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HCFC SURVEYS IN ARTICLE 5 COUNTRIES (PRESENTED BY UNDP)

- HCFC country surveys:
  Sri Lanka
  The Syrian Arab Republic

SURVEY OF HCFCs IN SRI LANKA

FINAL REPORT

National Ozone Unit
Ministry of Environment and Natural Resources, Sri Lanka
&
United Nations Development Programme (UNDP)

April/May 2007

EXECUTIVE SUMMARY

Sri Lanka acceded to the Vienna Convention and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in December 1989. Since the annual calculated consumption in Sri Lanka of controlled substances listed in Annex-A of the Montreal Protocol was less than 0.3 Kg per capita, Sri Lanka 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 for ODS phase-out, through the financial mechanism of the Montreal Protocol.

Sri Lanka’s Country Programme incorporating the National Strategy and Action Plan for controlling the use of Ozone Depleting substances was approved in March 1994. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country’s commitments and priorities. Until date, Sri Lanka 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 also due to proactive regulations.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore 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.

In Sri Lanka, HCFCs are used in the Refrigeration & Air Conditioning sector. The predominant HCFC used is HCFC-22. The consumption of HCFCs in Sri Lanka increased from about 112 metric tonnes in 1999 to 225 metric tonnes in 2006 signifying an average annual growth rate of about 9.11%. At a conservative annual growth rate in demand forecasted for HCFCs of 10% from 2007 until 2015, it is estimated that the consumption of HCFCs in Sri Lanka is likely to reach about 530 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 timely preparations and interventions. These could include reducing dependence on HCFCs and controlling and reducing HCFC use at an early date. The main constraint for converting from HCFCs to non-ODS alternatives is the reliable and economical availability of substitutes as well as technical and financial capacity for effecting the transition. 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. Sri Lanka expects the international community to recognize these challenges in order to ensure sustainability and credibility of ODS phase-out complying with the global efforts towards the protection of the ozone layer.

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LIST OF ABBREVIATIONS

CFC	Chlorofluorocarbons
CP	Country Programme
CTC	Carbon Tetra Chloride
ExCom	Executive Committee of the Multilateral Fund
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
GWP	Global Warming Potential
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	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

(a) 1.1 BACKGROUND

Sri Lanka is an island country in the Indian Ocean to the south of India, with a land area of about 65,000 sq. km. It has a population of about 21 million with an estimated GDP per capita (PPP) of about USD 4,600 (2006). The agricultural sector accounts for about 17% of GDP, the industry for about 27 % and the services sector for about 56%. The population density is about 300 persons per sq km and the urban population represents around 22 % of the total population.

Table-1 below shows the dates of ratification by Sri Lanka of the Vienna Convention, Montreal Protocol and its amendments. The ratification of the Beijing amendment is still in process.

Table-1: Sri Lanka - Ratification of Montreal Protocol and its Amendments

Agreement/Amendment	Ratification
Vienna Convention	December 1989
Montreal Protocol	December 1989
London Amendment	June 1993
Copenhagen Amendment	July 1997
Montreal Amendment	August 1999
Beijing Amendment	November 2002

The Country Programme (CP) incorporating the national strategy and action plan for phasing out ODS in Sri Lanka in accordance with the control schedule of the Montreal Protocol and its amendments, was approved in March 1994. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. The Foams and Refrigeration & Air Conditioning Sectors were the main ODS consuming sectors in Sri Lanka, therefore the national strategy prioritized the management of ODS consumption and eventual phase-out in these sectors.

The National Programme for Recovery and Recycling of refrigerants was approved in October 1996. The Refrigerant Management Plan was approved in December 2000. The National Compliance Action Plan for phase-out of CFCs was approved in July 2004.

Sri Lanka has made significant progress in ODS phase-out over the past few years and has complied with both interim control milestones (namely, the 1999 freeze and the 85% reduction by 2005) for Annex-A Group-I substances (CFCs). This has been made possible with the assistance of the Multilateral Fund and through project activities including technology transfer investments, technical assistance, training and capacity building, information dissemination and awareness-raising and also due to pro-active regulations.

HCFCs, which have Ozone Depleting Potential (ODP) up to 15% of that of CFCs, are classified as controlled substances under Annex-C, Group-I of the Montreal Protocol. HCFCs therefore, have use restrictions and 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 were approved as substitutes for CFCs in many of the projects and activities supported by the Multilateral Fund.

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 its 45th Meeting, funding for UNDP to carry out HCFC surveys in 12 countries. Sri Lanka 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:

Latín 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 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, ensuring the required country-level consultations within the respective industry and expert institutions. Consequently UNDP, in consultation with the Sri Lanka National Ozone Unit, selected a local firm, Inaire P. Ltd, as the national expert entity to undertake the national level tasks for the survey.

1.3 SURVEY METHODOLOGY

Data collection

A questionnaire in the prescribed format, for collecting field data was used. The following data were collected:

1. HCFC import data
2. HCFC-based equipment population data
3. HCFC consumption data by sectors.

Meetings were held with representatives from related government institutions, importers, distributors, industry associations, end-uses, as well as expert and senior technicians to supplement the data collection.

Data processing

Since Sri Lanka does not produce or export any CFCs and HCFCs, the HCFC consumption is equal to the amount of HCFC imported to Sri Lanka.

The data on imports and consumption obtained from various information sources was analyzed using best estimates.

2. OBSERVATIONS

(b) 2.1 INSTITUTIONAL FRAMEWORK

2.1.1 Institutional Arrangements

The activities related to ozone layer protection and implementation of the Montreal Protocol, are managed and coordinated through the National Ozone Unit, within the Ministry of Environment and Natural Resources. The national policies and priorities related to the implementation of the Montreal Protocol are formulated by the National Coordination Committee comprising of representation from various related ministries, agencies, technical institutions, industry associations and NGOs.

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

a) Monitoring the use and import of ODS to control
b) Prevention of illegal trade and capacity building of customs officials
c) Active participation in the preparation, implementation and monitoring for projects funded by MLF
d) Formulating guidelines and regulations as necessary for policy implementation
e) Supporting public awareness initiatives and campaigns for promoting ozone layer protection at the consumer level for encouraging public involvement.
f) Regular interaction with other ministries and departments, industry representatives and implementing agencies for information dissemination related to impact of policy measures
g) Promoting research on ozone-friendly technologies.

2.1.2 Policies and Regulations

Government of Sri Lanka has adopted policies that would support the ODS phase-out activities in the country in accordance with the Montreal Protocol control targets. Specifically, the policies focus on expediting the implementation of ODS phase-out projects and adoption of non-ODS substitute technologies.

In order to control the trade and use of ODS the Government of Sri Lanka has established the following regulations:

a) Prohibition of import of ODS-based products/equipment
b) Licensing system for import of ODS
c) Prohibition on establishing production capacity for ODS-based products.

Specific regulatory actions targeting HCFCs are:

a) HCFCs are designated as controlled substances
b) Import licensing system for HCFCs is in place since 2005

(c) 2.2 HCFC SUPPLY SCENARIO

(i) 2.2.1 Production

There is no production of HCFCs in Sri Lanka. The entire domestic demand is met through imports. Imports mainly originate from China, Europe, India and Singapore.

(ii) 2.2.2 Exports

There are no recorded exports of HCFCs from Sri Lanka.

(iii) 2.2.3 Imports

In Sri Lanka, there are thirteen authorized importers of HCFCs. Import of HCFCs into Sri Lanka since 1999 are tabulated below:

Table-2: Sri Lanka – HCFC Imports (1999 – 2006)

Substance/ Year	**Imports (metric tonnes)**							
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
HCFC-22	112	112	105	154	128	203	177	224
HCFC-141b and other	0	3	1	3	0	28	1	1
Total	**112**	**115**	**106**	**157**	**128**	**231**	**178**	**225**

Note: Rounded off to the nearest 1 tonne

(iv) 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.

(d) 2.3 HCFC CONSUMPTION

(i) 2.3.1 Aerosols Sector

There is no reported consumption of HCFCs in this sector as of 2006.

(ii) 2.3.2 Firefighting Sector

There is no identified use of HCFCs in the Firefighting sector in Sri Lanka.

(iii) 2.3.3 Foams Sector

The consumption of HCFCs in the Foams Sector was historically negligible and zero in 2006.

(iv) 2.3.4 Refrigeration & Air Conditioning Sector

The Refrigeration and Air Conditioning Sector is the main HCFC consuming sector in Sri Lanka. The Refrigeration and Air Conditioning Sector has experienced significant growth in the past decade due to the growth in the per capita incomes, the predominance of the service industry and the relatively low market penetration of refrigeration and air conditioning appliances and equipment in the past.

HCFCs are used as refrigerants (HCFC-22) and blowing agents (HCFC-141b) in the manufacture of refrigeration and air conditioning equipment. In servicing, HCFC-22 is the predominant HCFC used. For appliances such as comfort air conditioning equipment, HCFC-22 has been the traditional refrigerant. For domestic refrigeration appliances such as household refrigerators and freezers, HCFC-141b is used as a blowing agent for the foam insulation. In commercial refrigeration and industrial refrigeration equipment, HCFC-22 has been used both as a traditional refrigerant as well as a replacement refrigerant for CFC-12 and in addition HCFC-141b is used as a blowing agent for the foam insulation.

The historical consumption of HCFCs in the Refrigeration and Air Conditioning Sector from 1999 - 2006 is shown in Table-3 below.

Table-3: HCFC Consumption in Refrigeration & Air Conditioning Sector in Sri Lanka (1999-2006)

Year/Parameter	Consumption (metric tonnes)							
	1999*	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Manufacturing	110	19	18	24	19	51	30	31
Servicing		94	88	130	99	160	162	194
Total	**110**	**113**	**106**	**154**	**118**	**211**	**192**	**225**

* Breakdown not available
Note: All figures rounded off to the nearest 1 metric tonne

Manufacturing

The manufacturing activities in the Refrigeration and Air Conditioning Sector comprise of comfort air conditioning equipment (such as window and split air conditioners and air conditioning chillers), domestic refrigeration equipment (household refrigerators and freezers) and commercial/industrial refrigeration equipment (such display cabinets, chest freezers, beverage chillers, walk-in coolers and cold rooms). The manufacturing activities for refrigeration and air conditioning equipment in Sri Lanka are limited; only about 15% of the domestic demand is met through local manufacturing and the remaining through imports.

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, supermarkets, hotels and hospitals served by HCFC-based equipment for air conditioning, which require servicing. There are a number of cold room installations serving hotels, hospitals, supermarkets, restaurants and food industry for preserving, fruits and vegetables 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 and end-users.

The table below shows the breakdown of HCFC consumption in the Refrigeration and Air Conditioning Sector in Sri Lanka for 2006:

Table-4: Estimated Breakdown of HCFC Consumption in the Refrigeration and Air Conditioning Sector (2006)

Application	HCFC Consumption (metric tonnes)
Manufacturing	
Window/Split Air Conditioners	5
Air Conditioning chillers	10
Domestic Refrigeration	1
Commercial Refrigeration	5
Industrial Refrigeration	10
Servicing	
Servicing (all applications)	194
Total	**225**

(v)
(vi) 2.3.5 Solvents Sector

There is no identified usage of HCFCs as solvents as of 2006.

(vii) 2.3.6 Summary and Conclusions

The HCFC consumption in Sri Lanka is mainly concentrated in the Refrigeration and Air Conditioning sector. The predominant HCFC used is HCFC-22 as a refrigerant.

The table shown below shows the HCFC consumption in Sri Lanka during 2006, by sector/substance:

Table-5: Summary of HCFC Consumption in Sri Lanka (2006)

Sector	Consumption (metric tonnes)		
	HCFC-22	HCFC-141b	Total
Foams	0	0	0
Refrigeration & Air Conditioning			
Window/Split Air Conditioners	5	0	5
Air Conditioning Chillers	10	0	10
Domestic Refrigeration	0	1	1
Commercial Refrigeration	5	0	5
Industrial Refrigeration	10	0	10
Servicing	194	0	194
Total	**224**	**1**	**225**

3. ANALYSIS

(e) 3.1 Demand Forecasts

(i)

The demand for HCFCs in Sri Lanka is forecasted to grow due to the expected economic growth and consequent rise in demand for consumer and industrial goods. HCFC-22 is and will remain the most significant HCFC in use in Sri Lanka. Future HCFC consumption in Sri Lanka is linked to the growth of the Refrigeration and Air Conditioning sector. In addition, conversion of some of the residual CFC consumption to HCFCs, as well as increasing use of HCFC-based equipment will contribute to growth. The increasing population of HCFC-based products will additionally increase servicing demand. Based on this, it is possible to make projections of unconstrained future demand for HCFCs until 2015.

The HCFC demand in Sri Lanka increased from about 112 metric tonnes in 1999 to 225 metric tonnes in 2006, signifying an average annual growth rate of about 9.11% over the past 7 years.

Applying an average annual growth rate in demand of 10% from 2006 to 2015, which is the expected average growth rate in demand in the Refrigeration and Air Conditioning Sector, the unconstrained HCFC consumption in Sri Lanka is expected to reach 530 metric tonnes by 2015. The following table shows the unconstrained demand for HCFCs:

Table-6: Projected unconstrained demand for HCFCs in Sri Lanka by 2015

Substance	**Demand in 2006** (metric tonnes)	**Unconstrained demand in 2015** (metric tonnes)
HCFCs	225	530

(f) 3.2 Availability and Prices

(i) 3.2.1 Availability Scenario

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 Sri Lanka by 2015.

(ii) 3.2.2 Price Trends

The prevailing and projected prices of HCFCs in Sri Lanka (2006 and 2015) are shown in the table below.

Table-7: HCFC prices in Sri Lanka (2006 and 2015)

Year	Market Price (US$/kg)	
	HCFC-22	HCFC-141b
2006	3.50 – 4.00	3.50 – 4.00
2015	4.50 – 6.00	5.00 – 6.00

The projections are based on the assumption that the supply situation for HCFCs will not dramatically change for the foreseeable future. This is indeed likely to be the case as there is adequate manufacturing capacity for HCFCs in developing countries such as China and India and if production in developed countries is reduced, it is unlikely to affect the supply situation, as corresponding consumption controls are also in place in developed countries. Currently there are no consumption controls on HCFCs in developing countries (until the first control in 2016).

Thus it is seen that the prices of HCFCs in Sri Lanka in 2015 would not be dramatically higher, reflecting the relatively comfortable supply situation.

Substitutes for HCFCs are available, though not commonly used. The prices of substitutes vary between US$ 8.00 to US$ 15.00 per kg.

(g) 3.3 TECHNOLOGY

The selection of alternative technologies for HCFCs would be based on the following considerations:

- Maturity
- Availability
- Cost-effectiveness
- Energy-efficiency
- Environmental and occupational safety.

The selection of alternative technologies is also influenced by local circumstances, preferences of enterprises, accessibility to training, processibility and regulatory environment.

Certain non-ODP substitutes and alternative technologies to HCFCs, meeting many of these requirements have emerged in recent years for many applications.

(i) 3.3.1 Replacements for HCFC-22

HCFC-22 alternatives are relatively new to the market, especially in developing countries. The two main directions for the alternatives are natural substances (such as Ammonia, Hydrocarbons, Carbon Dioxide, etc) and synthetic substances (HFCs and their blends).

Natural Substances: These have excellent thermodynamic properties and have zero ODP and GWP.

Ammonia is toxic and slightly flammable and can only be used in new equipment specifically designed and where exposure is minimal. Ammonia is a very popular refrigerant in the industrial refrigeration sector. Materials incompatibility makes ammonia generally unsuitable for small systems.

Hydrocarbons are highly flammable and can be used in systems designed to address the flammability risk. As a general rule, hydrocarbons are viable alternatives in small and medium-sized systems where intensive fire and explosion safety provisions can be conveniently and cost-effectively made. Hydrocarbons 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 low-temperature applications such as industrial refrigeration.

Supercritical CO_2-based systems are available for certain applications, however currently because their high costs and relatively new technology are unlikely to be applied in the short term.

Synthetic Substances: HFCs and their blends are the major synthetic substances as alternatives to HCFCs. HFCs have zero ODP, no flammability and no toxicity, but have a high GWP, requiring minimization of leakages and emissions. All pure HFCs and most HFC blends require use of synthetic lubricating oils in place of the more conventional mineral oils used for HCFCs.

Currently the leading HFC blends to replace HCFC-22 are R-407C and R-410A. However, they both have some characteristics that make the transition from HCFC-22 potentially challenging. R-407C has a significant temperature glide and R-410A operates at a considerably higher discharge pressures than HCFC-22. The availability and prices of HFCs and HFC blends to substitute HCFC-22 are not favorable presently in developing countries.

The leading alternative technologies for HCFC-22 are tabulated below:

Table-8: Leading substitutes for HCFC-22

Application	Leading replacements
Window air conditioners	R-407C, R-410A
Unitary single package and split 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, HCs
Industrial Refrigeration/AC	R-134a, R-404a, Ammonia
Transport refrigeration/AC	R-134a, R-410A

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 Sri Lanka to use them.

(h) 3.4 ENVIRONMENTAL IMPACT

Table-9 shows the impact of HCFC consumption in Sri Lanka between 2006 and 2015, in terms of ODP and GWP. It can be seen that unconstrained demand would increase ozone depletion by 17.19 ODP tonnes and increase global warming by 540,810 tonnes/tonne CO2 by 2015.

Table-9: Environmental Impact of HCFC Consumption

HCFC	ODP	GWP	Impact 2006			Impact 2015		
			Demand	ODP	GWP (MT/MT CO2)	Demand	ODP	GWP (MT/MT CO2)
HCFC-141b	0.11	630	1	0.11	630	2.36	0.26	1,487
HCFC-22	0.056	1,780	224	12.54	398,720	528.18	29.58	940,160
Total			**225**	**12.65**	**399,350**	**530.54**	**29.84**	**941,647**

The above figures do not account for the GWP of substitutes to HCFCs.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

The major challenges, which would prove as constraints 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 technical and financial capacity to manage the transition
- Lack of awareness on the HCFC controls and available alternatives, as well as their impact on processes, practices and the environment.

The opportunities 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
- Technical and financial assistance for managing the transition from HCFCs to substitutes

(i) 3.6 Potential Compliance Measures

The potential actions for compliance would comprise of the following:

Preparing a strategy and action plan: It would be necessary 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 access and disseminate 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: It would 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 a burden on the consumers and industry.

(j) 3.7 Summary and Conclusions

In Sri Lanka, HCFC-22 is the predominant HCFCs used in the Refrigeration & Air Conditioning sector. HCFC-141b is used as a blowing agent for rigid polyurethane foams and HCFC-22 is used as a refrigerant for refrigeration and air conditioning systems.

Sri Lanka's consumption of HCFCs increased from 112 metric tonnes in 1999 to 225 metric tonnes in 2006. Unconstrained HCFC consumption in Sri Lanka is expected to reach 530 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 favorably 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.

Sri Lanka expects the incremental costs of compliance to be met under the mechanisms of the Montreal Protocol.

ANNEX

INFORMATION ON HCFC CONSUMING ENTERPRISES

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Refrigeration and Air Conditioning	Window/Split Air Conditioners	10
	Air Conditioning Chillers	25
	Domestic Refrigeration	3
	Commercial Refrigeration	75
	Industrial Refrigeration	30
SERVICING		
Refrigeration and Air Conditioning	All	Over 1,000

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.

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Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore 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.

In Sri Lanka, HCFCs are used in the Refrigeration & Air Conditioning sector. The predominant HCFC used is HCFC-22. The consumption of HCFCs in Sri Lanka increased from about 112 metric tonnes in 1999 to 225 metric tonnes in 2006 signifying an average annual growth rate of about 9.11%. At a conservative annual growth rate in demand forecasted for HCFCs of 10% from 2007 until 2015, it is estimated that the consumption of HCFCs in Sri Lanka is likely to reach about 530 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 timely preparations and interventions. These could include reducing dependence on HCFCs and controlling and reducing HCFC use at an early date. The main constraint for converting from HCFCs to non-ODS alternatives is the reliable and economical availability of substitutes as well as technical and financial capacity for effecting the transition. 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. Sri Lanka expects the international community to recognize these challenges in order to ensure sustainability and credibility of ODS phase-out complying with the global efforts towards the protection of the ozone layer.

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LIST OF ABBREVIATIONS

CFC	Chlorofluorocarbons
CP	Country Programme
CTC	Carbon Tetra Chloride
ExCom	Executive Committee of the Multilateral Fund
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
GWP	Global Warming Potential
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	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

(k) *1.1* BACKGROUND

Sri Lanka is an island country in the Indian Ocean to the south of India, with a land area of about 65,000 sq. km. It has a population of about 21 million with an estimated GDP per capita (PPP) of about USD 4,600 (2006). The agricultural sector accounts for about 17% of GDP, the industry for about 27 % and the services sector for about 56%. The population density is about 300 persons per sq km and the urban population represents around 22 % of the total population.

Table-1 below shows the dates of ratification by Sri Lanka of the Vienna Convention, Montreal Protocol and its amendments. The ratification of the Beijing amendment is still in process.

Table-1: Sri Lanka - Ratification of Montreal Protocol and its Amendments

Agreement/Amendment	Ratification
Vienna Convention	December 1989
Montreal Protocol	December 1989
London Amendment	June 1993
Copenhagen Amendment	July 1997
Montreal Amendment	August 1999
Beijing Amendment	November 2002

The Country Programme (CP) incorporating the national strategy and action plan for phasing out ODS in Sri Lanka in accordance with the control schedule of the Montreal Protocol and its amendments, was approved in March 1994. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. The Foams and Refrigeration & Air Conditioning Sectors were the main ODS consuming sectors in Sri Lanka, therefore the national strategy prioritized the management of ODS consumption and eventual phase-out in these sectors.

The National Programme for Recovery and Recycling of refrigerants was approved in October 1996. The Refrigerant Management Plan was approved in December 2000. The National Compliance Action Plan for phase-out of CFCs was approved in July 2004.

Sri Lanka has made significant progress in ODS phase-out over the past few years and has complied with both interim control milestones (namely, the 1999 freeze and the 85% reduction by 2005) for Annex-A Group-I substances (CFCs). This has been made possible with the assistance of the Multilateral Fund and through project activities including technology transfer investments, technical assistance, training and capacity building, information dissemination and awareness-raising and also due to pro-active regulations.

HCFCs, which have Ozone Depleting Potential (ODP) up to 15% of that of CFCs, are classified as controlled substances under Annex-C, Group-I of the Montreal Protocol. HCFCs therefore, have use restrictions and 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 were approved as substitutes for CFCs in many of the projects and activities supported by the Multilateral Fund.

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 its 45th Meeting, funding for UNDP to carry out HCFC surveys in 12 countries. Sri Lanka 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:

Latín 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 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, ensuring the required country-level consultations within the respective industry and expert institutions. Consequently UNDP, in consultation with the Sri Lanka National Ozone Unit, selected a local firm, Inaire P. Ltd, as the national expert entity to undertake the national level tasks for the survey.

1.3 SURVEY METHODOLOGY

Data collection

A questionnaire in the prescribed format, for collecting field data was used. The following data were collected:

4. HCFC import data
5. HCFC-based equipment population data
6. HCFC consumption data by sectors.

Meetings were held with representatives from related government institutions, importers, distributors, industry associations, end-uses, as well as expert and senior technicians to supplement the data collection.

Data processing

Since Sri Lanka does not produce or export any CFCs and HCFCs, the HCFC consumption is equal to the amount of HCFC imported to Sri Lanka.

The data on imports and consumption obtained from various information sources was analyzed using best estimates.

2. OBSERVATIONS

(l) 2.1 INSTITUTIONAL FRAMEWORK

2.1.1 Institutional Arrangements

The activities related to ozone layer protection and implementation of the Montreal Protocol, are managed and coordinated through the National Ozone Unit, within the Ministry of Environment and Natural Resources. The national policies and priorities related to the implementation of the Montreal Protocol are formulated by the National Coordination Committee comprising of representation from various related ministries, agencies, technical institutions, industry associations and NGOs.

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

h) Monitoring the use and import of ODS to control
i) Prevention of illegal trade and capacity building of customs officials
j) Active participation in the preparation, implementation and monitoring for projects funded by MLF
k) Formulating guidelines and regulations as necessary for policy implementation
l) Supporting public awareness initiatives and campaigns for promoting ozone layer protection at the consumer level for encouraging public involvement.
m) Regular interaction with other ministries and departments, industry representatives and implementing agencies for information dissemination related to impact of policy measures
n) Promoting research on ozone-friendly technologies.

2.1.2 Policies and Regulations

Government of Sri Lanka has adopted policies that would support the ODS phase-out activities in the country in accordance with the Montreal Protocol control targets. Specifically, the policies focus on expediting the implementation of ODS phase-out projects and adoption of non-ODS substitute technologies.

In order to control the trade and use of ODS the Government of Sri Lanka has established the following regulations:

d) Prohibition of import of ODS-based products/equipment
e) Licensing system for import of ODS
f) Prohibition on establishing production capacity for ODS-based products.

Specific regulatory actions targeting HCFCs are:

a) HCFCs are designated as controlled substances
b) Import licensing system for HCFCs is in place since 2005

(m) 2.2 HCFC SUPPLY SCENARIO

(i) 2.2.1 Production

There is no production of HCFCs in Sri Lanka. The entire domestic demand is met through imports. Imports mainly originate from China, Europe, India and Singapore.

(ii) 2.2.2 Exports

There are no recorded exports of HCFCs from Sri Lanka.

(iii) 2.2.3 Imports

In Sri Lanka, there are thirteen authorized importers of HCFCs. Import of HCFCs into Sri Lanka since 1999 are tabulated below:

Table-2: Sri Lanka – HCFC Imports (1999 – 2006)

Substance/ Year	Imports (metric tonnes)							
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
HCFC-22	112	112	105	154	128	203	177	224
HCFC-141b and other	0	3	1	3	0	28	1	1
Total	**112**	**115**	**106**	**157**	**128**	**231**	**178**	**225**

Note: Rounded off to the nearest 1 tonne

(iv) 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.

(n) 2.3 HCFC CONSUMPTION

(i) 2.3.1 Aerosols Sector

There is no reported consumption of HCFCs in this sector as of 2006.

(ii) 2.3.2 Firefighting Sector

There is no identified use of HCFCs in the Firefighting sector in Sri Lanka.

(iii) 2.3.3 Foams Sector

The consumption of HCFCs in the Foams Sector was historically negligible and zero in 2006.

(iv) 2.3.4 Refrigeration & Air Conditioning Sector

The Refrigeration and Air Conditioning Sector is the main HCFC consuming sector in Sri Lanka. The Refrigeration and Air Conditioning Sector has experienced significant growth in the past decade due to the growth in the per capita incomes, the predominance of the service industry and the relatively low market penetration of refrigeration and air conditioning appliances and equipment in the past.

HCFCs are used as refrigerants (HCFC-22) and blowing agents (HCFC-141b) in the manufacture of refrigeration and air conditioning equipment. In servicing, HCFC-22 is the predominant HCFC used. For appliances such as comfort air conditioning equipment, HCFC-22 has been the traditional refrigerant. For domestic refrigeration appliances such as household refrigerators and freezers, HCFC-141b is used as a blowing agent for the foam insulation. In commercial refrigeration and industrial refrigeration equipment, HCFC-22 has been used both as a traditional refrigerant as well as a replacement refrigerant for CFC-12 and in addition HCFC-141b is used as a blowing agent for the foam insulation.

The historical consumption of HCFCs in the Refrigeration and Air Conditioning Sector from 1999 - 2006 is shown in Table-3 below.

Table-3: HCFC Consumption in Refrigeration & Air Conditioning Sector in Sri Lanka (1999-2006)

Year/Parameter	Consumption (metric tonnes)							
	1999*	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Manufacturing	110	19	18	24	19	51	30	31
Servicing		94	88	130	99	160	162	194
Total	**110**	**113**	**106**	**154**	**118**	**211**	**192**	**225**

* Breakdown not available
Note: All figures rounded off to the nearest 1 metric tonne

Manufacturing

The manufacturing activities in the Refrigeration and Air Conditioning Sector comprise of comfort air conditioning equipment (such as window and split air conditioners and air conditioning chillers), domestic refrigeration equipment (household refrigerators and freezers) and commercial/industrial refrigeration equipment (such display cabinets, chest freezers, beverage chillers, walk-in coolers and cold rooms). The manufacturing activities for refrigeration and air conditioning equipment in Sri Lanka are limited; only about 15% of the domestic demand is met through local manufacturing and the remaining through imports.

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, supermarkets, hotels and hospitals served by HCFC-based equipment for air conditioning, which require servicing. There are a number of cold room installations serving hotels, hospitals, supermarkets, restaurants and food industry for preserving, fruits and vegetables 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 and end-users.

The table below shows the breakdown of HCFC consumption in the Refrigeration and Air Conditioning Sector in Sri Lanka for 2006:

Table-4: Estimated Breakdown of HCFC Consumption in the Refrigeration and Air Conditioning Sector (2006)

Application	**HCFC Consumption (metric tonnes)**
Manufacturing	
Window/Split Air Conditioners	5
Air Conditioning chillers	10
Domestic Refrigeration	1
Commercial Refrigeration	5
Industrial Refrigeration	10
Servicing	
Servicing (all applications)	194
Total	**225**

(v)

(vi) 2.3.5 Solvents Sector

There is no identified usage of HCFCs as solvents as of 2006.

(vii) 2.3.6 Summary and Conclusions

The HCFC consumption in Sri Lanka is mainly concentrated in the Refrigeration and Air Conditioning sector. The predominant HCFC used is HCFC-22 as a refrigerant.

The table shown below shows the HCFC consumption in Sri Lanka during 2006, by sector/substance:

Table-5: Summary of HCFC Consumption in Sri Lanka (2006)

Sector	Consumption (metric tonnes)		
	HCFC-22	HCFC-141b	Total
Foams	0	0	0
Refrigeration & Air Conditioning			
Window/Split Air Conditioners	5	0	5
Air Conditioning Chillers	10	0	10
Domestic Refrigeration	0	1	1
Commercial Refrigeration	5	0	5
Industrial Refrigeration	10	0	10
Servicing	194	0	194
Total	**224**	**1**	**225**

3. ANALYSIS

(o) 3.1 DEMAND FORECASTS

(i)

The demand for HCFCs in Sri Lanka is forecasted to grow due to the expected economic growth and consequent rise in demand for consumer and industrial goods. HCFC-22 is and will remain the most significant HCFC in use in Sri Lanka. Future HCFC consumption in Sri Lanka is linked to the growth of the Refrigeration and Air Conditioning sector. In addition, conversion of some of the residual CFC consumption to HCFCs, as well as increasing use of HCFC-based equipment will contribute to growth. The increasing population of HCFC-based products will additionally increase servicing demand. Based on this, it is possible to make projections of unconstrained future demand for HCFCs until 2015.

The HCFC demand in Sri Lanka increased from about 112 metric tonnes in 1999 to 225 metric tonnes in 2006, signifying an average annual growth rate of about 9.11% over the past 7 years.

Applying an average annual growth rate in demand of 10% from 2006 to 2015, which is the expected average growth rate in demand in the Refrigeration and Air Conditioning Sector, the unconstrained HCFC consumption in Sri Lanka is expected to reach 530 metric tonnes by 2015. The following table shows the unconstrained demand for HCFCs:

Table-6: Projected unconstrained demand for HCFCs in Sri Lanka by 2015

Substance	**Demand in 2006** (metric tonnes)	**Unconstrained demand in 2015** (metric tonnes)
HCFCs	225	530

(p) 3.2 AVAILABILITY AND PRICES

(i) 3.2.1 Availability Scenario

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 Sri Lanka by 2015.

(ii) 3.2.2 Price Trends

The prevailing and projected prices of HCFCs in Sri Lanka (2006 and 2015) are shown in the table below.

Table-7: HCFC prices in Sri Lanka (2006 and 2015)

Year	Market Price (US$/kg)	
	HCFC-22	HCFC-141b
2006	3.50 – 4.00	3.50 – 4.00
2015	4.50 – 6.00	5.00 – 6.00

The projections are based on the assumption that the supply situation for HCFCs will not dramatically change for the foreseeable future. This is indeed likely to be the case as there is adequate manufacturing capacity for HCFCs in developing countries such as China and India and if production in developed countries is reduced, it is unlikely to affect the supply situation, as corresponding consumption controls are also in place in developed countries. Currently there are no consumption controls on HCFCs in developing countries (until the first control in 2016).

Thus it is seen that the prices of HCFCs in Sri Lanka in 2015 would not be dramatically higher, reflecting the relatively comfortable supply situation.

Substitutes for HCFCs are available, though not commonly used. The prices of substitutes vary between US$ 8.00 to US$ 15.00 per kg.

(q) 3.3 TECHNOLOGY

The selection of alternative technologies for HCFCs would be based on the following considerations:

- Maturity
- Availability
- Cost-effectiveness
- Energy-efficiency
- Environmental and occupational safety.

The selection of alternative technologies is also influenced by local circumstances, preferences of enterprises, accessibility to training, processibility and regulatory environment.

Certain non-ODP substitutes and alternative technologies to HCFCs, meeting many of these requirements have emerged in recent years for many applications.

(i) 3.3.1 Replacements for HCFC-22

HCFC-22 alternatives are relatively new to the market, especially in developing countries. The two main directions for the alternatives are natural substances (such as Ammonia, Hydrocarbons, Carbon Dioxide, etc) and synthetic substances (HFCs and their blends).

Natural Substances: These have excellent thermodynamic properties and have zero ODP and GWP.

Ammonia is toxic and slightly flammable and can only be used in new equipment specifically designed and where exposure is minimal. Ammonia is a very popular refrigerant in the industrial refrigeration sector. Materials incompatibility makes ammonia generally unsuitable for small systems.

Hydrocarbons are highly flammable and can be used in systems designed to address the flammability risk. As a general rule, hydrocarbons are viable alternatives in small and medium-sized systems where intensive fire and explosion safety provisions can be conveniently and cost-effectively made. Hydrocarbons 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 low-temperature applications such as industrial refrigeration.

Supercritical CO_2-based systems are available for certain applications, however currently because their high costs and relatively new technology are unlikely to be applied in the short term.

Synthetic Substances: HFCs and their blends are the major synthetic substances as alternatives to HCFCs. HFCs have zero ODP, no flammability and no toxicity, but have a high GWP, requiring minimization of leakages and emissions. All pure HFCs and most HFC blends require use of synthetic lubricating oils in place of the more conventional mineral oils used for HCFCs.

Currently the leading HFC blends to replace HCFC-22 are R-407C and R-410A. However, they both have some characteristics that make the transition from HCFC-22 potentially challenging. R-407C has a significant temperature glide and R-410A operates at a considerably higher discharge pressures than HCFC-22. The availability and prices of HFCs and HFC blends to substitute HCFC-22 are not favorable presently in developing countries.

The leading alternative technologies for HCFC-22 are tabulated below:

Table-8: Leading substitutes for HCFC-22

Application	Leading replacements
Window air conditioners	R-407C, R-410A
Unitary single package and split 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, HCs
Industrial Refrigeration/AC	R-134a, R-404a, Ammonia
Transport refrigeration/AC	R-134a, R-410A

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 Sri Lanka to use them.

(r) 3.4 ENVIRONMENTAL IMPACT

Table-9 shows the impact of HCFC consumption in Sri Lanka between 2006 and 2015, in terms of ODP and GWP. It can be seen that unconstrained demand would increase ozone depletion by 17.19 ODP tonnes and increase global warming by 540,810 tonnes/tonne CO2 by 2015.

Table-9: Environmental Impact of HCFC Consumption

HCFC	ODP	GWP	Impact 2006			Impact 2015		
			Demand	ODP	GWP (MT/MT CO2)	Demand	ODP	GWP (MT/MT CO2)
HCFC-141b	0.11	630	1	0.11	630	2.36	0.26	1,487
HCFC-22	0.056	1,780	224	12.54	398,720	528.18	29.58	940,160
Total			**225**	**12.65**	**399,350**	**530.54**	**29.84**	**941,647**

The above figures do not account for the GWP of substitutes to HCFCs.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

The major challenges, which would prove as constraints 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 technical and financial capacity to manage the transition
- Lack of awareness on the HCFC controls and available alternatives, as well as their impact on processes, practices and the environment.

The opportunities 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
- Technical and financial assistance for managing the transition from HCFCs to substitutes

(s) 3.6 POTENTIAL COMPLIANCE MEASURES

The potential actions for compliance would comprise of the following:

Preparing a strategy and action plan: It would be necessary 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 access and disseminate 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: It would 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 a burden on the consumers and industry.

(t) 3.7 Summary and Conclusions

In Sri Lanka, HCFC-22 is the predominant HCFCs used in the Refrigeration & Air Conditioning sector. HCFC-141b is used as a blowing agent for rigid polyurethane foams and HCFC-22 is used as a refrigerant for refrigeration and air conditioning systems.

Sri Lanka's consumption of HCFCs increased from 112 metric tonnes in 1999 to 225 metric tonnes in 2006. Unconstrained HCFC consumption in Sri Lanka is expected to reach 530 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 favorably 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.

Sri Lanka expects the incremental costs of compliance to be met under the mechanisms of the Montreal Protocol.

ANNEX

INFORMATION ON HCFC CONSUMING ENTERPRISES

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Refrigeration and Air Conditioning	Window/Split Air Conditioners	10
	Air Conditioning Chillers	25
	Domestic Refrigeration	3
	Commercial Refrigeration	75
	Industrial Refrigeration	30
SERVICING		
Refrigeration and Air Conditioning	All	Over 1,000

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 SYRIA

FINAL REPORT

National Ozone Unit, General Commission for Environmental Affairs
Ministry of Local Administration and Environment
&
United Nations Development Programme (UNDP)

April/May 2007

EXECUTIVE SUMMARY

Syria acceded to the Vienna Convention and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in December 1989. Syria ratified the London, Copenhagen and Montreal Amendments in November 1999. Since the annual calculated consumption in Syria of controlled substances listed in Annex-A of the Montreal Protocol was less than 0.3 Kg per capita, Syria 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 for ODS phase-out, through the financial mechanism of the Montreal Protocol.

Syria's Country Programme incorporating the National Strategy and Action Plan for controlling the use of Ozone Depleting substances was approved in 1993. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. The Country Programme Update initiated in 1995, renewed and reinforced Syria's commitment, strategy and action plan to eliminate ODS. The needs of CFC consuming industry sectors for compliance and conversion were reassessed through surveys. Complete phase-out of CFCs was targeted for 2007. Until date, Syria 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 also due to proactive regulations. Syria has established a licensing system for ODS since 1999. Imports of goods containing specified ODS are prohibited since 1996.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore 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.

In Syria, HCFCs are used in the Refrigeration & Air Conditioning sector. The predominant HCFC used is HCFC-22. The consumption of HCFCs in Syria increased from about 470 metric tonnes in 1999 to 833 metric tonnes in 2006 signifying an average annual growth rate of about 8.4%. At a conservative annual growth rate in demand forecasted for HCFCs of 10% from 2007 until 2015, it is estimated that the consumption of HCFCs in Syria is likely to reach about 1,965 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 timely preparations and interventions. These could include reducing dependence on HCFCs and 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 reliable and economical availability of substitutes as well as technical and financial capacity for effecting the transition. 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. Syria expects that the international community will recognize these challenges in order to ensure sustainability and credibility of ODS phase-out complying with the global efforts towards the protection of the ozone layer.

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LIST OF ABBREVIATIONS

CFC	Chlorofluorocarbons
CP	Country Programme
CTC	Carbon Tetra Chloride
ExCom	Executive Committee of the Multilateral Fund
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
GWP	Global Warming Potential
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	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

(u) 1.1 Background

Syria is borders the Mediterranean Sea, with a land area of 185,000 sq. km and a population of about 19 million with an estimated GDP per capita (PPP) of about USD 4,000 (2006). The agricultural sector accounts for about 24% of GDP, the industry for about 18 % and the services sector for about 58%. Population density is approx. 108 persons per sq km where urban population represents around 50 % of the total population.

Table-1 below shows the dates of ratification by Syria of the Vienna Convention, Montreal Protocol and its amendments. The ratification of the Beijing amendment is still in process.

Table-1: Syria - Ratification of Montreal Protocol and its Amendments

Agreement/Amendment	Ratification
Vienna Convention	December 1989
Montreal Protocol	December 1989
London Amendment	November 1999
Copenhagen Amendment	November 1999
Montreal Amendment	November 1999

The Country Programme (CP) incorporating the national strategy and action plan for phasing out ODS in Syria in accordance with the control schedule of the Montreal Protocol and its amendments, was approved in 1993. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. The Foams and Refrigeration & Air Conditioning Sectors were the main ODS consuming sectors in Syria, therefore the national strategy prioritized the management of ODS consumption and eventual phase-out in these sectors.

The Country Programme Update initiated in 1995, renewed and reinforced Syria's commitment, strategy and action plan to eliminate ODS. The needs of CFC consuming industry sectors for compliance and conversion were reassessed through surveys.

Syria has made significant progress in ODS phase-out over the past few years and both interim milestones (namely, the 1999 freeze and the 50% reduction from the baseline by 2005) for Annex-A Group-I substances (CFCs) were met. This has been made possible through project activities including technology transfer investments, technical assistance, training and capacity building, information dissemination and awareness-raising and also due to pro-active regulations. Syria has established a licensing system for ODS since 1999. Imports of goods containing specified ODS are prohibited since 1996.

HCFCs, which have Ozone Depleting Potential (ODP) up to 15% of that of CFCs, are classified as controlled substances under Annex-C, Group-I of the Montreal Protocol. HCFCs therefore, have use restrictions and 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 were approved as substitutes for CFCs in many of the projects and activities supported by the Multilateral Fund.

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. Syria 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:

Latín 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, ensuring the required country-level consultations within the respective industry and expert institutions. Consequently UNDP, in consultation with the Syria National Ozone Unit, selected a local firm, Al-Hafez Group, as the national expert entity to undertake the national level tasks for the survey.

1.3 Survey Methodology

Data collection

A questionnaire in the prescribed format, for collecting field data was used. The following data were collected:

7. HCFC import data
8. HCFC-based equipment population data
9. HCFC consumption data by sectors.

Meetings were held with representatives from related government institutions, importers, distributors, and users as well as expert and senior technicians to supplement the data collection.

Data processing

Since Syria does not produce or export any CFCs and HCFCs, the HCFC consumption is equal to the amount of HCFC imported to Syria.

The data on imports and consumption obtained from various information sources was analyzed using best estimates.

Finally, in order to validate the result of estimations, meetings and discussions with relevant stakeholders were held.

2. OBSERVATIONS

(v) 2.1 Institutional Framework

2.1.1 Institutional Arrangements

The activities related to ozone layer protection and implementation of the Montreal Protocol, are managed and coordinated through the National Ozone Unit, within the General Commission for Environmental Affairs, Ministry of Local Administration and Environment.

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

o) Monitoring the use and import of ODS to control and prevent illegal trade and capacity building of customs officials through the ongoing Refrigerant Management Plan.

p) Active participation in the preparation, implementation and monitoring for projects funded by MLF

q) Formulating guidelines and regulations as necessary for policy implementation

r) Supporting public awareness initiatives and campaigns for promoting ozone layer protection at the consumer level for encouraging public involvement.

s) Regular interaction with other ministries and departments, industry representatives and implementing agencies for information dissemination related to impact of policy measures

t) Promoting research and use of ozone-friendly technologies.

2.1.2 Policies and Regulations

Government of Syria has adopted policies that would support the ODS phase-out activities in the country in accordance with the Montreal Protocol control targets. Specifically, the policies focus on expediting the implementation of ODS phase-out projects and adoption of non-ODS substitute technologies.

In order to control the trade and use of ODS the Government of Syria has established the following regulations:

g) Prohibition of import of ODS-based products/equipment since 1996
h) Imports of Halons have been prohibited since 1998

i) Licensing system for import of ODS since 1999
j) Prohibition on establishing production capacity for ODS-based products since 2000

(w) 2.2 HCFC Supply Scenario

(i) 2.2.1 Production

There is no production of HCFCs in Syria. The entire domestic demand is met through imports. Imports generally originate from China, EU, India and Middle East.

(ii) 2.2.2 Exports

There are no recorded exports of HCFCs from Syria.

(iii) 2.2.3 Imports

In Syria, there are fourteen authorized importers of HCFCs. Import of HCFCs into Syria since 1999 are tabulated below:

Table-2: Syria – HCFC Imports (1999 – 2006)

Substance/ Year	Imports (metric tonnes)							
	1999	2000	2001	2002	2003	2004	2005	2006
HCFC-22	470	364	561	197	630	653	619	774
HCFC-141b	0	0	0	0	0	80	237	56
Other	0	0	0	0	0	0	1	3
Total	**470**	**364**	**561**	**197**	**630**	**733**	**757**	**833**

Note: Rounded off to the nearest 1 tonne

The originating countries for these imports were mainly EU, USA, China and India.

(iv) 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.

(x) 2.3 HCFC Consumption

(i) 2.3.1 Aerosols Sector

There is no identified consumption of HCFCs in this sector in Syria.

(ii) 2.3.2 Firefighting Sector

There is no identified use of HCFCs in the Firefighting sector in Syria.

(iii) 2.3.3 Foams Sector

The consumption of HCFCs in the Foams Sector in Syria is due to conversion from earlier CFC-based technology, or establishment of HCFC-based production capacity directly. The predominant HCFC is HCFC-141b, which is used as a blowing agent in rigid polyurethane foam production. HCFCs were introduced in the late 1990s, but initially brought into the country as a component through pre-blended polyols. Standalone imports of HCFC-141b commenced from 2004. The historical HCFC consumption in the Foams Sector is shown below:

Table-3: HCFC Consumption in the Foam Sector (1999-2006)

Parameter	1999	2000	2001	2002	2003	2004	2005	2006
HCFC-141b (metric tonnes)	0	0	0	0	0	0	0	27

In the Foams Sector, the consumption of HCFCs (HCFC-141b) is concentrated in the production of rigid polyurethane foam. In the production of other foams such as flexible foam, HCFCs are not used.

(iv) 2.3.4 Refrigeration & Air Conditioning Sector

The Refrigeration and Air Conditioning Sector as the largest ODS consuming sector in Syria. The Refrigeration and Air Conditioning Sector has experienced significant growth in the past decade due to the consistent growth in the per capita incomes, the predominance of the service industry and the relatively low market penetration of refrigeration and air conditioning appliances and equipment in the past.

HCFCs (HCFC-22) are used as refrigerants and blowing agents (HCFC-141b) in the manufacture of refrigeration and air conditioning equipment. In servicing, HCFC-22 is the predominant HCFC used. For appliances such as comfort air conditioning equipment, HCFC-22 has been the traditional refrigerant. For refrigeration appliances such as household refrigerators and freezers, commercial refrigeration and industrial refrigeration equipment, HCFC-22 has been used both as a traditional refrigerant as well as a replacement refrigerant for CFC-12.

The historical consumption of HCFCs in the Refrigeration and Air Conditioning Sector from 1999 - 2006 is shown in Table-4 below.

Table-4: HCFC Consumption in Refrigeration & Air Conditioning Sector in Syria (1999-2006)

Year/Parameter	Consumption (metric tonnes)							
	1999	2000	2001	2002	2003	2004	2005	2006
Manufacturing	70	75	180	96	209	308	463	396
Servicing	400	289	381	101	421	426	395	410
Total	470	364	561	197	630	734	858	806

Manufacturing

The manufacturing activities in the Refrigeration and Air Conditioning Sector comprise of comfort air conditioning equipment (such as window and split air conditioners and central air conditioning chillers) and commercial/industrial refrigeration equipment (such as household refrigerators, display cabinets, chest freezers, beverage chillers, walk-in coolers and cold rooms).

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, 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 table below shows the breakdown of HCFC consumption in the Refrigeration and Air Conditioning Sector in Syria for 2006:

Table-5: Breakdown of Estimated HCFC Consumption in the Refrigeration and Air Conditioning Sector (2006)

Application	**HCFC Consumption (metric tonnes)**
Manufacturing	
Window/Split Air Conditioners	45
Central Air Conditioning Chillers	62
Domestic Refrigeration	90
Commercial Refrigeration	139
Industrial Refrigeration	60
Servicing	
Servicing (all applications)	410
Total	**806**

(v)

(vi) 2.3.5 Solvents Sector

There is no identified usage of HCFCs as solvents.

(vii) 2.3.6 Summary and Conclusions

The HCFC consumption in Syria 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 shows the HCFCs consumption in Syria during 2006, by sector/substance:

Table-6: Summary of HCFC Consumption in Syria (2006)

Sector	Consumption (metric tonnes)			
	HCFC-22	HCFC-141b	Other	Total
Foams	0	27	0	27
Refrigeration & Air Conditioning				
Window/Split Air Conditioners	43	2	0	45
Central Air Conditioning Chillers	57	3	2	62
Domestic Refrigeration	82	8	0	90
Commercial Refrigeration	127	11	1	139
Industrial Refrigeration	55	5	0	60
Servicing	410	0	0	410
Total	**774**	**56**	**3**	**833**

3. ANALYSIS

(y) 3.1 Demand Forecasts

(i)

The demand for HCFCs in Syria is expected to grow due to the expected economic growth and consequent rise in demand for consumer and industrial goods. HCFC-22 and HCFC-141b are, and will remain the most significant HCFCs in use in Syria. Future HCFC-22 and HCFC-141b consumption in Syria is linked to the growth of the Foams and Refrigeration and Air Conditioning sectors. 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. Based on this, it is possible to make projections of unconstrained future demand for HCFCs until 2015.

The HCFC demand in Syria increased from about 470 metric tonnes in 1999 to 833 metric tonnes in 2006, signifying an average annual growth rate of about 8.4% over the past 7 years.

Applying an average annual growth rate in demand of 10% from 2006 to 2015, which is the expected average growth rate in demand in the both the Foams and Refrigeration & Air Conditioning Sectors, the unconstrained HCFC consumption in Syria is expected to reach 1,965 metric tonnes by 2015. The following table shows the unconstrained demand for HCFCs by substance:

Table-7: Projected unconstrained demand for HCFCs in Syria by 2015

Substance	**Demand in 2005** (metric tonnes)	**Unconstrained demand in 2015** (metric tonnes)
HCFCs	833	1,965

(z) 3.2 Availability and Prices

(i) 3.2.1 Availability Scenario

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 Syria by 2015.

(ii) 3.2.2 Price Trends

The prevailing and projected prices of HCFCs in Syria (2006 and 2015) are shown in the table below.

Table-8: HCFC prices in Syria (2006 and 2015)

Year	Market Price (US$/kg)	
	HCFC-22	HCFC-141b
2006	2.00 – 2.50	3.50 – 4.00
2015	3.50 – 4.00	5.00 – 6.00

The projections are based on the assumption that the production and supply situation for HCFCs will not dramatically change for the foreseeable future. This is indeed likely to be the case as there is adequate manufacturing capacity for HCFCs in developing countries such as China and India and if production in developed countries is reduced, it is unlikely to affect the supply situation, as corresponding consumption controls are also in place in developed countries. Currently there are no consumption controls on HCFCs in developing countries (until the first control in 2016).

Thus it is seen that the prices of HCFCs in Syria in 2015 would not be dramatically higher, reflecting the relatively comfortable supply situation.

Substitutes for HCFCs are available, though not commonly used. The prices of substitutes vary between US$ 8.00 to US$ 15.00 per kg.

(aa) 3.3 Technology

The selection of the substitute or alternative technology is based on a combination of factors such as maturity, availability, cost-effectiveness, energy-efficiency and environmental and occupational safety. The selection is also influenced by local circumstances, preferences of enterprises, accessibility to training, processibility and regulatory environment. Certain non-ODP substitutes and alternative technologies to HCFCs are available in recent years for many applications.

(i) 3.3.1 Replacements for HCFC-22

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).

HFCs and HFC Blends: HFCs have zero ODP, no flammability and no toxicity, but have a high GWP, requiring minimization of leakages and emissions. All pure HFCs and most HFC blends require use of synthetic lubricating oils in place of the more conventional mineral oils used for HCFCs. Currently the leading HFC blends to replace HCFC-22 are R-407C and R-410A. However, they both have some characteristics that make the transition from HCFC-22 potentially challenging. R-407C has a significant temperature glide and R-410A operates at a considerably higher discharge pressures than HCFC-22. The availability and prices of HFCs and HFC blends to substitute HCFC-22 are not favorable presently.

Ammonia, Hydrocarbons (HCs) and CO_2: These are natural refrigerants and have excellent thermodynamic properties.

Ammonia is highly toxic and slightly flammable and can only be used in new equipment specifically designed and where exposure is minimal. Ammonia is a very popular refrigerant in the industrial refrigeration sector. Materials incompatibility makes ammonia generally unsuitable for small vapor compression systems.

Hydrocarbons are highly flammable and can be used in systems designed to address 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.

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 Syria to use them.

(bb) 3.4 Environmental Impact

Table-9 shows the impact of HCFC consumption in Syria between 2006 and 2015, in terms of ODP and GWP. It can be seen that unconstrained demand would increase ozone depletion by 65.39 ODP tonnes and increase global warming by 1,972,410 tonnes/tonne CO_2 by 2015.

Table-9: Environmental Impact of HCFC Consumption

HCFC	ODP	GWP	Impact 2005			Impact 2015		
			Demand	ODP	GWP (MT/MT CO_2)	Demand	ODP	GWP (MT/MT CO_2)
HCFC-141b	0.11	630	27	2.97	17,010	64	7.04	40,320
HCFC-22/oth	0.056	1,780	806	45.14	1,434,680	1,901	106.46	3,383,780
Total			**833**	**48,11**	**1,451,690**	**1,965**	**113.50**	**3,424,100**

The above figures do not account for the GWP of substitutes to HCFCs.

3.5 Compliance Challenges and Opportunities

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 technical and financial capacity to manage the transition
- Lack of awareness on the HCFC controls and available alternatives, as well as their impact on processes, practices and the environment.

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
- Technical and financial assistance for managing the transition from HCFCs to substitutes

(cc) 3.6 Potential Compliance Measures

The potential actions for compliance would comprise of the following:

Preparing a strategy and action plan: 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 access and disseminate 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: It would 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.

(dd) 3.7 Summary and Conclusions

In Syria, 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 for refrigeration and air conditioning systems.

Syria's consumption of HCFCs increased from 470 metric tonnes in 1999 to 833 metric tonnes in 2005. Unconstrained HCFC consumption in Syria is expected to reach 1,965 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 favorably 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.

Syria expects the incremental costs of compliance to be met under the mechanisms of the Montreal Protocol.

ANNEX

Information on HCFC consuming enterprises

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Foams	Rigid Polyurethane Foam	50
Refrigeration and Air Conditioning	Window/Split Air Conditioners	20
	Central Air Conditioning Chillers	25
	Domestic Refrigeration	15
	Commercial Refrigeration	100
	Industrial Refrigeration	30
SERVICING		
Refrigeration and Air Conditioning	All	Over 1,000

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 SRI LANKA

FINAL REPORT

National Ozone Unit
Ministry of Environment and Natural Resources, Sri Lanka
&
United Nations Development Programme (UNDP)

April/May 2007

EXECUTIVE SUMMARY

Sri Lanka acceded to the Vienna Convention and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in December 1989. Since the annual calculated consumption in Sri Lanka of controlled substances listed in Annex-A of the Montreal Protocol was less than 0.3 Kg per capita, Sri Lanka 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 for ODS phase-out, through the financial mechanism of the Montreal Protocol.

Sri Lanka's Country Programme incorporating the National Strategy and Action Plan for controlling the use of Ozone Depleting substances was approved in March 1994. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. Until date, Sri Lanka 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 also due to proactive regulations.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore 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.

In Sri Lanka, HCFCs are used in the Refrigeration & Air Conditioning sector. The predominant HCFC used is HCFC-22. The consumption of HCFCs in Sri Lanka increased from about 112 metric tonnes in 1999 to 225 metric tonnes in 2006 signifying an average annual growth rate of about 9.11%. At a conservative annual growth rate in demand forecasted for HCFCs of 10% from 2007 until 2015, it is estimated that the consumption of HCFCs in Sri Lanka is likely to reach about 530 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 timely preparations and interventions. These could include reducing dependence on HCFCs and controlling and reducing HCFC use at an early date. The main constraint for converting from HCFCs to non-ODS alternatives is the reliable and economical availability of substitutes as well as technical and financial capacity for effecting the transition. 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. Sri Lanka expects the international community to recognize these challenges in order to ensure sustainability and credibility of ODS phase-out complying with the global efforts towards the protection of the ozone layer.

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TR	Tons of Refrigeration
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UNOPS	United Nations Office for Project Services
WB	World Bank

1. INTRODUCTION

1.1 BACKGROUND

Sri Lanka is an island country in the Indian Ocean to the south of India, with a land area of about 65,000 sq. km. It has a population of about 21 million with an estimated GDP per capita (PPP) of about USD 4,600 (2006). The agricultural sector accounts for about 17% of GDP, the industry for about 27 % and the services sector for about 56%. The population density is about 300 persons per sq km and the urban population represents around 22 % of the total population.

Table-1 below shows the dates of ratification by Sri Lanka of the Vienna Convention, Montreal Protocol and its amendments. The ratification of the Beijing amendment is still in process.

Table-1: Sri Lanka - Ratification of Montreal Protocol and its Amendments

Agreement/Amendment	Ratification
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Montreal Protocol	December 1989
London Amendment	June 1993
Copenhagen Amendment	July 1997
Montreal Amendment	August 1999
Beijing Amendment	November 2002

The Country Programme (CP) incorporating the national strategy and action plan for phasing out ODS in Sri Lanka in accordance with the control schedule of the Montreal Protocol and its amendments, was approved in March 1994. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. The Foams and Refrigeration & Air Conditioning Sectors were the main ODS consuming sectors in Sri Lanka, therefore the national strategy prioritized the management of ODS consumption and eventual phase-out in these sectors.

The National Programme for Recovery and Recycling of refrigerants was approved in October 1996. The Refrigerant Management Plan was approved in December 2000. The National Compliance Action Plan for phase-out of CFCs was approved in July 2004.

Sri Lanka has made significant progress in ODS phase-out over the past few years and has complied with both interim control milestones (namely, the 1999 freeze and the 85% reduction by 2005) for Annex-A Group-I substances (CFCs). This has been made possible with the assistance of the Multilateral Fund and through project activities including technology transfer investments, technical assistance, training and capacity building, information dissemination and awareness-raising and also due to pro-active regulations.

HCFCs, which have Ozone Depleting Potential (ODP) up to 15% of that of CFCs, are classified as controlled substances under Annex-C, Group-I of the Montreal Protocol. HCFCs therefore, have use restrictions and 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 were approved as substitutes for CFCs in many of the projects and activities supported by the Multilateral Fund.

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 its 45th Meeting, funding for UNDP to carry out HCFC surveys in 12 countries. Sri Lanka 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:

Latín 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 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, ensuring the required country-level consultations within the respective industry and expert institutions. Consequently UNDP, in consultation with the Sri Lanka National Ozone Unit, selected a local firm, Inaire P. Ltd, as the national expert entity to undertake the national level tasks for the survey.

1.3 SURVEY METHODOLOGY

Data collection

A questionnaire in the prescribed format, for collecting field data was used. The following data were collected:

1. HCFC import data
2. HCFC-based equipment population data
3. HCFC consumption data by sectors.

Meetings were held with representatives from related government institutions, importers, distributors, industry associations, end-uses, as well as expert and senior technicians to supplement the data collection.

Data processing

Since Sri Lanka does not produce or export any CFCs and HCFCs, the HCFC consumption is equal to the amount of HCFC imported to Sri Lanka.

The data on imports and consumption obtained from various information sources was analyzed using best estimates.

2. OBSERVATIONS

2.1 INSTITUTIONAL FRAMEWORK

2.1.1 Institutional Arrangements

The activities related to ozone layer protection and implementation of the Montreal Protocol, are managed and coordinated through the National Ozone Unit, within the Ministry of Environment and Natural Resources. The national policies and priorities related to the implementation of the Montreal Protocol are formulated by the National Coordination Committee comprising of representation from various related ministries, agencies, technical institutions, industry associations and NGOs.

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

a) Monitoring the use and import of ODS to control
b) Prevention of illegal trade and capacity building of customs officials
c) Active participation in the preparation, implementation and monitoring for projects funded by MLF
d) Formulating guidelines and regulations as necessary for policy implementation
e) Supporting public awareness initiatives and campaigns for promoting ozone layer protection at the consumer level for encouraging public involvement.
f) Regular interaction with other ministries and departments, industry representatives and implementing agencies for information dissemination related to impact of policy measures
g) Promoting research on ozone-friendly technologies.

2.1.2 Policies and Regulations

Government of Sri Lanka has adopted policies that would support the ODS phase-out activities in the country in accordance with the Montreal Protocol control targets. Specifically, the policies focus on expediting the implementation of ODS phase-out projects and adoption of non-ODS substitute technologies.

In order to control the trade and use of ODS the Government of Sri Lanka has established the following regulations:

a) Prohibition of import of ODS-based products/equipment
b) Licensing system for import of ODS
c) Prohibition on establishing production capacity for ODS-based products.

Specific regulatory actions targeting HCFCs are:

a) HCFCs are designated as controlled substances
b) Import licensing system for HCFCs is in place since 2005

2.2 HCFC SUPPLY SCENARIO

2.2.1 Production

There is no production of HCFCs in Sri Lanka. The entire domestic demand is met through imports. Imports mainly originate from China, Europe, India and Singapore.

2.2.2 Exports

There are no recorded exports of HCFCs from Sri Lanka.

2.2.3 Imports

In Sri Lanka, there are thirteen authorized importers of HCFCs. Import of HCFCs into Sri Lanka since 1999 are tabulated below:

Table-2: Sri Lanka – HCFC Imports (1999 – 2006)

Substance/ Year	Imports (metric tonnes)							
	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
HCFC-22	112	112	105	154	128	203	177	224
HCFC-141b and other	0	3	1	3	0	28	1	1
Total	**112**	**115**	**106**	**157**	**128**	**231**	**178**	**225**

Note: Rounded off to the nearest 1 tonne

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.

2.3 HCFC CONSUMPTION

2.3.1 Aerosols Sector

There is no reported consumption of HCFCs in this sector as of 2006.

2.3.2 Firefighting Sector

There is no identified use of HCFCs in the Firefighting sector in Sri Lanka.

2.3.3 Foams Sector

The consumption of HCFCs in the Foams Sector was historically negligible and zero in 2006.

2.3.4 Refrigeration & Air Conditioning Sector

The Refrigeration and Air Conditioning Sector is the main HCFC consuming sector in Sri Lanka. The Refrigeration and Air Conditioning Sector has experienced significant growth in the past decade due to the growth in the per capita incomes, the predominance of the service industry and the relatively low market penetration of refrigeration and air conditioning appliances and equipment in the past.

HCFCs are used as refrigerants (HCFC-22) and blowing agents (HCFC-141b) in the manufacture of refrigeration and air conditioning equipment. In servicing, HCFC-22 is the predominant HCFC used. For appliances such as comfort air conditioning equipment, HCFC-22 has been the traditional refrigerant. For domestic refrigeration appliances such as household refrigerators and freezers, HCFC-141b is used as a blowing agent for the foam insulation. In commercial refrigeration and industrial refrigeration equipment, HCFC-22 has been used both as a traditional refrigerant as well as a replacement refrigerant for CFC-12 and in addition HCFC-141b is used as a blowing agent for the foam insulation.

The historical consumption of HCFCs in the Refrigeration and Air Conditioning Sector from 1999 - 2006 is shown in Table-3 below.

Table-3: HCFC Consumption in Refrigeration & Air Conditioning Sector in Sri Lanka (1999-2006)

Year/Parameter	Consumption (metric tonnes)							
	1999*	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Manufacturing	110	19	18	24	19	51	30	31
Servicing		94	88	130	99	160	162	194
Total	**110**	**113**	**106**	**154**	**118**	**211**	**192**	**225**

* Breakdown not available

Note: All figures rounded off to the nearest 1 metric tonne

Manufacturing

The manufacturing activities in the Refrigeration and Air Conditioning Sector comprise of comfort air conditioning equipment (such as window and split air conditioners and air conditioning chillers), domestic refrigeration equipment (household refrigerators and freezers) and commercial/industrial refrigeration equipment (such display cabinets, chest freezers, beverage chillers, walk-in coolers and cold rooms). The manufacturing activities for refrigeration and air conditioning equipment in Sri Lanka are limited; only about 15% of the domestic demand is met through local manufacturing and the remaining through imports.

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, supermarkets, hotels and hospitals served by HCFC-based equipment for air conditioning, which require servicing. There are a number of cold room installations serving hotels, hospitals, supermarkets, restaurants and food industry for preserving, fruits and vegetables 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 and end-users.

The table below shows the breakdown of HCFC consumption in the Refrigeration and Air Conditioning Sector in Sri Lanka for 2006:

Table-4: Estimated Breakdown of HCFC Consumption in the Refrigeration and Air Conditioning Sector (2006)

Application	HCFC Consumption (metric tonnes)
Manufacturing	
Window/Split Air Conditioners	5
Air Conditioning chillers	10
Domestic Refrigeration	1
Commercial Refrigeration	5
Industrial Refrigeration	10
Servicing	
Servicing (all applications)	194
Total	**225**

2.3.5 Solvents Sector

There is no identified usage of HCFCs as solvents as of 2006.

2.3.6 Summary and Conclusions

The HCFC consumption in Sri Lanka is mainly concentrated in the Refrigeration and Air Conditioning sector. The predominant HCFC used is HCFC-22 as a refrigerant.

The table shown below shows the HCFC consumption in Sri Lanka during 2006, by sector/substance:

Table-5: Summary of HCFC Consumption in Sri Lanka (2006)

Sector	Consumption (metric tonnes)		
	HCFC-22	HCFC-141b	Total
Foams	0	0	0
Refrigeration & Air Conditioning			
Window/Split Air Conditioners	5	0	5
Air Conditioning Chillers	10	0	10
Domestic Refrigeration	0	1	1
Commercial Refrigeration	5	0	5
Industrial Refrigeration	10	0	10
Servicing	194	0	194
Total	**224**	**1**	**225**

3. ANALYSIS

3.1 DEMAND FORECASTS

The demand for HCFCs in Sri Lanka is forecasted to grow due to the expected economic growth and consequent rise in demand for consumer and industrial goods. HCFC-22 is and will remain the most significant HCFC in use in Sri Lanka. Future HCFC consumption in Sri Lanka is linked to the growth of the Refrigeration and Air Conditioning sector. In addition, conversion of some of the residual CFC consumption to HCFCs, as well as increasing use of HCFC-based equipment will contribute to growth. The increasing population of HCFC-based products will additionally increase servicing demand. Based on this, it is possible to make projections of unconstrained future demand for HCFCs until 2015.

The HCFC demand in Sri Lanka increased from about 112 metric tonnes in 1999 to 225 metric tonnes in 2006, signifying an average annual growth rate of about 9.11% over the past 7 years.

Applying an average annual growth rate in demand of 10% from 2006 to 2015, which is the expected average growth rate in demand in the Refrigeration and Air Conditioning Sector, the unconstrained HCFC consumption in Sri Lanka is expected to reach 530 metric tonnes by 2015. The following table shows the unconstrained demand for HCFCs:

Table-6: Projected unconstrained demand for HCFCs in Sri Lanka by 2015

Substance	**Demand in 2006** (metric tonnes)	**Unconstrained demand in 2015** (metric tonnes)
HCFCs	225	530

3.2 AVAILABILITY AND PRICES

3.2.1 Availability Scenario

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 Sri Lanka by 2015.

3.2.2 Price Trends

The prevailing and projected prices of HCFCs in Sri Lanka (2006 and 2015) are shown in the table below.

Table-7: HCFC prices in Sri Lanka (2006 and 2015)

Year	Market Price (US$/kg)	
	HCFC-22	HCFC-141b
2006	3.50 – 4.00	3.50 – 4.00
2015	4.50 – 6.00	5.00 – 6.00

The projections are based on the assumption that the supply situation for HCFCs will not dramatically change for the foreseeable future. This is indeed likely to be the case as there is adequate manufacturing capacity for HCFCs in developing countries such as China and India and if production in developed countries is reduced, it is unlikely to affect the supply situation, as corresponding consumption controls are also in place in developed countries. Currently there are no consumption controls on HCFCs in developing countries (until the first control in 2016).

Thus it is seen that the prices of HCFCs in Sri Lanka in 2015 would not be dramatically higher, reflecting the relatively comfortable supply situation.

Substitutes for HCFCs are available, though not commonly used. The prices of substitutes vary between US$ 8.00 to US$ 15.00 per kg.

3.3 TECHNOLOGY

The selection of alternative technologies for HCFCs would be based on the following considerations:

- Maturity
- Availability
- Cost-effectiveness
- Energy-efficiency
- Environmental and occupational safety.

The selection of alternative technologies is also influenced by local circumstances, preferences of enterprises, accessibility to training, processibility and regulatory environment.

Certain non-ODP substitutes and alternative technologies to HCFCs, meeting many of these requirements have emerged in recent years for many applications.

3.3.1 Replacements for HCFC-22

HCFC-22 alternatives are relatively new to the market, especially in developing countries. The two main directions for the alternatives are natural substances (such as Ammonia, Hydrocarbons, Carbon Dioxide, etc) and synthetic substances (HFCs and their blends).

Natural Substances: These have excellent thermodynamic properties and have zero ODP and GWP.

Ammonia is toxic and slightly flammable and can only be used in new equipment specifically designed and where exposure is minimal. Ammonia is a very popular refrigerant in the industrial refrigeration sector. Materials incompatibility makes ammonia generally unsuitable for small systems.

Hydrocarbons are highly flammable and can be used in systems designed to address the flammability risk. As a general rule, hydrocarbons are viable alternatives in small and medium-sized systems where intensive fire and explosion safety provisions can be conveniently and cost-effectively made. Hydrocarbons 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 low-temperature applications such as industrial refrigeration.

Supercritical CO_2-based systems are available for certain applications, however currently because their high costs and relatively new technology are unlikely to be applied in the short term.

Synthetic Substances: HFCs and their blends are the major synthetic substances as alternatives to HCFCs. HFCs have zero ODP, no flammability and no toxicity, but have a high GWP, requiring minimization of leakages and emissions. All pure HFCs and most HFC blends require use of synthetic lubricating oils in place of the more conventional mineral oils used for HCFCs.

Currently the leading HFC blends to replace HCFC-22 are R-407C and R-410A. However, they both have some characteristics that make the transition from HCFC-22 potentially challenging. R-407C has a significant temperature glide and R-410A operates at a considerably higher discharge pressures than HCFC-22. The availability and prices of HFCs and HFC blends to substitute HCFC-22 are not favorable presently in developing countries.

The leading alternative technologies for HCFC-22 are tabulated below:

Table-8: Leading substitutes for HCFC-22

Application	Leading replacements
Window air conditioners	R-407C, R-410A
Unitary single package and split 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, HCs
Industrial Refrigeration/AC	R-134a, R-404a, Ammonia
Transport refrigeration/AC	R-134a, R-410A

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 Sri Lanka to use them.

3.4 ENVIRONMENTAL IMPACT

Table-9 shows the impact of HCFC consumption in Sri Lanka between 2006 and 2015, in terms of ODP and GWP. It can be seen that unconstrained demand would increase ozone depletion by 17.19 ODP tonnes and increase global warming by 540,810 tonnes/tonne CO2 by 2015.

Table-9: Environmental Impact of HCFC Consumption

HCFC	ODP	GWP	Impact 2006			Impact 2015		
			Demand	ODP	GWP (MT/MT CO2)	Demand	ODP	GWP (MT/MT CO2)
HCFC-141b	0.11	630	1	0.11	630	2.36	0.26	1,487
HCFC-22	0.056	1,780	224	12.54	398,720	528.18	29.58	940,160
Total			**225**	**12.65**	**399,350**	**530.54**	**29.84**	**941,647**

The above figures do not account for the GWP of substitutes to HCFCs.

3.5 COMPLIANCE CHALLENGES AND OPPORTUNITIES

The major challenges, which would prove as constraints 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 technical and financial capacity to manage the transition
- Lack of awareness on the HCFC controls and available alternatives, as well as their impact on processes, practices and the environment.

The opportunities 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
- Technical and financial assistance for managing the transition from HCFCs to substitutes

3.6 POTENTIAL COMPLIANCE MEASURES

The potential actions for compliance would comprise of the following:

Preparing a strategy and action plan: It would be necessary 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 access and disseminate 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: It would 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 a burden on the consumers and industry.

3.7 SUMMARY AND CONCLUSIONS

In Sri Lanka, HCFC-22 is the predominant HCFCs used in the Refrigeration & Air Conditioning sector. HCFC-141b is used as a blowing agent for rigid polyurethane foams and HCFC-22 is used as a refrigerant for refrigeration and air conditioning systems.

Sri Lanka's consumption of HCFCs increased from 112 metric tonnes in 1999 to 225 metric tonnes in 2006. Unconstrained HCFC consumption in Sri Lanka is expected to reach 530 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 favorably 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.

Sri Lanka expects the incremental costs of compliance to be met under the mechanisms of the Montreal Protocol.

ANNEX

INFORMATION ON HCFC CONSUMING ENTERPRISES

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Refrigeration and Air Conditioning	Window/Split Air Conditioners	10
	Air Conditioning Chillers	25
	Domestic Refrigeration	3
	Commercial Refrigeration	75
	Industrial Refrigeration	30
SERVICING		
Refrigeration and Air Conditioning	All	Over 1,000

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 SYRIA

FINAL REPORT

National Ozone Unit, General Commission for Environmental Affairs
Ministry of Local Administration and Environment
&
United Nations Development Programme (UNDP)

April/May 2007

EXECUTIVE SUMMARY

Syria acceded to the Vienna Convention and ratified the Montreal Protocol on Substances that deplete the Ozone Layer in December 1989. Syria ratified the London, Copenhagen and Montreal Amendments in November 1999. Since the annual calculated consumption in Syria of controlled substances listed in Annex-A of the Montreal Protocol was less than 0.3 Kg per capita, Syria 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 for ODS phase-out, through the financial mechanism of the Montreal Protocol.

Syria's Country Programme incorporating the National Strategy and Action Plan for controlling the use of Ozone Depleting substances was approved in 1993. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country's commitments and priorities. The Country Programme Update initiated in 1995, renewed and reinforced Syria's commitment, strategy and action plan to eliminate ODS. The needs of CFC consuming industry sectors for compliance and conversion were reassessed through surveys. Complete phase-out of CFCs was targeted for 2007. Until date, Syria 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 also due to proactive regulations. Syria has established a licensing system for ODS since 1999. Imports of goods containing specified ODS are prohibited since 1996.

Hydrochlorofluorocarbons (HCFCs) are classified as controlled substances under Annex-C Group-I of the Montreal Protocol and therefore 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.

In Syria, HCFCs are used in the Refrigeration & Air Conditioning sector. The predominant HCFC used is HCFC-22. The consumption of HCFCs in Syria increased from about 470 metric tonnes in 1999 to 833 metric tonnes in 2006 signifying an average annual growth rate of about 8.4%. At a conservative annual growth rate in demand forecasted for HCFCs of 10% from 2007 until 2015, it is estimated that the consumption of HCFCs in Syria is likely to reach about 1,965 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 timely preparations and interventions. These could include reducing dependence on HCFCs and 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 reliable and economical availability of substitutes as well as technical and financial capacity for effecting the transition. 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. Syria expects that the international community will recognize these challenges in order to ensure sustainability and credibility of ODS phase-out complying with the global efforts towards the protection of the ozone layer.

CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

CFC	Chlorofluorocarbons
CP	Country Programme
CTC	Carbon Tetra Chloride
ExCom	Executive Committee of the Multilateral Fund
GTZ	Gesellschaft für Technische Zusammenarbeit, Germany
GWP	Global Warming Potential
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	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

Syria is borders the Mediterranean Sea, with a land area of 185,000 sq. km and a population of about 19 million with an estimated GDP per capita (PPP) of about USD 4,000 (2006). The agricultural sector accounts for about 24% of GDP, the industry for about 18 % and the services sector for about 58%. Population density is approx. 108 persons per sq km where urban population represents around 50 % of the total population.

Table-1 below shows the dates of ratification by Syria of the Vienna Convention, Montreal Protocol and its amendments. The ratification of the Beijing amendment is still in process.

Table-1: Syria - Ratification of Montreal Protocol and its Amendments

Agreement/Amendment	Ratification
Vienna Convention	December 1989
Montreal Protocol	December 1989
London Amendment	November 1999
Copenhagen Amendment	November 1999
Montreal Amendment	November 1999

The Country Programme (CP) incorporating the national strategy and action plan for phasing out ODS in Syria in accordance with the control schedule of the Montreal Protocol and its amendments, was approved in 1993. The Country Programme proposed measures and actions by the government and industry, such as institutional and regulatory measures, awareness and information dissemination, technical assistance, training and investments for technology conversions, for facilitating the phase-out of ODS in the various ODS consuming industry sectors and to assist them for complying with the country’s commitments and priorities. The Foams and Refrigeration & Air Conditioning Sectors were the main ODS consuming sectors in Syria, therefore the national strategy prioritized the management of ODS consumption and eventual phase-out in these sectors.

The Country Programme Update initiated in 1995, renewed and reinforced Syria’s commitment, strategy and action plan to eliminate ODS. The needs of CFC consuming industry sectors for compliance and conversion were reassessed through surveys.

Syria has made significant progress in ODS phase-out over the past few years and both interim milestones (namely, the 1999 freeze and the 50% reduction from the baseline by 2005) for Annex-A Group-I substances (CFCs) were met. This has been made possible through project activities including technology transfer investments, technical assistance, training and capacity building, information dissemination and awareness-raising and also due to pro-active regulations. Syria has established a licensing system for ODS since 1999. Imports of goods containing specified ODS are prohibited since 1996.

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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. Syria 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:

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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:

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- 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, ensuring the required country-level consultations within the respective industry and expert institutions. Consequently UNDP, in consultation with the Syria National Ozone Unit, selected a local firm, Al-Hafez Group, as the national expert entity to undertake the national level tasks for the survey.

1.3 Survey Methodology

Data collection

A questionnaire in the prescribed format, for collecting field data was used. The following data were collected:

1. HCFC import data
2. HCFC-based equipment population data
3. HCFC consumption data by sectors.

Meetings were held with representatives from related government institutions, importers, distributors, and users as well as expert and senior technicians to supplement the data collection.

Data processing

Since Syria does not produce or export any CFCs and HCFCs, the HCFC consumption is equal to the amount of HCFC imported to Syria.

The data on imports and consumption obtained from various information sources was analyzed using best estimates.

Finally, in order to validate the result of estimations, meetings and discussions with relevant stakeholders were held.

2. OBSERVATIONS

2.1 Institutional Framework

2.1.1 Institutional Arrangements

The activities related to ozone layer protection and implementation of the Montreal Protocol, are managed and coordinated through the National Ozone Unit, within the General Commission for Environmental Affairs, Ministry of Local Administration and Environment.

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

a) Monitoring the use and import of ODS to control and prevent illegal trade and capacity building of customs officials through the ongoing Refrigerant Management Plan.

b) Active participation in the preparation, implementation and monitoring for projects funded by MLF

c) Formulating guidelines and regulations as necessary for policy implementation

d) Supporting public awareness initiatives and campaigns for promoting ozone layer protection at the consumer level for encouraging public involvement.

e) Regular interaction with other ministries and departments, industry representatives and implementing agencies for information dissemination related to impact of policy measures

f) Promoting research and use of ozone-friendly technologies.

2.1.2 Policies and Regulations

Government of Syria has adopted policies that would support the ODS phase-out activities in the country in accordance with the Montreal Protocol control targets. Specifically, the policies focus on expediting the implementation of ODS phase-out projects and adoption of non-ODS substitute technologies.

In order to control the trade and use of ODS the Government of Syria has established the following regulations:

a) Prohibition of import of ODS-based products/equipment since 1996
b) Imports of Halons have been prohibited since 1998
c) Licensing system for import of ODS since 1999
d) Prohibition on establishing production capacity for ODS-based products since 2000

2.2 HCFC Supply Scenario

2.2.1 Production

There is no production of HCFCs in Syria. The entire domestic demand is met through imports. Imports generally originate from China, EU, India and Middle East.

2.2.2 Exports

There are no recorded exports of HCFCs from Syria.

2.2.3 Imports

In Syria, there are fourteen authorized importers of HCFCs. Import of HCFCs into Syria since 1999 are tabulated below:

Table-2: Syria – HCFC Imports (1999 – 2006)

Substance/ Year	Imports (metric tonnes)							
	1999	2000	2001	2002	2003	2004	2005	2006
HCFC-22	470	364	561	197	630	653	619	774
HCFC-141b	0	0	0	0	0	80	237	56
Other	0	0	0	0	0	0	1	3
Total	**470**	**364**	**561**	**197**	**630**	**733**	**757**	**833**

Note: Rounded off to the nearest 1 tonne

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.

2.3 HCFC Consumption

2.3.1 Aerosols Sector

There is no identified consumption of HCFCs in this sector in Syria.

2.3.2 Firefighting Sector

There is no identified use of HCFCs in the Firefighting sector in Syria.

2.3.3 Foams Sector

The consumption of HCFCs in the Foams Sector in Syria is due to conversion from earlier CFC-based technology, or establishment of HCFC-based production capacity directly. The predominant HCFC is HCFC-141b, which is used as a blowing agent in rigid polyurethane foam production. HCFCs were introduced in the late 1990s, but initially brought into the country as a component through pre-blended polyols. Standalone imports of HCFC-141b commenced from 2004. The historical HCFC consumption in the Foams Sector is shown below:

Table-3: HCFC Consumption in the Foam Sector (1999-2006)

Parameter	1999	2000	2001	2002	2003	2004	2005	2006
HCFC-141b (metric tonnes)	0	0	0	0	0	0	0	27

In the Foams Sector, the consumption of HCFCs (HCFC-141b) is concentrated in the production of rigid polyurethane foam. In the production of other foams such as flexible foam, HCFCs are not used.

2.3.4 Refrigeration & Air Conditioning Sector

The Refrigeration and Air Conditioning Sector as the largest ODS consuming sector in Syria. The Refrigeration and Air Conditioning Sector has experienced significant growth in the past decade due to the consistent growth in the per capita incomes, the predominance of the service industry and the relatively low market penetration of refrigeration and air conditioning appliances and equipment in the past.

HCFCs (HCFC-22) are used as refrigerants and blowing agents (HCFC-141b) in the manufacture of refrigeration and air conditioning equipment. In servicing, HCFC-22 is the predominant HCFC used. For appliances such as comfort air conditioning equipment, HCFC-22 has been the traditional refrigerant. For refrigeration appliances such as household refrigerators and freezers, commercial refrigeration and industrial refrigeration equipment, HCFC-22 has been used both as a traditional refrigerant as well as a replacement refrigerant for CFC-12.

The historical consumption of HCFCs in the Refrigeration and Air Conditioning Sector from 1999 - 2006 is shown in Table-4 below.

Table-4: HCFC Consumption in Refrigeration & Air Conditioning Sector in Syria (1999-2006)

Year/Parameter	Consumption (metric tonnes)							
	1999	2000	2001	2002	2003	2004	2005	2006
Manufacturing	70	75	180	96	209	308	463	396
Servicing	400	289	381	101	421	426	395	410
Total	470	364	561	197	630	734	858	806

Manufacturing

The manufacturing activities in the Refrigeration and Air Conditioning Sector comprise of comfort air conditioning equipment (such as window and split air conditioners and central air conditioning chillers) and commercial/industrial refrigeration equipment (such as household refrigerators, display cabinets, chest freezers, beverage chillers, walk-in coolers and cold rooms).

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, 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 table below shows the breakdown of HCFC consumption in the Refrigeration and Air Conditioning Sector in Syria for 2006:

Table-5: Breakdown of Estimated HCFC Consumption in the Refrigeration and Air Conditioning Sector (2006)

Application	HCFC Consumption (metric tonnes)
Manufacturing	
Window/Split Air Conditioners	45
Central Air Conditioning Chillers	62
Domestic Refrigeration	90
Commercial Refrigeration	139
Industrial Refrigeration	60
Servicing	
Servicing (all applications)	410
Total	**806**

2.3.5 Solvents Sector

There is no identified usage of HCFCs as solvents.

2.3.6 Summary and Conclusions

The HCFC consumption in Syria 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 shows the HCFCs consumption in Syria during 2006, by sector/substance:

Table-6: Summary of HCFC Consumption in Syria (2006)

Sector	Consumption (metric tonnes)			
	HCFC-22	HCFC-141b	Other	Total
Foams	0	27	0	27
Refrigeration & Air Conditioning				
Window/Split Air Conditioners	43	2	0	45
Central Air Conditioning Chillers	57	3	2	62
Domestic Refrigeration	82	8	0	90
Commercial Refrigeration	127	11	1	139
Industrial Refrigeration	55	5	0	60
Servicing	410	0	0	410
Total	**774**	**56**	**3**	**833**

3. ANALYSIS

3.1 Demand Forecasts

The demand for HCFCs in Syria is expected to grow due to the expected economic growth and consequent rise in demand for consumer and industrial goods. HCFC-22 and HCFC-141b are, and will remain the most significant HCFCs in use in Syria. Future HCFC-22 and HCFC-141b consumption in Syria is linked to the growth of the Foams and Refrigeration and Air Conditioning sectors. 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. Based on this, it is possible to make projections of unconstrained future demand for HCFCs until 2015.

The HCFC demand in Syria increased from about 470 metric tonnes in 1999 to 833 metric tonnes in 2006, signifying an average annual growth rate of about 8.4% over the past 7 years.

Applying an average annual growth rate in demand of 10% from 2006 to 2015, which is the expected average growth rate in demand in the both the Foams and Refrigeration & Air Conditioning Sectors, the unconstrained HCFC consumption in Syria is expected to reach 1,965 metric tonnes by 2015. The following table shows the unconstrained demand for HCFCs by substance:

Table-7: Projected unconstrained demand for HCFCs in Syria by 2015

Substance	**Demand in 2005** (metric tonnes)	**Unconstrained demand in 2015** (metric tonnes)
HCFCs	833	1,965

3.2 Availability and Prices

3.2.1 Availability Scenario

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 Syria by 2015.

3.2.2 Price Trends

The prevailing and projected prices of HCFCs in Syria (2006 and 2015) are shown in the table below.

Table-8: HCFC prices in Syria (2006 and 2015)

Year	Market Price (US$/kg)	
	HCFC-22	HCFC-141b
2006	2.00 – 2.50	3.50 – 4.00
2015	3.50 – 4.00	5.00 – 6.00

The projections are based on the assumption that the production and supply situation for HCFCs will not dramatically change for the foreseeable future. This is indeed likely to be the case as there is adequate manufacturing capacity for HCFCs in developing countries such as China and India and if production in developed countries is reduced, it is unlikely to affect the supply situation, as corresponding consumption controls are also in place in developed countries. Currently there are no consumption controls on HCFCs in developing countries (until the first control in 2016).

Thus it is seen that the prices of HCFCs in Syria in 2015 would not be dramatically higher, reflecting the relatively comfortable supply situation.

Substitutes for HCFCs are available, though not commonly used. The prices of substitutes vary between US$ 8.00 to US$ 15.00 per kg.

3.3 Technology

The selection of the substitute or alternative technology is based on a combination of factors such as maturity, availability, cost-effectiveness, energy-efficiency and environmental and occupational safety. The selection is also influenced by local circumstances, preferences of enterprises, accessibility to training, processibility and regulatory environment. Certain non-ODP substitutes and alternative technologies to HCFCs are available in recent years for many applications.

3.3.1 Replacements for HCFC-22

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).

<u>HFCs and HFC Blends</u>: HFCs have zero ODP, no flammability and no toxicity, but have a high GWP, requiring minimization of leakages and emissions. All pure HFCs and most HFC blends require use of synthetic lubricating oils in place of the more conventional mineral oils used for HCFCs. Currently the leading HFC blends to replace HCFC-22 are R-407C and R-410A. However, they both have some characteristics that make the transition from HCFC-22 potentially challenging. R-407C has a significant temperature glide and R-410A operates at a considerably higher discharge pressures than HCFC-22. The availability and prices of HFCs and HFC blends to substitute HCFC-22 are not favorable presently.

Ammonia, Hydrocarbons (HCs) and CO_2: These are natural refrigerants and have excellent thermodynamic properties.

Ammonia is highly toxic and slightly flammable and can only be used in new equipment specifically designed and where exposure is minimal. Ammonia is a very popular refrigerant in the industrial refrigeration sector. Materials incompatibility makes ammonia generally unsuitable for small vapor compression systems.

Hydrocarbons are highly flammable and can be used in systems designed to address 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.

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 Syria to use them.

3.4 Environmental Impact

Table-9 shows the impact of HCFC consumption in Syria between 2006 and 2015, in terms of ODP and GWP. It can be seen that unconstrained demand would increase ozone depletion by 65.39 ODP tonnes and increase global warming by 1,972,410 tonnes/tonne CO_2 by 2015.

Table-9: Environmental Impact of HCFC Consumption

HCFC	ODP	GWP	Impact 2005			Impact 2015		
			Demand	ODP	GWP (MT/MT CO_2)	Demand	ODP	GWP (MT/MT CO_2)
HCFC-141b	0.11	630	27	2.97	17,010	64	7.04	40,320
HCFC-22/oth	0.056	1,780	806	45.14	1,434,680	1,901	106.46	3,383,780
Total			**833**	**48,11**	**1,451,690**	**1,965**	**113.50**	**3,424,100**

The above figures do not account for the GWP of substitutes to HCFCs.

3.5 Compliance Challenges and Opportunities

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 technical and financial capacity to manage the transition
- Lack of awareness on the HCFC controls and available alternatives, as well as their impact on processes, practices and the environment.

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
- Technical and financial assistance for managing the transition from HCFCs to substitutes

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

<u>Awareness and information dissemination</u>: It would be crucial to access and disseminate information on the impending obligations of the 2016 freeze, technical information on alternatives, etc. to ensure stakeholder commitment to the reduction goals.

<u>Reducing dependence on HCFCs</u>: It would 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 Syria, 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 for refrigeration and air conditioning systems.

Syria's consumption of HCFCs increased from 470 metric tonnes in 1999 to 833 metric tonnes in 2005. Unconstrained HCFC consumption in Syria is expected to reach 1,965 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 favorably 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.

Syria expects the incremental costs of compliance to be met under the mechanisms of the Montreal Protocol.

ANNEX

Information on HCFC consuming enterprises

Sector	Sub-sector	Estimated number of enterprises
MANUFACTURING		
Foams	Rigid Polyurethane Foam	50
Refrigeration and Air Conditioning	Window/Split Air Conditioners	20
	Central Air Conditioning Chillers	25
	Domestic Refrigeration	15
	Commercial Refrigeration	100
	Industrial Refrigeration	30
SERVICING		
Refrigeration and Air Conditioning	All	Over 1,000

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.