, this plan are today focus on the domestic refrigeration, commercial and automotive. Regarding to the HCFCs topic, Brazil are starting the survey of this market for at that way analyze future decisions.

2.2.3 Regulations and Other Control Measures

In Brazil, the first restrictive actions on Controlled Substances happened in a nation-wide effort through the National Secretary of Sanitary Surveillance of the Ministry of Health, with the edition of the Regulation SNVS no. 01 of 10.08.88, that defined instructions for the packaging labels of aerosols which didn't contain CFC and, soon after, with the Regulation no. 534, of 19.09.88, that prohibited, throughout the Country, the production and the commercialization of cosmetic, hygiene, perfumes and household sanitary products, under the form of aerosols that had CFC based propellants.

In the period 1989-1990, through a request by the Protocol Secretariat - of which Brazil was not yet a member, but in the process of joining - a Brazilian Case Study was developed by the Brazilian Institute of Environment and Natural Renewable Resources – IBAMA - with the technical support of the United States Environmental Protection Agency - USEPA - to determine the status of the Country in regard to ODS. This work, which was supported by all involved sectors, besides being the first one, served as base for the elaboration of the Controlled Substances Elimination Program as an example of what was done by most of the Parties.

The decisions of the Protocol were materialized through the publication of the Inter-ministerial Enactment no. 929, of October 04, 1991 of the then Ministry of the Economy, Finance and Planning, creating the Inter-ministerial Working Group-GTO to carry out , within the country, what had been agreed upon at the Montreal Protocol, about Ozone Layer Depleting Substances. The Working Group was composed of Ministry of Industry, Commerce and Tourism - MICT; Ministry of Foreign Affairs - MRE; Ministry of Science and Technology - MCT; Ministry of the Environment and Legal Amazon – MMA/IBAMA (Instituto Brasileiro de Meio Ambiente e dos Recursos Naturais Renováveis or the Brazilian Institute of Environment and Natural Renewable Resources) and Secretariat of Planning of the Presidency of the Republic, MICT's Secretary of Industrial Policy acting as Executive Secretary. Other agencies, from Public Administration and class associations as well, also participated as guests. GTO's mandate finished at the end of 1994. Its main function was to establish guidelines and to coordinate the fulfillment of the established norms, to elaborate the national program, besides analyzing, beforehand, the projects that pled resources from Multilateral Fund.

On January 11, 1993 IBAMA enacted Ordinance no. 04, establishing that all producers, importers, exporters, dealers and/or users of ODS must register with the Institute. More than six hundred companies registered. Currently, based on Law 10.156/2000, CONAMA Resolution 267/2000 and the IBAMA Normative Instruction 37/2004, the Brazilian Government regulates production, trade and usage of the ODS controlled under the Montreal Protocol.

In 1993, with the support of the Institutional Strengthening Project, approved by the Executive Committee of the Multilateral Fund, another government initiative was the elaboration of the Brazilian Country Program to phase out of Ozone Depleting Substances that was sent to the Montreal Protocol Secretariat in July, 1994. Brazilian Country Program contemplates a group of actions of normative, scientific, technological and economic essence aimed at projects of industrial conversion and segment analysis of all producers and users, defining strategies for the elimination of production and consumption of ODS.

In setting up the policies the working out of Country Program was of great importance in the sectoral diagnosis of ODS users and in the proposition of economic, technological and normative actions, being that the two last ones received more attention. The technological aspects were centered in specific regulation discussed and established by the National Council of Environment - CONAMA, which among other restrictive measures included a chronogram of ODS elimination by sector for new equipments.

Resolution n. 267 of CONAMA, approved in September and published in December 2000, forced companies that work, produce or market ODS to register with the federal agency of environmental control (IBAMA), otherwise they wouldn't be allowed to produce, import, export, market and/or use ODS.

The Resolution also prohibited throughout the whole national territory, the use of those substances in new systems, equipments and products, national and imported, except those applications characterized as permitted uses . This Resolution established reducing quotes for import of CFC-12, as follows:

a) 15% in 2001; b) 35% in 2002; c) 55% in 2003; d) 75% in 2004;
e) 85% in 2005; f) 95% in 2006; and g) 100% in 2007.

For CFC-11, this Resolution banned the consumption except for those enterprises that have projects approved by the MLF and for permitted uses—currently only in the manufacturing of MDIs.

In September, 2003, CONAMA resolution 340 was enacted, providing guidelines for recovery, recycling and reclamation activities. According to this legislation, all recovered CFCs must be sent do reclaim centers or to final destinations.

2.3 HCFC SUPPLY SCENARIO

2.3.1 Production

Brazil does not currently produce HCFCs

2.3.2 Exports

In the last 5 years Brazil exported HCFC-22 and HCFC-141b as follows:

Table 3 - Export of HCFCs 2001-2005 (ton/y ODS)

Year	HCFC-22	HCFC Blends	HCFC-141b
2001	0.03	0	0
2002	13.45	0	8,39
2003	21.76	0	0
2004	0.00	0	15.42
2005	82.70	0	0

Source: SISCOMEX

2.3.3 Imports

In the last five years, Brazil has been importing HCFCs broken down as follows:

Table 4 - Breakdown of Import of HCFCs 2001-2005 (t/y)

Year	HCFC-22	HCFC Blends	HCFC-141b	Total
2001	6,360	81	3,684	**10,125**
2002	7,373	61	2,820	**10,254**
2003	7,474	87	3,212	**10,773**
2004	7,805	328	3,894	**12,027**
2005	8,037	840	3,773	**12,650**

Source: SISCOMEX

2.3.4 Distribution and Supply Chain

HCFCs are distributed the following way into the Brazilian industrial market:

- Importers
- Distributors

Nowadays Brazil has seven large importers of HCFCs. DuPont do Brazil accounts for ~ 50% of the total imports. Frigelar and DuFrio account together for ~ 30% and the other 20% are shared by the remaining four large importers.

2.4 HCFC CONSUMPTION

HCFC consumption following the UNEP formula (consumption = production + import – export) would be as follows:

Table 5 - Breakdown of Consumption of HCFCs 2001-2005 (t/y)

Year	HCFC-22	HCFC Blends	HCFC-141b	Total
2001	6,360	81	3,684	**10,125**
2002	7,360	61	2,812	**10,232**
2003	7,452	87	3,212	**10,751**
2004	7,805	328	3,879	**12,012**
2005	7,954	840	3,773	**12,567**

Source: derived from SISCOMEX import/export data

These data have to match within reasonable margins (due to inventory variations) sector data as mentioned below.

2.4.1 Aerosols Sector

In 1995, Brazil disallowed the use of CFCs as propellants in most aerosols applications. Industries converted to butane or propane and a smaller part to HCFCs. There is continued use of CFCs in medical inhalers (classified by the Government as "essential" or "permitted use"). Detailed propellant consumption of HCFCs is as follows:

Table 6 – Consumption of HCFC in the aerosol sector (ton/y ODS)

HCFC	Year				
	2001	2002	2003	2004	2005
22	n.k.	8.40	4.30	0.80	3.52
141b	n.k.	-	-	0.40	010
Total	n.k.	8.40	4.30	1.20	3.62

Source: IBAMA, with some adjustment from market information
n.k = not known

2.4.2 Foam Sector

Foams in Brazil include rigid foams used in refrigeration applications. The sector used traditionally CFC-11 as blowing and insulating agent, with minor use of CFC-12 in extrusion foams. When looking for new technologies, sub-sectors selected different ways based on the desired properties of the blowing agents:

- Flexible foam, needing no insulation properties, selected methylene chloride, liquid carbon dioxide, water and additives;
- Rigid foams, needing good thermal insulation values, selected by enlarge HCFC-141 with some use of cyclopentane ;
- Integral skin and microcellular foams, looking for good skin properties selected butane or HCFC-141b with minor use of water (= chemically induced CO_2);
- Extruded (polyethylene or polystyrene) foams, looking for uniform cell size and some thermal insulation, selected butane, isobutane or liquefied petroleum/natural gases (LPG/LNG).

While a large number of companies benefited in their conversion program from MLF funding and technology support, a substantial amount of enterprises missed-out because of the establishment of national regulations forbidding the use of CFCs that took effect before all projects could be initiated. In this way, many foam and commercial refrigeration SMEs remained unaddressed. These companies converted their foam production to HCF-141b by themselves and on their own costs (and went to HCFC-22 as refrigerant). They were validated and remain theoretically eligible for support under MLF polices. ODS use at that time (1999-2000) was almost 300t and 790 companies were identified (by UNDP/Abripur). Using general growth figures for the industry, the related amount of HCFC-141b would be in 2005 500t or 15% of all HCFC-141b use in foams (ref table 7).

Table 7 - Consumption of HCFC 141b in Foam Applications (t/y ODS)

HCFC-141b	Year				
	2001	2002	2003	2004	2005
Total	2,977	2.538	2,890	3,505	3,383

Source: SISCOMEX

2.4.3 Firefighting sector

In the firefighting sector, Brazil is currently using Halons and CO_2. For new products, halons are not anymore used. Only halons for servicing of existing equipment are still allowed. The ban on virgin halons is part of CONAMA legislation 267. Brazil has a Halons Bank in São José dos Campos that received financial assistance from the MLF through a bilateral contribution form the Government of Canada and is recycling/reselling Halons. CO2 is being used in large scale in other firefighting applications. There was no identified consumption of HCFCs in this sector at the time of this survey but according to the market, there is some, but not quantified, use of HCFCs (Alotron, HCFC 123 and -124); (source: DuPont do Brasil). This will be followed up on.

2.4.4 Refrigeration and Air Conditioning (RAC) Sector

Refrigeration:

Most **domestic refrigerators and freezers** use HFC-134a as refrigerant, with some minor use of R-404 in split units. No major changes are expected in the future unless municipal laws that discourage the use of hydrocarbons would change. There is minor use of ammonia-based absorption units, such as frigobars. Private sector Government initiatives related to HC refrigerators have been identified. There is no use of HCFCs as refrigerant in this sub sector.

In **industrial refrigeration** there is predominant use of ammonia and virtually no use of HCFCs

In **commercial refrigeration**, the use of HCFC-22 prevails, with some HFC-407, 410, 404 and 134a.

There is also use of ammonia. Locally made unitary units use 90-100% HCFC-22. In **transportation refrigeration**, many units are imported preloaded (Carrier, Trane, York). The large number of HCFC-22 users can be explained from the ease of technology and the low cost of the substance. The sector is notorious for heavy gas losses that originally exceed, on an annual base, the original equipment charges. Recently, some significant improvements have been made as the following example from the supermarket sector shows:

There are in Brazil more than 73,000 supermarkets (DuPont). The amount is increasing rapidly because the increasing consumption of refrigerated/frozen food sold. Losses related to evaporation are huge:

- *Brazil* *Average leakage* *100% of the original charge per year*
- *Europe* *Average leakage* *20% of the original charge per year*

The largest HCFCs R-22 users are the Pão de Açucar, Carrefour and Wall Mart chains. Together, they count through 2,000 stores ~80% of the HCFC-22 use in supermarkets.
Only Pão de Açucar" has in the food sector more than 6.000 refrigeration pumps installed and uses in its >600 shops around 240 t/y HCFC-R22 for maintenance,

In the last 5 years this chains have invested much into retrofitting to replace R-502 and CFC-12 by, generally, HCFC-22. No freezer equipment is working at the present anymore with R502 and only a few with CFC-12. This has taken a lot of conversion costs, refrigerant collection and operator/maintenance training. Refrigerant collection and exchange has been executed mostly by DuPont. Other actions involved replacement of lubricants, resizing of pipes, layout changes, reconnection's and thermal insulation of piping. The result is an important upgrading in technology and sharp reduction of gas losses. These stores have reduced the average annual leakage to 50% of the original charge!

Because of these and similar conversions, recent growth in the use of HCFC-22 has been relatively modest compared to, for instance HCFC-141b. However, if the retrofit program will not be extended to other shops, growth could accelerate significantly again.

There is some use of HCFC-141b as solvent for refrigeration circuit flushing. This will be addressed under 2.4.5.: "Solvent Sector".

Air Conditioning:

In the air conditioning sector, Brazil shows substantial which is mainly concentrated in "comfort areas" (residential/split units). This is due to general price reductions as well as increased financial resources. Today one can buy a split AC unit for ~U$$ 450. The same did cost several years ago over U$$ 900.

Brazil produces annually around 1.0 million AC units which is just 1,7% of the world market. Around 800,000 of these are window units and 100,000 mini-splits. There is considerable import. Most of the units serve for cooling only (90%). The rest have heat pumps and serve for heating and cooling. Large manufacturers are

- Window Units: Carrier-Springer, Electrolux, Consul and Brastemp
- Mini-split: Gree, York, Carrier, Trane, Hitachi

HCFC-22 is the predominant refrigerant. Preloaded imports may include HFCs and HCFC-blends.

Mobile Air Conditioning (MAC) has completely converted to the use of HFC-134a.

As to chillers, according to information from main chiller manufacturers, 127 chillers with HCFC-123 were sold in Brazil since 1995, totaling around 82 metric tons HCFC 123 **installed**. Assuming leakage, service needs were estimated to be around 10- 15 tonnes in 2005.

It is expected that with the purchase of additional HCFC-123 chillers- at an estimated rate of about 10 of those chillers added per year, the current inventory—and along with that the use of HCFC-123 for servicing--will increase. Import records from Government system on imports, Siscomex, for 2005 and 2006 are under further study, as there is indication that 19 tonnes of HCFC 123 entered the country in 2005. Over 30 tons in 2006 has been identified. Sector distribution as presented in this report does not take that into consideration but will be revised once these figures are confirmed.

With the strong focus on energy efficiency programs by the utilities and Government programs, as well as approved building codes and labeling for energy efficient constructions, the market is expected to increasingly be looking at selection of equipment which benefits both ozone and climate. The Government has indeed designed its chiller replacement program in such way that chiller replacement selection will favor more energy efficient equipment as part of an overall building energy-saving design that looks into the entire system and all related environmental issues.

Table 8 shows the summarized use of HCFCs in RAC applications:

Table 8 - Consumption of HCFCs in RAC applications (t)

Year	Commercial Refrigeration		Air conditioning	Chillers	Related Service Applications	Total**
	HCFC-22	HCFC Blends				
2001	646	81	276	n.k.*	5,215	**6,218**
2002	775	61	331	n.k.*	6,257	**7,424**
2003	767	87	328	n.k.*	6,195	**7,377**
2004	822	328	351	n.k.*	6,634	**8,135**
2005	827	840	554	**	6,557	**8,778**

* No SISCOMEX data confirmed Source: SISCOMEX
** Excludes HCFC-123 for servicing applications for which SISCOMEX data available is been further investigated. There is indication of 19 metric tons HCFC- 123 in 2005 and 34 metric tons in 2006. Once officially confirmed they will be added to the totals.

2.4.5 Solvents Sector

Solvent applications cut across other sectors such as refrigeration (HCFC-141b for flushing) and foams (methylene chloride for mixing head cleaning). In Brazil, HCFC-141b is used for refrigeration circuit cleaning. While this constitutes only a small part of the total 141b use, it is in absolute numbers significant and technically as well as economically not needed. A sector-wide program for the phaseout of HCFCs in flushing applications could be one of the first and most successful HCFC-phaseout programs. Following table shows the use of 141b use in solvent applications over the last four years:

Table 9 – Consumption of HCFC in the solvent sector (t/y)

HCFC	Year				
	2001	2002	2003	2004	2005
141b	n.k.	282	321	389	376

Source : DuPont/ABRAVA

In **Sterilization Applications,** the use of CFCs has been forbidden since 2001 and industries have mostly converted to non-ODS alternatives. 2002 and 2003 show , however, still some use of HCFCs and this may continue—albeit without reporting. HCFC-22 and HCFC-141b are thought to be still consumed in small amounts in the chemical industry and in hospitals.

Table 10 – Consumption of HCFCs in Sterilization Applications (t/y)

HCFC	Year				
	2001	2002	2003	2004	2005
22	**n.k.**	**0.20**	**0**	**0.05**	**0.05**
141b	**n.k.**	**0**	**0.40**	**0.10**	**010**
Total	**n.k.**	**0.20**	**0.40**	**0.15**	**0.15**

Source: IBAMA, with some adjustments from market information

There is most likely also be some use of HCFC-141b and HCFC-142b in the formulation of (contact) cleaning agents but such could not be identified and quantified in this survey.

2.4.6 Feedstock Applications/Process Agent

There is use of HCFC 22 and HCFC 141b as a process agent , mainly in the chemical industry. Table 11 summarized this consumption:

Table 11 – Consumption of HCFC as a process agent (t/y)

HCFC	Year				
	2001	2002	2003	2004	2005
22	n.k	16.25	18.44	15.97	13.2
141b	n.k	-	0.40	0.24	0.31
Total	n.k	16.25	18.84	16.21	13.51

Source: IBAMA

2.4.7 Summary and Conclusions

The 2005 consumption of HCFC by sector can be summarized as follows:

Table 12 – 2005 HCFC Consumption by sector (t/y)

Sector \ Substance	HCFC-22	HCFC-141b	Blends****	Total
Air Conditioning	554	0	0	554
Commercial Refrigeration*	827	0	840	1,667
RAC Services	6,557	0	0	6,557
**Total RAC ** **	**7,938**	**0**	**840**	**8,778**
Foams* **	**0**	**3,383**	**0**	**3,383**
Flushing	0	363	0	363
Sterilants	0	0	0	0
Other Solvents	0	13	0	13
Total Solvents	**0**	**376**	**0**	**376**
Aerosols	**4**	**0**	**0**	**4**
Process Agents	**14**	**0**	**0**	**14**
Total	**7,956**	**3,759**	**840**	**12,555**

Source: SISCOMEX/ DuPont/Abrava

*   Excluding circuit flushing and insulation foams

** There is indication of 19 metric tons HCFC- 123 in 2005 and 34 metric tons in 2006. Once officially confirmed they will be added to the chillers sub sector consumption.

*** Including commercial refrigeration insulation foams

****Used for retrofits or as drop-in

The same can also be summarized according to the following uses:

Table 13 – 2005 HCFC Consumption by use (t/y ODS)

USE	APPLICATION	SECTOR(S)	AMOUNT (t)
Primary Use	Manufacturing	Aerosols, RAC, Foams	5,622
	Solvents, Feedstock/Process Agent	Cross Sectors	376
Secondary Use	RAC Servicing	RAC	6,557
Total			**12,555**

These data match very close the consumption data derived from imports and exports (12,650 t).

However, as mentioned, there are several areas where official data may not be reflecting the actual situation. Specifically for chillers the lack of HCFC-123 data officially confirmed at the time of this survey cannot be reconciled with the calculated need of for 2005 of 10 to 15 t HCFC-123 for service applications or even more. Other areas where more HCFCs may be used that reported are firefighting, sterilants, contact cleaners and, perhaps, aerosols in non-essential applications that do not allow hydrocarbons (party sprays).
In conclusion, and based on reference year 2005:

- Brazil is a large consumer of HCFCs, mainly HCFC-22, HCFC-containing blends and HCFC-141b
- Reasons for their wide-spread use are:
    - Easy to apply in new equipment and retrofits
    - Low in costs
    - Readily available
    - Not—or virtually not—controlled
    - Requiring low investment in technology and training
- HCFC-22 is with 63% the largest substance. Within the use of HCFC-22, service applications dominate. This emphasizes the continuing lack of proper containment procedures **and** inferior condition of currently used original equipment
- The second largest substance is HCFC-141b with 30% of the total. This is relatively high and emphasizes the lack of penetration by other, non-ODS substances such as cyclopentane
- Blends, the smallest group of HCFCs, amount to 7% of the total HCFC consumption. They consist of different HCFCs such as HCFC-22 and represent the effect of supermarket retrofits. As they are more energy-efficient and cut leakage almost in half, they constitute a bright spot in the overall picture and promise lower service rates for the future
- More investigation will be needed to clarify expected consumption in some sectors that are currently not reflected in the Government statistics

3. ANALYSIS

3.1 - DEMAND FORECASTS

To estimate future unconstrained HCFC demand, one has to start from general "real" growth expectations—i.c. without inflation figured in. For Brazil real growth is estimated to be at average 4% for the period 2005-2015 as the following table shows:

Table 14 – Real GDP Growth Projections for Selected LA Countries

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Argentina	7.7	4.6	3.1	2.9	3.6	3.7	3.8	3.7	3.3	3.4	3.4
Brazil	5.4	4.0	3.5	3.7	3.8	3.9	3.9	3.9	4.0	4.0	4.1
Colombia	3.6	3.7	4.0	4.1	4.2	4.1	4.1	3.7	3.8	3.8	3.7
Mexico	4.1	3.9	4.1	4.3	4.2	4.2	4.3	4.3	4.2	4.2	4.2
Venezuela	16.4	4.0	3.8	4.2	4.1	4.1	4.1	4.2	4.2	4.1	3.9

Source: "Global Insight" (formerly DRI-WEFA)

Upon these general growth figures, one has to superimpose special circumstances, such as:

- Historical development for specific sectors and/or substances
- Specific expected future sector and/or substance developments based on, inter alea
  - Higher than normal development of thermal insulation
  - Phaseout of **CFCs** in 2010 in all sectors
  - Change to refrigeration blends
  - Impact of expected regulations

These parameters will be applied in the following application specific scenarios.

3.1.1 Process Agents

HCFC 22 and HCFC 141b are the only substances used—in very small amounts—as process agents, mainly in the chemical industry. Their growth is expected to follow general growth expectations as applied in the following table:

Table 15 – Forecast for the Consumption of HCFC as Process Agent (t)

HCFC	Year		
	2005	2010	2015
22	13.2	16.11	19.52
141b	0.31	0.38	0.46
Total	**13.51**	**16.49**	**19.98**

3.1.2 Other Applications

There are several approaches to estimate unconstrained growth for the period 2005 (reference year) and 2015 the last year before imposition of a freeze on HCFC consumption). Following three scenarios are presented:

- A **low growth scenario** based on past consumption statistics from SISCOMEX:

Table 16 - Development over 2000-2005 and Forecast for 2005-2015

Substance	Year	Tons
R22	2000	6,806
	2005	7,956
	2010	9,100
	2015	10,400
Blends (R408a ,402a ,402b, R401a, 409a, 401b)	2000	15
	2005	840
	2010	1,258
	2015	1.635
R141b	2000	2,260
	2005	3,759
	2010	4,130
	2015	4,460
Total of HCFCs Consumption	**2000**	**9,081**
	2005	**12,555**
	2010	**14,448**
	2015	**16,495**

This scenario shows a much lower growth one than the TEAP predicted as world-wide Article 5(1) country growth. One argument against this scenario may be that it is based on past information only.

- A **moderate scenario** based on growth figures from 2001-2005 and special factors:

Table 17 - Consumption of HCFCs 2001-2005 (T)

Year	HCFC-22	HCFC Blends	Sub-total RAC*	HCFC-141b	Total
2001	6,135	81	6,219	3,307	9,526
2002	7,348	61	7,411	2,801	10,213
2003	7,267	87	7,356	3,211	10,567
2004	7,805	328	7,807	3,878	11,686
2005	7,956	840	8,796	3,759	12,555
Average Growth	6%	80%	9%	4%	7.5%

* Actually, this includes 18 t other applications but this is—with 0.2%--statistically insignificant

The historical growth trends from Table 14 can be applied directly to the Foam and RAC sectors as all other sectors have minimal impact. This leads to the conclusion that:

- Foams, solvents and aerosols will follow general market growth
- RAC will outpace general market growth by up to 5%
- Within the RAC sector, blends will increase their part of the market at the cost of HCFC-22

Table 18 – 2005-2015 Expected Growth in HCFC Use per Sector (t/y)

Sector	Annual Growth	2005	2010	2015
Aerosols	4%	14	17	21
Foams	4%	3,383	4,116	5,007
Firefighting	n/a	0	0	0
RAC	9%	8,778	13,506	20,780
Solvents	4%	376	456	554
Process Agents	4%	4	5	6
Total HCFCs	**7.5%**	**12,555**	**18,100**	**26,368**

- Another scenario, the **highest growth** , developed by the national expert, is based on writing forth the growth experienced from 1996-2005 into 2006-2015:

Table 19 - Development over the past of 5 years and Forecast for 2015 (t/y)

Substance	Year	Tons
All HCFCs	1996	3,754
	2000	9,080
	2005	12.555
	2010	18,830
	2015	37,660

This scenario shows the highest growth—but somewhat low through 2010 compared to the TEAP predictions. However, after 2010, when no new CFCs can be imported, the use of ternary HCFC blends are expected to increase, replacing any residual CFCs in service applications and, in this way, increasing the use of HCFCs in general.

3.1.3 Consolidated Forecast

In summary, following range of scenarios apply:

Table 20 – Summary of Unconstrained HCFC Growth Scenarios (ton/y)

Scenario	2005	2015	% Growth
Low Growth	12,555	16,495	130%
Moderate Growth	12,555	26,368	210%
High growth	12,555	37,660	300%

The moderate growth scenario has been used in this survey.

3.2 AVAILABILITY SCENARIOS AND PRICES

3.2.1 Scenarios

Global production and use scenarios have been subject of several TEAP reports (2003 HCFC Task Force Report, (2005 Report on HCFC Demand, Banks and Emissions; 2005 Supplementary Report). The 2003 report predicted a possible HCFC-22 production capacity shortfall beyond 2005. Sharp increase of production capacity in China—currently 368,000 t/y with a 75% utilization rate—has avoided this. In addition, regional CFC manufacturers (Argentina, Mexico, Venezuela) are looking into scenarios to shift to HCFC-22 production when their CFC production will stop somewhere between 2007 and 2009. For other major HCFCs (141b; 142b) no shortfalls were identified. It appears that the current supply situation for all HCFCs is very relaxed and that future supply is assured.

3.2.2 Price Trends

The HCFCs in Brazil prices of major HCFCs over the last year has been as follows (US$/kg):

Table 21 – HCFC Price Development in Brazil

HCFC	2000	2005
R22	U$ 4,20/Kg	U$$ 3,50/kg
R141B	U$ 4,50/Kg	U$$ 3,80/kg

Source: DuPont/ABRAVA

It shows that prices have considerably eroded over the past five years. It is expected that future prices will move along with or somewhat lower than general inflation. An historical comparison for HCFC blends if difficult because of their recent introduction in the market but, based on their (HCFC) components, identical development is expected.

Following are prices of the major blends currently offered:

Table 22 – Major HCFC-based Blends offered in the Brazilian Market

Identification	Composition	2005 Price
R-408a	**47% HCFC-22; 7% HFC-125; 46% HFC-143a**	**U$$ 12,50**
R-401a	**53% HCFC-22; 34% HCFC 124; 13% HFC 152a**	**U$$ 11,50**
R-409a	**65% HCFC-22; 25% HCFC-124; 15% HCFC-142b**	**U$$ 12,50**

3.3 TECHNOLOGY

In the **RAC Sector,** Brazil is nowadays looking into new technologies for refrigerants based on HFCs. The main fluids based on HFCs are R-134a, R-404a, R-407c and R-410a. At present, the only substitute for HCFC-22 in Brazil is HFC-R417a (Isceon 59), used in retrofits of window ACs, spits and chillers. Its price of US$ 28.00/kg compares with US$ 3.50 for HCFC-22!

Technically, it is possible replacing HCFCs by the following substances:

- Domestic refrigeration -DR - R-600a (HC)
- Commercial refrigeration (loads until 0.5 g) CR - R-600a (HC)
- Commercial refrigeration (supermarkets) CR - R-404a (HFC)
- Residential Air conditioning - R-407c and R-410a (HFC)

Related incremental cost increases will be considerable. Savings in energy and, in the CR area when executed in conjunction with retrofit, lower service losses will, at least partly, compensate for this. Specifically:

- **Energy Savings** – can be obtained in domestic refrigeration by converting to HCs. Initial investment will be considerable. In commercial refrigeration, large installations can be retrofitted to the use of HFCs. Again, the initial investment would be large. However, retrofitted equipment would require 40% less energy.

- **Refrigerant Savings** – the example given under 2.4.4 shows that retrofitted CR installations can reduce losses related to service from 100%/y to less than 50%--which is still twice the European standard and therefore subject to improvement. This very successful approach can be expanded as well replicated in other areas

In the **Foam Sector**, larger companies could convert to HCs (n-pentane, cyclopentane). For smaller companies, liquid HFCs (HFC-245fa, -365msc) could be considered. There are also other organic blowing agents entering the market. For instance, Methyl Formiate is actively marketed in Brazil under the name Ecomate.

In the **Solvent Sector,** there are technical and economic feasible solutions for the replacement of HCFC-141b in flushing applications. Colombia is in the final stages of a pilot program that looks very promising.. The use of HCFC-141b in contact sprays will require further investigation.

HCFC use in Other Applications are minor when compared to the above sectors and mostly related to applications where the generally applied technologies did not work. Individual solutions will have to be pursued in these cases.

3.4 ENVIRONMENTAL IMPACT

Measurements show that the steps being taken to protect the earth's ozone layer are slowly turning to be effective. Phasing out the use of HCFCs would further contribute to this effort. However, some of the potential replacements show relatively large GWPs as following overview shows:

Table 23– Environmental Properties of Selected Halocarbons

Parameter	CFC-11	CFC-12	HCFC-141b	HCFC-22	HCFC-123	HFC-245fa	HFC-365mfc	HFC-227ea	HFC-236fa
$GWP_{100\ years}$	4680	8500	713	1780	76	1020	782	3140	6300
ODP	1	1	0.11	0.055	0.02	0	0	0	0

Against relatively large GWPs stand sometimes better energy performances which, in itself could counteract the GWP impact. The Government of Brazil intends to weigh all these factors when guiding the way into HCFC replacement, looking into environment benefits as a whole Combining energy efficiency with ODS phaseout may lead to projects that provide climate as well as ozone layer protection benefits and could qualify for financing based on both effects (carbon credits and ODS phaseout).

Such projects would fit well with (sub-) sectoral approaches and may require an initial pilot project to verify and demonstrate expected benefits.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

The Government of Brazil is well aware that the current MP deadlines for an HCFC freeze in 2016 and a complete phaseout by 2040 are not possible without a management plan that will guide the industry towards these obligations. The challenge will be to prepare a strategy consisting of voluntary actions, technical and financial incentives and legislative measures to ease the industry towards these deadlines. Partnerships and the assistance of the MLF will be crucial in the implementation of such a strategy.
There are opportunities as well:

- Brazil has a high refill rate for refrigeration equipment and a lot of efficiencies can be gained by improved service procedures
- Brazil has a SME commercial refrigeration project under implementation which combines retrofit with energy savings and service reduction and can apply lessons learned in other applications
- Brazil has local expertise to use new technology
- Brazil has very active industry associations
- Brazil has energy efficiency standards and regulations, and energy savings programs which favor technology choices which protect ozone layer and climate.

3.6 POTENTIAL COMPLIANCE MEASURES

At this stage, only a growth minimization program appears to be required so that a smooth compliance with the freeze from 2016 onwards would be assured. To comply with this, an annual growth of 7.5%--or 940 t/y at baseline (2005) conditions—will have to be reversed.

Areas of opportunities to achieve this are:

- Best practices programs for HCFCs in RAC service
- Retrofit programs with conversion to alternatives and energy optimization for large CR installations
- Elimination of the use of HCFC-141b used as a solvent for refrigeration circuit flushing
- A conversion program for foam manufacturers to non-ODS technologies, including foams in refrigeration applications.
- The introduction of HCs a refrigerant in domestic refrigeration.
- Equipment replacement programs aiming at protecting climate and the ozone layer, benefiting from energy savings and partnerships for innovative financing including the MLF and other funding sources. Collection of ODS containing equipment and final destination logistics also will be required.

As a matter of priority, the MLF should tailor an assistance program for HCFC phaseout. The current program is geared towards CFCs and new guidelines are required, that look into cost effectiveness and eligibility criteria which reflect current situation and are not strictly tied to old CFC practices.

3.7 SUMMARY AND CONCLUSIONS

Brazil has a current (2005) annual HCFC consumption of 12,555 t, itemized as follows:

Table 24 – 2005 HCFC Consumption by sector (t/y)

Sector \ Substance	HCFC-22	HCFC-141b	Blends	Total
Air Conditioning	554	0	0	554
Commercial Refrigeration	827	0	840	1,667
RAC Services	6,557	0	0	6,557
Total RAC *	**7,938**	**0**	**840**	**8,778**
Foams	**0**	**3,383**	**0**	**3,383**
Flushing	0	363	0	363
Sterilants	0	0	0	0
Other Solvents	0	13	0	13
Total Solvents	**0**	**376**	**0**	**376**
Aerosols	**4**	**0**	**0**	**4**
Process Agents	**14**	**0**	**0**	**14**
Total	**7,956**	**3,759**	**840**	**12,555**

Source: SISCOMEX/DuPont/Abrava (*There is indication of 19 metric tons HCFC- 123 in 2005 and 34 metric tons in 2006. Once officially confirmed they will be added to the chillers sub sector consumption).

Growth of the consumption of HCFCs has been forecasted following low, medium and high growth scenarios. Following a moderate growth scenario, HCFC consumption is expected grow by 7.5%/y. This growth will be unevenly divided between sectors, with the RAC sector expected to grow annually by 9% and other applications by 4%, as following table shows:

Table 25 – Expected growth in HCFC use per sector (t/y)

Sector	Annual Growth	2005	2010	2015
Aerosols	4%	14	17	21
Foams	4%	3,383	4,116	5,007
Firefighting	n/a	0	0	0
RAC	9%	8,778	13,506	20,780
Solvents	4%	376	456	554
Process Agents	4%	4	5	6
Total HCFCs	**7.5%**	**12,555**	**18,100**	**26,368**

It follows that in an unconstrained scenario, the HCFC use in Brazil will more than double u/t 2015—the year that control measures under the Montreal protocol will start taking effect—and that even larger growth —up to triple the baseline use--is not unimaginable.

Brazil expects for the future ample HCFC supply at moderately increasing prices

Possible replacement technologies for HCFCs include HFCs and HCs for the RAC and foams sector with niche opportunities for other organic substances such as methyl formiate. Barriers to the introduction of these chemicals are high prices and/or high related investment costs. Brazil sees need that work should be done to decrease these barriers and is willing to entertain participation in related pilot programs.

The Brazilian Government is committed to meeting MP deadlines for HCFCs as currently applicable and is in favor of--accelerated phaseout programs. It has made a declaration to that matter at the meeting of the Parties to the Montreal Protocol in Delhi, November 2006.

The Government of Brazil deems the current MLF assistance program does not fund HCFCs and therefore it is not suitable for the purpose of assisting in reducing demand and the phaseout of HCFCs, and new guidelines should be prepared using current parameters, being less restrictive and using realistic thresholds on costs.

Activities where quick results could be achieved are:

- Best practices programs for HCFCs in RAC service
- Retrofit programs with conversion to blends and energy optimization for large CR installations
- Elimination of the use of HCFC-141b used as a solvent for refrigeration circuit flushing
- A conversion program for foam manufacturers to non-ODS technologies
  (HCs for larger ones and niche applications, HFCs or other organic blowing agents for SMEs)
- Equipment replacement programs aiming at protecting climate and the ozone layer, benefiting from energy savings and partnerships for innovative financing including the MLF and other funding sources. Collection of ODS containing equipment and final destination logistics also will be required.

However, as a matter of priority— a detail Strategy will have to be developed which will look into scenarios for the country taking into considerations technologies, cost, and the legal framework required,

SURVEY OF HCFCs IN COLOMBIA

DRAFT FINAL REPORT

COLOMBIAN NATIONAL OZONE UNIT (UTO)
and
UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

January 23, 2007

Executive Summary

Colombia is a signatory to the Montreal Protocol on Substances that Deplete the Ozone Layer. The status of the ratification of this protocol and its Amendments is as follows:

Instrument	Congress Law	Ratification	Entry into Force
Vienna Convention (1985)	# 30, 5-Mar-90	16-Jul-90	14-Oct-90
Montreal Protocol (1987)	# 29, 28-Dec-92	06-Dec-93	06-Mar-94
London Amendment (1990)	# 29, 28-Dec-92	06-Dec-93	06-Mar-94
Copenhagen Amendment (1992)	# 306, 5-Aug-96	05-Aug-97	03-Nov-97
Montreal Amendment (1997)	# 618, 6-Oct-00	16-Jun-03	14-Sep-03
Beijing Amendment (1999)	# 960, 28-Jun-05	15-Sep-06	15-Dec-06

Since the ratification of the Montreal Protocol, the Colombian Government, in close cooperation with the private industry and under the NOU leadership, has developed several programs to comply with the Country Programme approved in 1994. No programs exist at this time for HCFCs. HCFC-141b, HCFC-22 and HCFC-123 are the only HCFCs consumed in Colombia.

HCFC-141b is used in polyurethane foams (as blowing agent), in fire extinguishing, in refrigeration as cleaning agent for equipment lines (flushing) and as solvent in the silicon coating process for needles and catheters. Foam applications account for 90 % of total consumption. Import started in 1997 (206 t); the consumption was relatively constant-between 500 and 600 MTPA-during the period 2000-2004 but went in 2005 up to approximately 800 t. This significant increase can be explained by the tight CFC-11 availability and related high prices. Today, the conversion from CFC-11 to HCFC-141b in the foam sector is completed. The foam applications where HCFC-141b is consumed are domestic, commercial and industrial refrigeration (including construction) and integral skin foam for automotive and furniture. The large polyurethane (PU) suppliers blend the HCFC-141b with polyol and other additives to produce a "formulated polyol", which is sold along with isocyanate as a package (PU system). 2005 consumption was 9,950 t foam and 730 t HCFC-141b.

40 - 50 MTPA HCFC-141b are used for portable fire extinguishers. HCFC-141b is also sold by large distributors servicing the refrigeration segment as cleaning agent (flushing). In one case it replaces CFC-113 as silicon solvent.

The total consumption of HCFC substances for Refrigeration and Air Conditioning (RAC) has been in the range of 500 to 600 t/y during the early nineties and 900 – 1.000 t/y for the last three years. HCFC-22 (R-22) represents more than 95% of the use. Main reason for this incremental trend is the conversion of many refrigeration systems working with CFC -12 and R-502 to HCFC-22 (R-22). Most of the Importers of HCFC-22 in Colombia are distributors/wholesalers with national coverage that import, distribute and sell to both minor distributors/retailers and to commercial and industrial end users for applications such as refrigeration of dairy products, meat and poultry, supermarkets and department stores as well as engineering/contractors for air conditioning systems.

Since 1994 HCFC-123 has been used as a substitute for Halon-1211 and CFC-11/CFC-12 blends in portable fire extinguishers. During the period 2002-2004 consumption was around 20 MTPA and in 2005 went up to approx. 65 MT very likely due to CFCs poor availability and higher prices. For portable fire extinguishers HCFC-123 is brought in 55 gallons drums by mainly two importers and sold to several fire extinguishers producers (about 30) and several companies dedicated to recharging and maintenance.

Demand forecasts for HCFCs can be made based on 2002-2005 figures and on expected growth in the most significant industrial segments where these substances are used: foams, portable fire extinguishers and RAC applications. Estimated consumption level for HCFCs (business as usual scenario) in 2015 is expected to be almost 3,750 t, which is double the 2005 use.

Except for domestic refrigerants, CFCs have been 100 % converted to HCFCs. This substitution, from both the ozone depletion and climate change point of view, represents a significant progress in environment protection. However, although mitigated, these substances still have ODPs and considerable GWPs. Another point to consider is that foams, the main HCFC-141b application, is in the short to medium term a non emissive use and so special attention should be paid to the increase of ODP banks. For these reasons, conversion of HCFC use by zero ODP substances presents an opportunity to further environmental protection to which the Government is committed though the MP and its amendments. The challenge will be converting to zero ODP options and at the same time reducing the related climate change impact.

The National Ozone Unit and the Secretary of Environment jointly with other government entities have developed a set of measures and regulations that can easily be adapted to facilitate an HCFC management plan. The duty positions of the different HCFCs have already been disaggregated to allow their control. By resolutions 21 & 22 of April 1, 2005 (Secretary of Commerce, Industry and Tourism) the requirement receiving approval by NOU for imports/exports of HCFCs was established. A resolution to require licenses for HCFCs is in preparation and is expected to be in place during 2007. Along with this, the NOU has implemented an aggressive training program for customs officials to prevent ODS illegal trade.

According to global predictions (TEAP), HCFC availability is stable in the medium term

Following set of actions is recommended to prepare the industry to zero ODP alternatives with reduced impact on climate change:

- Create suitable technical and financial incentives through the MLF
- Prepare the domestic and commercial refrigeration industry to an early conversion to hydrocarbons. This conversion could become crucial to eventual future exports to developed countries and in case of a significant increase of HCFCs price.
- Develop a feasibility study on an early retirement of old domestic and commercial refrigeration units and their environmental sound destruction.
- Explore the possibility to replace HCFC-based extinguishers by foam or dry powder units.
- Extend the good practices in maintenance programs to HCFCs
- Establish a legal framework for the HCFC to secure good procedures in its use.
- Evaluate opportunities for synergies between environmental programs for ozone protection and against global warming

Colombia is prepared to participate in accelerated international phaseout schedules provided funding at reasonable terms will be made available for that purpose.

SURVEY OF HCFCs IN COLOMBIA

CONTENTS

LIST OF ABBREVIATIONS

ANDI	Asociacion Nacional de Emresarios/National Association of Enterprises
ATOC	UNEP Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride Technical Options Committee
CFCs	Chlorofluorocarbons
CP	Country Programme
CTC	Carbon Tetra Chloride
DIAN	Dirección de Impuestos y Aduania Nacionales (Customs)
DACS	Disposable Cans (used for refrigerants – DuPont: Dispose-A-Can^{R})
ExCom	Executive Committee of the Multilateral Fund
FTOC	UNEP Foams Technical Options Committee
PU	Poly Urethane
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IA	Implementing Agency
MAC	Mobile Air Conditioning
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MP	Montreal Protocol
MTPA	Metric Tons Per Annum
MT (or t)	Metric Tons
NOU	National Ozone Unit
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
OEM	Original Equipment Manufacturer
RAC	Refrigeration and Air Conditioning
R&R	Recovery and Recycling
SMEs	Small and Medium-sized Enterprises
STOC	UNEP Solvents, Coatings and Adhesives Technical Options Committee
TEAP	UNEP Technology and Economic Assessment Panel
UNDP	United Nations Development Programme
UNDP-MPU	United Nations Development Programme, Montreal Protocol Unit
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
UTO	Unidad Técnica Ozono
WB	World Bank
Y (y)	Year

1. INTRODUCTION

1.1. Background

Colombia ratified the Vienna Convention on 7/16/1990 and the Montreal Protocol on 12/06/1993. Since consumption per capita of controlled substances is less than 0.3 kg, the country belongs to Article 5(1) parties. Consequently, the schedule for reduction and elimination of the analyzed substances are:

- CFCs (Annex A, Group I): consumption freeze by 1999, a 50% reduction by 2005, 85% by 2007 and a total phase-out by January of 2010.
- Halons (Annex A, Group II): freeze by 2002, a 50% reduction by 2005 and a total phase-out by January of 2010.
- HCFCs (Annex C, Group I): approved as temporary substitutes for CFCs: a freeze in production and consumption by 2016 and a total phase-out by 2040.

In Colombia CFC-12, for the refrigeration and air conditioning applications, and CFC-11, for the foam sector, have been the largest ODS used. The country program, approved at the 12th Meeting of the Executive Committee held in March 1994 in Montreal, defined the HCFCs use as the transition strategy for the ODS phase-out in the foam sector: CFC-11 was replaced by HCFC-141b (and a small portion by HCFC-22) with no consideration in the short term of hydrocarbons or HFCs. Today the major HCFCs used in Colombia are: HCFC-22, mainly for refrigeration and air conditioning, HCFC-141b for foams and HCFC-23 for fire extinguishers.

1.2. Approach and Preparation

The Executive Committee of the Multilateral Fund at its 45th Meeting approved a project to be implemented by the United Nations Development Program (UNDP) aiming to conduct a limited survey of HCFC use in selected countries, with an objective of establishing a national aggregate level of HCFC consumption against which future projects and activities may be funded. In Latin America, Colombia was one of the five countries selected. This survey covers HCFC applications in Colombia following a top-bottom approach.

In order to speed up the administrative process, UNDP selected to implement it through its Montreal Protocol Unit (MPU) in close cooperation with the National Ozone Units and UNDP's Country Offices in the selected countries, from which Brazil is one. For each country, in consultation with the NOUs, national experts have been recruited to conduct and analyze the actual survey and to prepare a report following a template issued by UNDP. These reports have been edited by two international experts before being forwarded to UNDP-MPU. MPU, after conducting its own review, submitted the reports to the National Ozone Units with the request for comments by an as broad as possible cross-section of stake holders. After taking these comments into consideration, MPU prepared final versions of the national reports for submission to the MLF.

1.3. Survey Methodology

From information provided by the National Ozone Unit (NOU) and the database of the Colombian Secretary of Commerce, Industry and Tourism, *Ministerio de Comercio, Industria y Turismo*, the main HCFC importers were identified. Personal meetings with representatives of most of these companies were held complemented by phone interviews with others. They were asked on:

- Historical HCFC import data by sector and origin
- List of HCFC customers
- Annual quantities used since 1997 by customer
- Quantities of manufactured units per each customer
- Future perspective

Based on the field information and governmental database, worksheets on annual HCFC consumption were prepared by sector and substance. The data gathered was crosschecked and completed with the information on the Multilateral Fund Projects developed in the analyzed sectors.

As per decision 45/6(i), the survey provides information on current consumption by sector and substance, as well as the forecasted projections thru 2015. This information will allow the MLF Secretariat–if requested by the Executive Committee–to propose funding policies and procedures for the next years, including the possible establishment of an "eligible national aggregate level of HCFC consumption."

The survey resulted in a database of stakeholders—importers, distributors, associations and HCFC-consuming enterprises. The Government treats this database as confidential and will make it only available on a need-to-know basis as it involves commercial information that may be sensitive to some of the parties concerned. Requests for more detailed information should be sent to the National Ozone Unit. In addition, while the survey has identified a substantial amount of individual HCFC users, not all suppliers were willing to disclose individual customers. Additional individual users will be identified over the next years in case this survey will evolve into a sector-based HCFC management plan.

The following table provides the numbers of enterprises that were identified in the survey per category/sector:

Table 2 - Stakeholders identified in the HCFC Survey in Colombia

HCFC Stakeholders	Amount of Enterprises
Importers	18
Distributors	17
Chambers/Associations	3
HCFC-Consuming Enterprises by Sector	262*
Total All HCFC Stakeholders	**300**

* does not include service providers (more than 5,000—all on file)

2. OBSERVATIONS

2.1. Institutional Framework

2.1.1. Institutional Arrangements

The National Ozone Unit (Unidad Técnica Ozono or UTO), annexed to the Secretary of Environment (*Ministerio de Ambiente, Vivienda y Desarrollo Territorial*) is the organism responsible for complying with the countries commitments derived from Montreal Protocol, mainly the timely reduction and phase out of ODS. To accomplish its goals UTO has established a closed cooperation with the following public and private entities:

- The Colombian Customs Authority, *Dirección de Impuestos y Aduanas Nacionales -DIAN-*, responsible for the implementation of the customs legislation, valid since January 1st, 2002, *Estatuto Aduanero 2002*. It is part of the *Ministerio de Hacienda y Crédito Público*.
- A national technical entity, *Superintendencia de Industria y Comercio*, responsible for the consolidation of the industrial development (products regulation, quality control, etc.) and the general customer satisfaction. It is part of the *Ministerio de Comercio, Industria y Turismo*.
- The National Association of Enterprises, *Asociación Nacional de Empresarios, ANDI*, specifically with its chapter for appliances, in which all the domestic refrigerators producers and the main commercial refrigeration companies participate.

2.1.2. Policies

Since the ratification of the Montreal Protocol, Colombian government in close cooperation with the private industry and under the UTO leadership has developed several programs to comply with the Country Programme approved in 1994. The status of the ratification of Montreal Protocol and Amendments is:

Instrument	Congress Law	Ratification	Entry into Force
Vienna Convention (1985)	# 30, 5-Mar-90	16-Jul-90	14-Oct-90
Montreal Protocol (1987)	# 29, 28-Dec-92	06-Dec-93	06-Mar-94
London Amendment (1990)	# 29, 28-Dec-92	06-Dec-93	06-Mar-94
Copenhagen Amendment (1992)	# 306, 5-Aug-96	05-Aug-97	03-Nov-97
Montreal Amendment (1997)	# 618, 6-Oct-00	16-Jun-03	14-Sep-03
Beijing Amendment (1999)	# 960, 28-Jun-05	15-Sep-06	15-Dec-06

Source: UTO

2.1.3. Regulations and other control measurements

In chronological order, the regulations and control measurements that apply to HCFCs are[1]:

- **Law 99 of 1993** (Congress): The Secretary of Environment, *Ministerio del Medio Ambiente*, was created, and the National Environmental System was organized. Environmental licenses -issued by the Secretary of Environment- for the importation and production of substances controlled by international treaties were established.
- **Resolution 528 of June 18, 1997** (Secretaries of Environment and Foreign Trade): The use of CFCs (refrigerant and blowing agent) for the production of domestic refrigerators was banned.

[1] Personal communication with Nidia Pabón/UTO

- **Resolution 304 of April 16, 2001** (Secretaries of Environment and Foreign Trade): Imports of ODS listed in the Annex A, Group I, were regulated[2]. Annual quotas per company, defined according to the Country Programme and the import history, were established. NOU approval is required for the expedition of the environmental license.
- **Resolution 734 of June 22, 2004** (Secretaries of Environment -now called *Ministerio de Ambiente, Vivienda y Desarrollo Territorial*- and Foreign Trade -now called *Ministerio de Comercio, Industria y Turismo*-): Resolution 304 was modified to take into account the adjusted Country Programme.
- **Resolution 874 of July 23, 2004** (Secretaries of Environment and Foreign Trade): Resolution 734 is expanded. Methodology to quotas allocation is defined.
- **Government Decree 423 of February 21, 2005**: Exports of substances listed in Annex A, Groups I and II, Annex B, Groups I, II and III, Annex C, Groups I, II and III, and Annex E, Group I, are regulated. They required the approval of the Secretary of Environment (UTO)[3].
- **External Resolution 21 of April 1, 2005** (Secretary of Commerce, Industry and Tourism): The approval of UTO (Secretary of Environment) for the imports of HCFCs and Halons is established. The duty positions that require NOU approval are listed: Annex A, Groups I and II, Annex B, Groups I, II and III, Annex C, Groups I, II and III, Annex E, Group I, substitutes for HFCs, refrigerant blends containing ODS and HFCs and blends based on Methyl Bromide.
- **External Resolution 22 of April 1, 2005** (Secretary of Commerce, Industry and Tourism): The exports of substances listed in Annex A, Groups I and II, Annex B, Groups I, II and III, Annex C, Groups I, II and III, and Annex E, Group I are regulated. The Secretary of Environment (UTO) should established annual quotas per substance.
- **External Resolution 23 of April 7, 2005** (Secretary of Commerce, Industry and Tourism): The list of duty positions belonging to domestic refrigerators and freezers, whose imports require UTO approval, is updated.
- **Resolution 2188 of December 29, 2005** (Secretary of Environment): Exports are regulated with reference to Decree 423.
- **Resolution 901 of May 23, 2006** (Secretary of Environment): Imports of ODS listed in the Annex A, Group II, Halons, were regulated. Annual quotas per company, defined according to the Country Programme and the import history, were established. The use of halons in new installations was banned.
- **Resolution 902 of May 23, 2006** (Secretary of Environment): Imports of ODS listed in the Annex B, Group I, II and III, were regulated. Annual quotas per company, defined according to the Country Programme and the import history, were established. The use of halons in new installations was banned.
- **Resolution 2120 of October 31, 2006** (Secretaries of Environment and Commerce, Industry and Tourism). Imports of ODS listed in Annex C, Group I were regulated, companies interested in those importations have to present information about their costumers, about their imports and have to have environmental licenses. Imports of ODS listed in Annex C, Groups II and III were banned.

To reinforce the compliance with these regulations and to prevent the illegal trade the NOU has implemented an aggressive training program with the customs authorities.

2.2 HCFC Supply Scenario

2.2.1. Production

There is no HCFC production in Colombia.

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2 Unfortunately, substances listed in Annes A, Group II, were not included.
3 In 2003 it was estimated that 12 % of the imported ODS were exported.

2.2.2. Exports

In the period 1997-2005 the only registered exports from Colombia were:

- HCFC-141b: 5,590 kg in 2004 to Argentina (Huntsman) and 100 kg in 2005 to Ecuador (Olaflex) for foam applications
- HCFC-123: 400 kg in 2004 to Panama (Aire Caribe S.A.)

2.2.3. Imports

The following HCFCs are imported:

1. HCFC-141b: Used in polyurethane foams as blowing agent, cleaning for refrigeration equipment (flushing), solvents and fire extinguishing
2. HCFC-123: Used for fire extinguishing as a substitute for Halon 1211 and CFC-11/CFC-12 blends for portable fire extinguishers
3. HCFC-22: Mainly used in RAC applications. Since 2000, there is some use in combination with HCFC-141b and, once, HCFC-142b as a co-blowing agent for rigid PU foam. Official data show a single import in 2004 of 47,630 kg. 2005 consumption for this application was 120 MTPA
4. HCFC-142b: It was imported just one time in 2004 -blended with HCFC-22- as a co-blowing agent for rigid polyurethane foam (119,170 kg imported by Cabarría, a local distributor). It has been replaced by HCFC-141b and has been therefore integrated in the HCFC-141b data

HCFC Imports in Colombia (kg)

YEAR	HCFC-22	HCFC-141B	HCFC-123	TOTAL
1998	671.000	389,649	n/k	n/a
1999	511.000	71,330	n/k	n/a
2000	608.000	555,084	n/k	n/a
2001	801.000	637,259	n/k	n/a
2002	725.000	542,169	27,030	1,294,199
2003	871.000	508,166	16,200	1,395,366
2004	880.000	717,924	21,600	1,619,524
2005	900.000	856,871	63,925	1,820,796
Growth/y 2002-2005	**~10%**	**~15%**	**~35%**	**~13%**

Source: - Import Declarations, Database of the Secretary of Commerce, Industry and Tourism.
Notes: - Reliable import data are only available from 1998
- In 2005 approximately. 40-50 MT of HCFC-141b were imported for portable fire extinguishers.
- Data for HCFC-123 available before 2002 (not disaggregated in the duty classification)

2.2.4. Distribution and Supply Chain

Most of the Importers of **HCFC-22** in Colombia are distributors/wholesalers with national coverage, that import, distribute and sell to minor distributors, retailers as well as commercial/industrial users for different applications such as refrigeration of dairy products, meat, poultry, supermarkets and engineering/contractors for air conditioning systems. The traditional suppliers of HCFC-22 to Colombia have been global and regional companies like DuPont, ICI (Ineos Fluor), Honeywell, Atofina, Quimobásicos and Produven—all producers of HCFCs. International wholesalers like Harp Refrigerants and National Refrigerants are also significant suppliers. More than 90% of HCFC-22 sold in Colombia for RAC applications is made through these distribution channels. However, during the last five years low priced import from China and India has made significant inroads through wholesalers and direct import by final users.

12 Top Importers of HCFC-22 during the years 2001 thru 2005 – Colombia

Company Name	Imports (kg)	Share (%)	Segment / Application	Territorial Coverage
CABARRIA Y CIA	676,610	16	DISTRIBUTOR / WHOLESALER	NATIONAL
QUIMICA CA COMERCIAL ANDINA	472,105	11	DISTRIBUTOR / WHOLESALER	NATIONAL
BUNDY COLOMBIA S.A.	379,178	9	DISTRIBUTOR / WHOLESALER	NATIONAL
INCOPAR	365,021	9	DISTRIBUTOR / WHOLESALER	NATIONAL
REFRINORTE	248,063	6	DISTRIBUTOR / WHOLESALER	REGIONAL
CARVEL / CARRIER -EQUIPRAC	215,859	5	DISTRIBUTOR / WHOLESALER	REGIONAL
GASES INDUSTRIALES –CRYOGAS	161,543	4	DISTRIBUTOR / WHOLESALER	REGIONAL
YORK INTERNATIONAL –YIL	133,319	3	AIR CONDITIONING EQUIPMENT IMPORTER	NATIONAL
INVERPRIMOS	116,648	3	DISTRIBUTOR / WHOLESALER	REGIONAL
INDUSTRIAS THERMOTAR	108,545	3	AIR CONDITIONING EQUIPMENT IMPORTER	NATIONAL
FORMEX / CASTAÑEDA VELEZ	77,626	2	DISTRIBUTOR / WHOLESALER	REGIONAL
Total large Importers	2,954,517	71		
Other importers	1,221,483	29	(other importers are small entities or end users)	
Total	4,177,000	100		

The preferred offering through these channels are disposable cylinders of 30 lbs and 50 lbs; very few final large users use returnable cylinders of 125 lbs. Only two wholesaler/importers bring the HCFC-22 in pressurized isotanks containing 15-17 metric tons which are then transferred to stationary tanks from which the refrigerant is downloaded into returnable cylinders of 2.000 lbs. The HCFC-22 sold in this way is only used by Mabe Colombia, the main domestic refrigerator manufacturer, which mixes the HCFC-22 with HCFC-141b and/or 142b as a foaming agent for the PU refrigerator insulation.

HCFC-141b has been historically supplied by the global producers, mainly Arkema and Solvay, from U.S. and Europe. In 2002 Chinese producers (Fist Chemical, 3F) started to penetrate the market based on a low price strategy reaching today a significant share (approx. 30 %). The product is generally brought in drums of 55 gallons. There is a project to bring it in isotanks of 22 metric tons. For cleaning of refrigeration equipment some of the importers (Cabarría, Pedro Sánchez Ramírez) bring an ex-U.S. product from DuPont México, where it is packed in low volume offerings (1 liter). In the foam applications, thermal insulation foam and integral skin, the largest PU suppliers (Huntsman, Dow, GMP, Espumlatex) generally blend the HCFC-141b with the polyol and other additives to produce a "formulated polyol", which is sold along with isocyanate as a package (this is called a PU system). However, there is one large domestic refrigeration company that blends the HCFC-141b in-situ immediately before the injection. A significant portion (20-25 %) of the formulated polyol (with HCFC-141b included), blended in the country, is exported to Costa Rica, Ecuador and Perú.

HCFC-123 has been traditionally supplied by Solvay from Germany, although during last two years Chinese producers have reached a significant penetration (more than 25 % of the market). The product is brought in 55 gallons drums by mainly two importers for firefighting (Suramericana Proveer and Julmor) and sold to several fire extinguishers producers (about 30) and many companies dedicated to recharging and maintenance.

All stakeholders, importers, distributors and end users, see the HCFC market as stable in view of price and supply. Having low-priced alternatives to the historical suppliers—that are mostly originating in developed countries and faced with dwindling home markets—has put original fears for short supply largely to rest.

2.3 HCFC Consumption

2.3.1. Aerosols Sector

No HCFC consumption in aerosols applications has been identified. Propane and butane are used.

2.3.2. Foam Sector

The Colombian foam sector can be categorized in four different industrial segments: flexible PU foam (slabstock, molded and integral skin), rigid PU foam, microcellular PU elastomers (shoe soles) and extruded polystyrene foams. HCFCs have been and are currently used in rigid foam for thermal insulation and integral skin foams.

Three different sectors can be differentiated in PU rigid foam: domestic (refrigerators and freezers), commercial (mainly displays) and industrial (continuous and discontinuous panels, transportation and spray) refrigeration. These sectors are supplied by "system houses" (Huntsman, Dow Chemical, Espumlatex, GMP, Olaflex and Química Industrial y Comercial) that sell a two component system: a formulated polyol, which includes the blowing agent (HCFC), and an isocyanate (Polymeric MDI).

There are four manufacturers in **domestic refrigeration:** Mabe (owned by Mabe-Mexico, which is partially owned by General Electric), Haceb (local), Challenger (local) and Inducel (local). They serve the Colombian market and export 48 % of their production to the Andean countries (mainly Venezuela) and Central America. Supported by the Multilateral Fund these four companies switched from CFC-11 to HCFCs in October of 1997. In 2005 760,000 units with an average capacity of 10 cubic feet (292 liters) were produced: 68 % by Mabe, 18 % by Haceb, 7 % by Challenger and 7 % by Inducel. 2005 PU consumption -supplied by Huntsman and Dow Chemical- is estimated in 4,800 t/y, which represents 240 t/y HCFC-141b and 120 t/y HCFC-22. Although the average annual growth rate in units in the 2002-2005 period was 6%, the industrial segment is facing in the short term a critical situation caused by refrigerator imports, mainly from LG and Samsung manufactured in Mexico, which increased in the same period at an average annual rate of 39 % (from 53,000 to 144,000 units). April 25, 2006, the Secretary of Commerce, Industry and Tourism issued resolution 859, regulating the required technical characteristics for domestic refrigerators and freezers commercialized in the country. Nothing is said about foam specifications.

Currently there are four producers in the **commercial refrigeration** sector, Indufrial, Inducol, Friomix and Cold-Star, which manufactured bottle and commercial displays. As in the domestic refrigeration segment these enterprises developed individual projects with the Multilateral Fund support to replace CFC-11 by HCFC-141b by October of 1997. The PU chemicals suppliers are Huntsman, Dow Chemical and Espumlatex. Foam consumption is estimated at 650 t/y, which accounts for a HCFC-141b consumption of 70 t/y.

Slightly more than 550 enterprises -that today individually consume between 100 and more than 20,000 kg HCFC-141b per year-are present in the **industrial refrigeration** segment[4]. Some are in the spray application market (transportation and construction) but the majority produces discontinuous panels for thermal insulation (refrigeration and construction). There is only one company -METCOL, Metecno de Colombia- that manufactures continuous panels with annual foam consumption around 1,100 t[5]. This enterprise has in the last three years displaced several small/medium size producers, which focused their activities to manufacture the refrigeration apparatus and started to purchase the PU

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4 In this segment the insulating rigid foam for construction is included.

5 Also produces polyisocianurate foam (PIR)

foam from METCOL (Mastercooler, Friotérmica and others). Individual MLF projects were carried out with Daniel J. Fernández, Friotérmica, Indufrío, Mastercooler, Rojas Hermanos, Manilit, Dinalsa, and Refridcol. 2005 HCFC-141b consumption, including thermal insulation, transportation and construction, is estimated in 220 MT. The PU suppliers are Huntsman, Espumlatex, GMP, Olaflex and Química Industrial y Comercial.

Approximately 50 SMEs produce parts of integral skin foam for automotive and furniture. In 2005 foam consumption was around 250 MT, which represented 20 MT of HCFC-141b.

2005 Consumption of HCFC-141b in the Foam Market

Foam Application	Foam, MT	HCFC-141b, MT
Domestic Refrigeration	4,800	240
Domestic Refrigeration, Exports	1,800	180
Commercial Refrigeration	650	70
Construction	1000	100
Industrial Refrigeration	1200	120
Integral Skin	250	20
TOTAL	**9,950**	**730**

Source: Database of the Secretary of Commerce, Industry and Tourism. Personal interviews with Chemical Suppliers

The initial CFC phaseout strategy in the foam sector was based on individual projects: Mabe, Haceb, Icasa, Challenger, Inducel, Indufrial, etc. Having in mind that this approach did not address several small/medium-sized enterprises and very small users, integrated, sector-wide umbrella projects with assistance of their suppliers --system houses—were later on developed:

- The Olaflex Group
- The GMP Group
- The Espumlatex Group
- A Terminal, Investment and Technical Assistance project

In this way, the CFC-11 phaseout in foam applications even for the smallest enterprises is completed.

2.3.3. Refrigeration and Air Conditioning Sector

The use of HCFCs in the RAC sector is limited to commercial refrigeration. All domestic refrigeration converted to HFC-134a as refrigerant (but to HCFC 141b for foam insulation because cyclopentane was not available in Colombia in at that time). As there is no local AC manufacture and imported AC units come preloaded, HCFC use in air conditioning is limited to service only.

The total consumption of HCFCs in the sector has been 500-600 metric t/y for the early nineties and 900-1.000 t/y for the last three years. HCFC-22 (R-22) represents more than 95% of this number. The main reason for this incremental trend is the conversion of many commercial refrigeration systems working with CFC-12 and R-502 to HCFC-22 due to drastic limits on the production, trading and import of CFCs, adopted by Colombian Government to meet its commitments under the Montreal Protocol.

On the other hand, factors such as the significantly higher prices of non-ODS HFC blends (R404A , R407C, R-507 and others) as well as the lack of regulations for HCFCs and their expected long term availability have allowed that many commercial and industrial refrigeration manufacturers choose this HCFCs as the most convenient, most economical option.

2.3.4. Firefighting Sector

The only firefighting application where HCFCs are used is portable extinguishers. In the fixed systems Halon 1301 has been replaced by HFC-227ea and HFC-125. For portable extinguishers HCFC-123 replaced Halon 1211-not imported since 1996-but some use of CFC-11 and CFC-12 has been detected. Importers are Suramericana Proveer and Julmor, companies dedicated to firefighting, followed by Pinotho, a general distributor. Since 1994 the product has been imported by Suramericana Proveer (or Invermar Pa Ltda) from Solvay and commercialized under the trade name Solkaflam.
In 2003 Julmor started to import from China. During last three years due to the high HCFC-123 price, blends of this substance with HCFC-141b started to be used. The current annual consumption of HCFC-141b for fire extinguishers is estimated in 40 to 50 MT. **It should be emphasized that HCFC-141b is not adequate for this application and could be extremely dangerous**. In its Material Safety Data Sheet, the Fire and Explosion section says:

"*Non flammable - explosive vapour when exposed to heat/ignition source. Evacuate area and contact emergency services. Toxic gases (hydrogen chloride, phosgene, carbon oxides, chlorine, fluorine) may be evolved when heated. Remain upwind and notify those downwind of hazard. Wear full protective equipment including Self Contained Breathing Apparatus (SCBA) when combating fire. Use waterfog to cool intact containers*"[6].

The Government of Colombia is preparing a ban for this application and has started the procedures for establishing the regulations needed.

Suramericana Proveer and Julmor supply HCFCs to approximately 30 manufactures and over 120 enterprises dedicated to recharge and maintenance. There are no minimum requirements for fire extinguishers but a resolution of the Secretary of Commerce, Industry and Tourism is in process.

2.3.5. Solvents Sector

Laboratorios Rymco S. A. is the only company using HCFCs as solvents. Within a MLF project completed in 2004 they substituted HCFC-141b for CFC-113 as solvent in the silicon coating process of needles and catheters. They currently consume 11 MTPA of ex-U.S. Arkema product locally supplied by Química Comercial Andina. HCFC-141b is also used by refrigeration companies as cleaning agent (equipment flushing). Cabarría, a large national distributor serving the refrigeration market, supplies product made in U.S. and packed in liters by DuPont in Mexico. UTO is researching replacement of this substance by a non-ODS organic solvent. HCFC-141b is used for effectiveness, price and convenience. These are tough criteria for a substitute but preliminary results are encouraging.

2.3.6. Feedstock and Process Agent Applications

There are no feedstock or process agent applications for HCFCs in Colombia.

2.3.7. Summary and Conclusions

1. There is no production in Colombia of HCFCs. Exports are negligible. Therefore, imports are taken as equal to consumption. The following HCFCs were imported during 2000-2006 period:

   - HCFC-22: used as refrigerant in commercial refrigeration. Since 2000 a small amount is used in combination with HCFC-141b as a blowing agent for rigid PU foam. 2005 consumption

[6] HCFC-141b, Material Safety Data Sheet # 0194, 2004, BOC Limited.

- HCFC-141b: used in PU foams, for fire extinguishing, in a single solvent application and for cleaning of refrigeration circuits. Foam applications account for ~90 % of the total consumption

- HCFC-123: used for fire extinguishers as a substitute for Halon 1211 and CFC-11/CFC-12 blends

- HCFC-142b: was imported just one time in 2004 and blended with HCFC-22- as a co-blowing agent for rigid PU foam (119,170 kg).

2. The imports of HCFC-141b and HCFC-123 showed a dramatic increase in the period 2004-2005 due to CFCs low availability and higher prices.

3. ANALYSIS

3.1. Demand Forecasts

Demand forecasts of HCFCs can be made based on 2002-2005 data—when CFCs were already substantially replaced—and the expected growth in the most significant industrial segments that use these substances:

- RAC for HCFC-22
- Foams for HCFC-141b
- Portable fire extinguishers for HCFC-123.

From discussions with industrial associations (ANDI, appliances chapter), importers and consumers growth rates of 4 and 2 % are expected. This appears low compared with the 13% growth in 2002-2005. Even with the recent accelerated imports of refrigerators and taking into account that in 2002-2005 CFC substitution still took place, the industry's expectations appears too pessimistic and certainly does not take into account ongoing CFC substitution in the RAC servicing sector that will not be completed until 2010 and above average growth for comfort articles and thermal insulation. A more realistic scenario appears to be 10% growth for 2006-2010 and 5% for 2011-2015:

HCFC Use in Colombia (t) - Historical perspective and Expected Growth

YEAR	HCFC-22	HCFC-141B	HCFC-123	TOTAL
2002	725	542	27	1,294
2003	871	508	16	1,395
2004	880	718	22	1,620
2005	900	857	64	1,821
Growth/y 2002-2005	**~10%**	**~15%**	**~35%**	**~13%**
2006	990	943	70	2,003
207	1,089	1,037	77	2,203
2008	1,198	1,141	85	2,424
2009	1,318	1,255	94	2,667
2010	1,450	1,380	103	2,933
Growth/y 2006-2010	**10%**	**10%**	**10%**	**10%**
2011	1,522	1,449	108	3,079
2012	1,598	1,522	114	3,234
2013	1,678	1,598	119	3,395
2014	1,762	1,678	125	3,565
2015	1,850	1,762	132	3,744
Growth/y 2011-2015	**5%**	**5%**	**5%**	**5%**

In summary, under an unconstrained, rather conservative (compared with 2002-2005 growth) scenario it is expected that the 2005 HCFC use of 1,821 T will more than double to 3,744 t in 2015.

3.2. Availability Scenario and Prices

During the last three years a price dynamics has taken place in favor of a rapid conversion from CFCs to HCFCs. In 2002 the CIF prices of HCFC-141b were in the range of 3.50 to 4.30 dollars per kg and those of CFC-11 were in the order of $ 2.50/kg. In the middle of 2003 these numbers were on average U.S. $ 2.20 for HCFC-141b and $ 1.80 for CFC-11. In the period of 2003-first half of 2004 CFC-11 price surpassed that of HCFC-141b and at the same time Chinese products started to penetrate the market. In 2005 and 2006 CFC-availability has been low and prices today are two or three times higher than HCFC-141b. In 2005 HCFC-141b price was in the range $ 1.60-1.95/kg and nowadays is between $ 1.60 and $ 2.10 depending on source and volume. Product is easy available from China, U.S. and Europe.

The situation has been and is the same for HCFC-123.

For HCFC-22 the 2002 market price was $US 1.85/ kg—15-20%- higher than CFC-12 (US$ 1.55/kg). Beginning 2003, prices for CFC -12 started to increase and became higher than HCFC-22. In the middle of 2004, the prices for CFC-12 climbed to US$2.50-US$ 2.70 and prices for HCFC-22 were almost at the same level of 2002.

As to availability, there is currently an oversupply of HCFCs. It does not seem likely that this will change significantly in the near future.

3.3. Technology

3.3.1. Foams

Domestic and Commercial Refrigeration

Currently the external blowing agents used in these segments are HCFC-141b and HCFC-22 (just one domestic refrigeration company). All the enterprises have world wide competitive technology and, partially thanks to the MLF projects, have high pressure PU injection machines. Their challenge is in the conversion to zero ODP substances. With the exception of Mabe -with direct access to General Electric technology- the other companies will have to develop their own technology and decide between hydrocarbons or HFC. Hydrocarbon technology has been mostly based on cyclopentane, either “pure” grade (95%) or “technical” grade (75%). There is no significant difference in their performance in practice. Both are easy to process in formulations that have been developed around them. Because of their flammability, extensive but now well established modifications to the foaming part of the factory to meet appropriate safety requirements are essential. These include a dedicated storage tank for the cyclopentane, pre-mixers, adapted high pressure dispensers, suitable moulds (often water-cooled) plus process exhaust, hydrocarbon detectors, appropriate classification of electrical equipment, avoidance of static electricity and, above all, training of operating staff. These requirements make economic conversion to this technology, particularly in the cases of small factories, a difficult issue. However, in this sector most of the factories are large enough to make conversion to hydrocarbons an economic proposition. Conventional plastic liner systems, as used with CFC-11, are suitable for use with any of the hydrocarbon blowing agents, which represents an advantage over the present HCFC-141b based system.

The technologies that have been actively used, mainly in the United States, as non-hydrocarbon replacements for the HCFCs are those based on HFC-134a and HFC-245fa. Foams based on HFC-134a have been used in appliances for long periods and are being used in a few production lines today. The main issues are: processing because HFC-134a is a gas and has poor solubility in polyol formulations (requires an on line high shear mixer); and the thermal conductivity penalty of the foam - which is 15-20% compared to 141b-based foam. In contrast, the evaluation of HFC-245fa shows it to be a technically viable blowing agent for this application, giving similar densities to those of CFC-11-based foams. The thermal conductivity of the foam, at about 18.5 maw's°K (at 10°C) and the energy consumption of the appliance are equivalent to those of HCFC-141b-based products and up to 10% lower than for current hydrocarbon-blown foams. The boiling point of 15.3°C may mean that pressurized blending equipment will be necessary for its use, although evaluations reported to date suggest that HFC-245fa can be processed through foam equipment designed for use with CFC-11 and HCFC-141b in many cases. The very good solubility in polyol formulations is a significant factor in its use. The liner materials used with CFC-11 are suitable for use with HFC-245fa with the exception of some ABS compositions[7].

Industrial Refrigeration

In this sector there is a big technology gap between METCOL and the rest of enterprises, most of them of small/medium size. However, as a result of the implemented MLF projects, there are in the market several low pressure injection machines, which help the increase in quality and technology level. Similar to domestic refrigeration, conversion options for METCOL are hydrocarbons and HFCs. N-pentane has been used but requires equipment modification to counter its flammability. Referring to HFCs, HFC-365mfc (blended with HFC-227ea) is seen as the most significant option. For the small/medium sized enterprises hydrocarbon technologies are not feasible for economics and safety standards. The only options are liquid HFCs: HFC-245fa and HFC-365mfc are the best candidates. This is also valid for spray and integral skin applications.

Other Applications

Other applications include integral skin foams, and non-insulation applications of rigid foams. Because of the size of the enterprises—almost all SMEs, the statements under industrial refrigeration apply.

3.3.2. Portable Fire Extinguishers

The main challenge will be to eliminate the use of HCFC-141b in this application (more likely a regulation issue) and to go to zero ODP alternatives. For the conversion to non depleting options the industry is analyzing HFC-236fa. From a fire fighting perspective, it is as effective as blends whose major component is HCFC-123, such as Alorton I and NAF P-IV, and may be better on a weight basis. However, for most applications a halocarbon agent is not necessary and, in fact, in the US. a person cannot use HCFCs or HFCs in their house-they are for commercial/industrial use only. Generally speaking, for most in-home and/or commercial applications a multi-purpose dry powder extinguisher would be used, or a CO2 extinguisher if a clean agent was necessary. In Europe a foam extinguisher rather than dry powder would be used for many applications. The one area where HFC-236fa would be recommended is for on-board aircraft as a replacement for halons 1211. There are aircraft certified portable extinguishers that use both HFC-236fa and Halotron I (a blend whose major component is HCFC-123). From an environmental perspective, although HFC-236fa has zero ODP, it has a high GWP of 6,300 compared to HCFC-123's GWP of 76[8].

In portable fire extinguishers, the best solution is to go to foam or dry powder based units.

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[7] Paragraphs on future Technologies were written based on TEAP, HCFC Task Force Report, May 2003, ISBN 92-807-2336-7.

[8] Concept by David Catchpole, Co-chair of the UNEP Halons Options Committee, July 12, 2006.

3.3.3 Refrigerants

Main substitutes for CFCs in both developed and developing countries have been HCFCs and HFCs. HCFCs and Ammonia have become the most popular gases for RAC systems and preferred options over HFC blends. If high obsolescence costs are to be avoided, a rational approach to phaseout HCFC consumption should include a period to allow for development and commercialization of alternatives followed by a period to phase-in new equipment. For the short term, HCFCs are still a valid transitional option for refrigeration and air conditioning.

However, for the long term, only five important global refrigerant options remain for the vapor compression cycle (as well as various non vapor compression methods):

- Hydrofluorocarbons (HFCs, HFC-blends with 400 and 500 number designation);
- Ammonia (R-717);
- Hydrocarbons and blends (HCs, e.g. HC-290, HC-600, HC-600a etc.);
- Carbon dioxide (CO_2, R-744);
- Water (R-718).

All have advantages and disadvantages that should be considered. For instance, HFCs have relatively high global warming potentials, ammonia is toxic and both ammonia and hydrocarbons are flammable. Appropriate equipment design, maintenance and use can help to overcome these concerns.

Capital investment and energy efficiency should also be considered. Energy efficiency relates directly to global warming and greenhouse gas emissions. It is an important issue for all refrigeration technologies. Next to ozone depletion, global warming is the main environmental issue that should govern selection of refrigerant technologies. Although this issue is not covered by the Montreal Protocol, it forms an important selection criterion.

Interest in Ammonia is growing, not only because of low prices but also because of the fact that HFCs are greenhouse gases which may be subject to control measures in future. However, safety concerns require emission controls for Ammonia and Hydrocarbons.

Commercial refrigeration uses a wide range of equipment. The refrigeration capacity of centralized systems in supermarkets varies typically from 20 kW to 1000 kW while stand-alone equipment capacities are comparable to those of domestic equipment. Stand-alone equipment mainly uses HFC-134a and R-404a for low temperature applications. The most centralized systems are still using HCFCs since phaseout of HCFCs is not seen as a key factor at this time and users avoid HFC blends because of price and stability.

Other development efforts are focusing on improving energy efficiency, minimizing charge size, and minimizing refrigerant emissions.

Ammonia and HCFC-22 are currently the most commonly used refrigerants for industrial refrigeration, including cold storage and food processing. Many users switched to ammonia once the CFC restrictions became a fact at the end of 90´s and also many industries converted HCFC-22 systems to ammonia because economical factors. In these sectors CFCs have been replaced by new systems using ammonia, HCFC-22 and HFCs (HFC-134a, R-404A and R-507A). R-410A is not a widely considered option.

Hydrocarbons are under consideration but in not a present option; CO2 is not adopted at this time in any centralized systems .Retrofit activities in the industrial sectors are lower than predicted several years ago although various retrofit options have proven to be viable solutions.

Air-cooled air conditioners and heat pumps ranging in size from 2 kW to 420 kW comprise the vast majority of the air conditioning market. Nearly all of these units use HCFC-22 as working fluid. Significant progress has been made in developing alternatives to HCFC-22 for this category of products.

The HFC-blend R-407C is one retrofit candidate for HCFC-22 commercially available but still has high market prices.

Refrigerants including fluorocarbons (CFCs, HCFCs, HFCs), ammonia are used in the continuously growing number of water chillers used for air conditioning. Chillers using fluorocarbons predominate in the installed base and in new units, as initial costs are relatively low. Because HCFCs and HFCs are similar to CFCs physically and chemically, they can often replace CFCs in new and existing chillers with minor modification of chillers and equipment rooms.

Industrial refrigeration uses all types of refrigerants, with HCFCs and Ammonia representing the majority of volume.

3.4. Environmental Impact

Two points should be considered on environmental impact: depletion of the ozone layer and climate change. From both -the ozone depletion and climate change- points of view the replacement of CFCs by HCFCs represented a significant progress in the environment protection. However, although mitigated, these substances still have ODP and from this reason their conversion to zero ODP products presents an environmental opportunity. Following table (source; UNEP FTOC report 2002) provides important environmental and safety data for most traditional and prospective compounds:

Physical and Environmental Properties of Major CFCs and their Replacements

	CFC-11	CFC-12	HCFC-22	HCFC-142b	HCFC-141b	Methylene Chloride	HFC-134a	HFC-152a
Chemical Formula	$CFCl_3$	CCl_2F_2	$CHClF_2$	CH_3CClF_2	CCl_2FCH_3	CH_3Cl_2	CH_2FCF_3	CHF_2CH_3
Molecular Weight	137	121	86	100	117	85	102	66
Boiling point (°C)	24	-30	-41	-10	32	40	-27	-25
Gas Conduct. (mW/m°K at 10°C)	7.4	10.5	9.9	8.4	8.8	N/A	12.4	14.3*
Flammable limits in air (vol.%)	None	None	None	6.7-14.9	7.3-16.0	None	None	3.9-16.9
TLV or OEL (ppm) (USA)	1000	1000	1000	1000	500	35 to 100	1000	1000
GWP (100 Yr.) ***	4000	8500	1700	2000	630	N/A	1300	140
ODP	1.0	1.0	0.055	0.065	0.11	0	0	0
Producers (major)	Honeywell	Honeywell	Atofina Honeywell , Solvay DuPont	Honeywell Atofina, Solvay	Honeywell Solvay Atofina		Atofina, DuPont, INEOS, Honeywell Solvay	DuPont, Solvay

	HFC-245fa	HFC-365mfc	Isopentane	Cyclo-pentane	n-pentane	Carbon Dioxide	Isobutane	n-butane
Chemical Formula	$CF_3CH_2CHF_2$	$CF_3CH_2CF_2CH_3$	$CH_3CH(CH_3)CH_2CH_3$	$(CH_2)_5$	$CH_3(CH_2)_3CH_3$	CO_2	C_4H_{10}	C_4H_{10}
Molecular Weight	134	148	72	70	72	44	58.12	58.12
Boiling point (°C)	15.3	40.2	28	49.3	36	-139	-11.7	0.5
Gas Conduct. (mW/m°K at 10°C)	12.5**	10,6**	13.0	11.0	14.0	14.5	15.9	13.6****
Flammable limits in air (vol.%)	None	3,8-13,3	1.4-7.6	1.4-8.0	1.4-8.0	None	1.8-8.4	1.8-8.5
TLV or OEL (ppm) (USA)	N/A	N/A	1000	600	610	N/A	800	800
GWP (100 Yr.) ***	820	840	11	11	11	1		
ODP	0	0	0	0	0	0	0	0
Producers (major)	Honeywell Central Glass	Solvay	ExxonMobil Haltermann Phillips Shell	ExxonMobil Haltermann Phillips	ExxonMobil Haltermann Phillips Shell		Chevron Bayer Huntsman Phillips	Bayer DuPont Huntsman Phillips

The challenge is to convert to zero ODP options and at the same time reducing the climate change impact. In foams, hydrocarbons are the preferred solution but their implementation at small/medium sized enterprises is unpractical for economic and safety reasons. From an ozone depletion perspective HFCs are the only solution but all have high GWPs. However, in low emissive applications, like PU rigid foam, the impact on climate change could be significantly reduced by implement good practices for end-of-life management (blowing agent recovery).

Colombia intends to follow UNEP's stated goal for the global environmental agreements:

Promoting Synergies amongst Conventions

3.5. Compliance Challenges and Opportunities

Colombia has complied with the 1999 and 2002 freeze for CFCs and halons- as well as with the 2005 50 % reduction. It is very well prepared for the 2007 85 % reduction and the 2010 phaseout. The challenge is to make the conversion to zero ODP substances according to Montreal Protocol schedule, keeping the industry competitive and reducing the climate change impact. The opportunity is to accelerate this process. The following actions would fit such a combination of objectives:

- Prepare the domestic and commercial refrigeration industry for conversion to hydrocarbons.
- Study early retirement of old refrigeration units combined with environmental sound destruction.
- Explore the possibility to replace the HCFC-based extinguishers by foam or dry powder units according to European and U.S. practices.
- Substitute the use of HCFC-141b in flushing applications by a non-ODS/low GWP substance.
- Extend existing recycling and recovery programs to HCFC containing equipment
- Look into synergies between programs for ozone protection and against global warming

3.6. Potential Compliance Measures

With existing regulatory measures and a resolution in preparation on environment license for HCFCs Colombia has appropriate legislation to assure the compliance with the Montreal Protocol schedule.

3.7. Summary and Conclusions

- According to best current estimates the demand in 2015 for HCFCs will be 3,750 t/y.
- During last three years the price dynamics has favored the conversion to HCFCs. No availability shortage for HCFCs is anticipated in the short/medium term. Penetration of Chinese made products has played a positive role in both price and availability.
- In Foams the zero ODP options are hydrocarbons and HFCs. The first one is applicable in domestic and commercial refrigeration segments (medium to large size enterprises) but a significant investment for adequate product handling and safety is required. HFCs are the only solution for SMEs but all have high GWPs. However, in non short term emissive applications, like PU rigid foam, the impact on climate change could be significantly reduced by implement good practices for end-of-life management (blowing agent recovery).
- In portable fire extinguishers, the best solution will be to go to foam or dry powder based units.

- Colombia has complied with the 1999 and 2002 freeze -for CFCs and halons- and with the 2005 50 % reduction and is very well prepared for the 2007 85 % reduction and the 2010 total phase-out. To accelerate the process to zero ODP alternatives with reduced impact on climate change the following actions are suggested:
    - Create suitable technical and financial incentives through the MLF
    - Prepare the domestic and commercial refrigeration industry to an early conversion to hydrocarbons. This conversion could become crucial to eventual future exports to developed countries and in case of a significant increase of HCFCs price.
    - Develop a feasibility study on an early retirement of old domestic and commercial refrigeration units and their environmental sound destruction.
    - Explore the possibility to replace HCFC-based extinguishers by foam or dry powder units.
    - Extend the good practices in maintenance programs to HCFCs
    - Establish a legal framework for the HCFC to secure good procedures in its use.
    - Evaluate opportunities for synergies between environmental programs for ozone protection and against global warming

SURVEY OF HCFCs IN INDIA

FINAL REPORT

Ozone Cell, Ministry of Environment & Forests
United Nations Development Programme (UNDP)

January 2007

EXECUTIVE SUMMARY

India acceded to the Vienna Convention in 1991 and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in 1992. India ratified the London Amendment to the Montreal Protocol in 1992 and the Copenhagen Amendment in 2003.

The annual calculated consumption in India of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, India was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

India's Country Programme incorporating the national strategy and action plan for controlling the use of Ozone Depleting substances was approved at the 11th Meeting of the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol in November 1993. India's Country Programme Update was submitted to and approved at the 49th Meeting of the Executive Committee in July 2006. Until date, India is in compliance with the Montreal Protocol control schedule for Annex-A, B and E substances, through a combination of projects and programmes featuring technology transfer investments, technical assistance, training & capacity building, information dissemination and awareness-raising and institution of a proactive regulatory framework.

In compliance with Article-4B of the Montreal Protocol incorporated through the Montreal Amendment, India has established one of the most comprehensive and forward-looking regulations for controlling production, import, export, trade and use of all Annex-A, B, C and E controlled substances, which includes recovery, recycling and reclamation. All users of these substances are subject to mandatory registration and reporting requirements in addition to these controls.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore their use has to be reduced and eventually phased out. In accordance with the control schedule of the Montreal Protocol for Article-5 parties, production and consumption of HCFCs will be subject to a freeze at 2015 levels from 01 January 2016 and are required to be completely eliminated by 2040. HCFCs are used in India mainly in the Aerosols, Foams, Refrigeration & Air Conditioning and Solvent sectors, predominantly HCFC-141b and HCFC-22.

Due to the economic liberalization policies since early 1990s resulting in sustained growth in the purchasing power and consequent growth in demand for consumer and commercial products, the consumption of HCFCs in India increased from about 3,792 metric tonnes in 1994 to 11,027 metric tonnes in 2005, signifying an average annual growth rate of 11.3%. Much of this growth has occurred in the past few years. For example, since 2001, the consumption of HCFCs in India has increased from about 4,153 metric tonnes to 11,027 metric tonnes in 2005, signifying an average annual growth of about 27.7%. Based on projected annual growth rates in demand forecasted for HCFCs until 2015, it is estimated that the consumption of HCFCs in India is likely to reach about 27,103 metric tonnes in 2015. HCFCs additionally have a global warming impact due to their high global warming potential (GWP).

Concrete actions by Article-5 parties to control and reduce consumption of HCFCs to ensure compliance with the 2016 freeze would need to be formulated and initiated at the earliest. Challenges and constraints for such actions include sustained and cost-effective availability of environment-friendly substitutes for HCFCs and access to technology and funding to facilitate transition without undue burden on the economy of the country and constraints on consumers and industry. India expects that the international community will recognize these challenges and provide technical and financial assistance to Article-5 countries to meet the first control on HCFC use, i.e., the freeze in consumption at 2015 levels from 2016.

SURVEY OF HCFCs IN INDIA

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LIST OF ABBREVIATIONS

CFC	Chloro Fluoro Carbons
CP	Country Programme
CTC	Carbon Tetra Chloride
ExCom	Executive Committee of the Multilateral Fund
GWP	Global Warming Potential
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
HCFCs	Hydrochlorofluorocarbons
IA	Implementing Agency
MAC	Mobile Air Conditioning
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MOEF	Ministry of Environment and Forests, Government of India
MP	Montreal Protocol
MT	Metric Tonnes
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
R&R	Recovery and Recycling
SMEs	Small and Medium-sized Enterprises
TR	Tons of Refrigeration
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
WB	World Bank

1. INTRODUCTION

1.1 BACKGROUND

India became a party to the Vienna Convention on 19 June 1991 and acceded to the Montreal Protocol on Substances that Deplete the Ozone Layer on 17 September 1992. Table-1 shows the dates of ratification by India of the Protocol and its amendments. Since the annual calculated consumption of controlled substances in India, listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, India was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

Table-1: India - Dates of Ratification of Montreal Protocol and Amendments

Agreement/Amendment	Date of Ratification
Vienna Convention	19 June 1991
Montreal Protocol	17 Sept 1992
London Amendment	17 Sept 1992
Copenhagen Amendment	03 March 2003
Montreal Amendment	03 March 2003
Beijing Amendment	03 March 2003

India's Country Programme for phase-out of ozone depleting substances under the Montreal Protocol was prepared and finalized in August 1993 with the assistance of United Nations Development Programme (UNDP), The Energy and Resources Institute (TERI) and representatives of various ministries, industries and scientific institutions. The Country Programme was submitted to and approved at the 11th Meeting of the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol, in November 1993.

The key principles underlying India's Country Programme were:

- To implement phase-out of ODS without adversely affecting industrial and economic growth in the ODS consuming sectors, while protecting consumer and public interests

- To meet the demand for substitutes for ozone depleting substances, as far as possible from indigenous sources

- To reflect India's commitment to achieve compliance with the Montreal Protocol obligations, despite the barriers and problems India would face in the implementation of the Protocol.

India's Country Programme was contingent upon availability of adequate technical and financial assistance for mitigating the incremental costs of phase-out. The Country Programme was also intended to be a dynamic document and was intended to be reviewed and updated at an appropriate time to reflect the status of its implementation.

India requested funding for the preparation of their Country Programme Update under the Montreal Protocol, which was approved at the 36th Meeting of the Executive Committee of the Multilateral Fund in March 2002, with UNDP as the implementing agency. India's Country Programme Update was approved at the 49th Meeting of the Executive Committee of the Multilateral Fund in July 2006.

Since the approval of the original Country Programme for Phase-out of Ozone Depleting Substances in 1993, India has made significant progress in controlling the production and consumption of ODS. From a consumption level of 10,370 metric tonnes of ODS in 1991, the unconstrained demand was forecasted at about 96,000 metric tonnes by 2005.

The consumption of ODS by end-2004 was only about 9,000 metric tonnes annually. These reductions were achieved with technical and financial assistance from the Multilateral Fund, support from implementing agencies and due to proactive policy and regulatory actions by Government of India. Table-2 below summarizes the ODS phase-out activities, both completed and ongoing, in various sectors:

Table-2: Summary of ODS Phase-out Activities in All Sectors

Sector	Number of Projects	Funding (US$)	Phase-out (ODP metric tonnes)
Aerosols Sector	27	3,227,739	689
Foams Sector	159	34,785,641	4,373
Firefighting Sector (Halons)	18	2,458,701	2,162
Refrigeration & Air Conditioning Sector	49	32,254,823	3,203
Solvents Sector	41	61,358,042	12,966
Production Sector (including Halons)	2	84,600,000	22,988
Total	**296**	**218,684,946**	**46,381**

Of the above-mentioned activities, over 70% of the activities in terms of ODS phase-out are now completed. Almost all of the individually approved projects have been completed. The implementation of performance-based sector and national-level phase-out plans in the Foams, Refrigeration & Air Conditioning, Solvents and Production sectors is well on course, with the respective agreed annual phase-out targets met or exceeded so far.

Three main national/sector-level ODS phase-out activities, governed by multi-year performance-based agreements between Government of India and the Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, are currently under implementation:

NCCOPP (National CFC consumption phase-out Plan)

This project combines the CFC phase-out activities in the Foams, Refrigeration (Manufacturing) and Refrigeration (Servicing) Sectors, into a single agreement beginning March 2004. The agreed annual phase-out targets under the NCCOPP are as below:

Table-3: Agreed Annual CFC Phase-out Targets under NCCOPP from 2004-2010

Year	2004	2005	2006	2007	2008	2009	2010
ODS Phase-out (ODP MT)	1,675	854	496	147	145	173	0

From 2007, when the activities under the Foam Sector and Refrigeration (Manufacturing) Sectors are expected to be substantially completed, the focus of the NCCOPP would be expected to be predominantly on activities in the Refrigeration (Servicing) Sector. The key challenges identified are as below:

- Availability of adequate CFCs for servicing needs beyond 2010, through stockpiling, recovery/recycling and reclamation
- Accelerating retrofitting/replacement of CFC-based equipment to reduce dependence on CFCs for servicing
- Adequate capacity building and awareness at the field-level service establishments and technicians to minimize CFC emissions and losses

Intensive monitoring of the investment, technical assistance, training and capacity building components would be needed to ensure that India complies with the agreed phase-out targets. Appropriate institutional arrangements are in place to address the additional obligations such as performance verification and reporting.

CTC Phase-out Plan

The project addresses the production and consumption of non-feedstock CTC. The agreed annual production and consumption targets are as below:

Table-4: Agreed Production and Consumption Targets under CTC Phase-out Plan

Year	2005	2006	2007	2008	2009	2010
Maximum Consumption (ODP MT)	1,726	1,147	708	268	48	0
Maximum Production (ODP MT)	1,726	1,147	708	268	48	0

The implementation of this project is underway. The key challenges identified are as below:

- Adequate assistance to small scale CTC users in the textile and metal cleaning industry, including cost-effective availability of substitutes
- Ensuring timely phase-out of CTC in the large users in the process agent and solvents sectors

Intensive monitoring of the investment, technical assistance, training and capacity building components would be needed to ensure that India complies with the agreed phase-out targets. Appropriate institutional arrangements are in place to address the additional obligations such as performance verification and reporting.

Production Sector Gradual phase-out plan

This agreement is in place since 1999. The agreed annual limits on production are already shown in Table-5 below:

Table-5: Agreed Maximum Allowable CFC Production Levels from 1999-2010

Year	Production (MT)	Year	Production (MT)
1999	22,588	**2005**	11,294
2000	20,706	**2006**	7,342
2001	18,824	**2007**	3,389
2002	16,941	**2008**	2,259
2003	15,058	**2009**	1,130
2004	13,176	**2010**	0

Mechanisms for monitoring, reporting and verification as per the agreed protocols are already established and would continue to be implemented. So far India has complied with all provisions of the agreement governing this project.

Among the priorities highlighted in India's Country Programme Update for the future, Government of India considered the long-term management of HCFCs as an important area of activity.

As per the Montreal Protocol, controls on Annex-C Group-I substances (HCFCs) for Article-5 parties, begin in 2016. The production and consumption of HCFCs have to be frozen at 2015 levels from 2016. HCFCs are widely used as refrigerants in the Refrigeration & Air Conditioning Sector and as blowing agents in the Foams Sector. In 2005, India's production of HCFCs for non-feedstock use was 23,880 metric tonnes and the net consumption was 11,027 metric tonnes. The sectors using HCFCs in India are experiencing significant growth due to substantial increase in economic activity in the country and resultant GDP growth. It is expected that these sectors, and therefore the consumption of HCFCs would grow by 10-15% annually for the next decade.

Based on this, by 2015, India's consumption of HCFCs would cross 27,000 metric tonnes. In 2005, India exported 15,026 metric tonnes of HCFCs mostly to countries in Asia Pacific and Middle East, whose economies are also on a growth path and may thus show corresponding consumption growth, leading to increased demand for exports.

Expansion of HCFC production facilities to meet the growing demand may result in additional global environmental impacts. Increased production of HCFC-22 will require increased production of chloroform, which is used as a raw material for producing HCFC-22. Production of chloroform will result in additional production of CTC. As demand for HCFC-22 as feedstock for production of fluoropolymers is increasing in both developed and developing countries, proper management systems may be needed to address unwanted production of CTC, which has an ODP of 1.2 and GWP of 1,400.

Given the restrictions on HCFC use beginning 2016, given the unintended global environmental impacts of increased HCFC production and considering that important sectors of the economy would be affected, urgent steps are needed to ensure that sectors dependent on HCFCs are properly equipped to deal with the imminent restrictions after 2015. Based on these projections, Government of India has identified the long-term management of HCFCs as a crucial activity to be undertaken at the earliest, with the expectation of adequate technical and financial assistance from the Multilateral Fund to support the same.

Accordingly, at the 45th Meeting of the Executive Committee, funding was approved for UNDP to carry out HCFC surveys in 12 countries. India is one of the countries which requested to be a part of this activity.

1.2 APPROACH AND PREPARATION

The Executive Committee of the Multilateral Fund at its 45th Meeting, approved activities to be implemented by UNDP, which aimed to conduct limited surveys of HCFC use in selected countries, with a goal of enabling the Executive Committee to establish a national aggregate level of HCFC consumption in the future for these countries, against which projects and activities may be funded. The selected countries were:

Latin America:	Argentina, Brazil, Colombia, Mexico, Venezuela
Middle East:	Iran, Lebanon, Syria
South Asia:	India, Sri Lanka
Southeast Asia:	Indonesia, Malaysia

To ensure effective coordination of survey activities in this global project involving 12 countries and to better address cross-regional issues, UNDP planned the activities to be carried out, using a three-stage process:

- Data collection and survey at the national level
- Compilation and analysis of survey data
- Presentation and reporting of survey data

The national-level data collection and survey work was to be carried out through recruitment of a local consultant entity (either an individual or a firm/institution) recommended by the respective governments. The compilation and analysis of the survey data was carried out through UNDP's international experts and researchers to impart credibility and quality. The presentation and reporting of survey data was carried out in consultation with the country governments, which in turn ensured the required country-level consultations within the respective industry and expert institutions.

In India, Ark International, a local consulting and technical services firm, was retained by UNDP in consultation with Government of India to carry out the national-level survey activities. The main tasks to be carried out in close coordination with UNDP and the NOU were as below:

a) Conduct a Desk Study, with the aim of preparing a situation analysis on HCFC consumption in-country.

b) To interact with various chemical and equipment suppliers/importers and/or their representatives and relevant industry associations for identifying all current users of HCFCs in the Aerosols, Halons, Foams, Refrigeration & Air Conditioning, Solvents and any other sectors where HCFCs are used, maintain continuous contact with these users and maintain an updated list of all such users.

c) With the prior approval of UNDP and NOU, undertake plant visits to selected users and collect enterprise baseline information and other documentation as may be required by UNDP and NOU from all users, in accordance with the pro-forma/questionnaire provided for this purpose. The HCFC consumption data from users shall be collected from 1995 or the date of their establishment, whichever is later.

d) Classify the data generated from a) and b) above, as below:

    - HCFC consumption by sector
    - List of HCFC users, segregated by sector
    - List of HCFC users who received assistance under the Montreal Protocol Programme
    - List of HCFC users who did not receive assistance under the Montreal Protocol Programme
    - Approximate population of HCFC-based equipment segregated by sector

e) Collect and compile the following data on HCFCs, segregated by substance at the national level:

    - Historical production data preferably from 1995
    - Historical export data preferably from 1995 and segregated by destination countries
    - Historical import data preferably from 1995 and segregated by originating countries

f) To assist in obtaining any other confirmations, documentation or information from the identified HCFC users as may be required by UNDP and/or NOU from time to time.

g) To set up meetings for UNDP designated international experts and/or representatives, to meet with key managerial and technical personnel from the HCFC users and for plant visits as required, in line with their mission schedules in the country.

h) To assist UNDP and/or NOU in arranging workshops or similar information dissemination activities as may be requested, including assistance for ensuring participation of HCFC users selected for participating in such activities

i) To provide UNDP with interim progress reports on activities on a monthly basis and a final report incorporating the expected outcomes as mentioned above, at the end of the contract period.

Ark International was contracted by UNDP and carried out the above-mentioned tasks during 2006 and provided interim and final report as per the terms of reference. The draft final report was submitted to UNDP in December 2006. The final report was reviewed by UNDP's international technical experts and was then submitted to the Government for review and endorsement.

1.3 SURVEY METHODOLOGY

The sources of data collected were as below:

a) Existing records of production, consumption and export of HCFCs available with the Ozone Cell, Ministry of Environment and Forests.

b) Existing records of users generated during the implementation of ongoing CFC phase-out projects and programs/activities.

c) Industry associations, namely AIACRA (All India Air Conditioning and Refrigeration Association), RAMA (Refrigeration and Air Conditioning Manufacturers Association), NIRATA (North India Refrigeration and Air Conditioning Trade Association) etc. and their publications.

d) End users and original equipment manufacturers of HCFCs/HCFC-based products

Questionnaires in the prescribed format were obtained from select users.

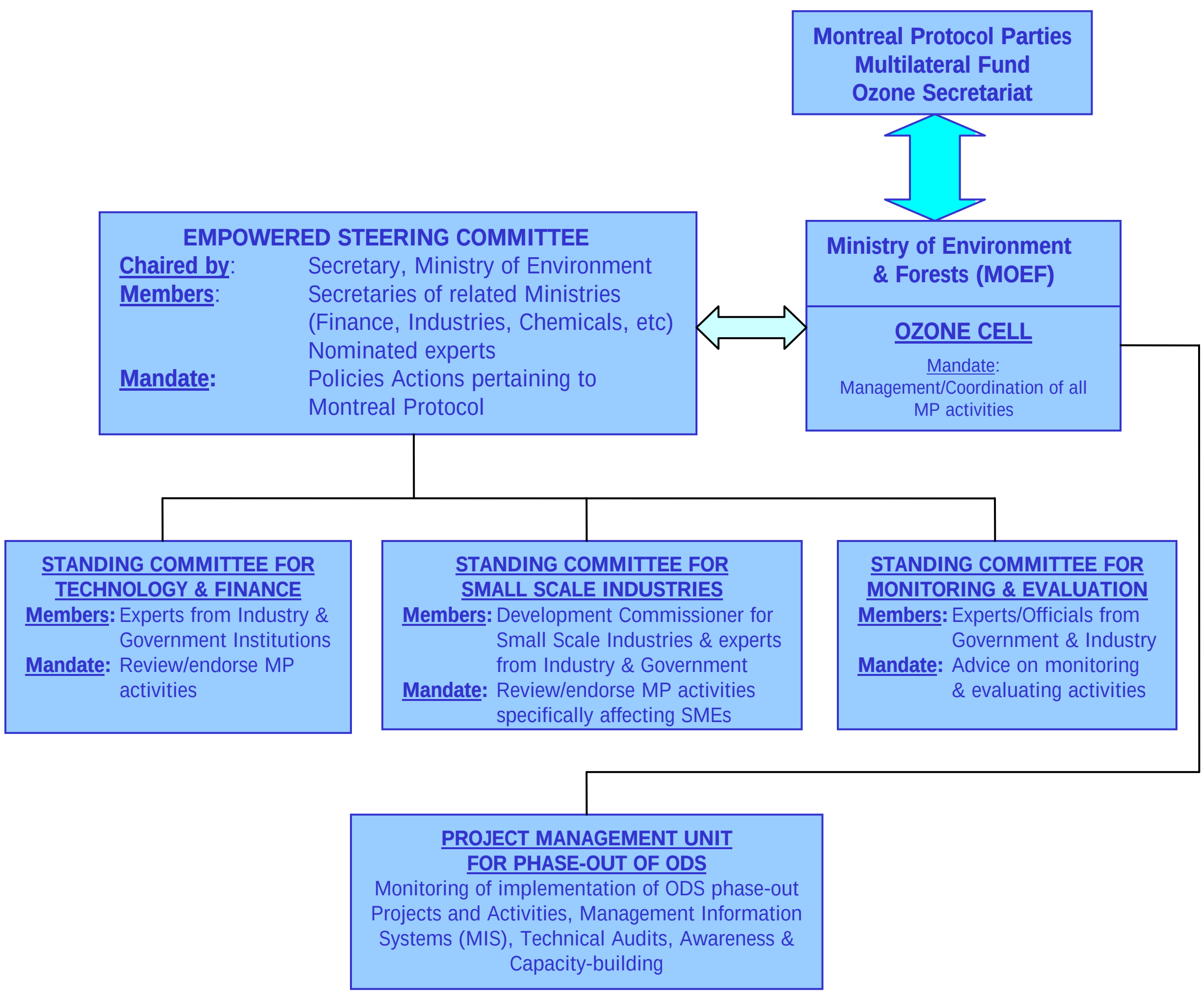
2. OBSERVATIONS

2.1 INSTITUTIONAL FRAMEWORK

2.1.1 Institutional Arrangements

Government of India designated the Ministry of Environment & Forests as the national coordinating body for implementation of the Montreal Protocol in India. The functions and responsibilities of the Ministry of Environment & Forests as the designated national authority, include notification of regulations pertaining to the Montreal Protocol, issues related to international cooperation, maintaining and managing data on production, imports, exports and consumption of ODS, monitoring of implementation of Montreal Protocol activities, interacting with other line ministries on technical and financial matters pertaining to implementation of activities, liaising with scientific, technical and other public institutions for technical matters, representing India at various multilateral meetings and discussions, etc. The Ministry of Environment & Forests established a special directorate (Ozone Cell) within the Ministry, dedicated to managing and coordinating the implementation of the Montreal Protocol in India. The institutional framework for Montreal Protocol implementation in India is shown in Figure-1 below.

Figure-1: Institutional Arrangements



2.1.2 Policies

India's Country Programme for phasing out ODS, established the following guiding principles reflecting national priorities:

- To strengthen national institutions for monitoring and managing the ODS phase-out, and formulation and implementation of appropriate policies.
- To assist indigenous industries for conversion to non-ODS technologies through the Montreal Protocol financial mechanism, while ensuring that the SMEs and other unorganized tiny enterprises are fully compensated for conversions, including retraining
- To minimize economic dislocation either through closure of manufacturing units, loss of productive capacity, or through major capital expenditure that could become obsolete in future.
- To maximize indigenous production by encouraging technology transfer for and local production of non-ODS substitutes
- To give preference to one-time replacements
- To minimize obsolescence costs by promoting recycling, retrofitting and drop-in substitutes to prolong economic life of existing equipment, until new replacement technologies become mature, cost-effective and available
- To institute decentralized management of ODS phase-out activities and arrangements to facilitate feedback for smooth implementation.
- To facilitate development of new standards and certification systems for products and processes including those for safety
- To integrate the ODS phase-out activities closely with the growth in the various industrial sectors, economic reforms, etc.
- To evaluate alternatives to ODS and the available substitute technologies on a continuing basis, so as to lead to wider adaptation and dissemination.
- To periodically reassess and revise the Country Programme to reflect technological developments, progress in implementation of ODS phase-out activities and evolving trends in the growth of the various industrial sectors.

2.1.3 Regulations

Recognizing the importance of establishing an effective regulatory framework for the successful implementation of the Country Programme, MOEF initiated a forward-looking programme to create such a framework to support the various ODS phase out measures.

In exercise of the powers conferred by sections 6, 8 and 29 of the Environment Protection Act of 1986, Government of India formulated draft ODS regulations termed as the Ozone Depleting Substances Rules, which were published in the Gazette of India in 1998 for public comments and also circulated in the industry for advance intimation and comments. These have been since been officially notified and have formally come in to effect from January 2000. The provisions of this comprehensive legislation are summarized as below:

ODS Production

- Mandatory registration with MOEF
- Restriction on production levels as per "base level" and specified time-bound reductions.
- Prohibition on creating new capacity or expansion of capacity

ODS Consumption

- Ban on new capacity or expansion of capacity for production of ODS based equipment.
- Mandatory registration with designated authorities
- Declaration requirement in prescribed format at the time of procurement of ODS
- Restrictions on production of ODS-based products in various sectors from 2003

ODS Trade

- Mandatory registration for exporters & importers with designated authorities
- Import of ODS and ODS containing equipment only against license
- Export restricted to countries who are signatory to the Montreal Protocol against quota

General

- Mandatory registration for reclamation and destruction of ODS. All registrations will be valid for specified periods, after which, they are required to be renewed.
- Every entity that produces, uses, imports, sells, stocks, reclaims or destroys ODS has to maintain records and file reports as specified.
- Every entity, which has received technical and/or financial assistance from any international agency or financial assistance from Government of India including duty exemptions, is required to maintain records and file reports as specified.

Other measures initiated by Government of India include:

<u>Trade Measures</u>

a) Trade in controlled substances with countries not party to the Montreal Protocol is prohibited.
b) The export of Annex-A and Annex-B substances to Non-Article 5 Parties is prohibited.
c) The import and export of all Annex-A and Annex-B substances are subject to licensing.
d) Import of Equipment containing ODS was subjected to licensing

<u>Fiscal Measures</u>

a) Full exemption from Customs and Excise tariffs on capital goods required to implement ODS phase out projects funded by the Multilateral Fund. This exemption has been extended to ODS phase-out projects, which were eligible for funding under the Multilateral Fund, whether or not such enterprises actually sought assistance from the fund. These also covered projects submitted for retroactive financing. The benefit was available subject to the condition that enterprises should give a clear legal commitment to stop using ODS in all future manufacturing operations after the projects were implemented. The duty exemptions were also extended to items of recurring use, including non-ODS alternatives, for such duration for which, incremental operating costs were committed by the Multilateral Fund in approved projects.

b) The duty exemptions were also extended to capital goods required for establishing new capacity with non-ODS technology.

c) Indian financial institutions were advised not to finance/refinance new ODS producing/consuming enterprises.

d) The Tariff Advisory Committee (a statutory body under the Insurance Act, 1938) decided to grant suitable discounts on fire insurance premiums if alternative agents are used to replace Halons.

2.2 HCFC SUPPLY SCENARIO

2.2.1 Production

India has indigenous production of only HCFC-22. Other HCFCs are imported. There are four active producers of HCFC-22 in India. Table below shows the 2005 production levels at these four producers:

Table-6: HCFC-22 Production in India in 2005

Producer	HCFC-22 production in 2005 (Metric Tonnes)
Gujarat Fluorocarbons Ltd	9,573
Hindustan Fluorocarbons Ltd	909
Navin Fluorine Industries	5,521
SRF Ltd	8,786
Total	**24,789**

The production by Hindustan Fluorocarbons Ltd. of 909 metric tonnes was entirely consumed for feedstock use, which is not controlled under the Montreal Protocol. The historical production of HCFC-22 in India is depicted in Table-7 below:

Table-7: Historical HCFC-22 Production in India in 1994-2005

Year	Production (MT)
1994	5,844
1995	6,693
1996	6,152
1997	6,301
1998	11,426
1999	15,412

Year	Production (MT)
2000	14,061
2001	14,868
2002	14,606
2003	19,216
2004	25,592
2005	24,789

2.2.2 Exports

In India, the exports of HCFCs are of HCFC-22. The historical exports of HCFC-22 are depicted in Table-8 below:

Table-8: Historical HCFC-22 Exports from India 1994-2005

Year	Exports (MT)
1994	2,052
1995	2,830
1996	1,766
1997	2,537
1998	3,818
1999	5,895

Year	Exports (MT)
2000	10,478
2001	10,917
2002	11,400
2003	14,568
2004	19,285
2005	15,026

In 2005, the total exports of 15,026 metric tonnes of HCFC-22 were made by two of the HCFC-22 producers, namely Gujarat Fluorocarbons Ltd (7,612 metric tonnes) and SRF Ltd (7,414 metric tonnes).

The export of HCFC-22 is mainly to South/Southeast Asia, Middle East and also to Latin America and Caribbean.

2.2.3 Imports

The main HCFCs imported in India are HCFC-141b, HCFC-123 and HCFC-124. In 2005, the quantities imported for these HCFCs are shown in Table-9 below:

Table-9: HCFC Imports in India in 2005

HCFC	Imports in 2005 (MT)
HCFC-123	15
HCFC-124	2
HCFC-141b	2,156
Total	**2,173**

2.2.4 Consumption

The predominant consumption of HCFCs in India is of HCFC-22, HCFC-141b and small amounts of HCFC-123/124. Other HCFCs are consumed in very small quantities. Table-10 below shows the historical consumption of HCFC-22, HCFC-141b and HCFC-123 in India.

Table-10: Historical HCFC-22, HCFC-141b and HCFC-123 consumption in India 1994-2005

Year	HCFC-22 (MT)	HCFC-141b (MT)	HCFC-123 (MT)
1994	3,792	---	---
1995	3,800	---	---
1996	4,386	---	---
1997	3,764	---	---
1998	7,608	107	---
1999	9,517	518	18
2000	3,583	483	20
2001	3,769	359	25
2002	3,206	1,401	25
2003	3,648	952	0
2004	7,228	1,357	60
2005	8,854	2,156	17

The predominant use of HCFC-22 is as a refrigerant in the Refrigeration and Air Conditioning Sector. The predominant use of HCFC-141b is as a blowing agent in the Foams Sector.

2.2.5 Distribution and supply chain

HCFCs are distributed in India through distributors and wholesale stockists located in major cities, who in turn route the supplies through hundreds of small and medium retailers.

2.3 HCFC CONSUMPTION

2.3.1 Aerosols Sector

In the aerosols sector presently, hydrocarbons are the preferred propellant technology employed for non-medical use, though HCFCs can be potentially used. In 2005, one identified manufacturer of industrial aerosols consumed 56 metric tonnes of HCFC-141b, as a propellant. There are likely to be additional small manufacturers in the informal sector, with a consumption estimated around 15 metric tonnes. In medicated aerosols, currently CFCs are used. There is no identified usage of HCFCs in medicated aerosols.

2.3.2 Foams Sector

Since the beginning of phase-out activities for CFCs in 1995 in India, HCFC-141b was the preferred substitute blowing agent especially in small and medium-sized enterprises in the rigid and integral skin polyurethane foam sub-sectors (as well as in insulation of domestic/commercial refrigeration equipment, covered in section 2.3.4). HCFC-22 is used as a blowing agent only in trace quantities. The EPE and phenolic foam manufacturers converted to hydrocarbons. In 2005, the total estimated consumption of HCFC-141b in the Foams Sector is shown in Table-11.

Table-11: HCFC consumption in the Foams Sector in 2005

Rigid Polyurethane Foam (MT)	Integral Skin Polyurethane Foam (MT)	Total (MT)
963	72	1,035

The HCFC-141b consumption in India steeply increased in the past five years; from 359 metric tonnes in 2001 to 2,156 metric tonnes in 2005 (See Table-10). This increase is ascribed to conversions of CFC-based capacity carried out under the Montreal Protocol and due to introduction and expansion of capacity of HCFC-141b based production.

Based on the baseline data available from HCFC-141b users and upstream chemical suppliers in the Foams Sector, it is estimated that in 2005, close to 60% of the above consumption of 1,035 metric tonnes, amounting to about 621 metric tonnes, originates from new and/or expanded capacity of HCFC-141b based production. The remaining about 414 metric tonnes originates from enterprises which converted to HCFCs under Montreal Protocol assistance. It may be noted that additional quantities of HCFC-141b could be consumed as a component of imported pre-blended polyols, particularly in converted enterprises.

2.3.3 Firefighting Sector

Under the Montreal Protocol programme in India, the Firefighting Sector phased out use of CFCs. The conversion technologies used were FM200, ABC powder, CO_2, etc. Thus, there is no residual use of HCFCs in the Firefighting Sector.

2.3.4 Refrigeration & Air Conditioning Sector

The Refrigeration and Air Conditioning Sector is by far the largest consumer of HCFCs in India. HCFC-22 is the predominant substance, used as a refrigerant and to a lesser extent HCFC-123. HCFC-141b is used as a blowing agent for the rigid foam component in the manufacture of domestic, commercial and industrial refrigerant equipment.

HCFC-123

HCFC-123 is typically used as a refrigerant in large capacity centrifugal chillers, serving the central air conditioning sub-sector. However, in 2005, the there was no import of HCFC-123 for such use, in the Refrigeration and Air Conditioning Sector.

HCFC-141b

HCFC-141b is used as a blowing agent in the manufacture of rigid polyurethane foam for insulation of domestic, commercial, industrial and transport refrigeration equipment. One manufacturer of domestic refrigeration equipment (Whirlpool) used HCFC-141b as the blowing agent for the polyurethane foam insulation. All other manufacturers of domestic refrigerators have converted to hydrocarbons as a foam blowing agent.

In the commercial refrigeration sub-sector, most manufacturers are predominantly small and medium-sized enterprises and consequently use HCFC-141b as a blowing agent for the polyurethane foam. HCFC-141b is also used as a blowing agent for rigid polyurethane foam used for insulation applications in the industrial refrigeration (process cooling, cold stores) and transport refrigeration and air conditioning (insulation of trucks and buses) sub-sectors.

Table-12 shows the breakdown of consumption of HCFC-141b as a blowing agent for the polyurethane foam used as insulation in the Refrigeration and Air Conditioning Sector.

Table-12: HCFC-141b use in the Refrigeration and Air Conditioning Sector in 2005

Sub-sector	HCFC-141b Consumption (MT)
Domestic Refrigeration	585
Commercial Refrigeration	310
Industrial Refrigeration	105
Transport Refrigeration and Air Conditioning	50
Total	**1,050**

Excluding the consumption in the domestic refrigeration sub-sector for 2005, amounting to 585 metric tonnes, which was directly imported by the user(s), the remaining consumption of 465 metric tonnes, originates from two sources. Based on data available from users and upstream suppliers, it is estimated that in 2005, about 60% of this consumption (amounting to about 279 metric tonnes) originated from new and/or expanded capacity of HCFC-141b based production. The remaining consumption, (amounting to about 186 metric tonnes) is estimated at capacities covered by the Montreal Protocol assistance.

HCFC-22

HCFC-22 is the most widely used refrigerant in the Refrigeration and Air Conditioning Sector in India. In 2005, the total consumption of HCFC-22 was 6,640 metric tonnes in manufacturing of new equipment and 2,214 metric tonnes used in servicing of existing equipment.

In the Residential & Commercial Air Conditioning sub-sector, there are 6 major manufacturers accounting for about 75% of the total production and about 30-50 medium-sized manufacturers and several hundred unorganized and informal manufacturers (or assemblers) accounting for the remaining production.

In the Industrial Air Conditioning/Chillers sub-sector covering production of reciprocating, scroll and screw compressor-based chillers for central air conditioning applications there are about 8 major manufacturers and many small and medium-sized manufacturers.

In the Commercial Refrigeration sub-sector, which mainly manufactures high/medium temperature refrigeration equipment (display cabinets, beverage coolers, etc.) there are about 300 small and medium-sized manufacturers

In the Industrial Refrigeration (process chillers, cold stores, etc.) sub-sector manufacturing HCFC-22 based equipment serving process cooling/chilling applications for the food, chemical and pharmaceutical industries, there are about 20 main manufacturers and up to 50 small and medium-sized enterprises.

In the Transport Air Conditioning & Refrigeration sub-sector covering air conditioning and refrigeration systems for buses, trucks and truck cabs, vans, railway coaches, etc., there are about 15-20 major manufacturers and up to 100 small and medium-sized manufacturers.

None of the manufacturers of the HCFC-22 based equipment, as described above, have been assisted so far under the Montreal Protocol programme in India. Also none of the above, including consumption figures, covers HCFC-22 contained in any of the imported equipment in each of these sub-sectors.

Table-13 below provides estimated levels of the manufacturing of Refrigeration and Air Conditioning equipment for 2005, by application.

Table-13: Refrigeration and Air Conditioning Equipment Production in India in 2005

Sub-sector	Products	Production in 2005 (units)
Residential/Commercial Air Conditioning	Window units	900,000
	Split units	600,000
Industrial Air Conditioning/Chillers	Centrifugal	30
	Reciprocating	1,350
	Scroll	1,000
	Screw	180
Commercial Refrigeration	All	100,000
Industrial Refrigeration	All	1,320
Transport Air Conditioning/Refrigeration	All	1,500

All the applications/products mentioned above, use HCFC-22 as a primary refrigerant. Table-14 below shows the estimated consumption of HCFC-22 in 2005, in the manufacture of the various applications/products, none of which was funded earlier by the Montreal Protocol assistance.

Table-14: HCFC-22 consumption in manufacturing of Refrigeration & Air Conditioning Equipment in 2005

Sub-sector	HCFC-22 Consumption (MT)
Residential/Commercial Air Conditioning	4,510
Industrial Air Conditioning/Chillers	470
Commercial Refrigeration	790
Industrial Refrigeration	480
Transport Air Conditioning/Refrigeration	390
Total	**6,640**

2.3.5 Solvents Sector

In 2005, about 17 metric tonnes of HCFC-123 and HCFC-124 were used for metal cleaning applications. There were trace quantities of HCFC-141b also used for cleaning of electronic parts.

2.3.6 Feedstock Applications

India has indigenous production of PTFE/Teflon, for which about 909 metric tonnes of HCFC-22 was used as feedstock in 2005. This quantity, however, being not controlled under the Montreal Protocol, is not included in the HCFC-22 production, export and consumption figures discussed earlier.

2.3.7 Summary and Conclusions

In India, the main HCFCs in use are HCFC-141b, HCFC-22 and to a smaller extent, HCFC-123, used in the Aerosols, Foams and Refrigeration & Air Conditioning Sectors. Table-15 below shows the summary of the consumption of these substances in various sectors/sub-sectors.

Table-15: Summary of HCFC Consumption in India in 2005

Sector	Sub-sector	HCFC Consumption (metric tonnes)			
		HCFC-22	HCFC-141b	HCFC-123	Total
MANUFACTURING					
Aerosols	Industrial applications		71		71
Foams	Rigid Polyurethane Foam	---	963	---	963
	Integral Skin PU Foam	---	72	---	72
Refrigeration and Air Conditioning	Domestic Refrigeration	---	585	---	585
	Residential/Commercial AC	4,510	---	---	4,510
	Industrial Air Conditioning	470	---	---	470
	Commercial Refrigeration	790	310	---	1,100
	Industrial Refrigeration	480	105	---	585
	Transport Ref & AC	390	50	---	440
Solvents	Metal cleaning	---	---	17	---
Total (Manufacturing)		**6,640**	**2,156**	**---**	**8,796**
SERVICING					
Refrigeration & Air Conditioning	All	2,214	---	---	2,214
Total (Servicing)		**2,214**	**---**	**---**	**2,214**
GRAND TOTAL		**8,854**	**2,156**	**17**	**11,027**

It may be noted that the consumption figures for HCFC-22, HCFC-141b and HCFC-123 mentioned above, do not include quantities imported as a part of products, e.g., pre-charged refrigeration and air conditioning systems, imported pre-blended polyols, etc. and also do not include quantities produced/sold for feedstock uses.

3. ANALYSIS

3.1 DEMAND FORECASTS

3.1.1 Factors affecting demand

The consumption of HCFCs in India is predominantly in the Aerosols, Foams, Refrigeration & Air Conditioning and Solvents Sectors, which primarily manufacture consumer, commercial and industrial products. The demand for HCFCs in India is expected to grow significantly in the next decade due to the following developments:

- Progressive liberalization in economic policies
- Expansion of commercial and industrial activities due to sustained economic growth
- Burgeoning middle class and increasing per capita incomes
- Expansion of rural electrification and other infrastructures and growth of urban and suburban areas
- Increased penetration of consumer, commercial and industrial products

3.1.2 Projected growth rates

Table-16 shows the expected annual growth rates in demand for the various HCFC consuming sectors/sub-sectors from 2007 to 2015. These projected growth rates are guided by growth rates recorded in previous years, estimates provided by end-users, suppliers and industry associations and projected macro-economic growth rates (GDP) for the next decade.

Table-16: Expected growth rates in HCFC consumption in various sectors

Sector	Sub-sector	Projected Annual Growth in Consumption (%)	
		2006-2010	2011-2015
MANUFACTURING			
Aerosols	Industrial applications	10	10
Foams	Rigid PU Foam	15	10
	Integral Skin PU Foam	10	10
Refrigeration and Air Conditioning	Domestic Refrigeration	10	10
	Residential/Commercial AC	15	10
	Industrial Air Conditioning	10	10
	Commercial Refrigeration	15	10
	Industrial Refrigeration	10	10
	Transport Ref & AC	10	10
Solvents	Metal cleaning	10	10
SERVICING			
Refrigeration & Air Conditioning	All	10	15

3.1.3 Unconstrained demand scenario

Based on the projected growth in demand tabulated in Table-16 above, the projected consumption figures for each sector/sub-sector and substance are worked out applying compounded annual growth rates mentioned therein.

The projected consumption figures by sector and substance for 2010 and 2015 when no interventions are made and the demand is allowed to grow without constraints are shown in Table-17 below.

Table-17: Projected unconstrained demand for HCFCs in 2010 and 2015

Sector	Sub-sector	Projected HCFC Demand (metric tonnes) 2010 141b			2015 141b		
		141b (2010)	22 (2010)	123 (2010)	141b (2015)	22 (2015)	123 (2015)
MANUFACTURING							
Aerosols	Industrial applications	114	---	---	184	---	---
Foams	Rigid PU Foam	1,937	---	---	3,120	---	---
	Integral Skin PU Foam	116	---	---	187	---	---
Refrigeration and Air Conditioning	Domestic Refrigeration	942	---	---	1,517	---	---
	Residential/Commercial AC	---	9,071	---	---	14,609	---
	Industrial Air Conditioning	---	757	---	---	1,219	---
	Commercial Refrigeration	624	1,589	---	1,005	2,559	---
	Industrial Refrigeration	169	773	---	272	1,245	---
	Transport Ref & AC	81	628	---	131	1,011	---
Solvents	Metal cleaning	---	---	27	---	---	44
SERVICING							
Refrigeration & Air Conditioning	All	---	3,566	---	---	7,173	---
GRAND TOTAL		**3,983**	**12,818**	**27**	**6,416**	**20,643**	**44**

Table-18 below shows the projected unconstrained demand by substance in 2010 and 2015.

Table-18: Projected unconstrained demand by substance in 2010 and 2015

Substance	Projected unconstrained demand 2010 (metric tonnes)	2010 (ODP tonnes)	2015 (metric tonnes)	2015 (ODP tonnes)
HCFC-141b	3,983	438.13	6,416	705.76
HCFC-22	12,818	640.90	20,643	1,032.15
HCFC-123	27	0.41	44	0.66
Total	**16,828**	**1,079.44**	**27,103**	**1,738.57**

3.2 AVAILABILITY SCENARIOS AND PRICES

3.2.1 Availability Scenarios

India has indigenous production capacity for HCFC-22. The total installed production capacity at all four producers in India is estimated at about 42,000 metric tonnes annually, when adjusted for HCFC-22 production, since these are swing plants capable of producing both CFCs and HCFC-22.

As shown in Tables 17 and 18, unconstrained demand for HCFC-22 is expected to reach 12,818 metric tonnes in 2010 and 20,643 metric tonnes in 2015, by conservative estimates. In 2005, the total production of HCFC-22 in India was 24,789 metric tonnes, which includes 909 metric tonnes for feedstock use. The existing plants are swing plants, which also produce CFCs (11,446 metric tonnes of CFC-11 and CFC-12 combined in 2005). By 2010, the CFC production would be discontinued and the capacity currently used for production of CFCs would become available for producing HCFC-22.

In light of the above, no constraints on availability are foreseen for HCFC-22, to meet the unconstrained demand of 20,643 metric tonnes by 2015.

For HCFC-141b or HCFC-123, there is no indigenous manufacturing capacity in India presently. Based on the current regulations governing HCFC-141b production and exports in major non-Article-5 countries as well as China, and based on observations in the TEAP HCFC Task Force Report, availability of HCFC-141b in 2015 will not be constrained. Given that the unconstrained demand in India for HCFC-141b in 2015 is projected at 6,416 metric tonnes, it does not seem likely that there would a pressure on supply of HCFC-141b to meet this demand.

3.2.2 Price Trends

The current average retail market price in India for HCFC-22 is about US$ 8.00/kg and for HCFC-141b is about US$ 3.10/kg, excluding sales tax, but including excise and import duties, which amount to 16% to 38% of the basic price. Adjusted for an average annual inflation rate of about 5%, in 2015 these prices would reach about US$ 13.50/kg for HCFC-22 and US$ 5.10/kg for HCFC-141b.

3.3 TECHNOLOGY

The general factors affecting the selection of alternatives to HCFCs are as below:

- Suitable thermophysical properties
- Proven performance
- Acceptable processing characteristics
- Economic and convenient availability
- Environmental and occupational safety

In addition to zero ODP, it is preferable that the alternatives either have low GWP and/or sufficiently higher energy efficiency to compensate for the higher GWP.

3.3.1 Replacements for HCFC-141b

HCFC-141b is used predominantly as a blowing agent for polyurethane foam, in which rigid foam insulation is the main application. It is also used as a propellant in aerosols.

Aerosols Sector

For replacing HCFC-141b use in non-medical aerosols, HFCs (134a, 152a, 227ea) as well as hydrocarbons (where flammability is not a concern) are the commercially available alternative propellant technologies.

Foams Sector

In **rigid polyurethane foams**, comparison of properties of major currently available alternative blowing agents to HCFC-141b is shown in Table-19 below:

Table-19: Comparison of Zero-ODP alternatives to HCFC-141b in rigid polyurethane foam

Parameter	HCFC-141b	Cyclopentane	HFC-134a	HFC-245fa	HFC-365mfc
Boiling Point (°C)	32	49	-26.5	15.3	40.2
ODP	0.11	0	0	0	0
GWP	630	11	1,300	820	840
VOC	No	Yes	No	No	No
Conductivity (W/m-K)	9.70	12.00	13.6	12.2	10.6
Flash point (°C)	None	-37	None	None	-25
Flammability (% volume)	7.4 - 15.5	1.5 – 8.7	None	None	3.5 – 13.0

HFC-245fa and HFC-365mfc have been commercially introduced in the last few years in US and other developed countries and their performance has been largely established, however their prices are still high and availability is not wide. Their application may involve some changes to existing processing equipment. Since HFC-365mfc is flammable, safety issues need to be addressed.

Pentane isomers including Cyclopentane are in commercial use, however, due to their flammability, their use is limited to high-volume applications in organized sectors, where additional challenges and costs for safety can be more effectively managed.

HFC-134a is not popularly applied in rigid polyurethane foams, where thermal conductivity is a critical property, due to its relatively lower insulation performance and also its poor miscibility with polyols.

Recent commercial introduction of additional organic chemicals (Methylal, Methyl Formate) as blowing agents for in rigid polyurethane foam systems has generated interest. While field validation of these technologies continues, safety issues resulting from their flammability need to be addressed.

In **integral skin polyurethane foams**, alternatives to HCFC-141b include water/CO_2 blown systems, as well as HFC-134a, both of which have been commercially applied for the last few years.

3.3.2 Replacements for HCFC-22

HCFC-22 is primarily used as a refrigerant in refrigeration and air conditioning systems.

In general, pure fluid alternatives are preferred, as they tend to provide stable and predictable performance, more efficient heat transfer, avoid temperature glides in the evaporator and have relatively less issues from leakage. On the other hand, blends can be better optimized for performance, but are accompanied by less efficient heat transfer, evaporator temperature glide and leakage issues.

New Equipment

Table-20 below shows available alternative technologies to HCFC-22 for new equipment.

Table-20: Select Zero-ODP Alternative Technologies to HCFC-22 in New Equipment

Substance	GWP	Application	Remark
Hydrocarbons	0	Small-capacity domestic and commercial refrigeration equipment	Flammability issues
Ammonia	0	Industrial refrigeration and process chillers	Flammability and toxicity issues
CO_2	0	Supermarket refrigeration in a secondary loop and in stationary and mobile air conditioning systems	Major redesign of system components needed.
HFC-134a	1,300	Domestic and commercial refrigeration, medium temperature applications	Not efficient in low-temperature systems. Needs synthetic lubricants
R-407C	1,520	Most applications	Properties closely match R22 Temperature glide, synthetic lubricants needed, slightly less efficient than R22
R-410A	1,710	Most applications	Higher pressures, better cooling capacity, low temperature glide, high GWP, synthetic lubricants needed
R-404A	3,260	Low temperature applications	High GWP, less efficient at medium temperatures, synthetic lubricants needed

Existing Equipment

For replacement of HCFC-22 in existing systems, the main considerations are compatibility with the lubricant, performance and ease of retrofitting. Table-21 below shows the available technologies for replacing HCFC-22 in existing systems as drop-in replacements:

Table-21: Select Zero-ODP Alternative Technologies to HCFC-22 in Existing Equipment

Substance	GWP	Application	Remark
Hydrocarbons	0	Small-capacity commercial refrigeration equipment	Flammability issues
R-417A	1,950	Residential and commercial air conditioning and commercial refrigeration	Slightly less efficient than R22, High temperature glide, high GWP, compatible with mineral oil
R-422D	2,290	Low and medium temperature commercial refrigeration, water chillers	About 5% less cooling capacity, lower discharge temperature and comparable efficiency with R22, high GWP, compatible with mineral oil
R-424A (RS-44)	NA	Most applications	Comparable performance to R22, compatible with mineral oil, lower discharge temperatures than R22

Most of the blends described have been recently introduced in the past 1-4 years. While being commercially available, their prices are still quite high and supplies are not predictable at present. It is expected that the prices and availability would improve as the demand for HCFC-22 replacements gathers more momentum.

3.4 ENVIRONMENTAL IMPACT

3.4.1 Ozone Depletion

Based on the projected unconstrained demand for HCFCs in India, as described in section 3.1.3, the impact of their consumption on ozone depletion is shown in Table-22 below:

Table-22: Ozone Depletion Impact of HCFC consumption in India

Substance/Impact	HCFC-123	HCFC-141b	HCFC-22
ODP	0.015	0.11	0.05
Projected Consumption in 2010 (metric tonnes)	27	3,983	12,818
Impact in 2010 (ODP tonnes)	**0.41**	**438.13**	**640.90**
Projected Consumption in 2015 (metric tonnes)	44	6,416	20,643
Impact in 2015 (ODP tonnes)	**0.66**	**705.76**	**1,032.15**

3.4.2 Global Warming

The overall global warming impact of the projected unconstrained HCFC consumption in India in 2010 and 2015 is difficult to estimate, considering that energy efficiency, leakage, atmospheric lifetime and other factors external to the use of these substances strongly influence the overall global warming impact. Moreover, direct emissions of these substances, which would actually contribute to global warming, are also difficult to estimate.

Based on the respective global warming potentials of the three predominant HCFCs, the impact on global warming of the projected unconstrained HCFC consumption in India for 2010 and 2015 is shown in Table-23 below:

Table-22: Global Warming Impact of HCFC consumption in India

Substance/Impact	HCFC-123	HCFC-141b	HCFC-22
GWP	76	720	1,780
Projected Consumption in 2010 (metric tonnes)	27	3,983	12,818
Impact in 2010 (tonnes per tonne CO_2)	**2,052**	**2,867,760**	**22,816,040**
Projected Consumption in 2015 (metric tonnes)	44	6,416	20,643
Impact in 2015 (tonnes per tonne CO_2)	**3,344**	**4,619,520**	**36,744,540**

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

3.5.1 Availability and Prices of HCFCs

For HCFC-22, as discussed in Section 3.2.1, the existing production capacity in India of about 42,000 metric tonnes for HCFC-22, is adequate to meet the projected unconstrained demand of 20,643 metric tonnes by 2015.

For HCFC-141b, based on projected availability quoted from other sources (TEAP HCFC Task Force Report and others), the projected unconstrained demand in India of 6,416 metric tonnes by 2015, would be met.

For HCFC-123/124 the consumption projected for 2015 is quite small.

Considering the above, there appears that it would not be a major challenge to meet the projected unconstrained demand for HCFCs in India by 2015.

The current domestic street prices for HCFCs in India, especially for HCFC-22, are quite high as compared to other markets due to higher taxes, thus proving the inelasticity of demand and therefore modulating the demand through further taxes or levies would have only a limited effect.

In accordance with the control schedule of the Montreal Protocol applicable to Article-5 parties, the consumption of HCFCs has to be frozen at the 2015 levels, from 01 January 2016. Thus, the critical challenge in meeting this control milestone effective from 01 January 2016 is the relatively comfortable availability of HCFCs to meet the growing demand.

3.5.2 Regulations

India has one of the most proactive and progressive regulatory frameworks for controlled substances under the Montreal Protocol, including HCFCs.

The key regulations in India governing HCFCs, which came into effect from 2000 and which are being enforced vigorously, are as below:

- Import of HCFCs is restricted (subject to licensing)
- Import of HCFCs from non-Parties to the Montreal Protocol is prohibited
- Import of equipment containing HCFCs is restricted (subject to licensing)
- Installation of new capacity to manufacture HCFCs is prohibited
- Expansion of existing capacity to manufacture HCFCs is prohibited
- Distribution, sale, purchase and all other uses of HCFCs are subjected to registration and reporting

Thus it is seen that Government of India has gone a long way towards effectively controlling HCFC production and consumption in India.

Table-23 below shows the current regulations governing HCFCs in major non-Article-5 parties:

Table-23: Summary of HCFC Regulations in major non-Article-5 parties

Country	Substance	Year	Regulation/Remarks
Australia	HCFCs	2007	Does not manufacture HCFCs. Maximum imports 130 ODP tonnes in 2007. (In 2005, 8 licenses for HCFCs and 592 licenses for products containing HCFCs were issued)
Canada	HCFC-141b HCFC-142b HCFC-22	2010	Zero production/imports for equipment
	All HCFCs	2020	Zero production/imports for equipment
		2030	Complete phase-out
European Union	HCFCs (Foams)	2004	Complete phase-out
	HCFCs (RAC)	2004	Zero production/import for equipment
		2010	Zero service with virgin HCFCs
		2015	Zero service with all HCFCs
	All HCFCs	2010	Complete phase-out in consumption
		2025	Zero production
Japan	HCFC-141b	2004	Complete phase-out
	HCFC-22/142b	2010	Complete phase-out for equipment
	HCFC-22	2020	Complete phase-out
United States	HCFC-141b	2003	Zero production/import
	HCFC-22/142b	2010	Zero production/import for equipment
		2020	Complete phase-out
	All HCFCs	2015	Zero production/import for equipment
		2030	Complete phase-out

Comparing regulations in non-Article-5 countries from the above table, it is seen that the regulations on production/consumption of HCFCs in India (described in section 3.5.2) are progressive. The capacities for HCFC production levels have been effectively curtailed since 2000 and many controls on HCFC consumption are also in place.

Thus, there appears to be limited scope of more stringent regulations governing HCFC use, which constitutes another challenge for meeting the 2016 freeze in consumption.

3.5.2 Availability and Prices of Substitutes

As noted in Section 3.3, most of the substitutes for HCFCs have been or are being developed recently and in tandem with evolving regulations on HCFCs in non-Article-5 parties. In most Article-5 countries including India, the dissemination of these new technologies has been either non-existent or extremely limited.

The availability of substitutes for HCFCs discussed section 3.3 in India is limited or non-existent. Based on current publicly available information, the bulk international prices of most substitutes are in the region of US$ 9.00 – US$ 12.00 per kg or more.

Technologies needed for converting production facilities from HCFCs to substitutes are not widely available, although limited technical information on most substitutes is published by the manufacturers of these substitutes.

Thus, prices, availability, technology and information/awareness are factors which presently are unfavorable to wider adoption of substitute technologies. This constitutes another major challenge for reducing demand for HCFCs and thereby compliance with the 2016 freeze.

3.6 POTENTIAL ACTIONS FOR COMPLIANCE

The potential interventions that would assist in meeting with the next control milestone for HCFC use, i.e., the freeze in consumption at 2015 levels by 2016, are as below:

- Preparation at the earliest, of a strategy and action plan for compliance with the freeze in HCFC consumption from 2016 and progressive reductions thereafter. Such a strategy and action plan could include and prioritize:

  - Identification of sectors and applications where HCFC demand can be reduced on a priority basis, by implementing technology conversions, best practices, conservation, etc. For example in the Foams Sector in India, where HCFC-141b consumption would reach 6,416 metric tonnes by 2015, could be addressed for reducing HCFC-141b demand by adopting available promising and proven substitute technologies, such as HFC-245fa, Hydrocarbons, etc. Also in the Refrigeration and Air Conditioning Servicing Sector, existing infrastructures created for reducing CFC demand could be appropriately supplemented for reducing HCFC demand, through additional equipment inputs and investments, technical assistance, training, capacity-building, etc. In addition, drop-in substitutes could be employed to reduce HCFC demand at end-users installations.

  - Intensive awareness programmes incorporating compliance obligations, information dissemination on alternative technologies, networking and information exchange and technical assistance, would be needed to sensitize stakeholders on the importance of taking early actions that would ensure compliance

- In conjunction with the above, potential regulatory interventions, such as restriction on installation of new capacities or expansion of existing capacities for manufacturing of HCFC-based products, could be considered.

However, these interventions would need technical and financial assistance for meeting their incremental costs and the net costs to the economy. In addition, in line with the national priorities and guiding principles outlined in India's Country Programme and its update, such interventions need to be designed in such a way as to minimize industrial dislocation and obsolescence, maximize indigenization of technologies and minimize the economic impact to the consumers and industry.

3.7 SUMMARY AND CONCLUSIONS

HCFC-141b, HCFC-22 and HCFC-123 are the predominant HCFCs used in India, in the Aerosols, Foams, Refrigeration & Air Conditioning and Solvent Sectors.

HCFC-22 is produced in India, while other HCFCs are imported. The total capacity available for producing HCFC-22 from 2010 onwards would be about 42,000 metric tonnes.

In 2005, the consumption of HCFC-123, HCFC-141b and HCFC-22 was respectively 17 metric tonnes, 2,156 metric tonnes and 8,854 metric tonnes, amounting to a total of 11,027 metric tonnes.

Projected unconstrained demand by 2015 for HCFC-123, HCFC-141b and HCFC-22 is expected to reach 44 metric tonnes, 6,416 metric tonnes and 20,643 metric tonnes respectively, amounting to a total of 27,103 metric tonnes, potentially leading to notable environmental impacts on ozone depletion and global warming.

The numbers of enterprises currently consuming HCFCs in various HCFC-consuming sectors in India are tabulated below:

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Aerosols	Industrial applications	10
Foams	Systems houses	10
	Rigid PU Foam	450
	Integral Skin PU Foam	40
Refrigeration and Air Conditioning	Domestic Refrigeration	2
	Residential/Commercial AC	500
	Industrial Air Conditioning	100
	Commercial Refrigeration	350
	Industrial Refrigeration	70
	Transport Ref & AC	120
Solvents	Metal/electronic cleaning	50
SERVICING		
Refrigeration and Air Conditioning	All	Over 20,000

Note: The numbers and data provided in the table are a result of a limited survey of various sectors related to HCFCs the primary aim of which was to generate information that would enable the ExCom to establish a permanent aggregate level of consumption against which future activities could be funded. The numbers and data in this table are therefore ***indicative only and not binding***. The numbers/data may be revised in future as a result of more detailed sector-level information becoming available. The numbers/data may not be used without the prior consent of the Government.

The most significant opportunity for compliance with the 2016 freeze in consumption of HCFCs is the robust and forward looking regulatory framework on controlled substances instituted by Government of India. The most significant challenges for meeting the 2016 freeze include the comfortable availability of HCFCs, high cost and unpredictable availability of mature and proven substitutes, access to technology and funding for meeting the incremental costs of conversion and inadequate levels of awareness, capacity and training.

Potential actions for compliance include early interventions to reduce demand for HCFCs and to establish frameworks for sustaining these reductions.

SURVEY OF HCFCs IN INDONESIA

FINAL REPORT

OZONE UNIT, MINISTRY OF ENVIRONMENT
UNITED NATIONS DEVELOPMENT PROGRAMME (UNDP)

January 2007

EXECUTIVE SUMMARY

Indonesia ratified the Vienna Convention, the Montreal Protocol and London Amendment in June 1992. The Copenhagen Amendment was ratified in June 1998. The Beijing and Montreal Amendments were ratified in 2005, thus signifying the clear commitment and obligation of the Government of Indonesia to reduce and eliminate the use of ODS including HCFCs, in accordance with the agreed control milestones. Indonesia has accordingly promulgated regulations for the control of ozone depleting substances, which provide for extensive control and monitoring of imports of these substances.

In Indonesia, HCFCs are used mainly in the Foams and Refrigeration & Air Conditioning sectors. HCFC-22 and HCFC-141b are the HCFCs most commonly used in those sectors.

The HCFC consumption in Indonesia increased from 1,250 MT in 1996 to 3,976 MT in 2005, indicating an average annual growth in consumption of over 12%. The figures do not include HCFCs contained in imported refrigeration and air conditioning equipment or HCFCs which are premixed in polyols.

Unconstrained demand for HCFCs in Indonesia is predicted to reach about 9,662 MT by 2015, which would have economic implications and also environmental impacts both on ozone depletion and global warming.

The first control on HCFCs under the Montreal Protocol will be a freeze in HCFC consumption at 2015 levels starting from 2016. In order to comply with this control measure, it is necessary that appropriate alternative technologies are available cost-effectively and such technologies will need to be gradually phased in, to allow time to industry and consumers to reduce their dependence on HCFCs. Currently the potential alternative technologies for HCFCs are not widely available and are expensive. In order to meet the challenge of compliance, technical and financial assistance to help the consumers, industry and other stakeholders for managing the transition effectively, is considered critical. Additionally, the existing regulatory and other structures, created for controlling CFCs, can be suitably supplemented, to expand them for controlling HCFCs.

SURVEY OF HCFCs IN INDONESIA

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LIST OF ABBREVIATIONS

AC = Air Conditioning
CFC = Chloro Fluoro Carbon
FK = Fluoroketone
GWP = Global Warming Potential
HC = Hydrocarbon
HCFC = Hydro Chloro Fluoro Carbon
HFC = Hydro Fluoro Carbon
KLH = Kemetrian Lingkungan Hidup (Ministry of Environment)
ODS = Ozone Depleting Substance
ODP = Ozone Depletion Potential
MOE = Ministry of Environment
MOT = Ministry of Trade
MT = Metric Tonnes
NOU = National Ozone Unit
RAC = Refrigeration and Air Conditioning
UNDP = United Nation Development Programme
XPS = Extruded Polystyrene

1. INTRODUCTION

1.1 BACKGROUND

Indonesia ratified the Vienna Convention and the Montreal Protocol in June 1992. The per capita consumption of ODS in Indonesia is being less than 0.3 kg; hence Indonesia is classified under Article-5 of the Montreal Protocol. In 1994, Indonesia prepared a Country Program incorporating the national strategy and action plan to phase out ODS in line with the Montreal Protocol control schedule. The action plan proposed to address each of the ODS consuming industry sectors, through six elements, namely, institutional measures, regulatory measures, incentive and disincentive measures, awareness and information dissemination, investment and technical assistance and monitoring. With the assistance of the Multilateral Fund, several investment and non-investment activities were implemented by Indonesia, from 1993 to 2000. Complete ODS phase-out was initially targeted ambitiously for 1998.

The Indonesia Government initiated preparation of the Country Program Update in 1998 with the assistance of the World Bank, UNDP and the industry, under which, the ODS consuming sectors were resurveyed. The updated country program renewed and reinforced Indonesia's commitment, strategy and action plans to eliminate ODS and is intended to serve as a guideline for future activities related to meeting Indonesia's obligations under the Montreal Protocol. Realizing the needs of the industry and the economy, the updated Country Program revised the target date for complete ODS phase-out to the end of 2007.

HCFCs, which have Ozone Depleting Potential (ODP) up to 15% of that of CFCs, are also classified as controlled substances under Annex-C, Group-I of the Montreal Protocol. HCFCs therefore, have use restrictions and would eventually have to be phased-out. For developing countries, the scheduled phase-out date for HCFCs is 01 January 2040 with an interim control measure of freezing HCFC production and consumption at 2015 levels, from 01 January 2016.

HCFCs have been approved as substitutes for CFCs in many of the projects and activities supported by the Multilateral Fund. However, recently restrictions on HCFC use have been increasingly adopted by developed countries. This may potentially affect availability of HCFCs in developing countries, especially those which do not produce HCFCs.

In order to establish a national aggregate level of HCFC consumption, a limited in-country study and survey will be carried out. The output of the study would be used in the future HCFC reduction or phase out program in Indonesia.

The expected outputs of this survey are:

- Situation analysis on HCFC consumption in Indonesia regarding its compliance with the Montreal Protocol.
- Historical import data preferably from 1995 and segregated by originating countries.
- HCFC consumption by sector.
- List of HCFC users, segregated by sector.
- List of HCFC users who received assistance under the Montreal Protocol Program
- List of HCFC users who did not receive assistance under the Montreal Protocol Program.
- Approximate population of HCFC-based equipment segregated by sector.

UNDP, in consultation and agreement with Ozone Unit/KLH, retained Dr. Ari Darmawan Pasek/Institut Teknologie Bandung, to carry out the survey. The survey was conducted in close cooperation with Ozone Unit/KLH and UNDP.

1.2 APPROACH AND PREPARATION

The Executive Committee of the Multilateral Fund at its 45th Meeting, approved activities to be implemented by UNDP, which aimed to conduct limited surveys of HCFC use in selected countries, with an objective of among other things, establishing a national aggregate level of HCFC consumption for these countries, against which future projects and activities may be funded. The selected countries were:

Latin America:	Argentina, Brazil, Colombia, Mexico, Venezuela
Middle East:	Iran, Lebanon, Syria
South Asia:	India, Sri Lanka
Southeast Asia:	Indonesia, Malaysia

To ensure effective coordination of survey activities in this global project involving 12 countries and to better address cross-regional issues, UNDP planned the activities to be carried out, using a three-stage process:

- Data collection and survey at the national level
- Compilation and analysis of survey data
- Presentation and reporting of survey data

The national-level data collection and survey work was carried out through recruitment of a local consultant entity (either an individual or a firm/institution) recommended by the respective governments. The compilation and analysis of the survey data was carried out through UNDP's international experts and researchers to impart credibility and quality. The presentation and reporting of survey data was carried out in consultation with the country governments, which in turn were expected to ensure the required country-level consultations within the respective industry and expert institutions.

Since Indonesia does not produce or export any HCFC, the HCFC consumption is equal to the amount of HCFC imported to Indonesia. For that reason, the import data will be search through Statistical Bureau and custom office. However, since the designation number of the HCFC especially HCFC blends mostly are not available, the import data obtained from custom and statistical bureau is only a best prediction. To support the import data, survey of the importer, distributors and end users were conducted. Meeting and workshop with related person and institution as mention above were held.

Hydrochlorocarbons (HCFCs) is compounds containing hydrogen, chlorine, fluorine and carbon atoms. They have been used in many applications as a pure compound or blend with other compound. The survey and identification work covered the servicing establishments, as well as manufacturers of refrigeration equipment related to the domestic, commercial, industrial and transport refrigeration sub-sectors, MAC and Chiller sub-sectors. List of common HCFCs and blend containing HCFC is listed in Table 1.1.a and 1.1.b respectively. Sectors of HCFCs application and the type of common HCFCs used in each sector is shown in Table 1.2. Table 1.3 shows the ODP and GWP of the substance.

As per ExCom Decision 45/6 (i), the 12 surveys provide information on current consumption by sector and substance, as well as the forecasted projections till 2015. This information will allow the Multilateral Fund Secretariat – if requested by the Executive Committee – to propose funding policies and procedures for the next few years, including the possible establishment of an eligible national aggregate level of HCFC consumption

1.3 SURVEY METHODOLOGY

The survey methodology comprised of the following steps:

- Interaction with National Statistical Bureau,
- Interaction with Custom office,
- Interaction with Ministry of Trade,
- Interaction with main importers,
- Interaction with main distributors,
- Interaction with manufacturers of refrigeration equipment,
- Interaction with major servicing establishments,
- Interaction with major end users, and
- Interaction with important resource persons and or associations.

The interaction was carried out through meetings and visits. Through these interactions, lists of HCFCs imported to Indonesia and its amount, main importers, major end users, main distributors, and entities involved in servicing of HCFC-based equipment, were obtained.

Table 1.1.a List of HCFCs and their designations

HCFCs	Formula	Chemical Name	HS Number	CAS Number
HCFC-21	$CHCl_2F$	Dichlorofluoromenthane	2903.49.	75-43-4
HCFC-22	$CHClF_2$	Chlorodifluoromethane	2903.49.	75-45-6
HCFC-31	CH_2ClF	Chlorofluoromethane	2903.49.	
HCFC-123	$CHCl_2CF_3$	2,2-Dichloro-1,1,1-trifluoromethane	2903.49.	306-83-2
HCFC-123a	$C_2HCl_2F_3$	1,2-Dichloro-1,1,2-trifluoromethane	2903.49.	354-23-4
HCFC-123b	$C_2HCl_2F_3$	1,1-Dichloro_1,2,2-trifluoromethane	2903.49.	812-04-4
HCFC-124	$CHClFCF_3$	2-Chloro-1,1,1,2-tetrafluoroethane	2903.49.	2837-89-0
HCFC-124a	C_2HClF_4	1-Chloro-1,1,2,2-tetrafluoroethane	2903.49.	354-25-6
HCFC-141b	CH_3CCl_2F	1,1-Dichloro-1-fluoroethane	2903.49.	1717-00-6
HCFC-142b	CH_3CClF_2	1-Chloro-1,1-difluoroethane	2903.49.	75-68-3
HCFC-225ca	$CHCl_2CF_2CF_3$	3,3-Dichloro-1,1,1,2,2-pentafluoropropane	2903.49.	422-56-0
HCFC-225cb	$CHCLFCF_2CCl_2$	1,3-Dichloro-1,1,2,2,3-pentafluoropropane	2903.49.	507-55-1

Table 1.1.b List of HCFC Blends and their designations

Blend	Formula	HS Number	CAS Number
R-401A	53% HCFC-22 + 34% HCFC-124 + 13% HFC-152a		
R-401B	61% HCFC-22 + 28% HCFC-124 + 11% HFC-152a		
R-401C	33% HCFC-22 + 52% HCFC-124 + 15% HFC-152a		
R-402A	38% HCFC-22 + 60% HFC-125 + 2% HC-290		
R-402B	60% HCFC-22 + 38% HFC-125 + 2% HC-290		
R-403A	75% HCFC-22 + 20% PFC-218 + 5% HC-290		
R-405A	45% HCFC-22 + 5.5% HCFC-142b + 7%HFC-152a + 42.5% PFC-C318		
R-406A	55% HCFC-22 + 41% HCFC-142b + 4% HC-600a		
R-408A	47% HCFC-22 + 7% HFC-125 + 46% HFC-143a		
R-409A	60% HCFC-22 + 25% HCFC-124 + 15% HCFC-142b		
R-409 B	65% HCFC-22 + 25% HCFC-124 + 10 % HCFC-142b		
R-411A	87.5% HCFC-22 + 11% HFC-152a + 1.5% HC1270		
R-411B	94% HCFC-22 + 3% HFC-152a + 3% HC-1270		
R-412A	70% HCFC-22 + 25% HCFC-142b + 5% PFC-218		
R-414A	51% HCFC-22 + 28.5% HCFC-124 + 16.5% HCFC-142b + 4% HC-600a		
R-414B	50% HCFC-22 + 39% HCFC-124 + 9.5% HCFC-142b + 1.5% HC-600a		
R-415A	82% HCFC-22 + 18% HFC-152a		
R-415B	25% HCFC-22 + 75% HFC-152a		
R-416A	39.5% HCFC-124 + 59% HFC-134a + 1.5% HC-600		
R-418A	96% HCFC-22 + 2.5% HFC-152a + 1.5% HC-600		
R-501	25% CFC-12 + 75% HCFC-22		
R-502	51.2% CFC-115 + 48.8% HCFC-22		
R-505	78% CFC-12 + 22% HCFC-31		
R-506	44.9% CFC-114 + 55.1% HCFC-31		
R-509A	44% HCFC-22 + 56% PFC-218		

Table 1.2 List of HCFCs sectors of application

Sector	HCFCs used
Refrigeration	
• Domestic refrigeration	HCFC-141b
• Commercial Refrigeration	HCFC-141b, HCFC-22, HCFC blends
• Industrial refrigeration[1]	HCFC-141b, HCFC-22, R-502
• Transport refrigeration	HCFC-141b, HCFC-22, R-502
Stationary Air Conditioning	
• Residential and commercial AC	HCFC-22
• Chiller	HCFC-22, HCFC-123
Mobile Air Conditioning	None
Foams	HCFC-141b, HCFC-142b, HCFC-22
Medical Aerosol	None
Non Medical Aerosol	HCFC-22, HCFC-141b, HCFC-142b
Fire Protection	HCFC-123, HCFC-124, HCFC-22 (blends)
Solvent	HCFC-141b, HCFC-225ca, HCFC-225cb

[1] including food processing/cold storage

Table 1.3 List of some pure HCFCs and its ODP and GWP[1]

Substance	ODP*	GWP**
HCFC-22	0.05	1780
HCFC-123	0.06	76
HCFC-141b	0.11	713
HCFC-142b	0.065	2270
HCFC-225ca	0.025	120
HCFC-225cb	0.033	586

**100 yr time horizon

[1] Intergovernmental Panel on Climate Change, Technology and Economic Assessment Panel, Safeguarding The Ozone Layer and The Global Climate System, Issue Related to Hydrofluorocarbons and Perfluorocarbons, WMO, UNEP, 2005.

2. OBSERVATIONS

2.1 INTRODUCTION

The HCFC consumption in Indonesia has experienced significant growth in the past decade due to the consistent growth in the per capita incomes, and the predominance of commercial AC and refrigeration market due to the growing of commercial building, apartment, and luxurious residential. The growth in HCFCs consumption is also due to the CFC phase out program that encourage people to use available HCFCs as an alternative. In Indonesia HCFCs are mainly consumed as blowing agents and refrigerants.

2.2 INSTITUTIONAL FRAME WORK

2.2.1 Institutional Arrangements

The activities related to ozone layer protection and implementation of the Montreal Protocol, are coordinated through the National Ozone Unit (NOU), within the Climate Change and Atmosphere Department of the Ministry of Environment. The NOU has a strong coordination with Ministry of Trade, Ministry of Industry, Custom office and local government in implementing of ODS phase out program and ODS import control and monitor.

The Ministry of Trade has the authority to:

1. create and amend relevant ODS import and trade policy and regulation;
2. issue permission to allow companies to become a producer-importer or registered importers of ODS; and
3. impose prohibition on either producer-importer or registered-importers that violate policies and regulations, by revoking the permit letter of ODS importation.

To be permitted as an ODS importers, a company must obtain recommendation from the Ministry of Industry and Ministry of Environment. The Ministry of Industry has the authority to:

1. Recommend changes to policy relevant to producer-importers, and can issue recommendation letters to prospective producer-importer companies; and
2. Impose restrictions on producer-importers that violate Ministry of Industry policies and regulations, by issuing a formal warning, or preventing renewal of registration as a producer importers.

Inter-departmental coordination proceeds through the Dangerous Materials Management and Handling Communication Forum, which includes Customs Department, Ministry of Industry, Ministry of Trade, Ministry of Environment, Drug and Food Monitoring Agency (BPOM), Ministry of Health and Ministry of Agriculture.

Since 2002, The Ministry of Environment has upheld a steering committee and technical committee to facilitate inter departmental coordination. Other representatives from government departments (Bappenas, Indonesia Police, Justice Department, etc), and expert from research institutions (BPPT, Universities) are member of the committees.

2.2.2 Policies

To provide regulatory and policy support for enabling the industry to eliminate ODS, the Government of Indonesia has taken the following initiatives and actions:

a) Establishing a licensing system for import of ODS from 1998 and the latest revised in year 2006 which include licensing system for HCFCs importer.
b) Ban on imports of goods containing ODS from 1998.
c) Monitoring the use and import of ODS to minimize illegal trade and capacity-building of customs officials in line with ASEAN agreements
d) Active monitoring of the progress of implementation of projects funded by MLF
e) Formulating guidelines and regulations as necessary for policy implementation
f) Supporting public awareness initiatives and campaigns for promoting ozone layer protection at the consumer level.
g) Regular interaction with other ministries and departments, industry representatives and implementing agencies for information dissemination related to impact of policy measures
h) Promoting development and use of ozone-friendly technologies

2.2.3 Regulations and Other Control Measures

Considering that Indonesia is a member of international community it considers it necessary to actively participate in joint activities for the purpose to prevent the ozone from degrading and depleting. Indonesia has developed several regulations concerning the ozone layer protection.

On 13th May 1992, Indonesia issued Presidential Decree number 23 year 1992 regarding ratification of Vienna Convention, Montreal Protocol, and London Amendment. Based on this Presidential Decree, on 27 January 1998, the Minister of Industry and Trade issued decree N0. 110/MPP/Kep/I/1998 on prohibition of producing and import of the Ozone Depleting Substance (ODS) and using ODS in new product and trading the new products containing ODS, and the requirement to put non CFC or non halon label in new products.

On 23rd June 1998, Indonesian Government ratified the Copenhagen Amendment to phase out methyl bromide through the Presidential decree No. 92 year 1998. Therefore Indonesia has an obligation to phase out methyl bromide gradually. To implement the Decree, the Minister Decree was amended by Ministerial Decree No. 410/MPP/Kep/9/1998 and No. 411/MPP/Kep/9/1998 for regulating of Methyl Bromide Import. The Methyl Bromide was allowed to be imported for quarantine, warehouse and pre-shipping purpose only through licensed importers.

The Minister of Industry and Trade decrees were supported by the decrees of Minister of Health and Minister of Agriculture. Through decree No. 376/Menkes/Per/VIII/1990, 2nd August 1990, the Health Ministry prohibit the use of ODS as aerosol propellant in cosmetic used. The Agriculture Minister issued decree No. 949/KPTS/TP.270/12/98 on 3rd December 1998, which consider methyl bromide as a limited pesticide; all products should be registered in Agriculture Department and should be labeled as a regulated product; and the Methyl Bromide can only be used by authorized personnel only.

The Indonesian Government also issued Law No. 74 year 2001 on Handling of Dangerous and Toxic Substances which includes ODS.

Later the Minister of Industry and Trade decrees were amended by Minister of Industry and Trade No. 789/MPP/Kep/12/2002 and No. 790/MPP/Kep/12/2002 to extent the time limit for phase out of several ODS. The methyl bromide, CFC-11, CFC-12, CFC-113, CFC-114, and CFC-115 still can be imported up to 31 December 2007 through the licensed importers. For CFC only one importer is appointed as a licensed importer. For methyl bromide, additional Agriculture Minister Decree No 123/KPTS/IP.270/2/2002 was issued on 13th February 2002. The decree required that the methyl bromide importers and distributors have to be registered in Agriculture Department.

The commitment of Indonesian Government to the Montreal Protocol was further extended by The President Decree No. 33 year 2005 for Beijing amendment ratification and decree No. 46 year 2005 for Montreal amendment ratification.

The Minister of Industry and Trade Decrees were amended again by Decree of Minister of Trade No. 24/M-DAG/PER/6/2006. With this new regulation, the licensed importer is open to any company provided they have proper recommendation from the Ministry of Environment and Ministry of Industry prior to their registration in Minister of Trade. The regulation also affects to the HCFC importers.

2.3 HCFC SUPPLY SCENARIO

2.3.1 Production

There is no production of HCFCs in Indonesia. The entire domestic demand is met through imports from USA, China, India, Korea, Europe, Singapore, etc.

2.3.2 Exports

Since Indonesia does not produce any HCFCs; there was no report on export or re-export of HCFCs from Indonesia.

2.3.3 Imports

Under the new regulation (Decree of Minister of Trade No. 24/M-DAG/PER/6/2006, approved in year 2006) ODS importers including HCFC importers have to be registered in Ministry of Trade.

Prior to the registration they have to obtain a recommendation letter from the Ministry of Environment (NOU Office). Currently, the Government of Indonesia has designated certain importers for HCFCs, and CFCs who are licensed to import mandated through the licensing regulation. The Government is also setup an import quota for each importer.

The HCFCs imported to Indonesia mainly are HCFC-22 and HCFC-141b. Very small quantities of HCFC-123, HCFC-142b, HCFC-124 and also blends R-4xx series, and R-5xx series are also imported. The HCFCs imported from 1996 to 2005 is shown in Figure 2.1.

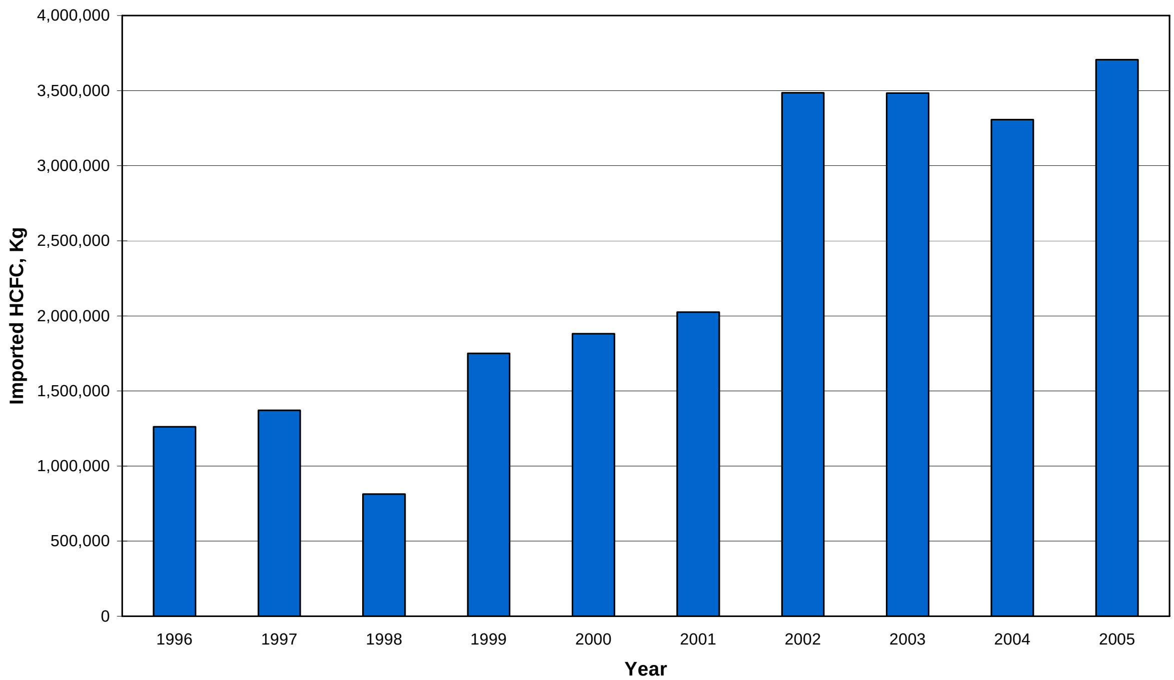

Figure 2.1 Imports of HCFCs to Indonesia

From the figure it can be seen that the HCFCs import has been more than tripled during the last 10 years, from 1,250 MT in year 1996 to almost 3,976 MT in year 2005. Most of the HCFCs imported to Indonesia are HCFC-22 and HCFC-141b. The quantities of the two main HCFCs, namely, HCFC-22 and HCFC-141b are shown in Table-2.1 below.

Table 2.1 HCFCs imported to Indonesia in 2005

Substance	Quantity (metric tonnes)
HCFC-141b	1,636
HCFC-22	2,340
Total	**3,976**

2.3.4 Distribution and Supply Chain

The HCFCs imported are sold to the users directly by the importers or indirectly through main distributors or retailers. Since the HCFCs consumption in Indonesia various sectors is significantly high, HCFCs are also supplied through service establishments and contractors.

2.4 HCFC CONSUMPTION

2.4.1 Aerosol Sector

Medical Aerosols

In Indonesia, CFCs are used as propellants for medical aerosols. In 2005, about 61 tonnes of CFCs were used in manufacture of metered dose aerosols by two pharmaceutical companies. However, no HCFCs were used in medical aerosols.

Non Medical Aerosols

For non medical aerosol application, hydrocarbons are used as propellant instead of HCFCs. This is because the hydrocarbon (Butane) has appropriate pressure. The pressure of butane is lower compare to HCFC-22, but it is higher compared to HCFC-141b.

2.4.2 Firefighting Sector

In the firefighting sector HCFCs are rarely used. Pressurized water, CO2, ABC powder and FM200 are used as substances in fire extinguishers.

2.4.3 Foams Sector

In Indonesia, foam polymer has been used in a variety of insulating and non insulating application, utilizing the potential for creating both flexible and rigid structures. Flexible foam is used for furniture, cushioning, bedding, and packaging and impact management (safety) foam. Rigid foams are used primarily for thermal insulation applications of the types required for appliances, transport and in buildings such as integral skin applications. Rigid foams are also used to provide structural integrity and buoyancy.
The foam type produced in Indonesia includes polyurethane, extruded polystyrene and extruded polyethylene.

The use of HCFCs in foam blowing is mainly for rigid foam insulation and integral skin applications. HCFC-141b is the most widely used CFC substitution technology for polyurethane foam in Indonesia. The main reasons are the modest transition cost, easy implementation, similarity of end product performance (including energy) and wide availability. Most foams for comfort and food applications use methylene chloride. The consumption of HCFCs in the foam sector is summarized in Table 2.2.

Table 2.2 HCFC-141b Consumption in Foam Sector in 2005

Application	Consumption (MT)
Rigid Foam	1,094
Integral Skin Foam	133
Total	**1,227**

2.4.4 Refrigeration and Air Conditioning Sector

In Indonesia HCFCs are used in commercial refrigeration, industrial refrigeration, transport refrigeration, and stationary air conditioning which includes residential and commercial air conditioning, and chillers. The HCFC used in those sectors is mostly HCFC-22. Small amounts of R-502 are consumed in cold storage refrigeration systems. The total consumption of HCFC-22 in the sector is approximately 2,340 MT in 2005, including servicing.

There is very little of production of air-conditioning chillers and refrigeration system. They are imported from North America, Europe, Japan, Korea, China and Southeast Asia. Some manufacturers assemble air-conditioning (and also refrigeration) systems in Indonesia but the components are imported from the aforementioned countries. In year 2005, the production of window type and split AC is double from 50,000 units in 1990 to almost 100,000 units in 2005. The composition of the AC type also changes, from 70% of window AC types in 1990 to 100% split AC type in year 2005. Other brands of air-conditioning are imported built-up from Japan, Korea, China, Thailand and Malaysia. The last two countries now are base country of manufacturer of several branded AC.

One company manufactures refrigeration hermetic compressors in Jakarta area. Other refrigeration system components, such as evaporators, condensers, etc. are partly imported and partly manufactured indigenously.

The distribution of HCFC-22 consumption in the sub sectors is shown in Table 2.3.

Table 2.3 HCFC-22 consumption in Refrigeration and Air Conditioning Sector

Sector	Estimated Consumption in 2005 (MT)
Domestic Refrigeration	30
Commercial Refrigeration	212
Industrial Refrigeration	29
Transport refrigeration	25
Stationary AC	289
Servicing	1,755
Total	**2,340**

2.4.5 Solvents Sector

In solvent sector HCFC-141b and HCFC-123 are used mainly in metal and electronic cleaning, however in very small quantities.

2.4.6 Feed stock Applications

Feedstock application is the application of HCFC as a raw material for production of other materials or goods. In Indonesia synthetic materials such as Teflon, PTFE and others are imported and none of them are produced in Indonesia.

2.4.7 Summary and Conclusions

In Indonesia, the HCFCs are used in Foam, Refrigeration, and air conditioning sectors. HCFC-22 and HCFC-141b are the HCFCs commonly used in those sectors. The 2005 consumption of HCFCs is shown in Table 2.4.

Table 2.4 Summary of HCFC consumption in Indonesia in 2005**

SECTOR	Consumption (MT)		
	HCFC-22	HCFC-141b	HCFC-123
Foam	---	1,227	---
Refrigeration & Air Conditioning			
Domestic Refrigeration	30	---	---
Commercial Refrigeration	212	310	---
Industrial Refrigeration/Chillers	29	50	---
Transport Refrigeration	25	49	---
Stationary Air Conditioning	289	---	---
Servicing	1,755	---	---
Total	**2,340**	**1,636**	**---**

**The figures do not include HCFCs contained in imported refrigeration or air conditioning equipments.

3 ANALYSIS

3.1 DEMAND FORECAST

The demand for HCFCs will tend to increase as the economic growth increases. It is predicted that for the Foams Sector, HCFC consumption growth will be about 7.5% annually until 2015 if unconstrained. Table 3.1 shows the prediction of unconstrained HCFC demand in Foam Sector from 2006 to 2015.

Table 3.1 Demand forecast of HCFCs in Foams Sector 2006-2015

HCFC	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
HCFC-141b	1,319	1,418	1,524	1,638	1,761	1,893	2,035	2,188	2,352	2,528

Thus, the unconstrained consumption of HCFCs in the Foams Sector in Indonesia in 2015 is expected to reach 2,528 metric tonnes.

In the Refrigeration and Air Conditioning Sector, the unconstrained growth is expected around 10% annually until 2015. This is because of progressively increasing demand for air conditioning appliances and also commercial and industrial refrigeration and air conditioning equipment. Also, because of increased requirement for servicing of the existing and incoming population of HCFC based equipment, the demand is expected to rise at that level. Table 3.2 shows the prediction of unconstrained demand for HCFCs in the Refrigeration and Air Conditioning sector from 2006 to 2015.

Table 3.2 Demand forecast of HCFCs in RAC Sector 2006-2015

HCFC	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
HCFC-141b	450	495	545	600	660	726	799	879	967	1,064
HCFC-22	2,574	2,831	3,114	3,425	3,768	4,145	4,560	5,016	5,518	6,070
Total	**3,024**	**3,326**	**3,659**	**4,025**	**4,428**	**4,871**	**5,359**	**5,895**	**6,485**	**7,134**

Thus, the unconstrained consumption of HCFCs in the Refrigeration and Air Conditioning Sector in Indonesia in 2015 is expected to reach 7,134 metric tonnes.

3.2 AVAILABILITY SCENARIO AND PRICES

Indonesia imports HCFCs from many countries. As long as HCFC remain available in the producer countries, Indonesia will not have difficulty in importing HCFCs. The tables also show that the imported HCFC are unloaded in many ports in Indonesia, implying high accessibility of distribution.

The CIF price of HCFC-22 is less than US$ 1.00/kg, and other HCFCs is around US$ 2.00/kg. This indicates that the HCFCs are in over supply and are likely to remain cheap in several coming years. Price increases may occur from 2010, when developed country producers may start to reduce their production. Prices of most substitutes are currently in the range of US$ 8.00 to US$ 15.00 per kg based on market information.

3.3 TECHNOLOGY

In order to reduce the environmental impact caused by HCFCs and to replace them, alternative substances need to be introduced. The alternative substances could be HFCs, hydrocarbon or other environmental friendly substances depending on the application sectors.

Foam sector

In the foam sector HFCs have been considered as replacement of HCFCs. HFC-134a and HFC 152a could be used in limited process such as those processes used to manufacture XPS (Extruded Polystyrene). The boiling points of these substances are not appropriate for wide range of processes. Recently HFC-245fa and HFC-365mfc have enabled a wider range of processes to be encompassed by HFC technologies. However, the availability and the price of HFCs (particularly the newer materials) has ensured that HFCs are only used where they are perceived to be absolutely necessary, where product liability, process safety and/or thermal performance benefits are evident.

In rigid polyurethane foam, the use of cyclopentane and various isomers of pentane to replace fluorocarbons has very rapidly gained wide acceptance in all regions in the world. For building applications, normal pentane is the most widely used isomer. Normal pentane and cyclopentane/isopentane blends are typically used in rigid polyisocyanurate insulating foam. In domestic refrigerators and freezers, cyclopentane was introduced in Europe in 1993 and it has gained acceptance in all regions except the USA, where existing regulation and stringent fire safety codes make the conversion of existing facilities uneconomical. Despite the higher thermal conductivity compare to foams based on HCFC-141b or HFC-245fa, appliances based on the hydrocarbon attain the highest energy efficiency. For rigid XPS insulation foams, hydrocarbons can be used as co-blowing agents with either CO_2 or HFC-based systems.

CO_2 and CO_2-water are widely used as blowing agents in many non insulating polyurethane foam sectors, including integral skin foam, molded foam for transportation and footwear. In many cases, this blowing agent technology has been the direct replacement for CFC-11. The technology is not widely used for insulating polyurethane foams since it gives a lower thermal performance. The commercialization of this technology is being monitored closely, but most recent reports suggest that some subsidy for equipment investment may be required to stimulate market acceptance. Hence, the use of CO_2-based blowing agent system is technically challenging, and not suitable for many existing manufacturing lines, particularly where such lines require substantial investment. These considerations put the technology out of reach for many small and medium enterprises.

For Indonesian conditions, hydrocarbons are one of the best alternatives, because cyclopentane, isopentane and normal pentane are/can be produced in Indonesia. However, their flammability has to be overcome by appropriate safety measures and sufficient infrastructure and management. Introducing this technology for HCFC replacement could be very challenging especially for small and medium enterprises.

HFC-245fa, HFC 365mfc and CO_2 based technology may become an attractive alternative as long as the substances are available in Indonesia with competitive prices.

Refrigeration and Air Conditioning Sector

HFC and non-HFC substances such as CO_2, hydrocarbons and ammonia could be used as HCFC replacements. However, for Indonesia, the new technology that is usually accepted is the one that has lowest investment costs. Drop-in substitute refrigerants are preferred for existing equipment because no investment is needed.

For commercial refrigeration, HFC 134a, Hydrocarbons or HFC blends such as R-407C or R-417 can be used to replace HCFC-22. However, HFC-134a is not widely used for lower temperature refrigeration used in food processing and cold storage.

For industrial refrigeration, R-404A or R-410A can be used for R-502 replacement, and R-407C, R-410A, or R-417 can be used for HCFC-22 replacement. These refrigerants can also be used for transport refrigeration, commercial and residential Air Conditioning system and chillers.

Hydrocarbon such as HC-290, HC-1270, and HC290/600a blends can be used for HCFC replacement. Blend of HC-290/HC-600a can be used in commercial refrigeration. HC-1270 can be used in lower temperature such as industrial refrigeration, and chiller. HC-290 can be used for HCFC-22 replacement in many sectors of refrigeration, air conditioning, and chiller.

Supercritical CO_2 and improved ammonia system are unlikely to be applied in Indonesia soon because their high cost and relatively new technology.

3.4 ENVIRONMENTAL IMPACT

Table 3.3 shows the ODP and GWP of existing HCFCs used in Indonesia. From the Table it can be seen that unconstrained demand would increase ozone depletion by 422.04 ODP tonnes and increase global warming by 7,871,640 tonnes/tonne CO2 by 2015.

Table 3.3 Environmental Impact

HCFC	ODP	GWP	IMPACT (2005)		IMPACT (2015)	
			ODP (MT/MT CFC-11)	GWP (MT/MT CO2)	ODP (MT/MT CFC-11)	GWP (MT/MT CO2)
HCFC-141b	0.11	630	179.96	1,030,680	395.12	2,262,920
HCFC-22	0.056	1,780	131.04	4,165,200	339.92	10,804,600
Total			**311.00**	**5,195,880**	**735.04**	**13,067,520**

These figures do not include the GWP of substitute (new) refrigerants.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

The compliance challenges would be:

- ***Availability and prices of new technology and new refrigerants***
  The HCFCs should be replaced by proven technology at reasonable prices. The drop-in substitute refrigerants are preferable because no addition system investment is needed. As long as the new technology is difficult to get with reasonable price, the HCFC reductions would be difficult to achieve.

- ***Illegal import of HCFCs***
  High demand, easy availability and reasonable prices of HCFCs and scarce or expensive replacement technology will encourage illegal imports of HCFC.

The compliance opportunities would be:

1. The new regulation on ODS in Indonesia has been endorsed in June 2006. With this new regulation, any company might become an importer as long as there are registered and import a certain amount of ODS (within national quota determined by KLH and MOT – currently applies to CFC sonly). The new regulation has made inter-departmental coordination and monitoring become stronger, which is needed in preventing illegal trade and monitoring the distribution of ODS.

2. Involvement of Customs in the phase out program done by the NOU, which include personnel training and procurement of refrigerant identification equipment, has increased the awareness of Customs about illegal imports of ODS. The knowledge and experience obtained by the Customs during their involvement in CFC phase-out program could be a valuable asset in managing HCFC imports in future.

3. Hydrocarbon refrigerants can be drop-in substitutes in HCFC-based refrigeration systems. Some Hydrocarbon refrigerants are now produced in Indonesia. With improvements in safety procedures and application of the same more widely, hydrocarbon refrigerants might become a potential replacement refrigerant for some applications.

3.6 POTENTIAL COMPLIANCE MEASURES

To facilitate compliance with the 2016 freeze in HCFC consumption at 2015 levels, the following measures are recommended:

1. Enforcing the new import regulation for HCFCs (MOT decree no. 24 year 2006) in such a way that import quotas are gradually reduced in line with the commitments on consumption levels
2. Monitoring the amount of HCFCs imports and distribution more closely
3. Expanding training and equipment for Customs to cover HCFCs
4. Informing exporting countries of Indonesian licensed importers.

5. Raising awareness and disseminating information on the HCFC freeze in 2016 and also on available new technologies for HCFC replacement, among government and industry stakeholders
6. Encouraging use of hydrocarbon refrigerants and safety procedures for their handling.
7. Encouraging recovery, recycling and reclamation of HCFCs through introduction of appropriate training and equipment.
8. Provide technical assistance through national and international experts for small and medium-sized enterprises (SMEs) in converting their HCFC-based production lines.
9. Strengthening the understanding and capability of personnel in stakeholder institutions to implement actions for meeting the 2016 freeze in HCFC consumption.
10. Develop strong coordination and collaboration between NOU and other related institutions and government departments.
11. Develop strong coordination and collaboration with HCFC producing and exporting countries.

3.7 SUMMARY AND CONCLUSIONS

HCFC-22 and HCFC-141b are the HCFCs most commonly used in Indonesia. They are used mainly in the Foams and Refrigeration and Air Conditioning sectors.

HCFC-141b is the most common blowing agent used in rigid polyurethane foam and integral skin foam in the Foams Sector. Also, it is used for rigid polyurethane foam in the manufacture of refrigeration and air conditioning equipment. Unconstrained demand for HCFC-141b is expected to reach 3,592 MT by 2015.

HCFC-22 is the most common refrigerant used in the Refrigeration and Air Conditioning sector. Unconstrained demand for HCFC-22 is predicted to reach 6,070 MT by 2015.

Unconstrained demand for HCFCs would increase ozone depletion by 422.04 ODP tonnes and increase global warming by 7,871,640 tonnes/tonne CO2 by 2015.

In Indonesia, Hydrocarbons and HFCs are the potential replacements for HCFCs. Hydrocarbons are available in Indonesia, however, significant investments required in safety equipment and practices could hamper their application. HFCs remain currently scarce and expensive in Indonesia. The prices of R-407C, R-410A, and R-417A are quite high, causing a barrier to their application presently.

High prices and difficult availability of new technologies and easy availability and reasonable prices of HCFCs are the main challenges for meeting the 2016 freeze obligations. However, the experience, the capacity and legal framework developed during the implementation of CFC phase out programme may be suitably supplemented to overcome these challenges.

ANNEX

Information on HCFC consuming enterprises

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Foams	Systems houses	5
	Rigid PU Foam	150
	Integral Skin PU Foam	30
Refrigeration and Air Conditioning	Domestic Refrigeration	2
	Residential/Commercial AC	60
	Industrial Air Conditioning	50
	Commercial Refrigeration	180
	Industrial Refrigeration	40
	Transport Ref & AC	50
Solvents	Metal/electronic cleaning	10
SERVICING		
Refrigeration and Air Conditioning	All	Over 15,000

Note: The numbers and data provided in the table are a result of a limited survey of various sectors related to HCFCs the primary aim of which was to generate information that would enable the ExCom to establish a permanent aggregate level of consumption against which future activities could be funded. The numbers and data in this table are therefore ***indicative only and not binding***. The numbers/data may be revised in future as a result of more detailed sector-level information becoming available. The numbers/data may not be used without the prior consent of the Government.

SURVEY OF HCFCs IN IRAN

FINAL REPORT

Ozone Layer Protection Unit
Department of Environment, Iran

United Nations Development Programme

January 2007

EXECUTIVE SUMMARY

Iran acceded to the Vienna Convention and the Montreal Protocol in October 1990. Iran's annual calculated consumption of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, therefore Iran was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

Iran's Country Programme for phasing out the use of Ozone Depleting substances was approved by the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol in June 1993. The Country Programme Update for Iran was approved by the Executive Committee in 2002. Iran is so far in compliance with the Montreal Protocol schedule for reduction of consumption of controlled substances. This has been made possible by projects and programmes featuring technology transfer investments, technical assistance, training & capacity building and information dissemination and awareness actions. Iran has strived to establish effective regulations for controlling import, export, trade and use of controlled substances under the Montreal Protocol.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore their use has to be reduced and eventually phased out. In accordance with the control schedule of the Montreal Protocol for Article-5 parties, production and consumption of HCFCs will be subject to a freeze at 2015 levels from 01 January 2016 and are required to be completely eliminated by 2040. HCFCs are used in Iran mainly in the Foams and Refrigeration & Air Conditioning sectors, predominantly HCFC-141b and HCFC-22.

Iran's HCFC consumption increased from 240 metric tonnes in 1995 to 2,114 metric tonnes in 2005, signifying a compounded annual growth rate of 24.3%. This growth has been more significant in the past few years. Since 2001, the HCFC consumption in Iran has increased from about 1,478 metric tonnes to 2,114 metric tonnes in 2005, signifying a more steady growth of about 7.4% annually. Based on projected annual growth rates in demand forecasted for HCFCs until 2015, it is estimated that the consumption of HCFCs in Iran will reach about 8,293 metric tonnes in 2015. This will produce an impact on the environment due to the ozone depleting potential (ODP) and global warming potential (GWP) of HCFCs.

It would be necessary to take early actions to reduce consumption of HCFCs, in order to meet the 2016 freeze in HCFC consumption at 2015 levels. Until 2015, availability of HCFCs appears to be predictable and adequate. At the same time, currently, the availability of environment-friendly and cost-effective substitute technologies is limited. Therefore, in order to accelerate the use of substitutes, it would be necessary for the industry in Iran to receive technical and financial assistance from the Montreal Protocol, so that they can reduce their consumption of HCFCs, to enable Iran to comply with the obligations under the Montreal Protocol.

CONTENTS

1. INTRODUCTION

1.1 Background

Iran ratified both the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer in March 1990. It has also subsequently ratified the 1990 London Amendment, the 1992 Copenhagen and 1997 the Montreal Amendment of the Montreal Protocol. Iran is classified as a country operating under Article-5 of the Montreal Protocol. The dates of ratification by Iran of the Vienna Convention, Montreal Protocol and its amendments are shown in Table-1 below:

Table-1: Iran: Ratification of Montreal Protocol and its Amendments

Agreement/Amendment	Date of Ratification	In Force From
Vienna Convention	03 October 1990	December 1990
Montreal Protocol	03 October 1990	December 1990
London Amendment	04 August 1997	November 1997
Copenhagen Amendment	04 August 1997	November 1997
Montreal Amendment	17 October 2001	January 2002
Beijing Amendment	Not yet ratified	

In 1993, Iran's Country Programme for the Implementation of the Montreal Protocol was finalized and submitted for approval. It was approved at the 10th Meeting of the Executive Committee in June 1993. An internal revision of the County Programme was made in 1995. The Country Programme Update was approved by the 36th Meeting of the ExCom in 2002. The Action Plan presented in the Country Programme outlined policies and proposals for ODS reductions through defining ODS use quotas, taxation on ODS and ODS-based products and gradual reduction of ODS imports, supported by technological and financial interventions to ODS users for transitioning to appropriate substitutes.

Iran's National Phase-out Plan for ODS (NPP) was approved at the 41st Meeting of the Executive Committee in December 2003. The National Phase-out Plan for ODS aims to eliminate the remaining consumption of 1,658 ODP metric tonnes of Annex-A Group-I substances (CFCs) and 50 ODP metric tonnes of Annex-B Group-II substances (CTC) by 2010 through a multi-year performance-based agreement.

Iran does not produce HCFCs and the domestic demand is entirely met through imports. The total imports of HCFCs in Iran during 2005 were 2,114 metric tonnes. At a conservative growth rates (see section 3.1), this would reach about 8,293 metric tonnes by 2015. Iran is one of the 12 countries in which HCFC Surveys were approved to be carried out by UNDP at the 45^{th} ExCom Meeting.

1.2 Approach and Preparation

The Executive Committee of the Multilateral Fund at its 45^{th} Meeting, approved activities to be implemented by UNDP, which aimed to conduct limited surveys of HCFC use in selected countries, with an objective of among other things, establishing a national aggregate level of HCFC consumption for these countries, against which future projects and activities may be funded. The selected countries were:

Latin America:	Argentina, Brazil, Colombia, Mexico, Venezuela
Middle East:	Iran, Lebanon, Syria
South Asia:	India, Sri Lanka
Southeast Asia:	Indonesia, Malaysia

To ensure effective coordination of survey activities in this global project involving 12 countries and to better address cross-regional issues, UNDP planned the activities to be carried out, using a three-stage process:

- Data collection and survey at the national level
- Compilation and analysis of survey data
- Presentation and reporting of survey data

The national-level data collection and survey work was carried out through recruitment of a local consultant entity (either an individual or a firm/institution) recommended by the respective governments. The compilation and analysis of the survey data was carried out through UNDP's international experts and researchers to impart credibility and quality. The presentation and reporting of survey data was carried out in consultation with the country governments, which in turn were expected to ensure the required country-level consultations within the respective industry and expert institutions.

In Iran, Karamadan Hampa Co. was retained as the national expert to carry out the HCFC survey by UNDP, with the concurrence of the Government. The main tasks expected were as below:

a) Conduct a Desk Study, with the aim of preparing a situation analysis on HCFC consumption in-country.

b) To interact with various chemical and equipment suppliers/importers and/or their representatives and relevant industry associations for identifying all current users of HCFCs in the Aerosols, Halons, Foams, Refrigeration & Air Conditioning, Solvents and any other sectors where HCFCs are used

c) Classify the data generated from a) and b) above, as below:
   - HCFC consumption by sector
   - List of HCFC users, segregated by sector
   - List of HCFC users who received assistance under the Montreal Protocol Programme
   - List of HCFC users who did not receive assistance under the Montreal Protocol Programme
   - Approximate population of HCFC-based equipment segregated by sector

Karamadan Hampa Co. prepared the interim report and final report, which was reviewed by UNDP and endorsed by Government for submission.

As per ExCom Decision 45/6 (i), the 12 surveys provide information on current consumption by sector and substance, as well as the forecasted projections till 2015. This information will allow the Multilateral Fund Secretariat – if requested by the Executive Committee – to propose funding policies and procedures for the next few years, including the possible establishment of an eligible national aggregate level of HCFC consumption

1.3 Survey Methodology

The responsible authorities (such as Customs Department, DOE) were contacted for getting up-to-date statutory information on imports, use and application of HCFCs. Different working groups were organized in order to investigate and gather needed data and arrange site visits, in order to provide as much as possible realistic data. This data was regrouped and then questionnaires based on the prescribed format were sent to HCFC users and/or importers. The feedbacks received were processed and selected users were visited in order to audit the information provided. The final report was then finalized after integrating the data collected.

2. OBSERVATIONS

2.1 Institutional Framework

The Department of Environment (DOE) is the designated nodal agency responsible for implementation of the Montreal Protocol in Iran. Within the Department of Environment, the Ozone Layer Protection Unit, established in 1994, serves as the national focal point for management, coordination and implementation of Montreal Protocol activities in Iran. In 1994, the National Ozone Committee, a high-level inter-ministerial body, was established to oversee the development and implementation of policies for effective implementation of the Montreal Protocol in Iran. The National Ozone Committee is constituted from other ministries, such as Industries and Mines, Foreign Affairs, Oil, Commerce, Management and Planning Organization, Customs and also scientific and technical institutions. Iran has consistently sought to develop and implement policies, and within the framework of these policies, appropriate regulations, for controlling and eliminating ODS. Some of the key regulatory actions include:

- Codification of all ODS
- Banned establishment of new enterprises producing ODS-based products
- Banned expansion of existing enterprises producing ODS-based products
- Prohibited enterprises using non-ODS technology to revert to ODS
- Exempted enterprises converted to non-ODS technology from sales tax
- Banned trade in ODS with countries that are not party to Montreal Protocol
- Banned import of CFC-based hermetic compressors in 2002
- Reduced excise tax on non-ODS compressors in 2002
- Reduced commercial benefit tax on import of non-ODS compressors in 2002
- Constituted the Laws and Regulations Sub-committee to develop plans for establishment and enforcement of a licensing system for ODS
- Import of Annex-A and B ODS are subject to annual quotas from 2003

2.2 HCFC Supply Scenario

2.2.1 Production

Presently there is no production of HCFCs in Iran. There is also no information on prospective investments for future production of HCFCs in Iran.

2.2.2 Exports

There are no exports or re-exports of HCFCs from Iran, except for small quantities across the Herat border with Afghanistan, which can be ignored.

2.2.3 Imports

The main imports of HCFCs in Iran have been of HCFC-141b and HCFC-22. Annual imports from 1995 to 2005 are depicted graphically in Figure-1 below:

Figure-1: HCFC Imports into Iran – 1995 to 2005

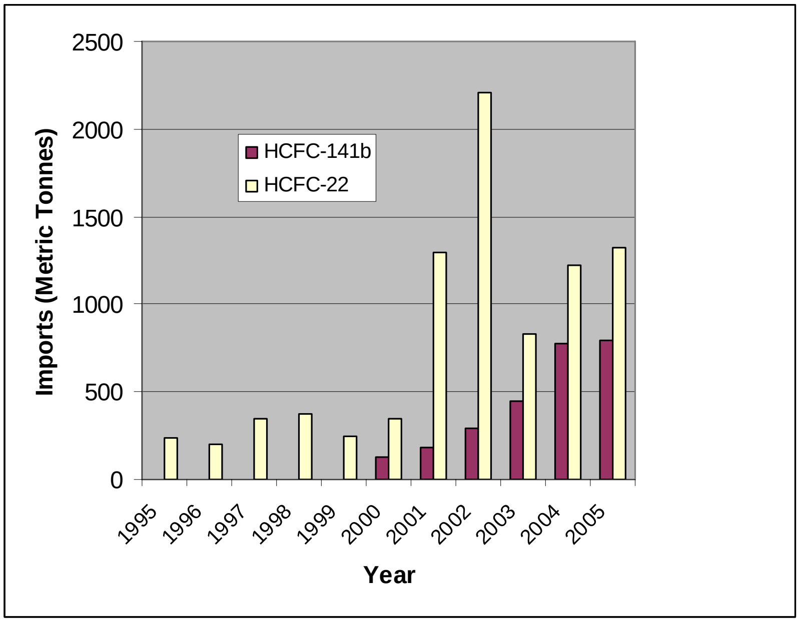

Table-2 below indicates the imports of HCFCs into Iran from 1995 to 2005.

Table-2: HCFC Imports into Iran - 1995 to 2005

Year	Imports (metric tonnes)	Year	Imports (metric tonnes)
1994	NA	**2000**	480
1995	240	**2001**	1,478
1996	200	**2002**	2,503
1997	350	**2003**	1,276
1998	370	**2004**	2,005
1999	250	**2005**	2,114

2.2.4 Distribution and supply chain

HCFCs are imported into Iran through three main sources: direct imports by end-users, imports by polyurethane foam systems houses and imports by traders in HCFCs. There are about 15 importers-traders, who import and then redistribute or resell HCFCs to smaller retail traders or to end-users. In 2005, these importers accounted for over 75% of the total imports.

2.3 HCFC Consumption

HCFC-22 and HCFC-141b are the two main HCFCs consumed in Iran. HCFC-141b is used as a blowing agent in foam production as a replacement for CFC-11. HCFC-22 is used as a refrigerant in air conditioning and refrigeration systems, especially in comfort air conditioning units, central air conditioning chillers and industrial refrigeration.

The HCFC consumption in Iran increased from 240 metric tonnes in 1995 to 2,114 metric tonnes in 2005. This shows an average annual growth rate in HCFC consumption of 24.3%. However, in the past five years, the consumption increased from 1,478 metric tonnes in 2001 to 2,114 metric tonnes in 2005, indicating a more steady growth rate of 7.4% annually.

2.3.1 Aerosols Sector

There is no identified consumption of HCFCs in the Aerosols sector.

2.3.2 Firefighting Sector

There is no identified consumption of HCFCs in the Firefighting sector.

2.3.3 Foams Sector

The main HCFC used in the Foams Sector is HCFC-141b as a blowing agent for producing polyurethane foam, both rigid and integral skin foam. In 2005, a total of 791 metric tonnes of HCFC-141b were imported into Iran, out of which, the Foams Sector consumed about 60% or 480 metric tonnes. The remaining HCFC-141b use is in the Refrigeration and Air Conditioning Sector as described in Section 2.3.4. The breakdown of HCFC-141b consumption in 2005 in the Foams Sector is as shown in Table-3 below:

Table-3: Breakdown of HCFC-141b consumption in 2005

Application	Consumption (metric tonnes)
Rigid Polyurethane Foam	360
Integral Skin Polyurethane Foam	120
Total	**480**

Much of the consumption of HCFC-141b in Iran is due to conversion of CFC-based production to HCFC-141b. It is estimated that about 70% of the HCFC consumption (about 336 metric tonnes) may be from such conversion. The remaining consumption (about 144 metric tonnes) is from users who did not or could not participate in the Montreal Protocol program.

2.3.4 Refrigeration and Air Conditioning Sector

The Refrigeration and Air Conditioning Sector in Iran is the most significant consumer of HCFCs. HCFC-141b is used as a blowing agent (for foam insulation) and HCFC-22 is used as a refrigerant in the production of refrigeration and air conditioning equipment. HCFC-123 consumption in this sector is not reported, however, the actual use of HCFC-123 if any, may need to be further investigated.

In 2005, about 311 metric tonnes of HCFC-141b was used in rigid polyurethane foam insulation in the production of refrigeration and air conditioning equipment. The total usage of HCFC-22 was 1,323 metric tonnes, of which 972 metric tonnes was used in manufacturing and 351 metric tonnes was used in servicing of refrigeration and air conditioning equipment.

Manufacturing

Table-4 below shows the estimated breakdown of HCFC consumption in manufacturing activities in the Refrigeration and Air Conditioning sector.

Table-4: Breakdown of HCFC consumption in Manufacturing

Sub-sector	HCFC Consumption (Metric tonnes)		
	HCFC-141b	**HCFC-22**	**Total**
Domestic Refrigeration	120	NA	120
Commercial Refrigeration	91	290	381
Industrial Refrigeration	30	100	130
Residential/Commercial Air Conditioning	NA	392	392
Industrial Air Conditioning/Chillers	25	105	130
Transport Refrigeration/Air Conditioning	45	85	130
Total	**311**	**972**	**1,283**

The above figures do not include HCFC-22 quantities that enter Iran through imported products such as air conditioners. For example, about 513,000 air conditioners were imported in Iran in 2005, which are estimated to contain up to 1,000 metric tonnes of HCFC-22.

Servicing

In 2005, about 351 metric tonnes of HCFC-22 were used in servicing of existing air conditioning and refrigeration equipment. As the age of the existing equipment increases and approaches the end of its economic life, the demand for HCFC-22 in servicing is expected to increase.

2.3.5 Solvents Sector

There is no identified consumption of HCFCs in the Solvents sector. However, it is likely that HCFC-141b could be used for cleaning or flushing and such use may need to be further investigated.

2.3.6 Summary and Conclusions

In Iran, the main HCFCs used are HCFC-141b and HCFC-22. HCFC-141b is used as a blowing agent in the production of polyurethane foams. HCFC-22 is used as a refrigerant.

In 2005, the Foams Sector consumed about 480 metric tonnes of HCFCs. The Refrigeration and Air Conditioning Sector consumed a total of 1,634 metric tonnes, of which about 1,283 metric tonnes was in manufacturing and 351 metric tonnes was in servicing.

The consumption figures do not include HCFCs contained in imported products such as pre-blended polyols, air conditioners, etc.

3. ANALYSIS

3.1 Demand Forecasts

The HCFC demand in Iran is likely to grow substantially in future due to rapid economic growth and resultant increase in demand for consumer, commercial and industrial goods.

Based on growth rates experienced in the past decade, it is realistically expected that unconstrained demand for HCFCs will grow at about 10% annually from 2006 to 2010 and at 7.5% annually from 2011 to 2015. Table-5 below shows the projected unconstrained demand by substance in 2015 after applying these growth rates.

Table-5: Projected unconstrained demand by substance in 2015

Substance	**Unconstrained demand in 2015** (metric tonnes)
HCFC-141b	3,103
HCFC-22	5,190
Total	**8,293**

3.2 Availability Scenarios and Prices

Iran does not produce HCFCs and is therefore dependent on supplies of HCFCs from countries that produce HCFCs, such as Europe, China, India, etc. From available information on production capacities in these countries, it does not seem likely that there would be any problem of availability of HCFCs until 2015.

The current retail prices of HCFC-22 and HCFC-141b in Iran are about US$ 3.00 to US$ 4.00 per kg. This is in line with prevailing retail prices in the region.

3.3 Technology

It is necessary to select the most suitable technologies for substitution of HCFCs. Wide application range, worldwide availability, favorable thermodynamic and physical properties, low energy requirement are some of the common factors. Some other considerations for selecting alternative technologies are:

- **Availability:** The technology should be available with minimum restrictions, such as import and export limitations, royalties, etc. If the technology is already applied in similar markets, it would be an advantage

- **Cost:** The cost should be reasonable and preferably stable

- **Flexibility:** It would be better if the technology can be applied to many applications, otherwise different technologies would need to be selected for different applications.

- **Processing:** The technology should be versatile, so that it can be put into operation without major changes in the production processes

- **Suitability for servicing:** The preferred substitute, especially refrigerants, should be available with or compatible with provisions, which will facilitate easy and economical servicing, including servicing accessories and fixtures, packaging sizes, fittings, etc.

- **Shelf life:** It is important that the alternative blowing agents or refrigerants should have long shelf life and also should be suitable for bulk shipments in containers, to reduce the cost of transportation and storage

It may not be feasible to find a perfect or single substitute which can meet all the above mentioned requirements, but it may be possible to apply a number of different substitutes for different applications, for different sizes of users, etc.

<u>Substitutes for HCFC-141b</u>

Mainly, there are two types of substitutes for HCFC-141b as the blowing agent. The first type is natural substances such as Hydrocarbons, Carbon Dioxide, etc. However, their application may not be suitable in all cases. In bigger enterprises, Hydrocarbons can be used more conveniently, because it is easier for such enterprises to bear the higher costs of safety, operations, modifying equipment and practices, etc. The second type of technology is synthetic substances such as HFCs. Recently new HFCs like HFC-245fa and HFC-365mfc have been introduced in developed countries. Their availability, cost and performance yet needs to be established fully in specific situations of developing countries. Thus, the replacements for HCFC-141b would need to evaluated on a case-by-case basis after detailed study of the particular application.

Substitutes for HCFC-22

Some of the considerations for properties of proper substitutes for HCFC-22, which is mainly used as a refrigerant, are refrigerating effect, volumetric capacity, evaporating and condensing temperatures and pressures, compatibility with lubricants, compatibility with compressors and other system components and materials, etc. The table below is for providing an overview of leading substitutes for HCFC-22:

Table-6: Leading substitutes for HCFC-22

Application	Leading replacements
Window air conditioners	R-407C, R-410A
Unitary single package and split system air conditioners and heat pumps	R-407C, R-410A
Air-cooled and water-cooled chillers	R-410A, R-134a
Commercial Refrigeration	R-410A, R-134a, R-404A
Industrial Refrigeration/AC	R-134a, R-404a, Ammonia
Transport refrigeration/AC	R-134a, R-410A

3.4 Environmental Impact

HCFCs have an ozone depleting potential (ODP) and also they have impact on global warming. The use of substitutes for HCFCs with zero ODP may still have an impact on global warming due to the global warming potential (GWP) and their atmospheric lifetime.

HCFC-22 has an ODP of 0.055 and GWP of 1,520. The expected consumption of 5,190 metric tonnes of HCFC-22 estimated for 2015, will lead to an environmental impact of about 286 ODP tonnes and global warming impact of about 7.9 million tonnes per tonne of CO_2.

HCFC-141b has an ODP of 0.11 and GWP of 630. The expected consumption of 3,103 metric tonnes of HCFC-141b estimated for 2015, will lead to an environmental impact of about 341 ODP tonnes and global warming impact equivalent to about 2 million tonnes of CO_2.

3.5 Compliance Challenges and Opportunities

By 2016, according to the Montreal Protocol and its amendments, developing countries must freeze their consumption and production of HCFCs at 2015 levels. Considering this obligation for Montreal Protocol Article-5 parties, following are the challenges to meet the same, especially for Iran:

- **Growth of consumption of HCFCs:** Considering the growth of HCFC consumption until 2015, it would be difficult to stabilize it without preparation
- **Availability of HCFCs:** It is expected that HCFCs would be available easily until 2015, because there are no significant controls on exports of HCFCs in developed and developing countries. Availability may however be adversely affected by potential sanctions imposed on Iran.

Because of these two factors, meeting the 2016 freeze in consumption of HCFCs may be difficult.

The main opportunities to realize compliance with the 2016 freeze in consumption would be that substitutes are available, although at a much higher cost and more difficult availability. The second factor is that there is possibility of technological and financial assistance to the HCFC users in Iran, under the Montreal Protocol, to reduce and eliminate their HCFC consumption and adopt the substitutes in a timely manner.

3.6 Potential Actions for Compliance

It would be best to prepare the industry, government and other stakeholders in Iran, for the imminent freeze in consumption of HCFCs from 2016. Some of the actions that could be taken for meeting the freeze would be as below:

- **Planning:** Preparation of a plan for management of consumption of HCFCs until 2015 and beyond, needs to be done. This can be done by preparing a strategic plan, which will consider all parameters.

- **Conversions:** Wherever possible in a cost-effective manner, it would be advisable to expedite conversions from HCFC technology to non-ODS technologies, may be by introducing interim measures to reduce dependence on HCFCs by best practices in servicing, increasing awareness about HCFC reduction goals, applying substitutes that are already mature and available, etc. For example, in the Foams Sector, substitutes for HCFCs are already being applied in developed and some developing countries, so it may be easier to start with the Foams Sector. In rigid foams, for example, HFC-245fa, HFC-365mfc or hydrocarbons, may be used as substitutes where feasible. In integral skin foams, water-blown or HFC-134a technology (or HFC-245fa/HFC-365mfc) could be utilized.

Of course there would be costs for taking these measures, which hopefully can be met through Montreal Protocol funding and technical assistance.

3.7 References

1. Refrigerant Report, 13th Edition, A-501-13, Bitzer International, Germany.
2. James M. Calm, P.E., "R-22 Replacement Status", *ASHRAE Journal*, 46(8):29-39, August 2004.

ANNEX

Information on HCFC consuming enterprises

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Foams	Systems houses	5
	Rigid PU Foam	50
	Integral Skin PU Foam	20
Refrigeration and Air Conditioning	Domestic Refrigeration	25
	Residential/Commercial AC	100
	Industrial Air Conditioning	40
	Commercial Refrigeration	150
	Industrial Refrigeration	30
	Transport Ref & AC	40
SERVICING		
Refrigeration and Air Conditioning	All	Over 10,000

Note: The numbers and data provided in the table are a result of a limited survey of various sectors related to HCFCs the primary aim of which was to generate information that would enable the ExCom to establish a permanent aggregate level of consumption against which future activities could be funded. The numbers and data in this table are therefore ***indicative only and not binding***. The numbers/data may be revised in future as a result of more detailed sector-level information becoming available. The numbers/data may not be used without the prior consent of the Government.

SURVEY OF HCFCs IN LEBANON

FINAL REPORT

Ozone Office – Lebanon
United Nations Development Programme (UNDP)

December 2006/January 2007

EXECUTIVE SUMMARY

Lebanon acceded to the Vienna Convention in March 30, 1993 and ratified the Montreal Protocol on Substances that Deplete the Ozone Layer on March 30, 1993. Lebanon ratified the London Amendment on March 31, 1993 and the Copenhagen Amendment on July 31, 2000.

The annual calculated consumption in Lebanon of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, Lebanon was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

Lebanon's Country Programme incorporating the National Strategy and Action Plan for controlling the use of Ozone Depleting Substances was approved at the 19th Meeting of the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol in May 1996. Until date, Lebanon is in compliance with the Montreal Protocol control schedule. This has been made possible through project activities including technology transfer investments, technical assistance, training and capacity building, information dissemination and awareness-raising and regulations. Lebanon has established a licensing system for designated controlled substances. All importers and exporters of these substances are required to register and obtain licenses which are issued based on annual quotas and are subject to reporting requirements.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore they have to be controlled and eventually phased out. In accordance with the control schedule of the Montreal Protocol for Article-5 countries, production and consumption of HCFCs will be subject to a freeze at 2015 levels from 01 January 2016 and are required to be completely eliminated by 2040. HCFCs are used in Lebanon in the Foams, Refrigeration & Air Conditioning sectors. The predominant HCFC used is HCFC-22 mainly in the Refrigeration & Air Conditioning Sector.

The consumption of HCFCs in Lebanon increased from about 143 metric tonnes in 1995 to 336 metric tonnes in 2005 signifying an average annual growth rate of about 8.1%. At a conservative annual growth rate in demand forecasted for HCFCs of 7.5% from 2006 until 2015, it is estimated that the consumption of HCFCs in Lebanon is likely to reach about 692 metric tonnes in 2015. This will lead to additional environmental impacts on ozone depletion as well as on global warming due to the ozone depleting potential and global warming potential of HCFCs.

In order to meet the 2016 freeze in HCFC consumption at 2015 levels, the industry, consumers and government will need to make preparations earlier on. This will involve reducing dependence on HCFCs, controlling and reducing HCFC use wherever possible at an early stage. The main constraint for transitioning from HCFCs to alternative environment-friendly substitutes is the dependable and economic availability of substitutes. For this, adequate technical and financial assistance would be needed to minimize the burden of transition on consumers and industry. Also, adequate institutional support will be needed to ensure that awareness of the impending consumption limits is duly disseminated and capacity-building and training programmes for stakeholders are carried out. Lebanon expects that the international community will recognize these challenges in order to ensure sustainability of our work and credibility of our operations complying with the global efforts towards the protection of the ozone layer.

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LIST OF ABBREVIATIONS

CFC	Chloro Fluoro Carbons
CP	Country Programme
CTC	Carbon Tetra Chloride
ExCom	Executive Committee of the Multilateral Fund
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
HCFCs	Hydrochlorofluorocarbons
IA	Implementing Agency
MAC	Mobile Air Conditioning
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MP	Montreal Protocol
MT	Metric Tonnes
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
R&R	Recovery and Recycling
SMEs	Small and Medium-sized Enterprises
TR	Tons of Refrigeration
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
WB	World Bank

1. INTRODUCTION

1.1 Background

Lebanon is a Mediterranean country with a land area of 10,452 sq. km and a population of about 3.8 million (2006) with an estimated GDP per capita of USD 4,000 in 2005, with the Agricultural sector accounting for 14% of GNP, the industry for 26 % and the service sector for 60 %. Population density is approx. 363 persons per sq km where urban population represents around 88 % of the total population.

It is relevant to mention that Lebanon succeeded in encountering the aftermath of 17 years of civil war. Accordingly, all sectors of the national economy and in particular the industrial sector progressed rapidly due mainly to the progress in political stabilization, the open market economy of the country, and the favourable conditions for foreign investments established by the Government's policy.

Lebanon ratified the Vienna Convention on March 30, 1993 (entered into force on June 28, 1993), Montreal Protocol on March 31, 1993 (entered into force on June 29, 1 993), and London amendments on March 31, 1 993 (entered into force on June 29, 1993), Copenhagen & Montreal Amendments on July 2000. The ratification of the Beijing amendment is still in process.

Table 1*: *Ratification of Montreal Protocol and its Amendments

Agreement	Ratified	Entry into Force
Vienna Convention	Ratified in 30 March 1993	June 28, 1993
Montreal Protocol	Ratified in 30 March 1993	June 28, 1993
London Amendment	Ratified in 31 March 1993	June 29, 1993
Copenhagen Amendment	Ratified in 31 July 2000	July 31, 2000
Montreal Amendment	Ratified in 31 July 2000	July 31, 2000

The Country Programme (CP) for phasing out ODS in Lebanon was prepared with the assistance of the National Working Committee on Ozone Depleting Substances, established in 1994 at the Ministry of Environment. Although the CP is dated as of March 1995, statistical data on ODS consumption by different sub-sectors are limited to 1992 - 1993. The forecast for the ODS consumption for 1995 - 2010 was prepared based on very uncertain assumptions.

The Country Programme was submitted to the Secretariat of the Multilateral Fund for presentation at the 17th Executive Committee Meeting, and it was reviewed and recommended for approval. However, due to a discrepancy in the accuracy of population data, provided by the country, the Ozone Secretariat classified Lebanon as non-Article 5 Party. Consequently, the Executive Committee decided at its 17th Meeting, (Decision 17/1) to defer the submission of the Country Programme of Lebanon and the projects included therein. By its decision VII/20, the 7th Meeting of the Parties decided, inter alia, that in case of any discrepancy on the accuracy of the data, the data provided by the party to the Ozone Secretariat should be used. In compliance with this decision, the Ozone Secretariat reclassified Lebanon as a Party operating under Article 5. At that time it was forecasted that consumption will increase from the 1993 level of 923.1 ODP Tonnes to approx. 1,001 ODP Tonnes in 1995, given that the economic situation becomes more stable with the end of the war and the country must be reconstructed rapidly. The total consumption may increase up to 2,082 ODP Tonnes in the year 2010, if the Montreal Protocol is not implemented in Lebanon.

Lebanon's total ODS consumption was estimated in 1993 at about 923.1 ODP Tonnes. The CP identified the aerosol sector, the refrigeration sector and the foam sector as the three key areas in which ODS were used. Hence, developing a national strategy for managing ODS phase-out programme and prioritizing its phase-out activities in these three main sectors was deemed necessary and essential.

In accordance with the MP control schedule, the phase-out date for Annex-A, Group-I substances (CFCs) for Article 5 countries stands at 2010, with intermediate targets for a freeze in consumption by 1999 (to the level of the average consumption during 1995-1997 (also termed as the baseline consumption), 50% reduction of the baseline consumption by 2005, with a further reduction to 85% of the baseline consumption by 2007, and a total phase-out in 2010. Lebanon's CP stated, "The phase-out will be mostly completed by 2005, while some ODS uses will continue until 2010".

According to the clarifications from the Ministry of Environment (MOE), the imbalance between usage of CFC-12 for production and service as stated in the CP is caused by the fact that in 1992-93 and due to the post war situation in the country, local manufacturing of domestic and commercial refrigeration equipment was very low; import of refrigeration and air conditioning equipment was also limited due to low financial capacity of the local market. Consequently, refrigeration equipment (domestic and commercial & industrial) repairing and recharging sub-sector was the major user of CFC-12.

The National Ozone Unit (NOU) within MOE was established in 1998 by the Government for the overall coordination of ODS phase-out programme in Lebanon and to act as a national focal point for the implementation of the Montreal Protocol. The operations of the NOU are funded by the MLF through the institutional strengthening programme, implemented by UNDP and executed nationally by MOE in close collaboration with the UNDP Lebanon country office. The overall objectives of the NOU are to effectively and efficiently phase-out ODS in the country through the creation and increase in national awareness on the dangers of using ODSs, implementing ODS phase-out activities, monitoring and evaluation of progress of implementation of ODS phase-out activities, dissemination of information on new technologies and ODS substitutes to the industrial sector in the country, reporting on ODS consumption & importation, developing & enforcement of legislations in order to meet the obligations of Montreal Protocol and its Amendments.

Lebanon has made significant progress in ODS phase-out over the past few years and both interim milestones (namely, the 1999 freeze and the 85% reduction by 2005) for Annex-A Group-I substances (CFCs) were met.

In 2003, the Country Programme was updated since Lebanon is committed to the complete phase-out of ODS in accordance with the Montreal Protocol control schedule. Lebanon received financial assistance from the MLF for developing an update of the Country Programme and a national strategy for phase-out of ODS in accordance with the milestones applicable to Article 5(1) countries. The CP update report provides an assessment of all the sectors and all regions of Lebanon including, for the first time, the South of Lebanon which was adversely affected by war in the early nineties. The CP update was prepared based on a review of current phase-out results, as compared to consumption identified in the original CP, as well as to additional activities undertaken in the refrigeration sector, the methyl bromide sector, through assessment of policies needs, and strategic planning and actions required to complete phase-out of remaining ODS in the country. Ongoing actions will continue as shown below:

- Completion of ongoing Aerosol, Halon, Foam and Refrigeration projects;
- Completion of the ongoing Methyl Bromide project.

All remaining CFC phase-out actions were addressed through the National Phase-out Management Plan for Annex-A, Group-I Substances (CFCs) in Lebanon (NPMP), which was approved at the 44th ExCom Meeting in November 2004 as a performance-based agreement with annual consumption and phase-out targets and complete phase-out of all remaining consumption Annex-A, Group-I Substances (CFCs) in Lebanon before 01 January 2009. To achieve this target, a combination of investment, training, technical support and institutional support activities will be carried out. The National Phase-out Management Plan for CFCs will enable Lebanon to comply with the Montreal Protocol control schedule milestones of achieving 50% of the baseline consumption by 2005 and 15% of the baseline consumption by 2007. Complete phase-out is proposed to be achieved by 2009. The CFC consumption reduction schedule proposed in the NPMP is in advance of or in compliance with the control schedule of the Montreal Protocol. Any residual demand for CFCs thereafter will be met either through recycled CFCs or CFCs imported before 2009 under the allowable import quota. From the supply-side, the plan will rely on the application of import licensing to regulate the quantity of CFCs allowed into the country. On the demand side, the plan will use a combination of regulatory measures to reduce the demand to remain in balance with the supply of CFCs. In addition, the plan will reduce demand by completing the implementation of on-going projects and retirement or retrofitting of existing CFC-containing equipment including chillers and vehicles.

HCFCs, which have Ozone Depleting Potential (ODP) up to 15% of that of CFCs, are also classified as controlled substances under Annex-C, Group-I of the Montreal Protocol. HCFCs therefore, have use restrictions and would eventually have to be phased-out. For developing countries, the scheduled phase-out date for HCFCs is 01 January 2040 with an interim control measure of freezing HCFC production and consumption at 2015 levels, from 01 January 2016. HCFCs being controlled substances, projects or activities leading to reductions of HCFCs may be eligible for funding by the Multilateral Fund at a future date.

HCFCs have been approved as substitutes for CFCs in many of the projects and activities supported by the Multilateral Fund. However, recently, restrictions on HCFC use have been increasingly adopted by developed countries. This may potentially affect availability of HCFCs in developing countries, especially those which do not produce HCFCs. Considering the increasing demand for HCFCs, and considering the imminent restrictions on HCFCs, including the 2016 freeze in consumption for Article-5 countries, the user industry needs to be equipped to address the technology and environmental issues arising from HCFC use reductions. Moreover, actions to reduce HCFC consumption may need to be initiated sooner than later. Recognizing these challenges, the ExCom approved at the 45th Meeting, funding for UNDP to carry out HCFC surveys in 12 countries. Lebanon is one of the countries which requested to be a part of this activity.

1.2 Approach and Preparation

The Executive Committee of the Multilateral Fund at its 45th Meeting approved a project to be implemented by UNDP, which aims to conduct a limited survey of HCFC use in selected countries, with a goal of enabling the Executive Committee to establish a national aggregate level of HCFC consumption against which future projects and activities may be funded. The selected countries are:

- Latin America: Argentina, Brazil, Colombia, Mexico, Venezuela
- Middle East: Iran, Lebanon, Syria
- South Asia: India, Sri Lanka
- Southeast Asia: Indonesia, Malaysia

To ensure effective coordination of survey activities in this global project involving 12 countries and to better address cross-regional issues, UNDP planned the activities to be carried out, using a three-stage process:

- Data collection and survey at the national level
- Compilation and analysis of survey data
- Presentation and reporting of survey data

The national-level data collection and survey work was to be carried out through recruitment of a local consultant entity (either an individual or a firm/institution) recommended by the respective governments. The compilation and analysis of the survey data was carried out through UNDP's international experts and researchers to impart credibility and quality. The presentation and reporting of survey data was carried out in consultation with the country governments, which in turn ensured the required country-level consultations within the respective industry and expert institutions.

Under the direct supervision of the NOU, the local consultant entity would have specific responsibility to carry out the following main tasks upon request, and in close coordination with the Ministry of Environment and UNDP:

a) Conduct a Desk Study, the aim being to prepare a situation analysis on HCFC consumption in-country.
b) To interact with various upstream suppliers/importers and/or their representatives and relevant industry associations for identifying all current users of HCFCs in the Aerosols, Halons, Foams, Refrigeration & Air Conditioning and any other sectors where HCFCs are used, maintain continuous contact with these users and maintain an updated list of all such users.
c) With the prior approval of the NOU, undertake plant visits to selected users and collect enterprise baseline information and other documentation as may be required by the Ozone Office from all users, in accordance with the pro-forma/questionnaire provided for this purpose. The HCFC consumption data from users shall be collected from 1995 or the date of their establishment, whichever is later.
d) Classify the data generated from a) and b) above, as below:
    - HCFC consumption by sector
    - List of HCFC users, segregated by sector
    - List of HCFC users who received assistance under the Montreal Protocol Programme
    - List of HCFC users who did not receive assistance under the Montreal Protocol Programme
    - Approximate population of HCFC-based equipment segregated by sector
e) Collect and compile the following data on HCFCs, segregated by substance at the national level:
    - Historical export data preferably from 1995 and segregated by destination countries
    - Historical import data preferably from 1995 and segregated by originating countries
f) To assist in obtaining any other confirmations, documentation or information from the identified HCFC users as may be required by the NOU from time to time.
g) To set up meetings for UNDP designated international experts and/or representatives, to meet with key managerial and technical personnel from the HCFC users and for plant visits as required, in line with their mission schedules in the country.
h) To assist the NOU in arranging workshops or similar information dissemination activities as may be requested, including assistance for ensuring participation of HCFC users selected for participating in such activities

Consequently UNDP, in coordination with the Ministry of Environment and the National Ozone Unit selected a local firm, Environment Management Company (EMC) to undertake the implementation of the tasks for the survey.

Following the contracting process the EMC initiated the work with some delays incurred for reasons beyond everyone's control caused by the eruption of the July war in Lebanon.

The first deliverable was the work plan designed by the consultant followed by the first report on findings and procedures to carry on with the full survey. Consequently the NOU was following up the local firm all the way ensuring that all areas are properly covered and facilitating all links with government institutions involved in the data collection process as well as peer reviewing process of work and other needed consultations with local experts, users and the Ministry of Environment.

1.3 Survey Methodology

The following activities were carried out to conduct a comprehensive survey that would give the clearest picture on the status of HCFC consumption and usage in Lebanon. It is worth mentioning here that the country had just come out from a difficult turmoil following the July 2006 events during the Israeli attacks on Lebanon. Areas affected in this conflict covered the totality of South Lebanon as well as a substantive area of Southern Beirut.

Consequently this war affected a number of HCFC service facilities initially known to the Ozone Unit at the Ministry of Environment both in Beirut and in the south. In addition to that, the survey team in the field was advised not to enter few geographic locations in some areas of South Lebanon where unexploded bombs are still left in the field causing enormous danger to surveyors.

Data collection

In order to undertake this process in an efficient and organized manner a set of questionnaire were designed to cover all requirements. Field work was intensive throughout the process in order to ensure crosschecking all data collected from official sources. The following data were collected from the field based on questionnaires designed for this purpose:

1. Primary or secondary HCFC import data
2. Primary or secondary HCFC based equipment population data and HCFC consumption.
3. HCFC volume of import from main importer.
4. HCFC consumption data by sectors from main distributors.
5. HCFC consumption data from main users
6. HCFC consumption and equipment from resource persons and or associations.

Meetings

Meetings were held with representatives from related government institutions, importers, distributors, and users as well as expert and senior technicians.

Following is a list of meetings/visits/interviews held in the course of implementation in addition to a comprehensive list of institutions visited in the field:

1. Meetings with government institutions: Central Administration of Statistics, Customs, Ministry of Economy and Trade
2. Meetings with main HCFC importers / Distributors.
3. Visits to HCFC major users/Plants (each sectors of application).
4. Meetings with HCFC experts and senior practitioners.
5. Regular coordination meetings with NOU/Ministry of Environment representatives.

Data Processing

Since Lebanon does not produce or export any CFC and HCFCs, the HCFC consumption is equal to the amount of HCFC imported to Lebanon.

However, since the Harmonized System (HS) code of the HCFC and especially the HCFC blends (where the HS code is for the HCFCs as a total) are not itemized (i.e. an HS code for HCFC-22 and another for the HCFC-141b). The import data obtained from custom and statistical bureau as well as from importers were analyzed using best estimates.

Finally, in order to verify and validate the result of estimations, meetings with relevant parties and institution as mention above were regularly organized.

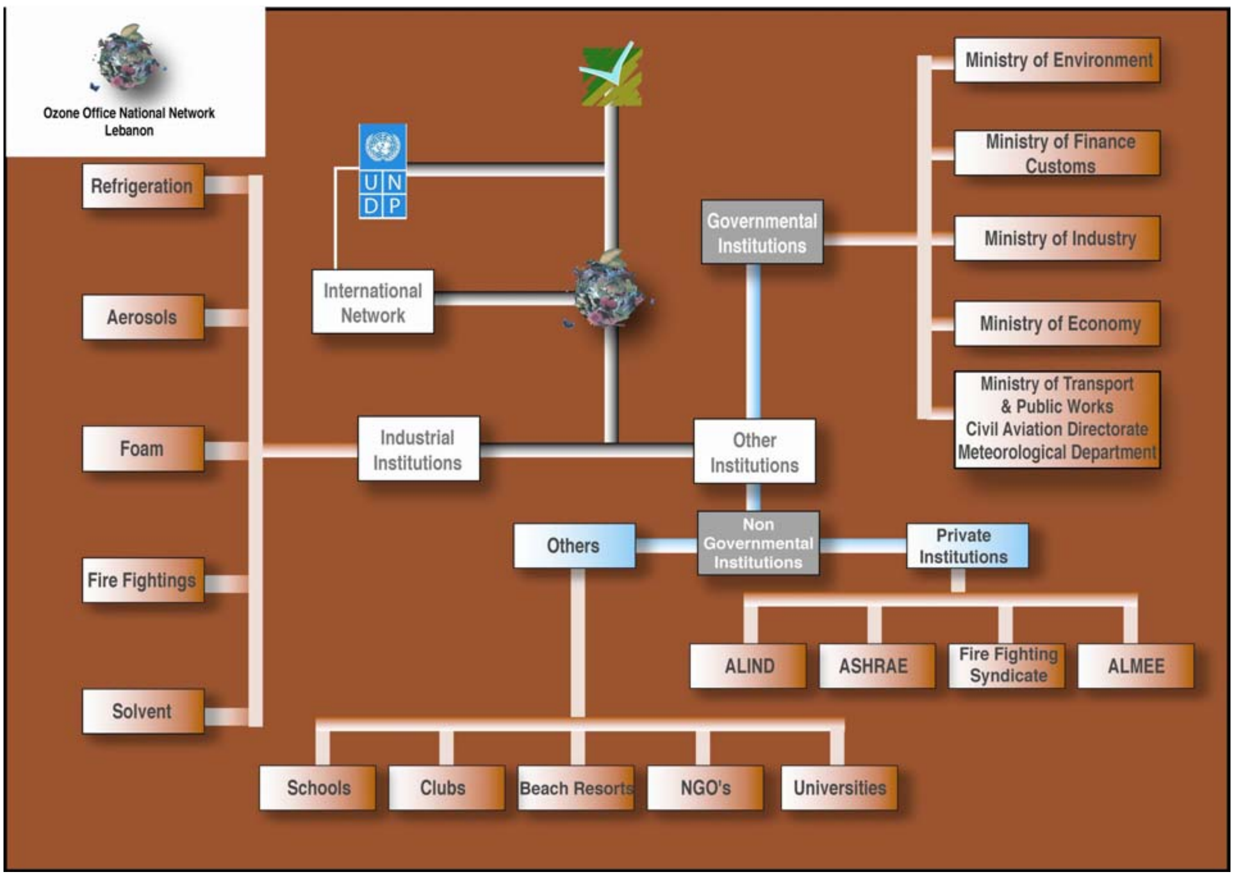
2. OBSERVATIONS

2.1 Institutional Framework

2.1.1 Institutional Arrangements

The operations of the NOU are funded by the MLF through the Institutional Strengthening programme executed nationally by the Ministry of Environment and managed by the UNDP country office. The NOU regularly seeks the advice of representatives from governmental authorities, NGOs, the private sector and academia. The following figure represents the project's operation with the National and International bodies and agencies (governmental and non-governmental).

***Figure 1*: National Ozone Unit Network**



The general objectives of the institutional strengthening project are to assist the Government to implement activities for meeting the obligations of the Montreal Protocol and its Amendments. Several major objectives relate to the direct Institutional Strengthening in the planning process:

1. Implementation of the NPMP through a combination of instruments, namely investment, technical support, training and institutional support, by eliminating the CFCs consumption in the manufacturing sectors through the development of investment projects and the remaining consumption in the service sector (Refrigeration) through non-investment projects.

2. Meeting the obligations of the Methyl Bromide National Phase-out Plan in accordance with the terms and conditions of the projects under implementation by UNDP (cut flower, tobacco, and vegetables) and UNIDO (strawberry).
3. Capacity building and technical assistance activities addressed to the Industrial Sector
4. Setting and implementing national public awareness /outreach strategies
5. Development of policies and legislations and follow-up on their implementation to put them into the right track for enforcement.
6. Setting-up of the appropriate guidelines for close monitoring and evaluation of Phase-Out Projects.

2.1.2 Policies and Regulations

National ozone policies formulated measures to support implementation of ODS phase-out activities in the country. They envisaged, in particular, (i) expediting of the implementation of activities for reduction of ODS use and adoption of substitute chemicals and technologies; (ii) public awareness of the ozone issues; (iii) as required, price increases of ODS to levels where the ODS substitutes become financially attractive; (iv) establishing a licensing system for ODS users; (v) establishing import monitoring procedures, and (vi) establishing other regulatory mechanisms as necessary.

In accordance with Decision IX/8 of the Parties, Lebanon found that it is necessary to have an ODS licensing system for ODS users. Consequently, ODS import monitoring procedure were introduced as an interim practice to control the imports and consumptions of ODSs, promoting the elimination of ODS and use of substitutes through its awareness activities. The specific policy and regulatory actions taken by Lebanon are as follows:

- In 1998, ODS were included in the list of items that require import license. It was also decided by the Government that MOE endorsement is required for requests of ODS importing licenses;
- In 1998, the MOE enacted regulations to ban imports of Halons;
- In 1998, the Ministry of Finance exempted all equipment inputs from MLF-funded projects, from taxes;
- In 2000, the Government prohibited establishment of new capacity using ODS;
- In 2003, the Government enacted regulations to control and monitor usage of ODS.

The licensing system for ODS imports, that is currently in place, requires importers to be registered and authorized by the Ministry of Environment. However, the NOU and Ministry of Environment are seeking to enhance the scope of this regulation, so that additional enforcement mandates are available which will require ratification by the parliament. The Office of Legal Affairs at the Ministry of Environment has therefore drafted a decree, which, upon approval by parliament would provide the required public mandate.

2.2 HCFC Supply Scenario

2.2.1 Production

There is no production of HCFCs in Lebanon. The entire domestic demand is met through imports.

2.2.2 Exports

The exports of HCFCs from Lebanon are rare and almost non-existent. Exporters, like importers, are both identified and designated by the Government of Lebanon. The survey was able to get the historical exports figures to the most extent available, as follows:

***Table 2*: Exports of HCFCs from Lebanon (2002-2005)**

Parameter	2002	2003	2004	2005
Quantity exported (metric tonnes)	11.20	0	0	9.25
Destination Countries	Kuwait			Egypt
	Liberia			Free Zone

2.2.3 Imports

In Lebanon, there are ten main importers of HCFCs. Import of HCFCs since 1995 are tabulated below:

***Table 3*: Lebanon – HCFC Imports (1995 – 2005)**

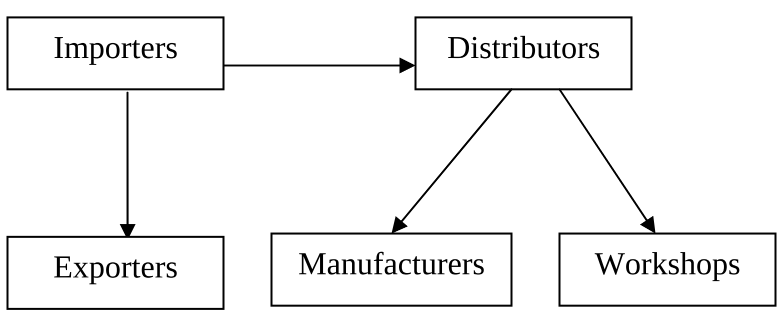
Year	Imports (metric tonnes)	Year	Imports (metric tonnes)
1994	NA	**2000**	257
1995	143	**2001**	291
1996	163	**2002**	375
1997	293	**2003**	331
1998	277	**2004**	315
1999	274	**2005**	336

The originating countries for these imports were mainly EU, USA, China and India.

2.2.4 Distribution and Supply chain

Imported HCFCs are sold directly to users by the importers or indirectly through secondary distributors or retailers. HCFCs are also supplied through service establishments and contractors.

***Figure 2*: HCFC Supply Chain**



2.3 HCFC Consumption

2.3.1 Aerosols Sector

In Lebanon, almost all of the non-medical aerosol manufacturers have converted to hydrocarbon propellants. One remaining enterprise will be addressed under the NPMP, also to convert to hydrocarbon propellants. There is no manufacturing of medical aerosols in Lebanon.

2.3.2 Firefighting Sector

There is no identified use of HCFCs in the Firefighting sector.

2.3.3 Foams Sector

The consumption of HCFCs in the Foams Sector in Lebanon is mainly due to conversion from earlier CFC-based technology. The historical reported HCFC consumption in the Foams Sector is illustrated in the following table:

Table 4: HCFC Consumption in the Foam Sector (1995-2005)

Parameter	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Consumption (metric tonnes)	NA	NA	NA	NA	8.20	NA	18.46	20.20	24.30	21.50	11.20

There is a likelihood of a few enterprises (less than 5) existing, which did not participate in the MP programme and directly converted or started production with HCFCs. Their HCFC consumption is estimated to be about 5-6 metric tonnes.

2.3.4 Refrigeration & Air Conditioning Sector

In 1993, the CP identified the Refrigeration and Air Conditioning Sector as the largest ODS consumption sector in Lebanon consuming an estimation of 422 tonnes of ODS.

Lebanon does not produce refrigeration compressors and the same are imported from all over the world. However, some components like evaporators, condensers, etc. are partly manufactured locally.

The overall reported consumption of HCFCs in the Refrigeration and Air Conditioning Sector from 1995 until date is shown in Table 16 below.

Table 5: HCFC Consumption in Refrigeration & Air Conditioning Sector (1995-2005)

HCFC Consumption (tonnes)	1995*	1996*	1997*	1998*	1999*	2000*	2001	2002	2003	2004	2005
Manufacturing	NA	NA	293.18	276.45	241.30	249.77	239	202.10	213.85	119.5	94
Servicing							32	64.70	71.3	137	230.4
TOTAL	**NA**	**NA**	**293.18**	**276.45**	**241.30**	**249.77**	**271**	**266.80**	**285.15**	**256.50**	**324.4**

** Breakdown of consumption in the sector between Manufacturing and Servicing was reported from 2001.*

Manufacturing

The manufacturing activities in the Refrigeration and Air Conditioning Sector are limited and mainly in window and split air conditioners and commercial refrigeration equipment. The cold rooms and chiller installations are assembled at site. There are 12 manufacturers of window/split air conditioning units and likely to be a few small-scale operators. There are about 30 manufacturers of commercial refrigeration equipment. The following table indicates the breakdown of HCFC consumption in manufacturing of HCFC-based refrigeration and air conditioning equipment:

***Table 6*: HCFC Consumption in Refrigeration & Air Conditioning manufacturing (2005)**

Application	HCFC Consumption (tonnes)
Cold Rooms	24.00
Chillers	20.00
Commercial Refrigeration eqpt	28.00
Window/split air conditioners	22.00
Total	**94.00**

Servicing

There is a significant existing population of domestic, commercial, industrial and transport refrigeration appliances, equipment and systems requiring servicing. Also, due to economic growth, there are several office buildings and complexes served by HCFC-based chillers for central air conditioning, which require servicing. There are a number of cold room installations serving hotels, hospitals, restaurants, food industry for preserving, fruits and vegetables, cut flowers and other perishables. Many of these installations are HCFC-based. As a result, there is a fast growing servicing sector comprising of a large number of servicing establishments.

The survey identified about 30 servicing workshops in the Bekaa region and 129 servicing workshops in the Beirut region, 34 servicing workshops in the North region and 35 servicing workshops in the Southern region. The following table shows the HCFC consumption (HCFC-22 is the dominant substance) from those servicing workshops in 2005:

***Table 7*: HCFC Consumption in Refrigeration & Air Conditioning servicing (2005)**

Region	R-22 (Tonnes)
Bekaa	32.10
Beirut	145.15
North	26.00
South	27.15
TOTAL	**230.40**

End-users

The HCFC-based equipment population in Lebanon includes cold rooms, chillers, commercial refrigerators and freezers and comfort air conditioning units (window, split, etc). The estimated population of HCFC-based equipment in these applications is summarized in Table 8 below.

***Table 8*: Population of HCFC-based Refrigeration & Air Conditioning Equipment (2005)**

Application	Estimated Total Population (Nos)	HCFC-based population (Nos)
Cold Room Installations	2,140	834
Major Chiller Installations	41	29
Window/split air conditioners	1,360,000	810,000
Commercial Refrigeration eqpt	100,000	20,000
Transport air conditioning units	5,000	1,000

2.3.5 Solvents Sector

There is no identified usage of HCFCs as solvents.

2.3.6 Summary and Conclusions

Since the establishment of the National Ozone Unit in 1998 it was hosted by the Ministry of Environment to undertake the implementation of the Montreal Protocol. As its main mandate was to phase-out usage of ODS, the NOU formulated policies for the implementation of different phase-out measures. In spite of continuous efforts in introducing rules and regulations for ODS phase out it is deemed necessary that these rules and regulations are further enhanced to cover a wider scope.

Lebanon is not a producing country of HCFCs hence all its domestic needs are met through imports by specific importers from whom data was collected during this survey. A small quantity of exports (9.25 metric tonnes) occurred in 2005.

The HCFC consumption is mainly concentrated in the Foams and Refrigeration and Air Conditioning sectors. The predominant HCFCs used are HCFC-141b and HCFC-22. HCFC-141b is used as a blowing agent in rigid polyurethane foam and HCFC-22 as a refrigerant.

The table shown below illustrates the HCFCs consumption by sector/substance:

***Table 9*: Summary of HCFC Consumption in Lebanon (2005)**

Sector	Consumption (metric tonnes)	
	HCFC-22	HCFC-141b*
Foam	---	11.20
Refrigeration & Air Conditioning		
Cold rooms	24.00	NA
Chillers	20.00	---
Commercial Refrigeration	28.00	NA
Stationary Air Conditioning	22.00	---
Servicing	230.40	---
Total	**324.40**	**11.20**

* Includes HCFC-141b used in cold rooms and commercial refrigeration

3. ANALYSIS

3.1 Demand Forecasts

HCFC-22 and HCFC-141b are, and will remain the most significant HCFCs in use in Lebanon. Future HCFC-22 and HCFC-141b consumption in Lebanon is linked to the growth of the refrigeration/air conditioning industry and the insulation and foam industry. The demand for HCFCs in Lebanon is likely to grow due to the expected economic growth and consequent rise in demand for consumer and industrial goods. In addition, conversion of some of the residual CFC consumption to HCFCs, as well as expansion of capacity of manufacturing HCFC-based equipment will contribute to growth. Also increasing population of HCFC-based products will increase servicing demand. While this is not certain due to the uncertainties associated with the political situation in the region, it is possible to project estimates of unconstrained future demand for HCFCs until 2015.

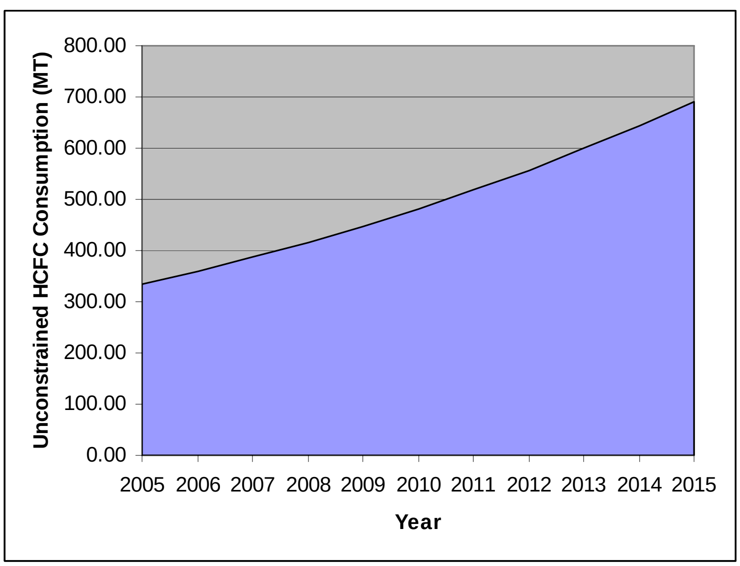
As shown in Table 4, the HCFC consumption in Lebanon increased from about 143 metric tonnes in 1995 to 336 metric tonnes in 2005, signifying an average annual growth rate of about 8.1% over the past 11 years. Applying an average annual growth rate in demand of 7.5% for the next 10 years, i.e. from 2006 to 2015, the unconstrained HCFC consumption in Lebanon is expected to reach 692 metric tonnes by 2015. The following table shows the unconstrained demand for HCFCs by substance:

***Table 10*: Unconstrained demand for HCFCs in Lebanon by 2015**

Substance	**Demand in 2005** (metric tonnes)	**Unconstrained demand in 2015** (metric tonnes)
HCFC-141b	11.20	23.10
HCFC-22	324.40	668.60
Total	**335.60**	**691.70**

Figure 4 below depicts the unconstrained growth of HCFC consumption in Lebanon until 2015.

***Figure 3*: Unconstrained HCFC consumption in Lebanon (2006-2015)**



3.2 Availability and Prices

3.2.1 Availability Scenarios

Due to increasing restrictions on HCFC use in developed countries, many of which would be in place by 2010, it is expected that in future the source of HCFCs would mainly be developing country producers, such as India and China. Based on market information, there is adequate manufacturing capacity in these countries to cater to the increased demand. It is also possible that some of the manufacturing capacity in developed countries may shift to developing countries. In view of these factors, it does not appear that there would be constraints on the availability of HCFCs in Lebanon by 2015.

3.2.2 Price Trends

The historical, prevailing and projected prices of HCFCs in Lebanon (1995-2015) are tabulated below.

Table 11*: *HCFC prices in Lebanon (1995-2015)

Year	**Market Price (US$/kg)**	
	HCFC-22	**HCFC-141b**
1995	8.25	NA
1996	6.50	NA
1997	6.00	NA
1998	5.20	NA
1999	7.40	NA
2000	4.75	6.50
2001	3.70	5.50
2002	3.85	6.00
2003	2.95	6.25
2004	2.60	5.50
2005	2.50	5.25
2006	2.40	5.00
2007	2.55	4.85
2008	2.30	4.65
2009	2.25	4.50
2010	2.25	4.50
2011	2.40	4.75
2012	2.85	5.00
2013	3.00	5.50
2014	3.30	5.85
2015	3.50	6.00

Thus it is seen that the prices of HCFCs in Lebanon in 2015 would not be dramatically higher, reflecting the relatively comfortable supply situation.

3.3 Technology

Certain non-ODP substitutes and alternative technologies to CFCs and HCFCs have become available in recent years for many applications. The selection of the substitute or alternative technology is based on a balance of maturity, availability, cost-effectiveness, energy-efficiency, safety, and safety costs. The selection is also influenced by local circumstances, preferences of enterprises, accessibility and cost-effectiveness, availability of training and regulatory compliance. This implies that developing countries need access to the newest information and need to be part of an adequate technical review process so that they can assess the choice of the most appropriate and integrated environmental solutions.

3.3.1 HCFC-22 Replacements

HCFC 22 alternatives are relatively new to the market. The main choices are between HFC blends and hydrocarbons (for small and medium sized systems) and between HFC blends and ammonia (for larger systems). Currently the leading HFC blends being used to replace HCFC 22 are HFC-407C and HFC-410A. However they both have some characteristics that make the move from HCFC 22 problematic for system designers (e.g. HFC-407C has a large "temperature glide" that makes it incompatible with some heat exchangers and HFC-410A operates at a considerably higher discharge pressure than HCFC 22). Other options are natural chemicals such as Hydrocarbons and Ammonia.

HFCs and HFC Blends: They have zero Ozone Depletion Potential. All pure HFCs and most HFC blends require use of synthetic lubricating oils in place of the more conventional mineral oils used for CFCs and HCFCs. This makes retrofitting more expensive. HFCs have a high GWP and if they need to be used they must be used with care. Every effort must be made to prevent/minimize leakage. The favourable properties of zero flammability and zero toxicity displayed by most HFCs make them a popular alternative in both existing and new systems. However, their availability and prices are unfavourable at the current time.

Ammonia, Hydrocarbons (HCs) and CO_2: These are the so-called "natural refrigerants". They have excellent thermodynamic properties and can be used in certain systems. Ammonia can only be used in new equipment specifically designed for ammonia. It is highly toxic and slightly flammable. Hydrocarbons are highly flammable and should only be used in systems designed to cope with the flammability risk. As a general rule, hydrocarbons are viable alternatives in small systems and in larger systems with intensive fire and explosion safety provisions. HCs can only be used in existing systems if great care is taken to address safety issues. Ammonia is a very popular refrigerant in the industrial refrigeration sector. Materials incompatibility makes ammonia generally unsuitable for small vapour compression systems. The tables below summarize the HCFC alternatives and their properties:

***Table 12*: Comparison of Alternatives to HCFC-22**

Parameter	HFC	HFC Blends	Ammonia	HC	CO_2
Flammability	0	0	Slight	High	0
Toxicity	0	0	High	Low	0
GWP	High	High	Low	Low	1
ODP	0	0	0	0	0

3.3.2 Replacements for HCFC-141b

Hydrocarbons: Pentane (n-, iso-, cyclo) based systems require extensive safety related provisions and investments due to their flammability. Cyclopentane has miscibility limitations with polyols. The molded densities and insulation values are marginally inferior to those obtained with HCFC-141b. The advantages are their relatively lower units costs, they are environmentally friendly (no ODP/GWP or health hazards) and constitute a permanent technology. Hydrocarbons are therefore the preferred conversion technology for large and organized users, where safety requirements can be complied with and investments can be economically justified.

HFCs: New HFC technologies such as HFC-245fa and HFC-365mfc have been commercially available recently. However, their prices and availability has not stabilized and is currently not cost-effective in countries like Lebanon to use them.

3.4 Environmental Impact

To accelerate the phase-out of HCFCs, it is important to use safe and environmental-friendly alternatives of HCFCs in the foam and refrigeration sectors that are commercially viable and affordable. When considering these options, benefits of alternatives in terms of increasing energy efficiency in case of replacing HCFC-22 with hydrocarbons in refrigeration and air-conditioning equipment, as well as costs of new technologies and new refrigerants should be taken in account.

In case developing countries opt to expand their production facilities of HCFCs, other global environmental impact should be considered. Increasing production of HCFC-22 in particular, will require increasing production of chloroform, which is used as raw material for producing HCFC-22. Production of chloroform will result in additional production of carbon tetrachloride. The production of HCFC-22 itself will also generate HFC-23 as a by-product or co-product. These unintended quantities of carbon tetrachloride and HFC-23 need to be considered. Carbon tetrachloride has an ODP of 1.1 while HFC-23 has zero ODP but its GWP is 12,000 versus carbon dioxide.

The GWP represents how much a given mass of a chemical directly contributes to global warming over a 100-year time period compared to carbon dioxide. Carbon dioxide's GWP is set at 1.0. As with ODP, if a refrigerant is not emitted to the atmosphere, there is no direct effect to the environment. This realization has produced legislation in many countries prohibiting the intentional release of refrigerants to the atmosphere and requiring the reclamation of used refrigerants and the repair of major equipment leaks. Equipment manufacturers have also responded by designing and manufacturing tighter new equipment and retrofitting kits to prevent leakage in existing equipment. Although these actions were initiated to reduce ozone depletion, they apply equally to global warming. The current science of global climate change suggests that the direct effect, or GWP, has a minor effect on total global warming compared to the indirect effect. A refrigerant's indirect effect has everything to do with the equipment's energy efficiency, the higher the equipment's efficiency, the less the contribution to global warming. Overall energy consumption will affect global warming the most.

The major part of greenhouse gas emissions from refrigeration and air-conditioning systems is related to the electricity used to operate them. Generation of electricity leads to CO_2 emissions from power stations. Energy efficiency is the primary environmental consideration for non-CFC technologies. While refrigerants each have a Global Warming Potential (GWP), refrigerants do not contribute to global warming unless they are released to the atmosphere.

The dominant global warming effect caused is due to the CO_2 emitted in the combustion of fossil fuels generating the electricity to drive the equipment, if and when electricity is produced by thermal power plants combusting fossil fuels. High efficiencies reduce the impact on global warming proportionally.

3.5 Compliance Challenges and Opportunities

Developing country usage patterns of alternative technologies are expected to follow the technology trends in non-Article 5(1) countries.

The challenge for the industry and equipment owners in the Refrigeration and Air Conditioning Sector, which is the predominant user of HCFCs, is to prepare for the orderly move from HCFC refrigerants to the many alternatives offered in the refrigeration marketplace. This is becoming more important when the typical life cycle of 10 to 30 years for HCFC equipment is taken into consideration. Based on these life cycle timeframes and the phase-out schedule for HCFCs, industry and consumers need to be aware of the facts on the HCFC phase-out and the alternatives available, when planning for future refrigeration and air conditioning equipment needs.

The major challenges, which would prove as disincentives for early transition from HCFCs to alternatives, are foreseen as below:

- Relatively adequate supply of HCFCs at reasonable prices until 2015
- High cost and inadequate availability of alternatives
- Inadequate capital and technical capacity to manage the transition
- Lack of awareness on the HCFC controls and available alternatives, so also their impact on processes and practices.

The opportunities which are present or would present themselves to meet the compliance requirements are as below:

- Experience gained and lessons learnt in phasing out CFCs
- Infrastructures established for managing CFC phase-out can be partially applied towards achieving HCFC reductions

3.6 Potential Compliance Measures

The potential actions for compliance would comprise of the following:

<u>Preparing a strategy and action plan</u>: It would be prudent to develop a national strategy and action plan for compliance reflecting national policies/priorities, which could incorporate the following:

- Assessment of existing/new institutional structures, mechanisms and stakeholders that would administer, facilitate and monitor compliance actions and strengthening them
- Techno-economic assessment of available alternative technologies and their applicability/costs
- A detailed industry profile with identification and prioritization for those sectors in which transition is feasible earlier and/or cost-effectively
- Incremental costs of transition and conversion

Awareness and information dissemination: It would be crucial to make available information on the impending obligations of the 2016 freeze, technical information on alternatives, etc. to ensure stakeholder commitment to the reduction goals.

Reducing dependence on HCFCs: While the national strategy would incorporate measures to reduce dependence on HCFCs, it would also be worthwhile to identify sectors/actions in/through which HCFC usage can be reduced, for example, introduction of best practices/equipment for reducing HCFCs in servicing, using existing networks and systems established for managing CFC phase-out. Additionally, in those applications where drop-in replacements for HCFCs are feasible, they could be encouraged and implemented, for example, in end users.

Technical Assistance and Training: It would be crucial to ensure that adequate technical assistance and training is provided to stakeholders in the government and industry, to make informed decisions and choices about HCFC reductions and HCFC management.

The incremental costs involved in implementing these compliance measures would need to be adequately funded under the existing Montreal Protocol mechanisms, so that these costs are not borne by the consumers and industry or the country's economy.

3.7 Summary and Conclusions

In Lebanon, HCFC-22 and HCFC-141b are the predominant HCFCs used, in the Foams and Refrigeration & Air Conditioning sectors. HCFC-141b is used as a blowing agent for rigid polyurethane foams and HCFC-22 is used as a refrigerant.

Lebanon's consumption of HCFCs increased from 143 metric tonnes in 1995 to 336 metric tonnes in 2005. Unconstrained HCFC consumption in Lebanon is expected to reach 692 metric tonnes by 2015. It appears that the availability and costs of HCFCs would not be adverse for the next few years. This would present potential barriers for compliance with the 2016 freeze in consumption. Potential replacements for HCFCs include hydrocarbons and HFCs/HFC blends. Their availability and/or techno-economic feasibility are not yet favourably established for wider use. Lack of information and awareness about alternatives is another barrier for their application. Lessons learnt and experience gained during implementation of the CFC phase-out, as well as application of the structures established therein towards effecting reductions in HCFC use, are considered opportunities for addressing compliance requirements.

Potential compliance measures include preparation of a national strategy and action plan for meeting the 2016 freeze in consumption and also for future management of HCFCs, reducing dependence on HCFCs in the interim where alternatives can be more easily applied, creating awareness and disseminating information on the 2016 freeze obligations and alternative technologies and providing technical assistance and training for making informed decisions on the transitions.

Lebanon expects the incremental costs of compliance to be met under the mechanisms of the Montreal Protocol.

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ANNEX

<u>Information on HCFC consuming enterprises</u>

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Foams	Rigid PU Foam	40
Refrigeration and Air Conditioning	Cold Rooms	30
	Chillers	20
	Stationary Air Conditioning	40
	Commercial Refrigeration	50
SERVICING		
Refrigeration and Air Conditioning	All	Over 500

Note: The numbers and data provided in the table are a result of a limited survey of various sectors related to HCFCs the primary aim of which was to generate information that would enable the ExCom to establish a permanent aggregate level of consumption against which future activities could be funded. The numbers and data in this table are therefore ***indicative only and not binding***. The numbers/data may be revised in future as a result of more detailed sector-level information becoming available. The numbers/data may not be used without the prior consent of the Government.

SURVEY OF HCFCs IN MEXICO

FINAL REPORT

Secretaría de Medio Ambiente y Recursos Naturales
and
United Nations Development Programme (UNDP)

February 18, 2007 (revised)

EXECUTIVE SUMMARY

Mexico participated in the Montreal Protocol Agreement (MP), through the SEDESOL Secretariat (now called SEMARNAT), in 1987. In that same year, Mexico ratified the Vienna Convention. Under the MP guidelines, a nation that consumes less than 300 grams of Ozone Depleting Substances (ODS) is considered a country under Article 5 of the Montreal Protocol.

The MP states that developing nations will freeze their consumption levels of HCFC's in 2016 (based on 2015 levels), and to eradicate HCFC use in 2040.

There are five types of HCFC's currently used in Mexico. These are:

1. HCFC-22 Uses: Refrigerant-pure and in blends
2. HCFC-123 Uses: Refrigerant, cleaning agent
3. HCFC-124 Uses: Refrigerant, cleaning agent
4. HCFC-141b Uses: Foaming agent, cleaning agent
5. HCFC-142b Uses: Component in refrigeration blends, foaming agent

The consumption of HCFC's in Mexico has grown considerably since 1995. In that year, Mexico consumed 4,800 metric tons of HCFC's; in 2004, the country consumed 18,600 metric tons (284% increase or ~15% /y).

There are two major HCFC consuming sectors in Mexico: Refrigeration and Air Conditioning (RAC) and Foams. HCFCs are used in considerable smaller amount as cleaning agents (solvents.

Estimates show that under an unconstrained scenario, Mexico will consume almost 33,000 t HCFC's by 2015—the reference year for the first control measure (2016 freeze at 2015 levels)

In order to comply with MP guidelines, the Mexican government requires all companies dealing with CFC's to report their activities to SEMARNAT. It is this government's office that sets limits to the amount of CFC's produced, imported and exported. The MP states that Article 5 countries (developing countries) are required to freeze CFC consumption in 2000, and to eliminate their use by 2010, triggering the need for control measures. However, because there are no current limits on the use of HCFCs in developing (article 5 (1)) countries until 2o15, there are currently no limits set by the government on these substances and thus no control measures exist. SEMARNAT is nonetheless requesting consumption data from the companies that import, export and produce HCFC's in Mexico, and is ready to regulate their usage according to MP requirements if and when need exists.

HCFC consumption levels of 2015 will set the upper limit of HCFC consumption in Mexico for 2016 thru 2040, after which the use of HCFC's is to be eliminated (except for essential uses). Mexico realizes that the sudden character of these measures will make compliance difficult unless actions are taken to bend the growth trend through 2015 to a flat level; to avoid any growth after that date and to decrease use well in advance of 2040 to allow full phaseout by that date.

Mexico is confident that, with appropriate support from the MLF, this can be achieved. SEMARNAT is already in the process to formulate sector-based approaches to that matter. It sees possibilities for quick action in

- The RAC service sector by complementing existing CFC-focused programs
- Energy reduction and climate related programs that include replacement of RAC equipment
- Chiller replacement programs
- Elimination of HCFC-141b for the flushing of refrigerator circuits (in combination with other LA countries)
- Selected HCFC phaseout programs in foam (sub)sectors

Some of these programs show promise for a tie in with carbon credit programs as well.

Major impediments in bending the trend towards 2015 and, later on, to completing elimination by 2040 are

- Current MLF rules that do not allow funding for follow-up projects to replace transitional substances as well as unrealistic cost thresholds on funding for projects when applied to HCFCs.
- The very low current costs of HCFCs
- The high investment costs related to some essential ODS-free technologies, specifically in the foam and solvent sector

Mexico therefore seeks a new set of guidelines by the MLF for HCFC phaseout projects and recommends efforts by industry and research centers to reduce costs of current technologies and come up with new, more economic ones. Where such technologies would require pilot projects in an Article 5(1) context, Mexico is willing to cooperate in such actions for the benefit of all developing countries.

SURVEY OF HCFCs IN MEXICO

CONTENTS

LIST OF ABBREVIATIONS

ATOC	UNEP Aerosols, Sterilants, Miscellaneous Uses and Carbon Tetrachloride Technical Options Committee
CFCs	Chlorofluorocarbons
CP	Country Programme
CTC	Carbon Tetra Chloride
DACS	Disposable Cans (used for refrigerants – DuPont: Dispose-A-Can^{R})
ExCom	Executive Committee of the Multilateral Fund
FTOC	UNEP Foams Technical Options Committee
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
IA	Implementing Agency
IPCC	Intergovernmental Panel on Climate Change
MAC	Mobile Air Conditioning
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MOP	Meeting of the Parties to the Montreal Protocol
MP	Montreal Protocol
NOU	National Ozone Unit
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
OEM	Original Equipment Manufacturer
R&R	Recovery and Recycling
SEDESOL	Secretaria de Desarrollo Social (Social Development Secretariat).
SEMARNAT	Environment and Natural Resources Secretariat (Secretaria de Medio Ambiente y Recursos Naturales)
SMEs	Small and Medium-sized Enterprises
STOC	UNEP Solvents, Coatings and Adhesives Technical Options Committee
TEAP	UNEP Technology and Economic Assessment Panel
TR	Tons of Refrigeration
UNDP	United Nations Development Programme
UNDP-MPU	United Nations Development Programme, Montreal Protocol Unit
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
WB	World Bank
XPS Foam	Extruded Polystyrene Foam
Y	Year

LIST OF TABLES

1. INTRODUCTION

1.1 BACKGROUND

Mexico's participation in the Montreal Protocol Agreement.

The Mexican government participated in the Vienna Convention and the Montreal Protocol through the SEDESOL Secretariat (today called SEMARNAT). This agreement restricts the production, import and use of ozone Depleting Substances (ODS).

Under the MP, Mexico is considered a recipient country; its consumption levels were at that time around 110 gram ODS per capita per year, well under the 300 gram limit. Currently, Mexico consumes approximately 190 grams of ODS per capita per year (2004 levels). It is therefore eligible for financial, technical and institutional support extended through the Multilateral Fund for the Implementation of the Montreal Protocol (MLF).

Mexico's status of ratification of the MP and its amendments is as follows:

Table 1. Mexico's ratification status.

Treaty	Date of Ratification	Type
Vienna Convention	14 Sep 1987	(R)
Montreal Protocol	31 Mar 1988	(At)
London Amendment	11 Oct 1991	(At)
Copenhagen Amendment	16 Sep 1994	(At)
Montreal Amendment	July, 2006	(At)
Beijing Amendment	Pending	

Key: R=Ratification / At=Acceptance.

Entry into Force for Vienna Convention: 22.9.1988
Entry into Force for Montreal Protocol: 1.1.1989
Entry into Force for London Amendment: 10.8.1992
Entry into Force for Copenhagen Amendment: 14.6.1994
Entry into Force for Montreal Amendment: 10.11.1999
Entry into Force for Beijing Amendment: 25.2.2002

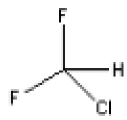
SEMARNAT is responsible, among other environmental issues, for ensuring that the MP guidelines, restrictions, limits and goals are met. It has formed within the Secretariat a National Ozone Protection Unit (NOU) that is responsible for all operational issues related to the MP as well for the formulation of regulations to assure compliance. Other governmental agencies communicate to the NOU relevant information on HCFC's, with Customs being one of the principal sources for data accumulation.

HCFC's in Mexico.

There are five HCFC chemical substances currently used in Mexico:

1.- HCFC-22

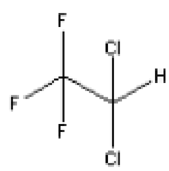
ODP=0.055
GWP=0.36
Synonyms: difluorochloromethane; chlorodifluoromethane; Freon 22; R-22; R22; refrigerant R22; halocarbon 22.
CAS No.: 75-45-6
Molecular formula: CHClF2
Molecular weight: 86.469
Structural Formula:



Uses: Refrigerant

2.- HCFC-123

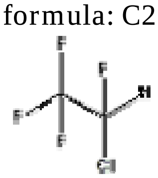
ODP=0.02
GWP=0.02
Synonyms: 1,1-Dichloro-2,2,2-trifluoroethane; Freon 123; Dichlorotrifluoroethane; R-123; Fluorocarbon 123; FC-123
CAS No.: 306-83-2
Molecular formula: C2HCl2F3



Uses: Refrigerant; foaming agent; solvent

3.- HCFC-124

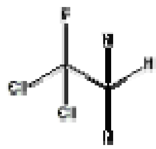
ODP=0.02
GWP=0.10
Synonyms: 2-Chloro-1,1,1,2-tetrafluoroethane, 1-Chloro-1,2,2,2-tetrafluoroethane, Freon 124; chlorotetrafluoroethane; R-124; Hydrochlorofluorocarbon 124; FC-124
CAS No.: 2837-89-0
Molecular formula: C2HClF4



Uses: refrigerant; fire extinguishing agent

4.- HCFC-141b

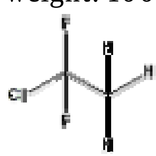
ODP=0.11
GWP=0.09
Synonyms: 1,1-dichloro-1-fluoroethane; 1-fluoro-1,1-dichloroethane; dichlorofluoroentane; Freon 141b; R141b; HCFC141b
CAS No.: 1717-00-6
Molecular formula: C2H3Cl2F
Molecular weight: 116.95
Structural formula:



Uses: Foaming agent; solvent

5.- HCFC-142b

ODP=0.06
GWP=0.36
Synonyms: 1-Chloro-1,1-difluoroethane; Freon 142b; Freon 142; Difluoro-1-chloroethane; 1,1-Difluoro-1-chloroethane; R-142b
CAS No.: 75-68-3
Molecular formula: C2H3ClF2
Molecular weight: 100.50



Uses: Component in refrigerant blends; foaming agent for extruded foams with high insulation values

HCFC production in Mexico.

The only HCFC produced in Mexico is HCFC-22. It is produced by Quimobásicos S.A. de C.V. (QB), a subsidiary of Honeywell. It is used locally as well as exported to other countries in Latin America. In 1995, the company produced 2,141 t and in 2005 8,776 t. Production has thus grown considerably in the past ten years. Quimobásicos was unable to provide information on estimated future production levels because of (i) significant supply through distributors that do not disclose details of their markets and (ii) current volatile pricing that makes forecasts difficult.

HCFC consumption in Mexico.

The following lists the HCFC's based on their consumption levels.

1.- HCFC 22	2004 metric tons consumed:	10,828
2.- HCFC 141b	2004 metric tons consumed:	7,753
3.- HCFC 123	2004 metric tons consumed:	43
4.- HCFC 124	2004 metric tons consumed:	37
5.- HCFC 142b	2004 metric tons consumed:	0

The first two represent the bulk of HCFC consumption in Mexico. The last three are used to some extent but in very small quantities. HCFC-142b, while not imported in 2004, was imported in previous years and in 2006. there has been in the past some use of HCFC-225 but not recently and this substance has therefore been deleted from the survey.

HCFC's are consumed in the following sectors:

1) Refrigerants.
2) Chillers (industrial refrigeration systems).
3) Foam industry.
4) Cleaning Solvents (very small amounts).

As mentioned, only HCFC-22 is produced in Mexico; the country imports all four other HCFCs mentioned above. Countries that serve the Mexican market are primarily the USA and France. In turn, Mexico exports HCFC's to numerous countries, mainly serving the Latin American market. All countries receiving HCFC's from Mexico are Parties of the MP.

There are three key players in the HCFC market in Mexico:

1) Quimobásicos
2) DuPont
3) Arkema

These companies use HCFCs for their own blending activities, sell HCFCs to other users (chemical companies, foam manufacturers, refrigerant service shops, etc.), and export to other countries.

In summary, Mexico only consumes HCFC-22 and -141 B in considerable amounts. HCFC-142 B and -123 are used in very small quantities. The only HCFC produced in Mexico is HCFC-22. Mexico exports to other Latin-American markets, the main substance being HCFC-22. In addition, some HCFC-141b is exported.

1.2 APPROACH AND PREPARATION

The Executive Committee of the MLF approved at its 45th Meeting a project prepared by UNDP which aims to conduct a survey of HCFC use in selected countries with the objective of establishing an eligible national aggregate level of HCFC consumption in the future against which proposals would be funded (Decision 45/6). Additional motivation for this survey was found in the Supplement IPCC/TEAP special report and related decisions by the MOP. Although the report focuses on effects from ODS banks, it very much applies to HCFCs because these are already the largest contributor in mass and will be shortly the largest contributor in ODS as well. It mentions early phaseout of HCFC use in developing countries as the less expensive option to reduce ODS banking. The report also mentions joint benefits of saving ODS and GWP emissions and therefore the benefit of cooperation between the applicable protocols (and, for funding purposes, between the MLF and GEF). The preparation of a survey and evaluation of possible action to reduce HCFC use is of interest to achieve reduction in ODS banking as well.

In order to speed up the administrative process, UNDP selected to implement it through its Montreal Protocol Unit (MPU) in close cooperation with the National Ozone Units and UNDP's Country Offices in the selected countries, from which Brazil is one. For each country, in consultation with the NOUs, national experts have been recruited to conduct and analyze the actual survey and to prepare a report following a template issued by UNDP.

These reports have been edited by two international experts before being forwarded to UNDP-MPU. MPU, after conducting its own review, submitted the reports to the National Ozone Units with the request for comments by an as broad as possible cross-section of stake holders. After taking these comments into consideration, MPU prepared final versions of the national reports for submission to the MLF.

1.3 SURVEY METHODOLOGY

The National Expert was directed to prepare initially a desk study with the aim to

- locate sources of information,
- identify the different applications for HCFCs,
- identify the stakeholders, such as importers, exporters and associations, and
- determine the scope of work for the final survey.

For the sake of uniformity and completeness, MPU provided a template for this study. The expert prepared this study based on sources located within SEMARNAT.

After editing and acceptance of the desk study by MPU, a final survey was conducted, again, following an MPU-provided template. Activities for this survey included

- interaction with various stakeholders to identify and categorize all current users of HCFCs
- collection of baseline information following formats provided by MPU
- classification of this information as below:
    - historical consumption data (determined from production + import – export)
    - segregation of these data by sector
    - segregation of these data by users (or, for smaller users, groups of users)
    - segregation of these data by users that received/did not receive prior MLF assistance

The national expert incorporated these data along with related forecasts, conclusions and recommendations into a final report, for which MPU provided a detailed template. This report was reviewed, completed and edited by the international expert responsible for the Latin America region, then discussed with SEMARNAT and HCFC producers/importers and subsequently forwarded to UNDP-MPU for final review and submission to the MLF.

Information contained in this survey was obtained from three main sources:

1. The Government of Mexico
    - SEMARNAT, specifically the NOU
    - Customs
2. HCFC importers and producers
3. Other industrial sources

The national expert arranged initially a series of meetings with the NOU to review all information collected by that unit. Then the three chemical companies operating in Mexico in the HCFC market were contacted and asked to respond to a questionnaire. All historical consumption data included in this report are based on individual invoices and customs forms. The consumption estimates for 2006-2015 are based on each company's outlook of the HCFC market, and are thus subjective. However, they have been questioned, discussed, analyzed and justified in attendance of suppliers and SEMARNAT.

As per decision 45/6(i), the survey provides information on current consumption by sector and substance, as well as the forecasted projections thru 2015. This information will allow the MLF Secretariat–if requested by the Executive Committee–to propose funding policies and procedures for the next years, including the possible establishment of an "eligible national aggregate level of HCFC consumption."

The survey resulted in a database of stakeholders—importers, distributors, associations and HCFC-consuming enterprises. The Government treats this database as confidential and will make it only available on a need-to-know basis as it involves commercial information that may be sensitive to some of the parties concerned. Requests for more detailed information should be sent to the National Ozone Unit. In addition, while the survey has identified a substantial amount of individual HCFC users, not all suppliers were willing to disclose individual customers. Additional individual users will be identified over the next years in case this survey will evolve into a sector-based HCFC management plan.

The following table provides the numbers of enterprises that were identified in the survey per category/sector:

Table 2. Stakeholders identified in the HCFC Survey in Mexico

HCFC Stakeholders	Amount of Enterprises
Producers	1
Importers	3
Refrigeration Distributors	134
Aerosol Distributors	2
Foam Distributors	7
Chambers/Associations	1
HCFC-Consuming Enterprises by Sector	*
All HCFC Stakeholders	**148**

* There are thousands of individual users on file with SEMARNAT and Distributors

2. OBSERVATIONS

2.1 INTRODUCTION

In 1974, Dr. Mario Molina, a Mexican scientist, and Dr. Sherwood Rowland, a US scientist, published the first studies on the depletion of the ozone layer (they were both awarded the Nobel Prize in chemistry in 1995). Dr. Molina has since worked closely with the international community in efforts to reduce ODS, as well as with SEMARNAT on Mexico's compliance with MPA guidelines. SEMARNAT created Mexico's NOU. It is through this branch of SEMARNAT that Mexico deals with all issues of the MP. Other government agencies are involved as needed. A licensing system was designed and implemented to control CFC consumption. Mexico's Customs office works closely with the NOU to ensure that pertinent controlled substance limits are strictly observed.

2.2 INSTITUTIONAL FRAMEWORK

2.2.1 Institutional Arrangements

Mexico's Secretariat of Environment and Natural Resources (Secretaría del Medio Ambiente y Recursos Naturales, or SEMARNAT) is a government agency whose main purpose is to create a State environmental protection policy reversing the tendencies of ecological deterioration and establishing a base for sustainable development in the country. It is therefore thorough SEMARNAT that Mexico deals with all MP guidelines.

The National Ozone Protection Unit (NOU) was created to manage the elimination of Ozone Depleting Substances (ODS) in the country. This Unit is overseen by the General Directorate of Air Quality Management, Pollutant Release and Transfer Registry, which, in turn, is overseen by SEMARNAT. In addition, the NOU works closely with Implementing Agencies such as the United Nations Development Programme (UNDP), the United Nations Environmental Programme (UNEP), the United Nations Industrial Development Organization (UNIDO), The World Bank, etc. to ensure Mexico's timely adherence to MP stipulations.

2.2.2 Policies

The following table displays Mexico's commitments under MPA policies and guidelines:

Table 3. Mexico's MPA commitment summary

Ozone Depleting substance	***Starting Point***	***Reduction Agreement***
CFC's and Halons	*Average consumption 1995-1997.*	*50% by 2005;85% by 2007; 100% in 2010*
Methyl Bromide	*Average consumption 1995-1998*	*20% by 2005; 100% in 2015.*
HCFC's	*Production and consumption freeze in 2016 based on 2015 levels.*	*100% in 2040.*

MP rules for Article 5(1) countries (developing countries) require a consumption freeze of HCFC's from 2016 onwards and a stop on the usage of HCFC by 2040. Based on this deadline, the Mexican government is not yet limiting HCFC usage in Mexico. Chemical companies dealing with HCFC's are allowed at this time to consume whatever amount of HCFC's they require. SEMARNAT intends to develop a regulatory framework in time to comply with the MP deadlines. As of date, the Office is only requesting consumption data of HCFC's from the chemical companies operating in Mexico.

2.2.3 Regulations and other control measures

While there are control measures for CFC's, there are currently none for HCFC's. As mentioned in 2.2.2 of this survey, this will not occur until 2016, in accordance with current MP rules unless other international arrangements are made.

Control measures for CFCs that may be of interest for future application on HCFCs are

Technical Assistance Activities - In the framework of the Technical Assistance activities, the project management and the monitoring capacity of the NOU was strengthened. The activities also included project verification, reporting and increased awareness of the general public.

Customs training - Appropriate application and enforcement of national and international laws and regulations with regard to the trans-boundary movement of ozone depleting substances are cornerstones to the success of the implementation of Montreal Protocol and compliance with the Protocol obligations of the respective countries. The customs officers were trained and equipped to undertake proper inspection of goods and enforce the respective legislation. A special training program was designed and implemented to train the custom officers in the year 2005.

National project for training of service technicians - A program for training RAC service technicians in "best service practices" is one of the major components in the CFC phase-out strategy for the refrigeration service sub-sector. This training also promotes the recovery, recycling and reclamation of refrigerants in order to reduce dependency on virgin CFCs leading to the reduction of CFC consumption.

National Recovery and Recycling Project - There is a multitude of obsolete refrigerating equipment using CFC refrigerant. They constitute a threat to the Ozone Layer since the containment of this equipment is low. In general, this equipment is characterized by much high energy consumption. An incentive program has started earlier in the chiller sector through UK–World Bank cooperation. The Mexican Government decided to extend the said program to domestic refrigeration and air-conditioning systems. This would enable early and organized retirement of obsolete equipment and recovery/recycling of CFC from the appliances prior their disposal.

Equipment Retirement Program - A very successful incentive program for retirement of old domestic refrigeration and air conditioning equipments was organized in 2005 through UNIDO and the Fund for Energy Savings Fund (FIDE). This program has accelerated the replacement of old appliances, resulting in reductions of the use of CFC, since the new equipment are free of CFC and thus the release of CFCs is continuously reduced in the service sector.

Service tools for certified technicians - As a part of this program, 2,100 certified (1,500 service technicians and 600 MAC service shops) technicians will be equipped with a set of service tools.

Chiller replacement program - This program is linked with the recovery and recycling project but oriented to the obsolete refrigeration equipment using CFC refrigerant in the chiller sector. In general, this equipment is characterized by high energy consumption. An incentive program has started earlier in the chiller sector through U.K. – World Bank co-operation. In 2006/7 this program will continue with the assistance of the World Bank using resources transferred from this sector plan. The chiller replacement program has been implemented through a joint cooperation between SEMARNAT-NOU, World Bank, FIDE and NAFIN (National Financier). A total of five projects were prepared with the following achievements:

Other achievements through on-going projects - With regard to the use of CFC in the manufacturing sector, Mexico completed in 2004 the first tranche of a UNDP-sponsored CFC phase out project for the foam sector. The second part is also technically completed and the only pending activities are awareness measures. Likewise, the remaining aerosol sector companies still using CFCs signed the respective contracts to phase out the use of these substances within the ongoing phase out program, by the first semester of 2006.

Regulatory Activities - The Mexican Government is enhancing its regulation on the uses of CFCs in the Country. The proposed regulation aims for a gradual abandonment of the use of CFCs in all sectors consistent with the Montreal Protocol obligations, through the enactment of a norm that allows use of CFCs to satisfy only the basic internal needs and essential uses in the Country, and prohibits the production or imports of all kinds of refrigeration equipment, air conditioning equipment, propellant formulations, plastic foam or solvent cleaning operations that use or contain CFCs, except those related to essential uses as defined by the Montreal Protocol. The implementation of the "Total Annual Quota Program for the National Consumption of CFCs", which establishes caps for the consumption of CFCs in the Country. The Program will be compulsory for producers and importers of CFCs.

This policy is also consistent with the CFC Production Closure Project approved at the 40th ExCom Meeting.

2.3 HCFC SUPPLY SCENARIO

2.3.1 Production

Mexico produces only one type of HCFC (HCFC-22). The company that produces this substance is Quimobásicos, S.A. de C.V., a subsidiary of Allied Chemical in the USA. In 1995, the company produced 2,141 metric tons. In 2005, it produced 8,776 metric tons (an increase of 309.9%). The greatest increase in production levels occurred from 1995 to 1996, where the production level as compared to the previous year increased by 151.9%. Production then stabilized for an average of 5,513 metric tons per year between 1996 and 2005 (a 10 year average).

Table 4. HCFC Production in Mexico for 1995 thru 2005 (t)

Production	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	2,141	5,394	5,515	4,337	5 ,981	4 ,311	3 ,204	4 ,947	5 ,117	7 ,548	8 ,776

Source: SEMARNAT

2.3.2 Exports

Mexico exports HCFC-22 to other countries. Small quantities HCFC-141-b are also exported and even smaller quantities of HCFC-225 have been exported in 2002 to Guatemala only. Out of the four companies involved in HCFC supply, only two are involved in export: Quimobásicos and DuPont.

HCFC-22 export levels show a steady growth trend in the period between 2001 and 2004, and this is likely to continue. The USA is the recipient of the bulk of Mexican exports of HCFC-22 (a 69% share of the export market), while Argentina, Colombia, Chile, Peru and Venezuela combined are the recipients of 19% of the Mexican exports. These countries represent 88% of Mexican exports.

Table 5. HCFC Export Data for Mexico for 1995-2004 (t)

Substance	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	4 096	3 449	2 852	3 601	2 468	1 816	2 974	3 079	4 362	5 108
HCFC-123	0	0	0	0	0	0	0	0	0	0
HCFC-124	0	0	0	0	0	0	0	0	0	0
HCFC-141b	18	0	0	0	0	0	7	6	6	315
HCFC-142b	0	0	0	0	0	0	0	0	0	0
Total	4 114	3 449	2 852	3 601	2 468	1 816	2 981	3 085	4 368	5 423

Table 6. Detailed HCFC Export Data for Mexico for 2002-2004 (t)

Product	Country	2002	2003	2004
CFC-22	Antigua y Barbuda	10.00	10.00	12.49
	Argentina	12.00	38.00	183.49
	Belize	24.00	7.00	4.00
	Bolivia	33.00	12.00	13.00
	Brazil	62.00	0.00	32.00
	Colombia	101.00	40.00	179.00
	Costa Rica	24.00	17.00	11.00
	Cuba	47.00	91.00	88.49
	Chile	138.00	169.00	144.00
	Span	0.00	0.00	21.00
	Ecuador	25.00	34.00	72.49
	El Salvador	41.00	36.00	33.00
	Francis	32.00	0.00	65.00
	Guatemala	60.00	33.00	50.46
	Guyana	0.00	0.00	21.49
	Honduras	39.00	4.00	6.00
	Nicaragua	39.00	52.00	34.98
	Panama	54.00	29.00	44.95
	Paraguay	48.00	10.00	0.00
	Peru	90.00	139.00	159.95
	República Dominicana	74.00	32.00	45.00
	Uruguay	60.00	29.00	35.00
	USA	1 652.00	2 165.00	2 988.00
	Venezuela	309.00	132.00	126.00
	Total	**2,974.00**	**3,079.00**	**4,370.79**
HCFC-141b	Chile	0.00	0.00	3.00
	Guatemala	0.00	3.00	6.00
	Peru	0.00	2.00	1.00
	Uruguay	7.00	1.00	0.00
	Total	7.00	6.00	10.00
CFC-124	Guatemala	1.50	0.00	0.00
	Total	1.50	0.00	0.00
	Total HCFC's Exports	**2,982.50**	**3,085.00**	**4,380.79**

Source: Mexican Customs Authority

2.3.3 Imports

Mexico imports HCFCs from the USA and from France. Most of the imports are HCFC-22 and HCFC-141b. In 2004, a considerable increase in imports was registered. In 2003, 7,372 metric tons of HCFC's were imported, while in 2004, the figure rose to 15,481 metric tons. Most of the HCFC's imported into Mexico come from the USA. Tables XXX and XXX specify the exporting countries serving the Mexican market.

Table 7. Import Data for Mexico (t)

Substance	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	2 020	1 538	2 409	2 834	4 154	5 712	2 283	3 520	7 642	3 546
HCFC-123	13	19	28	28	102	70	16	4	43	46
HCFC-124	0.00	2	7	16	124	134	10	1	37	0
HCFC-141b	1 512	2 123	2 350	7 696	13 759	7 068	2 403	3 847	7 759	7 317
HCFC-142b	0	0	0	0	8	0	0	0	0	263
Total	**3 544**	**3 681**	**4 794**	**10 574**	**18 147**	**12 985**	**4 711**	**7 372**	**15 481**	**11 172**

Source: Semarnat

2.3.4 Distribution and Supply Chain

There are four chemical companies dealing with CFC's and HCFC's in Mexico. They are:

1.- Quimobásicos.
2.- DuPont
3.- Arkema
4.- Praxair

Of these, only the first three are relevant for the purpose of this survey (Praxair is not a major importer, exporter or distributor). The chemicals are imported in ISO containers or tank cars, and are distributed in ISO containers, tank trucks or through a pipe system (when in bulk). For smaller quantities, CFC's and HCFC's are delivered in barrels, disposable cylinders or reusable cylinders. A list of distributors for this industry sectors in included in Annex 3.

The Mexican Industry Sectors that use these substances are:

1.- Refrigerants
2.- Chillers (industrial refrigeration systems)
3.- Foam Industry
4.- Solvents

Of these listed, only the first three are relevant for the purpose of this survey. The companies distributing CFC's and HCFC's in Mexico can be divided into two categories:

1.- Refrigerants & Chillers.
2.- Foam Industry.

Annex 3, includes a list of distributors.

2.4 HCFC CONSUMPTION

2.4.1 Aerosols Sector

The aerosol sector includes aerosol solvents and aerosol propellants. An aerosol is a liquid or solid that is suspended in the air in tiny particles or droplets once it is released from its container. The aerosol sector has historically used CFC's and HCFC's. However, after the Montreal Protocol agreements, CFC use has been drastically reduced in favor of hydrocarbons, some HCFCs and even less HFCs. There are only a few sub-sectors that use CFC's within the aerosol sector, i.e.: medical applications. Mexico's aerosol sector is very small compared to the refrigeration and foam sectors. Only one company reported selling HCFC's to the aerosol sector: DuPont (Arkema did not report any sales to this sector, and Quimobásicos refused to participate in this survey).

Based on DuPont's and Arkema's data, and taking into account information from industry experts, it is concluded that approximately 3% of Mexico's HCFC consumption is used in the aerosol sector.

Table 8. HCFC Consumption, Aerosol Sector, Mexico (t)

Substance	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	100	108	117	156	180	213	128	167	325	0
HCFC-141b	45	64	71	231	413	212	72	115	233	0
Total	145	172	188	387	593	425	200	282	558	0

Source: Semarnat/UPOL. The data are statistical. 2005 is not in agreement with SEMARNAT reports

2.4.2 Foams Sector

The use of HCFC's for the foam sector in Mexico is divided into three categories:

1. Rigid Foam (RPF)
2. Integral Skin Foam (ISF)
3. Extruded Polystyrene Foam (XPS)

Foams for refrigerator insulation are in Mexico reflected as part of the RAC sector.

RPF— for years the sector used CFC's as the blowing agent (Freon 11), but has in recent years been substituted with HCFC-141-b. It is this gas that is trapped within the cells that are formed in the reaction, and what gives the material its thermal properties. In Mexico, UNDP (UNOPS) implemented projects to replace the equipment that used CFC's with equipment that uses HCFC's. Today, all equipment producing rigid foams in the country use HCFCs.

ISF—there are two major consumers of micro cellular foam: the auto industry and the shoe sole industry. As in the case of the rigid foam industry, the companies producing these foams were included in the UNDP (UNOPS) project, substituting CFC's with HCFC's.

XPS— There is reportedly one company left that produces extruded polystyrene panels using HCFC-142b.

The entire foam sector consumes approximately 40% of the HCFC-141b consumed in Mexico with the remainder used for foam and flushing in refrigeration applications. Following are the detailed HCFC consumption data for the Mexican foams industry:

Table 9. HCFC consumption, Foam Sector, Mexico (t)

Substance	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	166	180	195	261	300	355	213	278	541	0
HCFC-123	0	0	0	0	0	0	0	0	0	0
HCFC-124	0	0	0	0	0	0	0	0	0	0
HCFC-141b	598	849	940	3 079	5 504	2 827	958	1 536	3 101	2 101
HCFC-142b	0	0	0	0	0	0	0	0	0	263
Total	764	1 029	1 135	3 340	5 804	3 182	1 171	1 814	3 642	2 364

Source: Semarnat

2.4.3 Fire Fighting Sector

CAISA, the major distributor of halons and other firefighting gases in Mexico, informed that HCFCs are not used in this sector. Only HFC-227 and HFC 236a are imported for this application.

2.4.4 Refrigeration and Air Conditioning Sector

In Mexico, the refrigeration sector consumes most of the HCFC's. Most of the HCFC-22 imported into Mexico is used in this sector (a small amount, approximately 5%, is used in the foam sector). Additionally, 60% of the HCFC-141b consumed in Mexico, is used by this sector. As mentioned before, insulation foam is not counted under the foam sector but incorporated in the RAC sector.

Table 10. HCFC consumption, Refrigeration Sector, Mexico (t)

Substance	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	3 152	3 424	3 699	4 953	5 697	6 745	4 043	5 280	10 287	7 214
HCFC-123	13	19	28	28	102	70	16	4	43	46
HCFC-124	0	2	7	16	124	134	10	1	37	0
HCFC-141b	896	1 274	1 410	4 618	8 256	4 241	1 438	2 305	4 652	4 902
HCFC-142b	0	0	0	0	8	0	0	0	0	0
Total	**4 061**	**4 719**	**5 144**	**9 615**	**14 187**	**11 190**	**5 507**	**7 590**	**15 019**	**12 162**

Source: Semarnat

2.4.5 Solvents Sector

Although HCFC-based solvents are worldwide widely used in a number of industries (medical, electronics, aerospace, metal cleaning, etc.), in Mexico there is little use of HCFCs as solvents. There is some for contact sprays (aerosols) and maybe for refrigeration circuit cleaner 9reported under RAC). The most common HCFC used by the solvent sector is HCFC-141b.

Table 11. HCFC consumption data, Solvent Sector (t)

Substance	1999	2000	2001	2002	2003	2004	2005
HCFC-22	0	0	0	0	0	0	0
HCFC-142b	0	0	0	0	0	0	0
HCFC-124	0	0	0	0	0	0	0
HCFC-141b	26	33	31	37	136	175	0
Total	**426**	**33**	**31**	**37**	**136**	**175**	**0**

Source: Semarnat

2.4.6 Feedstock and Process Agent Applications

HCFC suppliers report no sales for feedstock applications. There is no Teflon production in Mexico.

2.4.7 Summary and Conclusions

Mexico's HCFC market can be divided into two main segments: the foam sector and the refrigeration sector. There is much smaller use in solvent and aerosol applications.

All sectors obtain their HCFC's ultimately from four companies that import HCFC's into the country: Quimobásicos (also produces), DuPont, Arkema and Praxair with the first three controlling more than 95% of the market. There are a large number of distributors throughout the country (see Annex 3), who sell HCFC's to the end user. However, they all purchase their HCFC's from the four companies mentioned in the previous paragraph.

Because of this stepped distribution system, the large amount of distributors, and their reluctance to surrender individual customer data it is not possible to include individual user data in this survey. Such is only possible when these individual users would be directly approached—as has been done under the CFC phaseout program. Over the last ten years, HCFC consumption has grown considerably due to Mexico's overhaul of the foam sector's equipment, replacing CFCs with HCFCs and the increased use of HCFCs in the RAC sector.

HCFC suppliers expect continuous growth in the market—albeit at somewhat lower rates. The lower growth is mostly related to the fact that the USA and other industrialized nations are replacing their use with non-ODS substances such as HFC's and this impacts HCFC export and the use of HCFC in export articles.

Table 12. Mexico' HCFC consumption 1996-2005 (t)

Substance	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC-22	3 318	3 604	3 894	5 214	5 996	7 100	4 256	5 558	10 828	7 214
HCFC-123	13	19	28	28	102	70	16	4	43	46
HCFC-124	0	2	7	16	124	134	10	1	37	
HCFC-141b	1 494	2 123	2 350	7 696	13 759	7 068	2 396	3 841	7 753	7 002
HCFC-142b	0	0	0	0	8	0	0	0	0	263
Total	**4 825**	**5 748**	**6 279**	**12 954**	**19 991**	**14 372**	**6 678**	**9 404**	**18 661**	**14 525**

Source: Semarnat

3. ANALYSIS

DEMAND FORECASTS

The baseline for growth expectation is the GNP growth which is expected to maintain an annual rate of at average 4.1-4.3 % for the next ten years. Extraordinary circumstances have to be extrapolated on this baseline. Much HCFC is used in "comfort" applications such as refrigeration and air conditioning, which is expected to grow up to 10% over GNP. Energy efficiency—the strength of rigid foam applications—will grow 4-5% over GNP.

Over the last ten years, HCFC consumption has grown considerably at an annual rate of almost 15% to a level that is triple the 1995 level. This growth was due to two factors:

- Mexico's overhaul of foam and RAC equipment, replacing CFCs with HCFCs
- An expanding economy with over-average growth in comfort applications

Importers/producers expect the HCFC market to continue this growth until 2010 and then to flatten somewhat. In detail, they expect consumption for:

- **HCFC-22** to grow 10-15%/y for 2006-2010 and 5-10% for 2011-2015
- **HCFC-141b** to grow ~7%/y
- **HCFC-123, -124, -142b** to grow approximately at GNP (4.2%)

Wherever the industry provides ranges, the average of the range has been applied.

Table 13. HCFC Projected consumption 2005-2015 (t)

Substance	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
HCFC-22	7 214	8 116	9 130	10 271	11 555	13 000	13 165	15 023	16 149	17 360	18 663
HCFC-123	46	48	50	52	54	57	59	61	64	67	69
HCFC-124	0	0	0	0	0	0	0	0	0	0	0
HCFC-141b	7 002	7 492	8 018	8 579	9 180	9 822	10 510	11 245	12 032	12 875	13 776
HCFC-142b	263	274	286	298	310	323	337	351	366	381	397
Total	**14 525**	**15 928**	**17 477**	**19 210**	**21 084**	**23 182**	**24 054**	**26 656**	**28 585**	**30 655**	**32 905**

3.2 AVAILABILITY SCENARIO AND PRICES

Historically, HCFC's (and CFC's) were either produced in Mexico or imported from the US, Canada or France. It is expected that China's HCFC products may be offered in Mexico soon at a much lower price. While some industry experts question the quality of Chinese HCFC's, they have already shown a dramatic impact in South-American countries with producers in Argentina and Venezuela reconsidering their expansion plans. With this added purchase option, availability of HCFC-22 should remain plentiful and pricing may even drop.

In general, it is expected—in line with TEAP (tentative) forecasts—that all HCFCs currently used in Mexico will continue to be available. Prices, apart from HCFC-22, are expected to increase along inflation or higher when nearing the consumption freeze date of 2016 for Article 5(1) countries and industrialized nations phasing out the use of HCFCs altogether and production is expected to be adjusted to this.

3.3 TECHNOLOGY

The Mexican HCFC market is driven basically by two sectors: Foam and Refrigeration.

Foam applications have been recently changed from CFC consumption to HCFC. In an unconstrained scenario, this is not likely to change. Available options for change such as the use of hydrocarbons, liquid HFCs or other alternative blowing agents such as methyl-formiate will only be used with technical and financial encouragement. The price of these options will be otherwise a major barrier. Because HCFC based foam equipment can use most other blowing agents with small (liquid HFCs) or more elaborate (HCs) modifications, a change away from HCFCs will be lower in cost than the past conversion from CFCs.

In refrigeration applications, the situation is not much different despite efforts from, specifically, DuPont to introduce non-ODS refrigerants. The price difference between these options, mostly binary and ternary, HFC blends is just too high. Use of HC refrigerants is not expected without encouragement as it is expected to follow the US market which currently does not favor use of hydrocarbons as refrigerants.

3.4 ENVIRONMENTAL IMPACT

Mexico has the firm intention to continue with its Montreal Protocol commitments. In this regard it considers seriously accelerating the phaseout of the consumption of HCFCs that not only deplete the ozone layer but also cause global warming. Reduction of energy consumption is also a priority. Following issues should be considered when preparing an HCFC management plan:

- HFCs are very energy efficient in insulation applications
- HCs are effective in refrigeration applications (better than HFC-134a)
- México ratified in 2001 the Kyoto protocol and is therefore committed to options that combine zero ODP with favorable GWP properties and low energy impact

Table 14. Mexico's Environmental Impact, Ozone Depleting Potential

Substance	ODP	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HCFC-22	.06	217	182	198	214	287	330	391	234	306	596
HCFC-123	.02	0	0	0	0	0	2	1	0	0	1
HCFC-124	.02	1	0	0	0	0	3	3	0	0	1
HCFC-141b	.11	94	164	234	259	847	1 514	778	264	423	853
HCFC-142b	.06	0	0	0	0	0	0	0	0	0	0
Total		312	346	432	473	1 134	1 849	1 173	498	729	1 451

Source: Semarnat, customs, companies

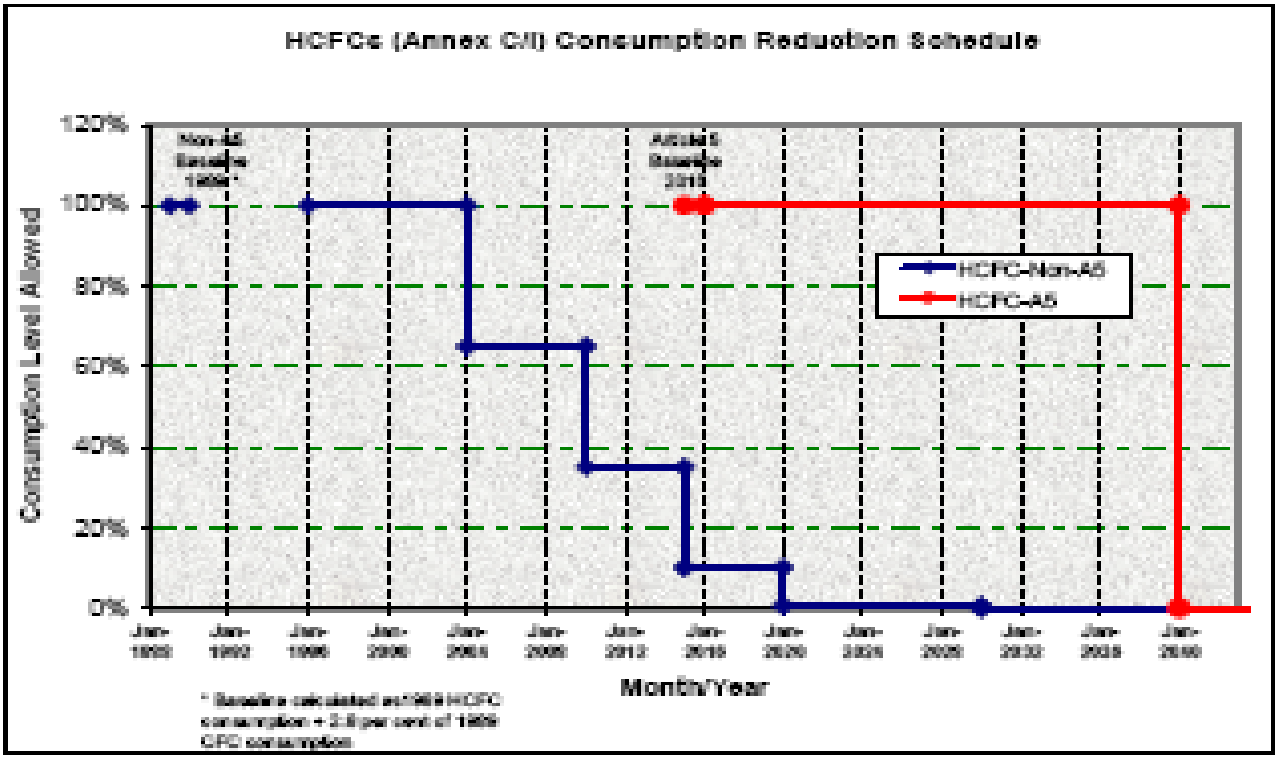
Table 15. Mexico's Environmental Impact, Global Warming Potential.

Substance	GWP	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
HCFC-22	.36	1 421	1 194	1 298	1 402	1 877	2 159	2 556	1 532	2 001	3 898
HCFC-123	.02	0	0	0	1	1	2	1	0	0	0
HCFC-124	.1	4	0	0	1	2	12	13	1	0	4
HCFC-141b	.09	77	134	191	212	693	1 238	636	216	346	698
HCFC-142b	.36	0	0	0	0	0	3	0	0	0	0
Total		1 502	1 328	1 489	1 616	2 573	3 414	3 206	1 749	2 347	4 600

Source: Semarnat, customs, enterprises

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

Following is a graphic depiction of compliance measures contained in the Montreal Protocol regarding HCFCs:



It is evident that the phaseout as foreseen for A5 countries is not practical and that a phased approach as foreseen for the developed countries will be needed. This implies that A5 countries may need to adopt a policy of HCFC growth containment leading up to a growth freeze by 2016 and then move to a phased reduction towards a complete phaseout by 2040. Such a policy would only be geared towards compliance with the current HCFC reduction schedule and not towards accelerated phaseout. IPCC and TEAP have pointed out the rapid addition of HCFCs to the ODS bank while their high GWPs are a concern for global warming. Many developed countries have reacted to these concerns by imposing accelerated HCFC phaseout schedules and developing countries may consider the same. While Mexico would be in favor of an accelerated HCFC phaseout program for A5 countries, Mexico sees several challenges in the adoption of such a program:

- The cost for such a program will be high for the A5 countries. Financial and technical assistance will be needed;
- The current MLF technical and financial support mechanism is not fit for HCFC phaseout;
- Applicable phaseout technologies are high in investment costs (HCs) or high in consequential costs (HFCs);
- There is a certain "fatigue" on industrial level—suppliers as well as users. HCFCs were introduced as being an acceptable option for a long period. Now phaseout is considered while the CFC phaseout program is still ongoing.

There are also opportunities:

- All A5 countries have compliance structures for CFCs in place that easily can be extended to HCFCs;
- Equipment modifications made under the CFC phaseout program will function for many HCFC replacements as well;
- There is potential synergy with energy savings and carbon credit programs;
- With its dependence on exports to the USA Mexico may improve its environmental standards to match those of the USA

3.6 POTENTIAL COMPLIANCE MEASURES

At this time, only compliance with existing stipulations under the Montreal protocol is relevant. This means:

- Bending the current growth scenario towards no growth from 2016 onward;
- Enforcing a freeze after that;
- Curtailing HCFC consumption well before 2040 towards essential use only after 2040.

The existing coordination and enforcement system can be extended to the management of HCFC as follows:

- Existing regulations applying to CFCs can be applied to HCFCs as well;
- The NOU can assume a coordination function for HCFCs;
- The current license system for CFCs can be simply extended to HCFCs and be used as a compliance tool;
- The current cooperation with the Mexican Customs Agency will be extended to HCFCs;
- Voluntary phaseout projects can be prepared and executed the same way as for CFC phaseout—albeit under a modified MLF mechanism that will reflect the lower ODP of the substances to be phased out.

The NOU has reviewed possible early phaseout projects and sees opportunities in the foam, solvent and RAC servicing sectors as well as combinations with current energy saving programs.

SUMMARY AND CONCLUSIONS

The use of HCFCs in Mexico has been—and still is—an essential tool in the phaseout of CFCs. A combination of continued CFC phaseout and considerable market growth causes annual growth rates between 5-15%. Unconstrained growth under a moderate scenario would more than double the expected consumption in Mexico of HCFCs by 2015 compared to 2005.

Such a growth cannot be constrained in just one year to meet freeze conditions under the Montreal Protocol for 2016. A growth reduction program will be needed to assure compliance with these conditions. Taking into account HCFC's contribution to global warming and the ODS bank, an even more aggressive reduction in the use of HCFCs should be considered.

Mexico sees some challenges that need to be addressed before such a program can be successfully implemented:

- The related costs. Financial and technical assistance will be needed;
- The current MLF support mechanism, which is not fit for HCFC phaseout;

- The current low costs of HCFCs compared to many replacements;
- The current high cost of some essential phaseout technologies;
- Resistance on industrial level against “yet another” ODS phaseout program.

Assuming that these impediments will be addressed, Mexico would be prepared to develop a more detailed strategy that will include:

- A regulatory framework
- Potential HCFC phaseout projects
- An awareness program
- Other program support measures

Mexico sees opportunities for immediate action to contain growth in HCFC consumption through

- Complementing existing CFC-focused programs in the RAC sector
- Energy reduction and climate related programs that include replacement of RAC equipment
- Chiller replacement programs
- Elimination of HCFC-141b for the flushing of refrigerator circuits
- Selected foam (sub)sector HCFC phaseout projects

Some of these programs show promise for a tie in with carbon credit programs as well.

SURVEY OF HCFCs IN VENEZUELA

FINAL REPORT

Fondo Venezolano para la Reconversión Industrial y Tecnológica,
Ministerio del Ambiente
and
United Nations Development Programme (UNDP)

January 23, 2007

EXECUTIVE SUMMARY

Venezuela acceded to the Vienna Convention in September 1988 and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in February 1989. Subsequently, Venezuela ratified the London Amendment, in July 1993, the Copenhagen Amendment in December 1997, the Montreal Amendment in May 2002 and the Beijing Amendment in June 2006.

As the annual calculated consumption in Venezuela of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, Venezuela was classified as a party operating under Paragraph-1, Article-5 of the Montreal Protocol and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol.

Venezuela's Country Programme, incorporating a national strategy and action plan for controlling the use of Ozone Depleting substances, was approved at the 17th Meeting of the Executive Committee of the Multilateral Fund for Implementation of the Montreal Protocol in July 1995. Since 1995 until to date, Venezuela has been generally in compliance with the Montreal Protocol control schedule for Annex-A, B and E substances, through a combination of projects and programs featuring technology transfer investments, technical assistance, training & capacity building, information dissemination and awareness-raising and institution of a proactive regulatory framework. In compliance with Article-4B of the Montreal Protocol incorporated through the Montreal Amendment, Venezuela has established a licensing system for import and export of Annex-A, -B, -C and -E controlled substances, which includes recovery, recycling and reclamation. All importers and exporters of these substances are required to register and obtain licenses which are issued based on annual quotas and are subject to reporting requirements.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore their use has to be controlled and eventually phased-out. In accordance with the control schedule of the Montreal Protocol for Article-5 countries, production and consumption of HCFCs will be subject to a freeze at 2015 levels from 01 January 2016 and are required to be completely eliminated by 2040. HCFCs are used in Venezuela in the Aerosols, Foams, Firefighting, Refrigeration & Air Conditioning and Solvents sectors. The predominant HCFC used is HCFC-22 mainly in the Refrigeration & Air Conditioning Sector (more than 95%). There is also significant use of HCFC-141b, predominantly in foam applications and, to a lesser extent, as a cleaning agent.

Venezuela has faced in 2002-03 economic problems due to socio-political disturbances. This was reflected in its GDP. HCFCs consumption has shown a similar irregular behavior. Expectations for the future are optimistic though. The economy is very tightly linked to international oil prices, which have shown a tendency to increase. This represents a window of opportunity for Venezuela. Conservative growth projections for Venezuela are at 4-5 %/y through 2015. Considering that, according to the 2001 census, only 15% of homes are equipped with air conditioning, and that there is a huge deficit of houses, there is room for refrigeration and air conditioning to grow above average at about 6 %y to more than 4,000 t in 2015:

	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
2005 actual	1,887	256	9	32	62	**2,246**
2015 forecast	3,378	458	13	57	111	**4,017**

Venezuela realizes that bending the current significant growth in HCFCs into a no-growth scenario in 2016 cannot be achieved without addressing use patterns early on. This implies that actions to control/reduce consumption of HCFCs to ensure compliance with the 2016 freeze would need to be initiated well in advance of that date. Challenges and constraints for such actions include sustained and cost-effective availability of environment-friendly substitutes for HCFCs and access to technology and funding to facilitate transition without undue burden on the economic health of the country and on the consumers and industry.

As for now, Venezuela expects to reduce the use of HCFCs by

- Implementing good practices in the service of HCFC-containing equipment
- Introducing HCs in domestic refrigeration applications (a relatively sophisticated industry that can cope with safety issues)
- Increasing the use of hydrocarbons in foam and refrigeration applications
- Changing to HFC technology in those aerosol applications that do not allow for the safe use of hydrocarbons

Venezuela expects that the international community will recognize management of HCFCs as a crucial activity to be undertaken at the earliest, supported with adequate technical and financial assistance from the Multilateral Fund. To move this forward, changes in funding policy are required. Cost effectiveness standards based on ODP would severely "punish" HCFC projects while current eligibility will effectively defeat any program

Given adjustments in the mentioned policies, projects would be possible in a variety of sectors and applications:

- the **RAC Service Sector** through the introduction of 'best practices"
- the **Solvent Sector** by replacing HCFC-141b by other, non-ODS organic solvents
- the **Aerosol Sector** by replacing the use of HCFC-141b in contact sprays
- the **RAC Sector** by introducing the use of HFCs or hydrocarbons as refrigerant
- the **Foam Sector** by introducing HFCs , HCs and other non-ODS blowing agents

Besides having an ozone depleting potential (ODP), HCFCs have a significant global warming impact . Venezuela acceded to the Kyoto Protocol in 2006. There may be potential to develop selected HCFC phaseout projects along with carbon credit components thus generating co-funding on a bilateral level. The development of pertinent pilot projects could be a part of the mentioned strategy.

SURVEY OF HCFCs IN VENEZUELA

CONTENTS

LIST OF ABBREVIATIONS

BDP	Business Development Programme
CFCs	Chlorofluorocarbons
CP	Country Programme
ExCom	Executive Committee of the Multilateral Fund
FONDOIN	Fondo Venezolano para la Reconversión Industrial y Tecnológica
FTOC	UNEP Foams Technical Options Committee
HC	Hydrocarbons
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HS Code	Harmonized System Code
IA	Implementing Agency
INE	Instituto Nacional de Estadísticas [National Statistics Institute]
IPCC	Intergovernmental Panel on Climate Change
MAC	Mobile Air Conditioning
MINAMB	Ministerio del Ambiente [Ministry for the Environment]
MILCO	Ministerio de Industrias Ligeras y Comercio
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MP	Montreal Protocol
MPU	Montreal Protocol Unit
MRE	Ministerio de Relaciones Exteriores [Foreign Affairs Ministry]
MT or t	Metric Tonnes
N/A	Not available
NPP	National Phaseout Programme
NOU	National Ozone Unit
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substances
OEM	Original Equipment Manufacturer
PSU	Programme Suport Unit
R&R	Recovery and Recycling
SMEs	Small and Medium-sized Enterprises
TEAP	UNEP Technology and Economic Assessment Panel
TR	Tons of Refrigeration
UNDP	United Nations Development Programme
UNDP-MPU	United Nations Development Programme, Montreal Protocol Unit
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNOPS	United Nations Office for Project Services
WB	World Bank
XPS Foam	Extruded Polystyrene Foam
Y	Year

1. INTRODUCTION

1.1 BACKGROUND

The Bolivarian Republic of Venezuela ratified the Vienna Convention as well as Montreal Protocol on Substances that deplete the Ozone Layer and all it subsequent amendments:

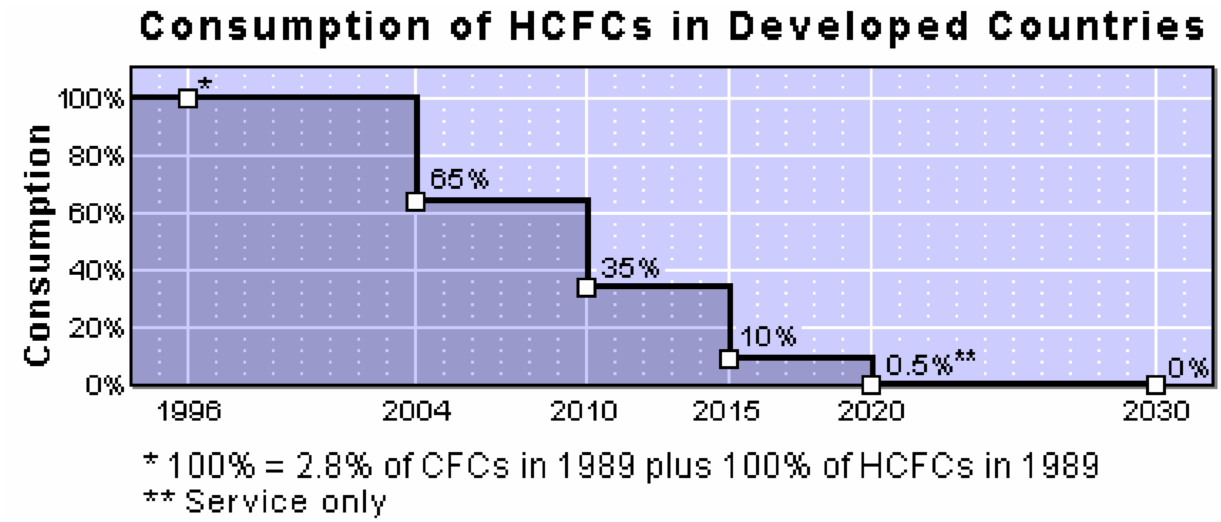
Treaty	Date of Ratification**	Type*
Vienna Convention	**1 Sep 1988**	**(Ac)**
Montreal Protocol	**6 Feb 1989**	**(R)**
London Amendment	**29 Jul 1993**	**(R)**
Copenhagen Amendment	**10 Dec 1997**	**(R)**
Montreal Amendment	**13 May 2002**	**(R)**
Beijing Amendment	**9 June 2006**	**(R)**

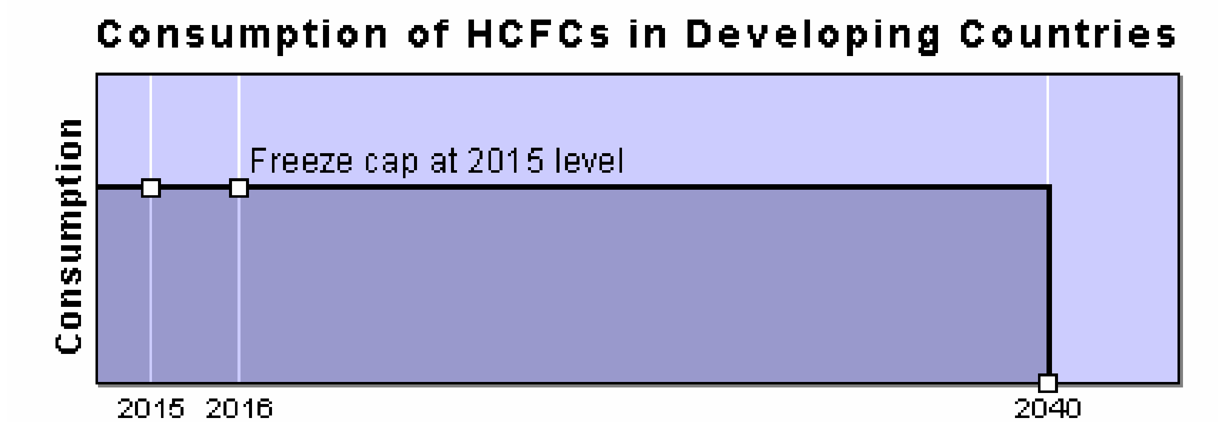
* R: Ratification Ac: Accession At: Acceptance Ap: Approval Sc: Succession

As the annual calculated consumption in Venezuela of controlled substances listed in Annex-A of the Montreal Protocol, was less than 0.3 Kg per capita, it was classified as a party operating under Paragraph-1, Article-5 of the MP and thus qualified for technical and financial assistance, including transfer of technology, through the financial mechanism of the Montreal Protocol. The applicable schedule for reduction and elimination of the these substances is:

- CFCs (Annex A, Group I): consumption freeze by 1999, a 50% reduction by 2005, 85% by 2007 and a total phase-out by January of 2010.
- Halons (Annex A, Group II): freeze by 2002, a 50% reduction by 2005 and a total phase-out by January of 2010.
- HCFCs (Annex C, Group I): a freeze in production and consumption by 2016 and a total phase-out by 2040.

Following is a comparison between the Montreal Protocol's HCFC phaseout schedule for Article 5 (1) (developing) and for non-Article 5 (developed) countries:





The schedule for developed countries includes a freeze starting 1996, based on a limit determined from the 1989 consumption, followed by a phase reduction form 1996 through 2019. This allows for six years adjustment to the imposed freeze and 24 year of phased reduction.

The schedule for developing countries is based on a freeze for 2016 through 2039 based on the consumption in the previous year followed by an instantaneous phaseout. This schedule is economically not feasible.

While the HCFC phaseout schedule for developed countries appears feasible, compliance with the HCFC phaseout schedule's abrupt deadlines cannot be met without significant intervention. It will, at a minimum, require bending the current significant growth into a no-growth scenario before 2015, followed, after a period of stable consumption, by phased reduction towards elimination by 2040. This cannot be achieved without addressing use patterns early on and implies that actions to control/reduce consumption of HCFCs to ensure compliance with the 2016 freeze would need to be initiated well in advance of that date.

HCFCs, however, are likely to remain for a long time important as "transitional substances" in refrigeration and air conditioning, insulating and integral skin foams, cleaning and in specialty uses. A concern, though, is the future availability of HCFCs. With non-Article 5 Parties continuing to reduce their consumption of HCFCs to comply with the Montreal Protocol control schedule and, in several cases, to make reductions that go beyond the Montreal Protocol requirements, there will be a reduction in global demand that may lead to a decrease in global production capacity. This may impact Venezuela less because of local HCFC-22 production by PRODUVEN. This production of ~650 t will increase substantially after the enterprise stops production of CFCs and uses its (swing plant) capacity of 10,000 t/ for HCFC-22 alone.

This survey intends to provide informational background that will allow the Government of Venezuela to prepare an HCFC management plan to comply with the stipulations of the Montreal Protocol and for the MLF to consider appropriate support to that goal. I will provide supply patterns, price information and growth expectations as well as preliminary strategy considerations by the Government of Venezuela.

1.2 APPROACH AND PREPARATION

The Executive Committee of the MLF approved at its 45th Meeting a project prepared by UNDP which aims to conduct a survey of HCFC use in selected countries with the objective of establishing an eligible national aggregate level of HCFC consumption in the future against which proposals would be funded (Decision 45/6).

In order to speed up the administrative process, UNDP selected to implement it through its Montreal Protocol Unit (MPU) in close cooperation with the National Ozone Units and UNDP's Country Offices in the selected countries, from which Brazil is one. For each country, in consultation with the NOUs, national experts have been recruited to conduct and analyze the actual survey and to prepare a report following a template issued by UNDP. These reports have been edited by two international experts before being forwarded to UNDP-MPU. MPU, after conducting its own review, submitted the reports to the National Ozone Units with the request for comments by an as broad as possible cross-section of stake holders. After taking these comments into consideration, MPU prepared final versions of the national reports for submission to the MLF.

1.3 SURVEY METHODOLOGY

The National Expert was directed to prepare initially a desk study with the aim to

- locate sources of information,
- identify the different applications for HCFCs,
- identify the stakeholders, such as importers, exporters and associations, and
- determine the scope of work for the final survey.

For the sake of uniformity and completeness, MPU provided a template for this study. After editing and acceptance of the desk study by MPU, a final survey was conducted, again, following an MPU-provided template. Activities for this survey were to include:

- interaction with the various identified stakeholders to identify and categorize all current users of HCFCs
- collection of baseline information following formats provided by MPU
- classification of this information as below:
  - historical consumption data (determined from production + import – export)
  - segregation of these data by sector
  - segregation of these data by users (or, for smaller users, groups of users)
  - segregation of these data by users that received/did not receive prior MLF assistance

Regretfully, most stakeholders were less than cooperative and actual survey work was restricted to the only local HCFC manufacturer (PRODUVEN) as well as FONDOIN and the Ministry of Environment, presenting information derived from customs. The national expert incorporated their data along with related forecasts, conclusions and recommendations into a final report, for which MPU provided a detailed template. This report was reviewed, completed and edited by the international expert responsible for the Latin America region and then forwarded through UNDP-MPU to FONDOIN.

After conducting its own review, FONDOIN arranged for endorsement by the Government of Venezuela through the Ministerio de Industrias Ligeras y Comercio [MILCO]. Comments and opinions by the Government of Venezuela and its institutions prior to endorsement have been reflected in the final version of the report that herewith is presented to the Executive Committee.

As per decision 45/6(i), the survey provides information on current consumption by sector and substance, as well as the forecasted projections thru 2015. This information will allow the MLF Secretariat–if requested by the Executive Committee–to propose funding policies and procedures for the next years, including the possible establishment of an "eligible national aggregate level of HCFC consumption."

The survey resulted in a database of stakeholders—importers, distributors, associations and HCFC-consuming enterprises. The Government treats this database as confidential and will make it only available on a need-to-know basis as it involves commercial information that may be sensitive to some of the parties concerned. Requests for more detailed information should be sent to the National Ozone Unit. In addition, while the survey has identified a substantial amount of individual HCFC users, not all suppliers were willing to disclose individual customers. Additional individual users will be identified over the next years in case this survey will evolve into a sector-based HCFC management plan.

The following table provides the numbers of enterprises that were identified in the survey per category/sector:

Stakeholders identified in the HCFC Survey in Colombia

HCFC Stakeholders	Amount of Enterprises
Importers	13
Distributors	44
Chambers/Associations	1
HCFC-Consuming Enterprises by Sector	247
All HCFC Stakeholders	**305**

2. OBSERVATIONS

2.1 INSTITUTIONAL FRAMEWORK

2.1.1 Institutional Arrangements

Venezuela, as part of the Montreal Protocol signatories, qualifies as an Article 5 country, and has ratified all its amendments, inclusive, very recently the Beijing Amendment. Venezuela has implemented all control and training programs recommended by the Montreal Protocol and actively participated in the ongoing activities related with the implementation of the Montreal Protocol resolutions. The local Ozone Unit is FONDOIN – "*Fondo Venezolano para la Reconversión Industrial y Tecnológica*" - created by National Decree 2590, published in *Gaceta Oficial* N° 35073 dated October 20, 1992. FONDOIN is charged with coordination of the MP compliance actions. It is an Agency under the Ministerio de Industrias Ligeras y Comercio, with the following entities on its Board:

- FONDOIN President
- Ministerio de Industrias Ligeras y Comercio (MILCO)
- Ministerio de Relaciones Exteriores (MRE)
- Ministerio del Ambiente (MINAMB)
- Association for the (petro-)chemical Industry in Venezuela (ASOQUIM)

2.1.2 Policies, Regulations

The Government of Venezuela formulated its policies regarding the use of ozone depleting substances in its Country Programme, approved by the MLF in its 11th meeting November 1993. This was followed by a Foams Program, approved in the 36th meeting of the ExCom in March 2002 and the National Phaseout Program, (NPP), approved by the MLF at its 42nd meeting April, 2004,

Based on the CP as well as the NPP and the MP with all its amendments, the Government of Venezuela developed a comprehensive set of legal instruments to assure compliance with the MP stipulations and the CP.

The first regulations related to ODS are the ratification of the Vienna Convention in 1988 and the Montreal Protocol in 1989 which became laws of the Republic. The first decree regulating these matters was issued in April 1992, under number 2215, setting the import licensing requirement. This decree was superseded by National Decree 3220, which dates back to January 1999, and sets norms to "regulate and control consumption, production, imports, exports and uses of Ozone Depleting Substances [ODS]". It has been modified in November 2004, by Decree 3228; and most recently, in March 2006, by Decree 4335, to update the norms as required by the changes in the ratified amendments of the Montreal Protocol and to improve the application of the control measures.

The Constitution of the Bolivarian Republic of Venezuela of 1999, in its Article 127 refers explicitly to the protection of the Ozone Layer.

These regulations define the different products, classify them, set production limits and reduction schedules as well as import and export rules. They require that importers and exporters be registered with the controlling authority *[MINAMB]*.
The regulations have been written with a focus on eliminating CFCs as top priority, and with second objective to regulate imports and exports of all other ODS (HCFCs and other ODS substances following the stipulations of the Montreal Protocol and its amendments).

Until June 28, 2005, all HCFCs have been listed under a single customs code [**2903.49.10**], called "*all other derivatives from methane, ethane or propane, halogenated only with fluorine and chlorine*". Custom codes were then modified [Decree N° 3,679 issued 30 May 2005 and published in Gaceta Oficial dated June 28, 2005] and since then, code [**2903.49.10**], has been broken down in four sub codes [following recommendations from the harmonized system code [HS code]:

- [2903.49.11] for: *chlorodifluoromethane – HCFC 22*
- [2903.49.12] for: *dichlorotrifluoroethane – HCFC 123, chlorotetrafluoroethane – HCFC 124, Dichlorofhluoroethanes – HCFC 141 and HCFC 141b, and chlorodifluoroethanes – HCFC 142 and HCFC 142b.*
- [2903.49.13] for *dichloropentafluoropropanes – HCFC 225, HCFC 225ca and HCFC 225cb.*
- [2903.49.19] for *all others.*

Custom code [**3824.71.00**] is used to classify *Blends of derivatives of acyclic hydrocarbons fully halogenated with at least two different halogens, fluorine and chlorine.* This custom code does not differentiate if the blend contains CFCs, HCFCs, HFCs or HCs.

This lack of detail in the customs code has made it very difficult to differentiate individual HCFCs from other halogenated substances imported in Venezuela. This has been only partially solved after the codes modification made on June 28, 2005.

2.2 HCFC SUPPLY SCENARIO

Official import data are provided by the National Institute of Statistics *[Instituto Nacional de Estadísticas, or INE]*. They are, though, not adequate for this purpose, except for determining the countries of origin/destination of the imported/exported substances.

MINAMB is the official issuer of import authorizations for ODS and therefore a source of information. Import licenses are only issued to importers that meet the requirements of the applicable law (currently Decree 4335). MINAMB requires importers to report their previous six months imports, backed-up with documents, as a requisite to issue further import permits. However, MINAMB cannot verify all information it receives. Usually, import permits requested much larger quantities than what is actually imported and this difference makes it difficult to determine the actual imports this way. Importers reluctantly abide by the obligation to report. For this reason, consumption past reports to the MP Secretariat are suspect. MINAMB also collects actual import data for HCFCs.

Fondoin did provide the detailed consumption data for this report (consumption defined as Production + Import - Export) for each HCFC. The Fondoin data are based on license information.

2.2.1 Production

Venezuela has one local producer of HCFC-22 (Produven). Production information for the years 1995 to 2005 is shown in Table 1

Table 1 – HCFC Production in Venezuela

HCFC 22 PRODUCTION DATA FOR VENEZUELA
FROM 1995 TO 2005
PRODUCER: PRODUCTOS HALOGENADOS DE VENEZUELA - PRODUVEN
UNITS: METRIC TONS

HCFC	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	TOTAL
22	METRICT ONS	1,656	1,590	1,607	1,298	453	500	773	493	443	994	636	10,443
% HCFC 22 / TOTAL PRODUCTION		27	26	22	26	14	18	22	23	18	22	21	22

Source: Produven

PRODUVEN **(**Productos Halogenados de Venezuela, C. A.) was founded in 1972 as a joint venture between PEQUIVEN, a Venezuelan state-owned corporation (with a 50% stake) and ATOFINA a French corporation which specialized in the field of halogenated substances (today known as ARKEMA) (with the balance 50%). It started production in January 1976 with the objective of serving local and foreign markets on blowing agents, propellants and refrigerants. In 2002 Atofina sold its share to a group of local investors with interests in the Venezuelan refrigeration industry. Little afterwards Pequiven did the same. In this way it became a privately owned national corporation.

Built as a "swing" plant, with a total production capacity of 10,000 t/y, using two reactors, it can produce CFCs or HCFCs, depending solely on the raw materials fed into the process; the common halogenator being Hydrofluoric Acid [HF], which is reacted in one of the reactors with Carbon Tetrachloride [Cl_4C] to generate R11 + R12 or, in the second reactor, with Chloroform (Trichloromethane) [$CHCl_3$] to generate HCFC21 + HCFC22 + HFC23. After CFC production ends, by December 31st, 2006, both reactors will be used for production of HCFCs, alternatively. Hydrochloric Acid is obtained as a commercial byproduct. The plant is tuned so as to minimize output of HCFC-21 and HFC-23. Production of HCFC-22 has never surpassed 30% of total annual production.

CFC production at Produven

December 31st 2006, Produven will shut production of CFCs, as per agreement reached with the World Bank under the MLF. It will continue to produce HCFC-22.

Produven has been authorized to produce an inventory of CFCs to cover demand through the years 2007 - 2010 (when all use of CFCs will be banned, except for recovered, recycled and/or regenerated products). In the mean time, the market should accommodate to the increasing scarcity of these substances and begin to use substitutes. These substitutes may be more difficult to use and present higher risks of equipment failures due to the unpreparedness and lack of proper tools of the technicians that work on the service and repair market.

HCFCs production at Produven

Under the stipulations imposed by the Montreal Protocol, Venezuela, as an Article 5 country,, is allowed to produce HCFCs until 2040. Venezuela produces and is planning to produce HCFC 22 accordingly.

The decision as to how long the plant will continue to operate will depend on how competitive it remains in relation to other producers, mainly located in China and India, which are offering their products at very low prices.

2.2.2 Exports

Exports of HCFCs are small. Traditional receptor countries are: Colombia, Ecuador, Perú, Brazil, Cuba and Chile.

HCFC Production and export Data for Venezuela

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HCFC 22 PRODUCTION	1585	1561	1618	1206	456	569	773	493	443	994	636
HCFC 22 EXPORTS	171	514	203	209	72	127	91	65	40	100	74
%EXPORTS/ PRODUCTION	**11**	**33**	**13**	**17**	**16**	**22**	**12**	**13**	**9**	**10**	**12**

Source: Produven

2.2.3 Imports

Imports have been divided into individual "pure" HCFCs and HCFC-containing blends.

"PURE" HCFCs

HCFC-22

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
Boc Gases de Venezuela	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	19
Corporación Saira	N/A	N/A	N/A	14	35	7	N/A	N/A	N/A	29	0
DuPont	N/A	N/A	N/A	299	1020	176	N/A	N/A	N/A	1493	397
Elga de Venezuela	N/A	N/A	N/A	7	0	28	N/A	N/A	N/A	0	29
Expoaire,	N/A	N/A	N/A	25	76	208	N/A	N/A	N/A	64	170
Falop	N/A	N/A	N/A	60	163	45	N/A	N/A	N/A	160	126
Interfrigo de Venezuela,	N/A	N/A	N/A	0	150	75	N/A	N/A	N/A	66	0
Multi Supplies	N/A	N/A	N/A	3	0	0	N/A	N/A	N/A	0	0
Pescadería San...	N/A	N/A	N/A	0	0	7	N/A	N/A	N/A	0	0
Refrielectric Shop	N/A	N/A	N/A	60	0	0	N/A	N/A	N/A	0	0
Refriemca	N/A	N/A	N/A	0	35	34	N/A	N/A	N/A	0	0
Refrigeración Insular	N/A	N/A	N/A	1	0	0	N/A	N/A	N/A	25	12
Refrig. Master	N/A	N/A	N/A	109	280	343	N/A	N/A	N/A	254	489
Refriquim,	N/A	N/A	N/A	48	279	219	N/A	N/A	N/A	335	21
Sigo – Proveeduría	N/A	N/A	N/A	0	35	13	N/A	N/A	N/A	0	0
Stefan Mar	N/A	N/A	N/A	0	9	0	N/A	N/A	N/A	0	0
York	N/A	N/A	N/A	0	197	0	N/A	N/A	N/A	0	0
Total	**273**	**319**	**563**	**626**	**2279**	**1155**	**2782**	**1013**	**740**	**2426**	**1263**

HCFC-141b

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	79	45	0	N/A	N/A	N/A	71	41
Produven	N/A	N/A	N/A	6	23	0	N/A	N/A	N/A	0	0
Refrig. Master Venezolana	N/A	N/A	N/A	6	2	12	N/A	N/A	N/A	91	28
Refriquim	N/A	N/A	N/A	20	16	14	N/A	N/A	N/A	0	0
Sinthesis,	N/A	N/A	N/A	6	34	81	N/A	N/A	N/A	123	186
Servicios NCH	N/A	N/A	N/A	0	5	4	N/A	N/A	N/A	0	0
Total	N/A	N/A	N/A	117	125	111	N/A	N/A	N/A	286	256

HCFC-142b

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
Refr. Master	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	29
Total	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	29

HCFC-123

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
Boal	N/A	N/A	N/A	0	0.5	0	N/A	N/A	N/A	0	0
DuPont	N/A	N/A	N/A	1.2	1.2	0	N/A	N/A	N/A	65.6	0
Ref. Master	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0.5	9
Refriquim	N/A	N/A	N/A	0	2.7	0	N/A	N/A	N/A	0	0
Total	N/A	N/A	N/A	1.2	4.4	0	N/A	N/A	N/A	66.1	9

HCFC-124

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N /A	N /A	N /A	6.5	11.8	0	N /A	N /A	N /A	91.4	0
Refr. Master	N /A	N /A	N /A	0	0	0	N /A	N /A	N /A	0	45
Total	N /A	N /A	N /A	6.5	11.8	**0**	N /A	N /A	N /A	91.4	45

HCFC Containing Blends

Oxyfume 2002

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
BOC Gases	N /A	N /A	N /A	0	6.1	1.8	N /A	N /A	N /A	8.1	10
Total	N /A	N /A	N /A	0	6.1	1.8	N /A	N /A	N /A	8.1	10

R401A

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	2.1	20	0	N/A	N/A	N/A	18.1	30
Refrigeración Master	N/A	N/A	N/A	3.6	0	0	N/A	N/A	N/A	0	0
Total	N /A	N /A	N /A	5.7	20	0	N /A	N /A	N /A	18.1	30

R401B

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	2.2	20	0	N/A	N/A	N/A	18.1	0
Refriquim	N/A	N/A	N/A	0	0	28.1	N/A	N/A	N/A	0	0
Total	N /A	N /A	N /A	2.2	20	28.1	N /A	N /A	N /A	18.1	0

R402A

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	5.9	23	0	N/A	N/A	N/A	15.5	0
Refriquim	N/A	N/A	N/A	1.7	0	0	N/A	N/A	N/A	0	0
Total	N /A	N /A	N /A	7.6	23	0	N /A	N /A	N /A	15.5	0

R402B

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	15.3	23	0	N/A	N/A	N/A	15.5	0
Total	N /A	N /A	N /A	15.3	23	0	N /A	N /A	N /A	15.5	0

R408A

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	0	23	0	N/A	N/A	N/A	15.5	0
Produven	N/A	N/A	N/A	26	0	0	N/A	N/A	N/A	0	0
Refrigeración Master	N/A	N/A	N/A	7.5	9.6	9.5	N/A	N/A	N/A	4.1	9
Refriquim	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	5.4	0
Total	N /A	N /A	N /A	33.5	32.6	9.5	N /A	N /A	N /A	25	0

R409A

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
DuPont	N/A	N/A	N/A	0	20	0	N/A	N/A	N/A	20	6
Falop	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	17
Total	N /A	N /A	N /A	0	20	0	N /A	N /A	N /A	20	23

R415B

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
Corporación Saira	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	15
Total				0	0	0				0	15

R502

IMPORTER	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	Metric tons										
Corporación Saira,	N/A	N/A	N/A	2.7	0	0	N/A	N/A	N/A	0	0
Interfrigo	N/A	N/A	N/A	0	4.5	0	N/A	N/A	N/A	0	0
Refrigeración Máster	N/A	N/A	N/A	9.9	0	0	N/A	N/A	N/A	0	0
Refriquim	N/A	N/A	N/A	11.6	0.7	0.8	N/A	N/A	N/A	1.5	0
Stefan Mar	N/A	N/A	N/A	1	0	0	N/A	N/A	N/A	0	0
Total				25.2	5.2	0.8				1.5	0

Source of all tables: Fondoin – Originator MinAmb

No data was made available for importers for the years indicated with the legend N/A.

2.2.4 Distribution and supply chain

PRODUVEN sells its production in bulk containers to three wholesale distributors: Indugas, C. A., Refrigeración Master Metropolitana, C, A. and Comercial San Antonio, C. A. These distributors operate charging plants that allow them to fraction the bulk products into smaller commercial containers [60kg cylinders is mainstream] to be distributed among their customers: refrigeration-spare-parts stores – which number some 300-400 – and large service shops – which number some 100-150.

These sales shops attend the demand of an undetermined number of refrigeration technicians, which are estimated to be in the order of 5,000.

Produven also runs a small operation for charging non returnable cylinders for the export market, when required, but usually exports in bulk containers (Iso-tanks).

Aggregated demand, not covered by PRODUVEN products, is covered by a number of importers that compete commercially between themselves and with PRODUVEN.

The detail of these importers and the products in which they compete in are shown in the preceding lists.

2.2.5 HCFC Pricing

Prices for HCFCs have decreased over the years. This is particularly the case with HCFC-22. reasons for this decline are (i) global demand being down because important markets such as Europe and the USA are applying regulatory restrictions, (partially) changing to HFCs, and (ii) additional production capacities are coming on stream in China and India.

Compared to the HFCs and HFC blends, there is a large price difference in favor of HCFCs. This is a big impediment in the introduction of such blends—even if it technically would make sense. For instance, R-404A would be the technically correct and logical refrigerant for low temperature applications in commercial refrigeration (previously R-502), but lower costs dictates the use of technically inferior HCFC-22.

The current prices of HCFCs and HFCs are as follows (distributor level/in US$/kg – VATax not included):

PACKING	HCFC22	HCFC141b	HCFC123	R-404A	R-407C	R409A	R-410A
Drums		3.86	11.2				
Non reusable cylinders				15.25	17.03		17.68
Bulk	3.26					6.90	

Source: PRODUVEN

Prices above represent current prices (as of December 2006). HCFC22 price has soared up due to a shortage of product caused by the fact that PRODUVEN has been using all its capacity for the last six months to build up an inventory of CFCs as has been approved by the MP, in order to fill the needs of the service market in the interim period until 2010, when use of CFCs in the service sector will be restricted to recovered, recycled or reclaimed products.

Another pressure factor has been caused by a shortage of imported inventory, limited by the availability of foreign currency approval for imports by the national government. Otherwise, the price had been oscillating around US$ 2.25 at distributor level.

2.3 HCFC CONSUMPTION

2.3.1 Aerosol Sector

Information from producers indicate that in 2005 10 metric tones of HCFC-141b was used for electronic cleaning (contact sprays) and 3 metric tonnes as non-flammable propellant. While the use is in the aerosol sector, the actual use of the HCFC 141b is as a solvent, stressing once more that solvent applications do not really constitute a distinct sector.

2.3.2 Foam Sector

HCFC use in the Foams Sector is restricted to industries producing rigid foams for insulation, structural parts and integral skin foams. The largest use of foams in Venezuela has been in the refrigeration industry. All companies identified by Fondoin were converted between 1998 and 2000 to replace CFC 11 with HCFC 141b as an interim technology because the costs of conversion to HCs was deemed too high. These conversion agreements include a paragraph that rules out the availability of MLF funding for further conversions to other technologies in the future. This ExCom decision would need to be revised and a serious attempt is to be made to convince this industry to replace HCFCs ahead of the MP stipulations. Companies that received

CFC phaseout assistance are listed in Annex-4. It is believed that these constitute all HCFC users in this sector.

There are currently two polyol blend suppliers to this market: Bayer de Venezuela and Sinthesis. Sinthesis is a registered importer and brings its own HCFC 141b from abroad. Bayer de Venezuela is not registered as an importer and purchases its HCFC 141b locally from importers. In past years there was a larger number of polyol blend producers and included: Plasquipol, Polyresin, Poliuretanos and Urequímicos.

2005 use of HCFCs in the foam sector was 256 t.

2.3.3 Firefighting Sector

The Association of Fire Extinguisher Producers claim that no HCFCs are being used in charging fire extinguishers in Venezuela. HCFC 123 is being used for chiller applications and HCFC 124 as a basis to produce R409A blend.

2.3.4 Refrigeration & Air Conditioning Sector

Produven, the local producer of CFCs will, in compliance with an agreement with The World Bank on behalf of the Government of Venezuela, end production of CFC-11 and CFC**-12** by December 31, 2006. As the news about CFC production nearing its end reached the market, the use of imported ternary HCFC blends and binary and ternary HFC blends are surging and several local entities are considering local blending.

Refrigeration

The **domestic refrigerator industry** used in the past CFC 11 for foam insulation and CFC12 as refrigerant. All foam is now based on HCFC-141b, and all refrigerant is HFC 134a.

Commercial refrigeration, including transportation refrigeration turned to HCFC-141b in foams and HCFC-22 as refrigerant. Exceptions are some low temperature applications using R-404—a ternary HFC blend—and R-507–a binary HFC blend.

Industrial Refrigeration uses also HCFC-141b-based foam but to a very large extent HCFC-22 as refrigerant with some ammonia, remaining CFC-11 and -12, HFC-123a and HCFC-123. All new equipment is based on HFC134a

Refrigeration Servicing will continue to use the original charging substances, including CFC-11 and -12 for as long as supply lasts and the price does not escalate out of proportions. However, for domestic and commercial refrigeration technicians, anticipating change, have begun experimenting with blends.

CFC12 replacements

The most commonly heard of is **R 409a** {*60% HCFC22* + *25% HCFC124* + *15% HCFC142b*}, known as Forane FX-56, Genetron 409a, Suva 409a, depending on the source. The local representative of Honeywell, Refrimaster, which is one of the registered importers, is believed to have begun production of R 409A at its facility. It is competitive in price (30% lower) when compared with CFC12 and it is marketed as a replacement for CFC-12 in domestic and commercial refrigeration. Produven is also studying plans to produce R 409a as an option, once the production of CFC12 shuts down.

Another HCFC blend, **R-415b** {*25% HCFC22 + 75% HFC-152a*}, produced in China, reached the Venezuelan market in 2004. Due to its high content of **HFC-152a** it is classified as flammable (A2 following ASHRAE 34), which is considered a risk in Venezuela, because of refrigeration technicians low flammable chemicals awareness.

Additionally, traditional HCFC based blends, such as Suva MP-39 [R 401a] {*53% HCFC 22 + 34% HCFC 124 + 13% HFC 152a*} and Suva MP-66 [R-401b] {*61% HCFC 22 + 28% HCFC124 + 11% HFC 152a*} have been used in the market for quite some time.

When CFC 12 was the dominant refrigerant, there always has been a concern that servicing led to much shorter product life due to poor service practices. Doubts on results after switching to blends are therefore plentiful because, in addition to poor service practices, would come an incorrect use of blends. A training program accompanying the replacement would go a long way to improve practices and thereby reduce emissions and increasing product life times.

R-502 replacements

R502 {*48.8% HCFC 22 + 51.2% CFC 115*}, is a CFC containing blend that is no longer available in Venezuela. As replacement, a number of blends have been introduced:

- Suva HP80 [R402A] {*38% HCFC 22 + 60% HFC 125 + 2% HC 290*},
- Suva HP81 [R402B] {*60% HCFC22 + 38% HFC125 + 2% HC 290*},
- Forane FX10, or Genetron R408A or Suva 408A, [R408A] {*47% HCFC 22 + 7% HFC125 + 46% HFC 143a*}.

In addition, there are two HFC based blends which have already gained market acceptance and are currently preferred, by experienced technicians, to the abovementioned HCFC based blend alternatives.
Adoption by the rest of technicians will as usual depend on pricing by the suppliers:

- Forane FX-70 or Genetron R404a, [R404a], and
- Refrigerant AZ-50 [R-507a]

Air Conditioning

Automotive air conditioning [MAC] shops today deal with two pure substances: CFC-12 and HFC-134a, depending on the car being manufactured prior or after 1995. There are other available products with current minor use:

- R 406a {55% HCFC 22 + 41% HCFC 142b + 4% HC 600a}, a drop-in replacement in CFC-12 systems, using the argument that no oil change is required. Some refrigerant merchants are selling it as replacement that does not require an oil change, thus making it readily accepted by most technicians. This product may also be found advertised as apt to be used in direct expansion systems in commercial applications.
- Recently, DuPont introduced a new HFC based option, under the trade name Isceon MO49, which is an HFC based blend {*R-413a: 88% HFC-134a + (% FC-218 + 3& HC600a*}.

The comfort air conditioning market is by far the largest consumer of HCFCs. All new central (roof top) and compact air conditioning equipment built in Venezuela and most imported units are designed and built to use HCFC-22. Compact systems are factory charged with HCFC-22, whereas all central systems are factory pressurized with nitrogen and the equipment installer charges the refrigerant (in all cases HCFC-22) onsite with refrigerant purchased in the local refrigeration merchandisers.

New imported small size (split type) air conditioning equipment may occasionally be factory charged with R407C or R410A, (HFC based blends) instead of HCF-22, which is still the most commonly used refrigerant in imported and locally made equipment. To serve this market, small quantities of Genetron R407C [R407C], and Forane AZ20 [R410A] have been imported.

The large number of installers includes well organized corporations as well as informally organized technicians that compete for small to mid size projects. Large projects, like supermarkets, shopping centers, large industrial equipment, central building, and other, 15 refrigeration tons or bigger, are usually contracted with large companies. These companies will also service this equipment throughout their life.

AC Service is provided by the same companies and technicians that serve refrigeration equipment . They represent the largest market for HCFC-22 and buy the refrigerant from many local refrigeration merchandisers. Some have been listed in the database but the number of technicians is surprisingly large (~5,000).

Conclusions on refrigerant substitutes.

Depending on the relative success of each of the options mentioned above, with particular consideration given to product pricing, we may see a continued reliance on HCFC based blends or an upsurge of HFC based refrigerants; or, if new technologies become economically and technically feasible, we might see additional options to change. The generalization in the use of blends, which require technical training for successful results, particularly in replacing CFC12 in domestic and commercial refrigeration as well as automotive air conditioning, which are tasks normally performed by a large number of poorly trained self educated technicians, may bring about a serious crisis of underperforming systems and an increase in the rate of equipment failure; which would be highly undesirable.

In past times, blends were almost exclusively employed by trained technicians, who had the technical know-how and training to use them properly. Untrained technicians self restrained themselves and relied on pure substances such as CFC12 or HFC134a for these simple applications. Substituting CFC12 with HFC134a has proven to be very cumbersome due to the requirement of oil changing to a very low level of mineral or alkylbenzene oil residue. Some of the newly offered blends offer the technical advantage of not requiring this oil substitution, but they have particular characteristics, such as the need to be charged as a liquid, that may produce undesired results if not respected. New situations have also begun to develop that need to be paid particular attention to: The Venezuelan market has been used to commercialization of pure substances sold on a “per kilo” basis. That means that a technician owns a cylinder (usually a 1 to 13 kg capacity) that he uses to buy refrigerant transferred from a larger recipient (usually a 60 kg cylinder), owned by the detail store, at the point of sale. The salesman transfers as much refrigerant as the customer wishes to buy.
This procedure introduces a serious risk of fractionalization if used when selling a blend, if correct handling is not maintained, and therefore creating the risk of changing the characteristics of the product that may pose a hazard.

Another reason for concern is the fact that the retailer may advertise this product (a blend designed to substitute a pure substance) as if it were the pure substance itself that it intends to replace, without letting it be known to his customer. (There have been reports of this kind of fraudulent behavior).

A training program on good refrigeration practices is actually being carried on in Venezuela, sponsored by UNIDO. About 43 instructors have been trained to teach these good refrigeration practices to what will finally be a number of some 3000 refrigeration technicians, in the initial phase of the program. These technicians are going to be equipped with the required equipment that will allow them to apply the good practices that they are being taught.

It is expected that these technicians will recover all refrigerants removed from serviced systems, reuse them if possible, recycle them whenever applicable or return them to retailers so that they are sent to a processing facility/ies which will finally classify them as apt for reclaiming or otherwise destruction. This/ese facility/ies will send these classified products to a final processing unit, very likely to be Produven, for final reclaiming or destruction, if this equipment is installed to process these ODP plus the HFC 23 byproduct of the HCFC 22 production.

2.3.5 Solvents Sector

HCFC 141b is the only ODS used in solvent applications. Its use is largely restricted to the flushing of refrigeration circuits and in electronic cleaners.

It is estimated that in 2005, 23 t HCFC-141b were used in solvent applications—13 t for flushing and 10 t for electronic cleaning sprays.

2.3.6 Feedstock and process Agent Applications

There are no feedstock applications of HCFCs in Venezuela.

2.3.7 Summary and Conclusions

It has been stressed before that reliable data are difficult to come by. FONDOIN has in the past reported based on licenses issued but these data do not match at all with official import data. The reason is that importers request inflated licenses and import frequently only a fraction of the approved amount. Because import data are not available before the reporting deadline to the MP Secretariat, FONDOIN felt it had no choice than reporting based on licenses

The following table proves the point. It compares FONDOIN data—which are reliable for production and import—with MINAMB import data:

HCFC CONSUMPTION BY PRODUCT											
PRODUCT	FONDOIN DATA										
HCFC 22	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PRODUCTION	1,656	1,590	1,607	1,298	453	500	773	493	443	994	636
IMPORTS	273	319	563	1480	758	1155	2782	1013	740	2552	3455
EXPORTS	153	153	200	210	72	127	91	65	40	100	49
CONSUMPTION	***1,775***	***1,757***	***1,969***	***2,568***	***1,139***	***1,528***	***3,464***	***1,441***	***1,143***	***3,446***	***4,042***

HCFC 141b	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	0	2	15	601	61	88	459	134	126	286	569
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	***0***	***2***	***15***	***601***	***61***	***88***	***459***	***134***	***126***	***286***	***569***
HCFC 142b	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	0	0	0	0	0	0	2	30	0	3	217
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	***0***	***0***	***0***	***0***	***0***	***0***	***2***	***30***	***0***	***3***	***217***
HCFC 123	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	36	1	1	1	2	0	24	55	0	66	42
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	***36***	***1***	***1***	***1***	***2***	***0***	***24***	***55***	***0***	***66***	***42***
HCFC 124	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	0	2	0	0	0	10	39	65	68	112	332
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	***0***	***2***	***0***	***0***	***0***	***10***	***39***	***65***	***68***	***112***	***332***
TOTAL HCFCs	***1,811***	***1,762***	***1,985***	***3,170***	***1,202***	***1,626***	***3,988***	***1,725***	***1,337***	***3,913***	***5,202***

HCFC CONSUMPTION BY PRODUCT											
PRODUCT	**MINAMB DATA**										
HCFC 22	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	1,656	1,590	1,607	1,298	453	500	773	493	443	994	636
IMPORTS	N/A	N/A	N/A	566	1,154	1,138	N/A	N/A	N/A	N/A	1,300
EXPORTS	153	153	200	210	72	127	91	65	40	100	49
CONSUMPTION	***N/A***	***N/A***	***N/A***	***1,654***	***1,535***	***1,528***	***N/A***	***N/A***	***N/A***	***N/A***	***1,887***
HCFC 141b	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	N/A	N/A	N/A	117	125	111	N/A	N/A	N/A	N/A	256
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	**N/A**	**N/A**	**N/A**	**117**	**125**	**111**	**N/A**	**N/A**	**N/A**	**286**	**256**

HCFC 142b	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	N/A	29
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	**N/A**	**N/A**	**N/A**	**0**	**0**	**0**	**N/A**	**N/A**	**N/A**	**N/A**	**29**
HCFC 123	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	N/A	N/A	N/A	1.2	4.4	0	N/A	N/A	N/A	N/A	9
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	**N/A**	**N/A**	**N/A**	**1.2**	**4.4**	**0**	**N/A**	**N/A**	**N/A**	**N/A**	**9**
HCFC 124	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
PRODUCTION	0	0	0	0	0	0	0	0	0	0	0
IMPORTS	N /A	N /A	N /A	6.5	11.8	**0**	N /A	N /A	N /A	N /A	45
EXPORTS	0	0	0	0	0	0	0	0	0	0	0
CONSUMPTION	**N /A**	**N /A**	**N /A**	**6.5**	**11.8**	**0**	**N /A**	**N /A**	**N /A**	**N /A**	**45**
TOTAL HCFCs	**N/A**	**N /A**	**N /A**	**1,779**	**1,676**	**1,639**	**N /A**	**N /A**	**N /A**	**N /A**	**2,226**

As MINAMB stands by their data—which come from the Venezuelan Customs Office–conclusion must be that the actual consumption from MP reports is overstated by a factor 2-3 and that a more reliable consumption for 2005 is **2,226** t rather than the reported **5,202** t .

HCFCs are used for their original applications as well—in dramatically increased amounts—for CFC replacement. Because of the size of individual users and the limitations of technologies, it has not been economically and/or technically feasible in most cases to replace CFCs by non-ODS substances—even when financed by the MLF.

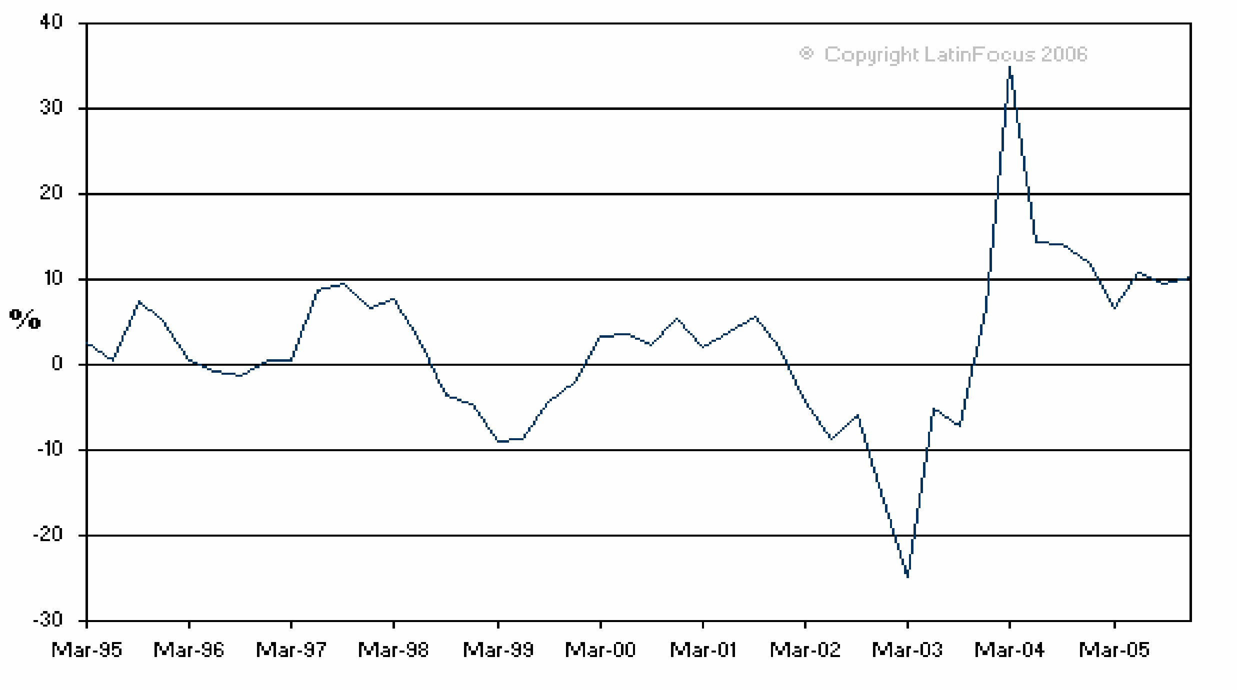
3. ANALYSIS

3.1 DEMAND FORECASTS

To estimate future HCFC demand, we have to consider several factors:

1. The economic growth in the country
2. Developments in sectors that use HCFCs that differ from the general trend
3. The cost of replacement of HCFCs
4. Introduction rate of HFCs blends for the replacement of HCFCs

Growth factors - Venezuela has faced f2002-2003 economic problems due to socio-political disturbances. This was reflected in its GDP as shown in the following chart:



HCFCs markets have shown a similar irregular behavior

Expectations for the future are optimistic. Venezuela's economy is tightly linked to oil, which prices are showing a tendency to increase for the foreseeable future. This represents a window of opportunity. Conservative growth projections for Venezuela are around 4 %/y until 2015:

Table 14 – Real GDP Growth Projections for Selected LA Countries

Country	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Argentina	7.7	4.6	3.1	2.9	3.6	3.7	3.8	3.7	3.3	3.4	3.4
Brazil	5.4	4.0	3.5	3.7	3.8	3.9	3.9	3.9	4.0	4.0	4.1
Colombia	3.6	3.7	4.0	4.1	4.2	4.1	4.1	3.7	3.8	3.8	3.7
Mexico	4.1	3.9	4.1	4.3	4.2	4.2	4.3	4.3	4.2	4.2	4.2
Venezuela	16.4	4.0	3.8	4.2	4.1	4.1	4.1	4.2	4.2	4.1	3.9

Source: "Global Insight" (formerly DRI-WEFA)

The government is promoting the highest possible growth rate, while at the same time keeping inflation below 10%/y, which is not an easy objective. The exchange rate has been fixed and availability of foreign currency for imports is being strictly controlled, so that the economy is growing at a rate the government desires and directed towards areas it assigns priority to. After closing an election year (2006), there should be at least 6 years (until 2013) of continuity, therefore allowing more stable scenarios than the past 10 years have allowed

Construction and service growth factors should be above these estimates for Venezuela. Up and above that, only 15% of homes are currently equipped with air conditioning, and there is a huge deficit of houses. Consequently, there is plenty of room for refrigeration and air conditioning to grow. For all HCFCs, growth is expected therefore to be around 2% over GNP—or 6%/y.

Closure of the local CFC production will not make a measurable initial impact, as Produven stocked considerable inventories. However, just the news of the closure may cause a ripple effect in favor of HCFC blends (HCFC-22, -123, 124, 142b). However, from 2008 onwards when CFC stocks are diminishing and after 2010, when CFC stocks are expected to be depleted, there may be a surge in the use of HCFC blends, increasing growth to 10% or more.

The introduction rate of HFC blends for the replacement of HCFCs is strongly related to the prices evolution of both substances. At the present, HFC blends are 4-5 times more expensive than HCFCs prices, and only the R-404A has some application in low temperature commercial refrigeration.

It is interesting to compare the introduction of HCFC alternatives to the CFC-12 experience in the most important sectors:

- **Mobil Air Conditioning:** in Venezuela, all car manufacturers are subsidiaries of global manufacturers and the decision for the use of HFC-134a was corporate and simultaneous for virtually all companies.
- **Domestic Refrigeration**: local manufacturers received assistance under the MLF for their CFC conversion and chose therefore HFC-134a.
- **Aftermarket:** until 2005, the majority used R-12, but CFC-12 availability and price motivated the use of HCFC-based ternary blends.

However, possible HFC blends penetration cannot be compared with the CFC-12 experience:

- The majority of the OEM's are local companies, in some cases connected through agreements with global enterprises, but not necessarily dependent to the extent that they have to adopt the same policy.
- More important, there is uncertainty about the evolution of the HCFC-22 price. According to PRODUVEN, if the carbon credit system under the Kyoto Protocol continues to leverage production of HCFC-22 in countries that are favored by such carbon credits, the HCFC-22 price—which has already decreased dramatically—may further fall.
- Finally, MLF support is currently far from assured.
- Regarding HFC blends, a gradual price decrease can be expected, depending on whether they continue to be accepted worldwide as long term replacement and not interim products because of related global warming concerns.

Taking into account the factors above mentioned, the percentage of growth until 2015 for each HCFC can be summarized as follows:

SUBSTANCE	2006-2007	2008-2010	2011-2015
HCFC-22	6%	6%	6%
HCFC-123	4%	4%	4%
HCFC-141b	6%	6%	6%
HCFC-142b	6%	6%	6%
HCFC-124	6%	6%	6%

Considering the actual 2005 consumption of each HCFC and using the growth for the different periods, estimated 2015 consumption in metric tons is as follows:

	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
2005 actual	1,887	256	9	32	62	**2,246**
2015 forecast	3,378	458	13	57	111	**4,017**

In summary, HCFC use in a moderate, unconstrained scenario will increase between 2005 and 2015 by a factor 1.8

3.2 AVAILABILITY SCENARIOS AND PRICES

3.2.1 Availability Scenarios

Venezuela is one of two countries in South America with local production source for the by now largest and most critical ODS substance, HCFC-22, with a production capacity of 10,000 t/y—essentially more than four times the 2005 and more than double the 2015 demand. However, the prices offered from China are such that the continuity of local production is not assured. Nevertheless, with Chinese production capacity for the production of HCFC-22 being close to 400,000 t/y, no constraints in supply are expected.

The only other substantial use is in HCFC-141b. The Government of Venezuela expects, along with TEAP forecasts that no constraints in supply is to be expected.

Based on the situation as described, Venezuela does not expect any availability issues for HCFCs over the period 2006-2015.

3.2.2 Price Trends

Price development of HCFCs has been downwards to roughly half the 1995 price. This is a typical development from proprietary, brand name products produced in developed countries to commodities produced wherever the costs are the lowest. As this development has been completed, price development along inflation development is from now on expected.
Over the same period the price of CFC-12 increased from US$ 3.00/kg to US$ 8.00/kg and CFC-11 from US$ 2.50/kg to US$ 5.00/kg Prices for ternary HCFC blends, on the other side, dropped as low as US$ 6.00/k (R 409A). This implies that HCFC-based ternary blends can now compete with CFCs. The same is —and most likely will not be in the foreseeable future—not the case for scenarios including HFCs, which are around US$ 10.00-13.00/kg.

3.3 TECHNOLOGY

Review of available zero ODP options has been limited to the two largest applications, refrigerants and foams

Refrigerants

The issue for refrigerants is not the availability but the price (HFCs and HFC-based blends) or the perceived safety (HCs). Even in subsidized projects, the price difference between HCFCs and HFCs will be difficult to cover as it is too substantial. Progress in HCFC containment in this case will have to come from rigorous application of "good practices". The application of HCs is more promising but will require a carefully designed program that emphasizes safety in manufacturing as well as service.

Foams

After the introduction in the market of liquid HFCs there have not been many new ODS-free technologies introduced in the market. The exception may be the use of methyl formiate (offered as a proprietary product under the name "Ecomate"), but this product is not yet offered or tested in Venezuela.

Non-ODS technologies have been expensive and many companies have gone through long and sometimes bitter learning experiences. By now these technologies have developed and matured. Overly restrictive safety restrictions have been adjusted based on widespread actual applications, equipment requirements have been optimized for different applications, lower priced low-pressure technology has adjusted to the new requirements and world-wide competition—including products from Article 5(1) countries, has lead to significantly lower equipment prices. In addition, most companies purchased high-pressure foam equipment for the use of HCFCs and retrofit for the use of non-ODS substances can be obtained by retrofit rather than replacement. As a result, conversion projects today should be significantly lower priced that they were, say, 10 years ago.

Venezuela will prefer options that combine zero ODP with favorable GWP properties. This implies that, while HFCs will be part of the solution, their overall environmental impact—GWP as well as energy requirements and end of life issues—need to be assessed. Such assessments have global significance and are not part of this survey. They should, however, be considered for the HCFC-management strategy that Venezuela hopes to develop as a consequence of this document.

As for now, Venezuela expects to reduce the use of HCFCs by

- Implementing good practices in the service of HCFC-containing equipment
- Introducing HCs in domestic refrigeration applications (a relatively sophisticated industry that can cope with safety issues)
- Increasing the use of hydrocarbons in foam and refrigeration applications
- Changing to HFC technology in those aerosol applications that do not allow for the safe use of hydrocarbons

3.4 ENVIRONMENTAL IMPACT

As mentioned, HCFCs have, apart from an ozone depleting potential, rather large Global warming potentials, as the following table shows:

PARAMETERS	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124
ODP	0.055	0.11	0.02	0.065	0.22
GWP	1,780	713	76	2,270	599

Source: 2005 IPCC/TEAP Special report

Other facts to be taken into account are:

- HFCs are energy efficient in insulation applications, yet their GWPs are even more considerable. Wouldn't it be best to move into the HCs realm altogether as soon as possible, considering their lower cost (in spite of the recognized fact that safety considerations make the initial investment higher)?
- HCs are effective in refrigeration applications (better than HFC-134a) and as foaming agents.
- Venezuela acceded in 2006 to the Kyoto Protocol and is therefore committed to options that combine zero ODP with favorable GWP properties and low energy impact.

These issues will be considered when preparing an HCFC management plan.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

Non-Article 5 countries such as the European Union, Japan and the USA have already shown the way to—albeit not full completion of—an ODS-free society using technologies such as HFC-based binary/ternary blends and HCs for refrigerants as well as liquid HFCs and HCs for foams. Technically, the same can be applied in Venezuela.

The challenge will be the costs in investments and/or recurrent costs. For instance, HCFC-22 costs US$ 3.26/kg (bulk). Replacing it by HFC blends will triple the price!. The same is true when replacing HCFC-141b with liquid HFCs. Typical HC projects cost US$ 300,000-500,000 in investment.

Another challenge will be to come up with a suitable policy framework for financial and technical assistance. An example: under current rules

- A foam project involving 100 t CFC-11 can receive up to US% 783,000
- The same project involving 100 t HCFC-141b could receive US$ 86,130

A third challenge in Venezuela, when using HCs, will be to enforce safety in SME settings. Simplification and economizing the technology may be required to overcome this.

There are opportunities as well. If the simplification of HC technology would be successful, there may be operational savings. The simultaneous introduction of good operational practices may decrease the use of HFCs and limit the cost increase—at least in service applications.

3.6 POTENTIAL COMPLIANCE MEASURES

To identify potential compliance measures one may be reminded of the actual ExCom decision approving this survey. The Executive Committee of the MLF approved at its 45th Meeting a project prepared by UNDP which aims to conduct a survey of HCFC use in selected countries with the objective of

establishing an eligible national aggregate level of HCFC consumption in the future against which proposals would be funded

(Decision 45/6).

Proposals alone will not do. Current policies on eligibility and cost thresholds will need to be revisited and, where deemed necessary, revised. Provided such a revision will be effected and lead to a suitable assistance framework, Venezuela is willing to cooperate in the preparation of HCFC phaseout projects and modification of the current legal framework to assure that such a phaseout will be sustainable.

Projects would be possible in a variety of sectors and applications:

- In the **RAC Service Sector** through the introduction of 'best practices" for HCFCs.
- In the **Solvent Sector** by replacing HCFC-141b by other, non-ODS organic solvents
- In the **Aerosol Sector** by replacing the use of HCFC-141b in contact sprays
- In **RAC Sector** by introducing the use of hydrocarbons as refrigerant
- In Foam Applications by introducing HFCs , HCs and other non-ODS blowing agents

3.7 SUMMARY AND CONCLUSIONS

HCFCs are used in historical applications as well—in sharply increased amounts—for CFC replacement. Because of the size of individual users and the limitations of technologies, it has not been possible in most cases to replace CFCs by non-ODS substances—even when financed by the MLF. The use of HCFCs has been part of the success of the Montreal Protocol but the related remaining ODP keeps us from calling the MP a complete success. In addition, other negative properties of HCFCs such as their global warming potential are an impediment for accomplishing another declared goal for the MP parties: **"To promote Synergy amongst Conventions".**

Considering actual volume in 2005 and using established expected growth rates, the 2015 consumption in metric tons is estimated as follows:

	HCFC-22	HCFC-141b	HCFC-123	HCFC-142b	HCFC-124	TOTAL
2005 actual	1,887	256	9	32	62	**2,246**
2015 forecast	3,378	458	13	57	111	**4,017**

HCFCs are mainly used because of price and low cost investment requires to introducing its use. To replace them will require large investments and cause increased operating costs.

There is currently a temporary supply problem in Venezuela related to a temporary reduction of supply by the local producer, Produven, which is concentrating on stockpiling CFCs before shutting down the production by year's end. This has also driven the price up. However, as mentioned, this is temporary and in general there are no supply problems with HCFCs nor are any expected in the period through 2015. Prices have come down for virtually all HCFCs in the last ten years and are currently relatively stable.

Current technical alternatives are by and large the same as those for ODS-free CFC replacement. Exceptions are recently developed liquid HFCs for foams, HFC binary and ternary blends for refrigeration and the use of non-ODS/non HFC organic blowing agents in foam.

While the use of HCFCs in the servicing sector can be reduced through "best practices" approaches that are essentially the same as the currently used ones for servicing with CFCs, complete phaseout of its use can only be achieved through prior phaseout of the use in primary applications.

Venezuela is prepared to design and implement an “HCFC Management Plan”. Under the assumption that technical and financial assistance through the MLF will be provide on amended term as compared to the almost completed CFC phaseout.

An important part of the HCFC Management Plans will be the sequencing of projects with priorities for projects that offer sustainability by offering low operating costs—or even operating benefits. Venezuela sees opportunities for projects in the following sectors:

- the **RAC Service Sector** through the introduction of ‘best practices”
- the **Solvent Sector** by replacing HCFC-141b by other, non-ODS organic solvents
- the **Aerosol Sector** by replacing the use of HCFC-141b in contact sprays
- the **RAC Sector** by introducing the use of hydrocarbons as refrigerant
- the **Foam Sector** by introducing HFCs , HCs and other non-ODS blowing agents

While initial projects will be intended to smooth the way to compliance with the MP imposed freeze by 2016, further projects could be used towards a phased reduction of HCFC consumption and even towards an accelerated phaseout date of its use.