CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

Empowered lives.
Resilient nations.

HFC Inventory

BANGLADESH

2011-2013

Prepared by Mohammad Reazuddin
Implemented by the United Nations Development Programme (UNDP)
For the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants

2014

LIST OF ABBREVIATIONS

AC	Air Conditioner
ATM	Automated Teller Machine
BAU	Business as Usual
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BRAMA	Bangladesh Refrigeration and Air-Conditioning Marchant Association
CCAC	Climate and Clean Air Coalition to Reduce Short-lived Climate Pollutants
CFC	Chlorofluorocarbon
DOE	Department of Environment
EPA	Environmental Protection Agency
GWP	Global Warming Potential
HC	Hydrocarbon
HCFC	Hydrochloro fluorocarbon
HFC	Hydrofluorocarbon
HFO	Hydrofluoro olefin
HPMP	HCFC Phase-out Management Plan
ICD	Inland Container Depot
ICU	Intensive Care Unit
LGA	Low Global Warming Potential Application
MAC	Mobile Air Conditioner
MDI	Metered Dose Inhaler
MOEF	Ministry of Environment and Forests
MT	Metric Ton
NBR	National Board of Revenue
ODP	Ozone Depleting Potential
ODS	Ozone Depleting Substance
RAC	Refrigeration and Air-conditioning
SLCP	Short-Lived Climate Pollutants
SME	Small and Medium Enterprise
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America

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Chapter 1
INTRODUCTION

1.1 Background

Bangladesh is partner of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants (CCAC), an initiative of the United Nations Environment Programme and a group of countries launched in 2012 for a collective action to reduce short-lived climate pollutants (SLCPs) such as black carbon (soot), methane and some hydrofluorocarbons (HFC). Bangladesh ratified the United Nations Framework Convention for Climate Change (UNFCCC) and the Kyoto Protocol and is making progress in the implementation of Bangladesh Climate Change Strategy & Action Plan (BCCSAP) which was prepared in 2009 aiming at sustainable adaptation options and low carbon development.

Bangladesh ratified the Vienna Convention and the Montreal Protocol with all its amendments to control the consumption of the substances that deplete the ozone layer. To fulfill its obligation to the Montreal Protocol, a Country Programme was framed in 1994 and updated in 2005. 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 ODS phase-out in various ODS consuming industry sectors and assisting them in complying with the country's commitments and priorities. The Foams and Refrigeration and Air Conditioning Sectors were the main ODS consuming sectors in Bangladesh. The National strategy prioritized the management of ODS consumption and eventual phase-out in these sectors except essential use of CFCs in MDI sector. The Country Programme was updated in 2005 to address MDI issues.

The irony is that globally CFCs were phased out mainly by introduction of HCFCs and HFCs in many applications. HCFCs are low ODP substances but found to have high GWP. As a result, consumption and emission of these substances contributes to global warming. Owing to this situation, the Montreal Protocol has undertaken programmes to phase-out HCFCs through accelerated HCFC phase-out programs. Bangladesh exceeded its commitments under accelerated HCFC phase-out schedules. A comprehensive HPMP (Stage-I), which incorporates the strategy and action plan for Bangladesh for compliance with 2013/2015 control targets, was prepared. On the other hand, as a member of CCAC, it is also committed to reducing the consumption of HFCs by appropriate, safe and efficient alternatives.

The objectives of the project is to conduct initial survey of HFC consumption in Bangladesh to establish the current consumption of HFCs and provide future projections of growth patterns by substance and to the extent feasible, by sector and also to identify opportunities and challenges for transition to low-GWP alternatives for various applications. Establishing use and growth patterns for various species of HFCs in the country at this stage would provide data to facilitate selection of appropriate safe and efficient low-GWP alternatives, wherever currently available for various applications, therefore contributing to direct and indirect emission reductions, when implemented.

1.2 Scope of Work

The scope of services for "CCAC-HFC Survey" included the following:

- Establish current consumption of HFCs by substance (and to the extent feasible, by sector);
- Establish estimated growth patterns in HFC consumption by substance (and to the extent feasible, by sector); and,
- Identify challenges and opportunities for transition to low-GWP alternatives for various applications.

1.2.1 Analysis of Scope of Work

Analysis of the scope of work reveals that the survey had to cover all the sector and subsectors using HFCs. An exercise was made, based on the review of potential information available at the Ozone Unit of the DoE, to categorically identify all the sectors and subsectors with estimated approximate population. Table 1 provides approximate sectoral and sub-sectoral population.

Table 1.1: Estimated Sector and subsector population.

Sl.	Sector	Subsector	Approximate Population
1.	Service Shop		15,000
2.	Chemical Importers		30 to 35
3.	Enterprises		15 to 20
4.	Metered Dose Inhaler Manufacturers		6
5.	Assembly Industry		15 to 20
6.	Equipment Importers		10 to 15
7.	Chillers	Radio Station	36
		Television Station	17
		Airport	10
		Seaport	2
		Land Port	2
		Railway	1
		Market Places (AC)	50
		Malls	4
		Hotel	20
		Community Centre (AC)	100
		Auditorium	100
		Convention Centre	25
		Cinema Hall	100
		Theatre Hall	50

Sl.	Sector	Subsector	Approximate Population
		Cold Storages	300
		Fish Freezing/ Processing Industries	300
		Meat Processing and freezing	5
		Pharmaceutical Industries	50
		Spinning Mills	100
		Textile / Garment Industries	1000
		Food and Beverage Industries	100
		Ice-cream Factories	100
		Poultry	500
		Ice Factories	2000
		Printing Industries	100
		Tobacco Factories	15
8.	Air-conditioning	Database Server Room	500
		ATM Booth	5000
		Mobile Tower control Room	400
		Operation Theatre	2500
		Medicine Store Room	2000
		Medical Equipment Room	200
		ICU	300
		Laboratory	70
		Instrument Room	70
		Radio Station	27
		Television Station	30
		Airport	8
		Seaport	2
		ICD	2
		Land Port	2
		Railway	1
		Transport	10,000
		Museum	20
		Office Room	7000
		Shops	7000
		Super shops	200
		Malls	150
		Hotel	700
		Restaurants	3000
		Lounge	30
		Fitness Centre	100

Sl.	Sector	Subsector	Approximate Population
		Clubs	30
		Bar	30
		Community Centre	400
		Auditorium	400
		Convention Centre	50
		Cinema Hall	250
		Theatre Hall	60
		Pharmaceutical Industries	70
		Control Rooms	1500
		Ship building	4
		Domestic	500
9.	Refrigeration	Medicine Store Room	500
		Laboratory	70
		Airport	8
		Seaport	2
		Land Port	8
		Railway	1
		Transport	1000
		Shops	700
		Super shops	200
10.	Fire fighting		
11.	Solvent Sector	Cleaning	Not estimated
		Medical Equipment	
		Electronics	
12.	Ship Building		4
13.	Ship Breaking		300

Source: HCFC Survey, 2011. *It must be noted that HFCs can be used in applications where ODSs have never been used. Currently, such uses are negligible/not known.*

1.2.2 Sample Size

A representative sample size in various applications was planned as follows **(based on the experiences in past surveys especially the survey on HCFCs in 2011).** It is also to be noted that during data collection geographical distribution was taken into consideration.

Table 1.2: Sample Size

Sl.	Sector	Sample Size
1	Chemical importers	All
2	Equipment importers	All
3	Manufacturers/ Enterprise	All
4	Assembly Industry	All
5	Chiller	100
6	Air-conditioner	50
7	Refrigeration	20
8	Fire fighting	Secondary source
9	Ship-building	All
10	Ship-breaking	Secondary source
11	Service-shop	500
12	Transport refrigeration	Secondary source

1.3 Approach and Methodology

1.3.1 Methodology

Both primary and secondary data were collected in the survey. HFC consumption data were collected through the Questionnaire Survey and cross checked with the import data. A set of Questionnaire for each sector was developed to cover various sectoral uses of HFCs. Questions pertaining to availability and use of alternatives formed part in the relevant questionnaire. Field testing of questionnaires was done on a limited scale before applying for full scale data collection. In total, there were eleven questionnaires developed as follows:

1. Questionnaire for Chemicals Importers
2. Questionnaire for Equipment Importers
3. Questionnaire for Chillers
4. Questionnaire for Equipment Manufacturers/Assemblers
5. Questionnaire for Service Shops
6. Questionnaire for Assemble Industry
7. Questionnaire for Air-conditioning Sector
8. Questionnaire for Refrigeration Sector
9. Questionnaire for Pharmaceuticals
10. Questionnaire for foam manufacturers
11. Questionnaire for Automobile sector

1.3.2 Data Collection

Apart from the quantitative data collection through the questionnaires, qualitative data were also collected from various relevant organizations and agencies. Sources of qualitative data include, but not limited to, the following:

- National Ozone Unit of DoE
- National Board of Revenue (NBR)/ Customs Services
- HFC Importers and Distributers
- Industry Associations (including refrigeration and servicing associations)
- HFC based Enterprises
- Bangladesh Cold Storage Association
- Bangladesh Refrigeration & Air-conditioning Merchants Association (BRAMA)
- Bangladesh Frozen Foods Exporters Association
- Bangladesh Road Transport Authority
- Fire Service and Civil Defense
- Bangladesh Railways

1.3.3 Special Investigation

Special investigations were carried out in a few sectors. These included:

- Import of HFCs and mixed blend for the year 2011, 2012 and 2013.
- Manufacturing/enterprise and assemble sectors for obtaining baseline data/ information.

1.3.4 Stakeholder discussion

The consultant conducted stakeholder discussion(s) with a wide range of stakeholders. They included:

- HFC importers and Distributors
- Foam Manufacturers
- Residential RAC Assembler/Manufacturers
- Commercial RAC Installers
- Chiller Assemblers/Manufacturers
- Cold Storage Association
- Bangladesh Refrigeration and Air-conditioning Merchant Association (BRAMA)
- Mobile Refrigeration Agencies
- Automobile A/C Agencies
- Firefighting Agencies
- MDI Sector
- Ship Breaking Association
- Servicing Technicians

Chapter 2
HFC MARKET ANALYSIS

HFCs have been introduced into commercial use largely because they have proven effective substitutes for ODSs. They do not deplete the ozone layer and are suitable for use in applications where CFCs and HCFCs were used.

The use of HFCs is increasing rapidly as a result of global economic development and population growth.

2.1 Substances

It was observed from the HFC survey that, in Bangladesh, HFC134a, R-404A, R-407C, R-410A were widely used in different applications in refrigeration and air-conditioning systems. Besides, there were applications of HFC-125 and HFC-227ea in fire protection systems.

2.2 Overview of Sectors and Applications

From the survey, a wide range of uses of HFCs in Bangladesh was observed. But these uses basically fell under air-conditioning and refrigeration. There was a limited application of HFCs in fire suppression system.[1] No application was found in the survey in foam, solvent and non-medical aerosol application. HFCs were used for the production of MDIs in Bangladesh and for non-medical aerosols HCs were used. A summary of sectoral uses of these chemicals are given in Table 2.1.

Table 2.1: Sectoral use of HFCs

Sectors of use	Specific application	Types of HFCs
Unitary air conditioning equipment	Small self-contained air conditioners	R-407C, R-410A
Small water chillers of about 100 kW refrigeration capacity	Screw chillers	HFC-134a, R-410A
	Reciprocating chillers	HFC-134a, R-407C
	Centrifugal chillers	HFC-134a
Commercial refrigeration equipment	Cold storage	HFC-134a
	Ice cream freezers	R-404A, HFC-134a
	Ice making machines	HFC-134a
	Glass-door bottle coolers	HFC-134a
	Plug-in display cabinets	R-404A
Industrial refrigeration	Industrial heat pumps and heat recovery	HFC-134a, R-404A, R-407C

[1] Please also refer firefighting application presented in later in this report

Sectors of use	Specific application	Types of HFCs
	Server computers in data centers	R-404A, R-407C
	Industrial chillers	HFC-134a
Refrigerated transport and mobile air conditioning	Reefer ships	HFC-134a, R-404A, R-410A,
	Refrigeration and air conditioning fishing vessels	HFC-134a, R-404A
	Road transport (trailers, diesel trucks, small trucks)	HFC-134a
	Air conditioning in trains	HFC-134a
	Air conditioning in buses and cars	HFC-134a
Foam	Extruded polystyrene foam	HFC application not found
	Rigid polyurethane foam	
	Polyethylene foam	
	Integral skin foam	
Solvent applications	Cleaning	HFC Application not found
Aerosols	Non-medical aerosol products	HFC application not found
Aerosols	Medical application in MDI production	HFC-134a
Fire extinguishing	Fire suppression system	HFC-125, HFC-227ea

Source: HFC Survey 2014

2.3 Production of HFCs

There was no production of HFCs in Bangladesh.

2.4 Export of HFCs

In the survey, it was found that Bangladesh did not export any virgin HFCs. There are few equipment manufacturing companies like refrigerator manufacturing company who are trying to export refrigerators in the foreign market using HFC-134a refrigerant in the system. Only Walton Hi-tech Industries Ltd. has so far been successful. The volume of export of this company in 2013 was around 25,000 units. Few other companies are also exploring opportunities.

2.5 Import of HFCs

During the survey, an interview was carried out with the Ozone Cell, Department of Environment. During the interview, detailed discussions were carried out on possible uses of HFCs in Bangladesh. The Ozone Cell also indicated possible importers. Import data were collected from the National Board of Revenue and also about the name of the importers. Data on imports from the importers were collected through specific questionnaire.

The survey findings showed that HFCs were imported primarily from **USA, Japan, China, Singapore, and Thailand**. The total quantity of HFCs imported by individual substance over the last three years is given in the table below.

Table 2.2: HFC imports by substances *(All figures in MT)*

Substance	2011	2012	2013
HFC134a	336.80	396.40	508.540
HFC-23	0.045		0.090
HFC 125/227ea	1.25	1.00	3.00
R-404A (Mixed)	6.10	8.40	12.65
R-410A (Mixed)	12.60	20.10	19.70
R-407C (Mixed)	2.60	1.13	3.39
	359.395	**427.03**	**547.37**

Source: NBR

It may be noted that, under mixed refrigerants, there are different kinds of HFCs. These HFCs were generally being imported as FM200 and NAF125 as automatic fire suppression system, and if those HFCs are accounted separately, then we get 2013 import data in terms of single substances as follows:

Table2.3: Single molecule wise import data for the year 2013 *(In MT.)*

Name of Chemicals	Imported in MT.	HFC-134a	HFC-23	HFC-32	HFC-125	HFC-143a	HFC-125/227ea
HFC-134a	508.540	508.540					
HFC-23	0.090		0.090				
HFC-125/227ea	3.00						3.00
R-404A (mixed)	12.65	0.506			5.566	6.578	
R-410A (mixed)	19.70			9.85	9.85		
R-407C (mixed)	3.39	1.762		0.780	0.848		
Total	**547.37**	**510.808**	**0.09**	**10.63**	**16.264**	**6.578**	**3.00**

Source: HFC Survey 2014

Note: R-404A: HFC-125(44%) +HFC-143a (52%) +HFC-134a (4%)
R-410A: HFC-32(50%)+ HFC-125(50%)
R-407C: HFC-32 (23%), HFC-125(25%), HFC-134a(52)
Ref: www.epa.gov/ozone/snap/refrigerants/refblend.html

A bar chart on HFCs imports as single substance in 2013 is given below.

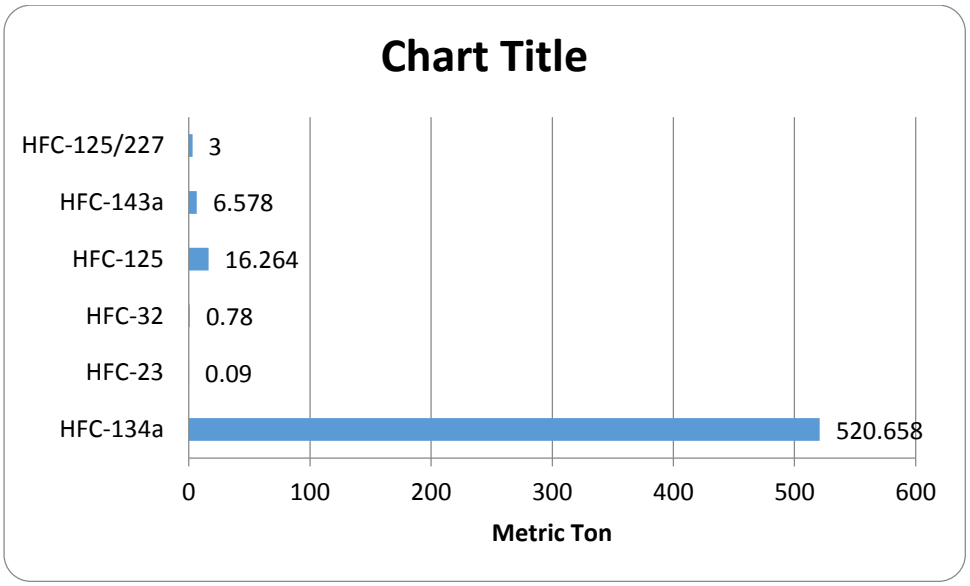

Figure 2.1: HFC imports as single substance

From the above chart, it is clear that approximately 95% of the total HFC consumption is HFC-134a because of its consumption in RAC (manufacturing and servicing) and medical applications in the country.

Chapter 3
INDUSTRY STRUCTURE AND CONSUMPTION OF HFCS IN DIFFERENT SECTORS

3.1 Refrigeration sector

From the HFC survey, it was noted that the consumption of HFCs in refrigeration sector was divided into two broad categories such as manufacturing and servicing. Broadly, domestic, commercial, industrial and transport refrigeration systems fell under manufacturing categories. Bangladesh has had no facilities to manufacture transport refrigeration system. The following table shows the 2013 data of refrigeration manufacturing sector.

Table 3.1: HFCs use in Refrigeration manufacturing sector in 2013 (in MT)

Particulars in MT	HFC-134a	R-404A	Total
Domestic Refrigeration Manufacturing	172.4		172.4
Commercial/ Transport / Industrial Refrigeration Manufacturing	5.9	3.10	9.00
Industrial Refrigeration including Chillers	5.46	1.70	7.16
Total	**183.76**	**4.8**	**188.56**

Source: HFC Survey 2014

From the Table 3.1, it is clear that domestic refrigeration manufacturing had the major market share of HFC consumption in the refrigeration sector.

3.2 Air-conditioning sector

From the survey, it was observed that residential, commercial, industrial and mobile air-conditioning equipment was assembled in Bangladesh and there was HFCs consumption in this sector apart from HCFCs and not in-kind technologies. The following table shows 2013 data of HFC consumption in air-conditioning manufacturing/assembling sector.

Table 3.2: HFC Consumption in Air-conditioner Manufacturing/Assembling in Bangladesh in 2013

Particulars in MT	HFC-134a	R-404A	R-410A	R-407C	Total
Residential Air-conditioner manufacturing			2.20	0.70	2.9
Commercial/ Industrial Chiller manufacturing	2.10	2.00			4.10
Mobile Air-conditioner manufacturing	1.70				1.70
Sub-total : Air-conditioner manufacturing	**3.80**	**2.00**	**2.20**	**0.70**	**8.70**

Source: HFC Survey 2014

From the above table, of the total HFCs consumed in air-conditioning equipment manufacturing applications, the highest levels of consumption were in residential and commercial/industrial equipment manufacturing and assembly activities. There was no use of HFC 134a in residential air-conditioner manufacturing. In this sector, R-410A and R-407C are being used along with HCFC-22 where as in commercial/ industrial chiller, HFC-134a and R-404A were being used. However, in mobile air-conditioner, it was only HFC-134a.

For commercial and industrial chillers, there were also other alternatives available in the market such as natural refrigerant and not in-kind technologies. During the stakeholder discussions, the manufacturers and assemblers engaged in this sector indicated that the demand of HFCs in these applications is expected to increase in future.

There was also increasing demand of mobile air-conditioning in Bangladesh. As road transport was on rise and AC car owners increased in Bangladesh, the consumption in this sector would further grow.

The mobile ACs had mainly HFC-134a in the system. After the phase-out of CFC-12, HFC-134a was used as a refrigerant in this sector. Importers of automobiles did not find other suitable alternatives as yet. The servicing technicians mainly use HFC-134a.

3.3 Foam sector

In Bangladesh, refrigerator insulation foam, pipe insulation foam, kitchen ware insulation, cushion, and sandwich panels were made. Most of the manufacturers were using pre-blended polyol based on HCFC-141b. HC were being used for the manufacturing of refrigerator insulation foam as a blowing agent. The total consumption of preblended polyol with HCFCs was about 150 MT per year.

The Government amended the Ozone Depleting Substance (Control) Rules 2004 in September 2014 and imposed control on import and use of preblended polyol with HCFC-141b. Big industries like refrigerator manufacturers took cyclopentane as low GWP alternatives. But SMEs, like pipe insulation foam, kitchen ware insulation, sandwich panel manufacture might switch to HFCs. It was likely that this sector would have around 20 to 30 MT of HFCs (single substance) demand per year.

3.4 Aerosol sector

After successful phase-out of CFCs in the manufacturing of MDIs in Bangladesh, the MDI industry was growing and seven pharmaceutical companies was manufacturing HFC based MDIs in Bangladesh.

Table 3.3: Consumption of HFC-134a in MDI Production in MT

Sl. No	Name of User	2011	2012	2013
1.	Beximco	31.00	42.10	52.20
2.	Square	15.40	17.08	27.90
3.	ACME	2.89	3.40	4.00
4.	GSK	5.00	6.20	7.50
5.	ACI Ltd	5.80	7.00	8.20
6.	Health Care Pharmaceutical Ltd	-	0.20	1.00
7.	Aristopharma	0.50	0.86	1.65
	Total	**60.59**	**76.84**	**102.45**

Source: HFC Survey 2014

In this sector, Bangladesh was experiencing a steady growth in terms of production and exports. During stakeholder discussion, experts indicated that this growth rate should be higher in future.

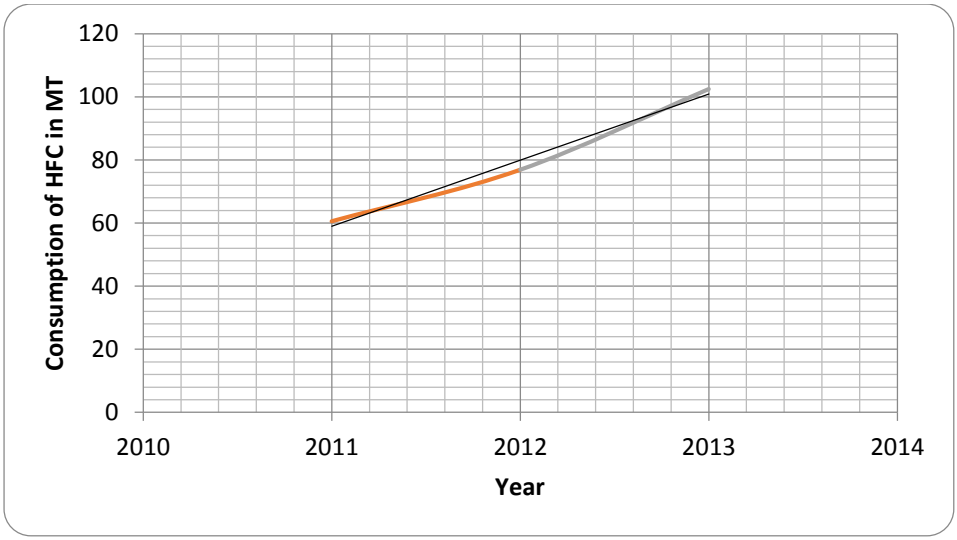

Figure 3.1: Shows an increasing trend of HFC consumption in this sector.

3.5 Fire Fighting

In the firefighting sector, it was revealed that HFCs were important halon substitutes primarily in occupied areas with space and weight constraints, or speed of suppression. HFC use for fire-fighting still represented a very small share of total use about 1.06 MT of HFC 125 and HFC-227ea in 2013. The alternatives were water based system, foam, dry powder and fire protection engineering approaches involving risk analysis, prevention steps and early detection system combined with portable extinguishing equipment.

Few companies were also using HCFC-123 for firefighting. But these chemicals are under control of the Montreal Protocol and would be phased out as per the MP schedule. Therefore, growth of HFC-125/227ea is likely to be increased in more than business as usual scenario. There was also an increasing trend of use of HFC fire suppression system due to the attributes of the system.

3.6 Service Sector

The servicing technicians basically were engaged in domestic refrigeration and unitary air-conditioning system repair and maintenance. They seldom used to repair the commercial RAC system. They informed that they usually got HFC-134a systems for domestic refrigeration and HCFC-22 system for unitary air-conditioning system. They also got R-600a and R-406A systems in domestic refrigerator and R-410A systems for air-conditioning system. Charge of R-600a and R-406A and R-410A systems are usually low compared to HFC-134a and HCFC-22 systems. HC alternatives are not yet much popular with the technicians as these are not available in the market and the HC based system found for servicing are also low but when the price of refrigerant is looked into, HC based refrigerant is lesser than that of HFC based refrigerant.

The following table provides HFCs consumption in servicing sector.

Table 3.4: Consumption in Service Sector in MT

Sector	HFC-134a	HFC-23	R-404A	R-410A	R-407C	HFC-125/227ea	Total
Domestic Refrigerator	84.30						84.3
Commercial Refrigerator	10.00		1.78				11.78
Domestic Air-conditioner				10.10	1.62		11.72
Industrial Air-conditioner	3.4		3.29				6.69
Mobile Air-conditioner	68.2						68.2
Fire Extinguisher						1.60	1.6
Sea going vessels	8.28						8.28
Refer Container/ refrigerated van/fishing trawler	4.72		0.40	1.93			7.05
Railway	2.65						2.65
Fish Freezing							0
Cold Storage	1.9			1.16			3.06
ATM Both				1.03	0.65		1.68
Mobile Phone Tower				1.1	0.1		1.2
Super Mall/Shops	2.9						2.9
Blade Industries		0.9					0.9
Other Servicing	3.19			1.46			4.65
Total	**189.54**	**0.9**	**5.47**	**16.78**	**2.37**	**1.6**	**216.66**

Source: HFC Survey 2014

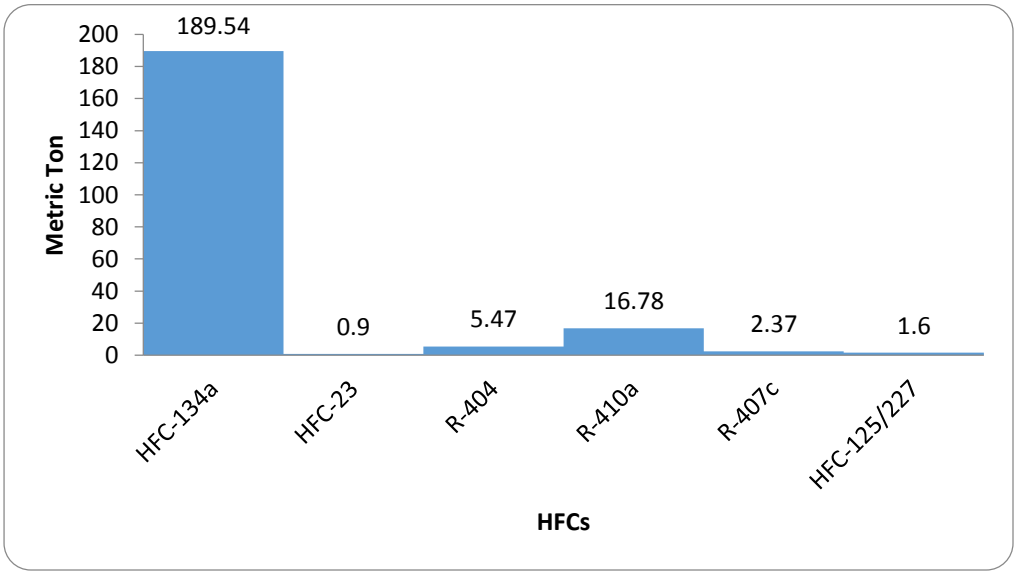

Figure 3.2: Different types of HFC used in servicing for the year 2013

From the Figure 3.2, 87% of HFCs consumed in this sector is HFC-134a. Dominant use of this chemical in this sector was for repair of domestic refrigerator followed by mobile air-conditioners. There was also a considerable use of R-410A in domestic air conditioner.

A summary of HFC consumption of 2013 in different sectors by substances is given below in the table.

Table 3.5: Consumption of HFCs in different sectors in 2013 (Source: HFC Survey 2014)

Particulars in MT	HFC-134a	HFC-23	R-404A	R-410A	R-407C	HFC-125/227ea	Total
Domestic Refrigeration Manufacturing	172.40						172.40
Commercial/Industrial Refrigeration Manufacturing	4.80		3.10				7.90
Industrial air-conditioning including chillers	5.46		1.70				7.16
Transport Refrigeration manufacturing	1.10						1.10
Sub-total : Refrigeration manufacturing	**183.76**		**4.80**				**188.56**
Residential Air-conditioner manufacturing				2.20	0.70		2.90
Commercial/ Industrial Chiller manufacturing	2.10		2.00				4.10
Mobile Air-conditioner manufacturing	1.70						1.70
Sub-total : Air-conditioner manufacturing	**3.80**		**2.00**	**2.20**	**0.70**		**8.70**
Fire Extinguishers manufacturing						1.06	1.06
Sub-total : Fire fighting						**1.06**	**1.06**
Pharmaceutical Applications (MDIs)	102.45						102.45
Sub-total : Pharmaceutical (MDIs)	**102.45**						**102.45**
Total – Manufacturing	**290.01**		**6.80**	**2.20**	**0.70**	**1.06**	**300.77**
Service sector (for all applications)	189.54	0.90	5.47	16.78	2.37	1.60	216.66
Sub-total : Servicing	**189.54**	**0.90**	**5.47**	**16.78**	**2.37**	**1.60**	**216.66**
Total: Servicing	**189.54**	**0.90**	**5.47**	**16.78**	**2.37**	**1.60**	**216.66**
Grand total	**479.55**	**0.90**	**12.27**	**18.98**	**3.07**	**2.66**	**517.43**
Total in GHG emission in MT CO2 eqv. (consumption based)	**623,415**	**10,530**	**48,123**	**32,741**	**4,943**	**7,714**	**727.47**

Chapter 4
DRIVERS OF HFCS CONSUMPTION GROWTH AND ESTIMATED HFC CONSUMPTION IN THE NEXT FIVE YEARS

4.1 Drivers of HFC Consumption and Growth

The HFC were basically consumed in the RAC Sector in the manufacturing as well as in servicing. The other potential use was in the pharmaceutical sector under aerosol application. Among the HFCs consumed in the country, HFC-134a consumption was the highest and this was followed by R-404A, R-410A, R-407C, HFC-125/127. HFC-134a alone accounts for 92.67% of the product consumed.

To understand the dynamics of the market, the study team had consultations with relevant stakeholders including Bangladesh Refrigeration and Air-conditioning Merchant Association (BRAMA), HFC Importers, Service technician, RAC Assembly/Manufacturer/Chillers Assemblers/Manufacturer, MDI Manufacturers firefighting authorities and private sector etc.

According to BRAMA, refrigerant import in Bangladesh include R-600a for refrigerators, HC Blends for refrigerators and MAC, YRS-12 (HC) for ice-cream chillers, HFC-134a for refrigerators, MAC and chillers, R-407A and R-407C for chillers, HCFC-22, R-410A, R-404A for AC and Chillers and CO_2, NH_3, HCFC-123 for chillers. Currently, the total import of HCFC-22 is over 60% of the total refrigerant imports and HFC-134a is 30% and all others account for the remaining 10%.

From the sectoral consumption analysis, the major consumption of HFC-134a was in the domestic refrigeration (manufacturing and servicing) and mobile air-conditioning sector (servicing). It appeared from the trend that these would continue to grow despite a growing market share of R-600a, as mobile air-conditioning equipment used in the country was increasing at a fast pace.

Most of the refrigerators manufactured, assembled and imported were based on HFC 134a. Again, there were several chiller applications and mobile air-conditioning applications with HFC-134a. Moreover, the technology is well proven and mature and therefore popular in the country.

HFC importers reported that the import of HFCs had increased after phasing of CFCs in the RAC system. Servicing technicians engaged in domestic and unitary air-conditioning system repair and maintenance informed that they seldom repaired domestic and commercial type RAC system. They usually procured HFC-134a system for domestic refrigeration and HCFC-22 system for unitary air-conditioning system. According to them, there was an increasing trend of getting more and more HFC based RAC system for servicing. They also made the comment that people were buying refrigerators more than before and as a result, demand for refrigerants for servicing would continue to increase.

The general perception was that, due to steady economic growth in the range of around 6% (GDP growth) in the last decade, buying capacity of the middle income and lower middle

income group people had substantially increased. They could now afford to buy refrigeration units and/or air conditioners. Price range of these products had become competitive as these were also being locally manufactured. A large number of new buyers had also entered into the market.

In the area of climate change, when average temperature was already up by 0.5 to 1°C on average in the country, scorching heat in the summer became unbearable. Given this, people did not consider RAC utilities a luxury any more.

4.2 Projection of HFC consumption for the next 05 years.

The estimated HFC consumption for the years 2014-2018 in a business as usual (BAU) scenario presented in a simple linear regression model below.

$Y = 93.988X – 188,658$ (Correlation $R^2 = 0.9745$)

Where

X = year (2015, 2016 etc.)

Y = HFC consumption in MT

From the linear regression model, it is seen that the future HFC import is likely to increase around 100 MT per year. It is to be noted that the data input for a linear regression model has been very minimal. With this limitation, this projection has been calculated assuming the following considerations.

- Bangladesh is currently implementing the first phase of HPMP under the umbrella of the Montreal Protocol along with other policy and regulatory measures. These have already caused impact on the increase of import of HFCs in different applications, particularly in the refrigeration, MDI, MAC and chiller sectors. On the other hand, the sector including foam, firefighting and air-conditioning (domestic and commercial) will experience increased growth and consumption, if low GWP options are not made available.
- Accelerated phase-out schedule of HCFCs may increase consumption of HFCs in foam sector due to imposed control on imports and use of preblended polyol with HCFC-141b. The foam sector industries (SMEs) may switch over HFCs. In the firefighting sector, the agencies started importing HFC-125 and HFC-227ea in parallel with HCFC-123.
- The RAC sector grew in the years 2011-2013 with an average compounded growth of around 23%. Though the consumption in domestic refrigeration sector is likely to be offset by R-600a, this decrease will be overshadowed by the growth in mobile air-conditioning sector.
- In the MDI sector, Bangladesh is experiencing a steady growth in terms of production and exports. Experts involved in this sector indicated that this growth rate would increase further in future. As viable alternatives for use in this sector are still at a research stage, consumption of HFCs in this sector will substantially increase.
- Due to restriction on the import of HCFC-123, growth of HFC-125/227ea are likely to be increased in the firefighting sector as alternatives.

- The growth on the use of RAC equipment is on a steady increase, so their repair and maintenance need are on the rise as evident in the servicing sector consumption. The consumption in servicing sector is anticipated to maintain a steady growth.
- All these factors will have a cumulative effect on the rise of import and consumption of HFCs.
- Considering all the above, around a 100 MT likely increase of HFC consumption per year is projected.

Chapter 5
OPPORTUNITIES AND CHALLENGES FOR TRANSITION TO LOW GWP ALTERNATIVES AND ITS IMPACT

5.1 Opportunities and Challenges

The significant growth in HFC consumption in the BAU scenario is driven partially by the HCFC phase down and partially by steady economic growth. This represents a significant challenge for the country due to the associated climate change impact.

From the Stakeholder Consultation, some alternatives were identified against the HFCs that are in use now for various applications.

Table 5.1: HFCs and alternatives used in different applications

System	HFCs	Alternatives
Domestic Refrigeration	HFC-134a	R-600a
Mobile Air conditioning	HFC-134a, R-404A	HC Blend (retrofit option), HFO 1234yf
Unitary air-conditioning	R-407C, R-410A	HFC-32 (also HFC having low GWP and lower flammability), R-290
Chillers	HFC-134a, R-410A, R-407C	Ammonia, C-40 (HC)
Commercial refrigeration	R-404A, R-410A	-
Foam Insulation	-	-
Solvents	-	-
Aerosol	HFC-134a	Not in kind technologies
Fire fighting	HFC-125, HFC-227ea	Not identified

Source: HFC Survey 2014 (Stakeholder Consultation)

Stakeholder's consultation provided the following analyses on the type of barriers against adoption of HFC free technologies and the possible solutions to address these barriers.

Table 5.2: Barriers to adoption of HFC free alternatives and solutions

Type of barriers	General statement of the barriers	Solutions to address barriers
Technical	Flammability issues	• Training, information and equipment needed. • Proper regulation and standards needed
Supply and availability	Alternatives are not available in market Users insufficiently trained to handle these option	• Information dissemination needed • Training needed for the end users
Commercial	Significant greater cost to establish the system while using alternatives Price barriers	• Proper regulation and policy needed
Market	Less demand Low market acceptance Low willingness to invest for the new system	• Information dissemination needed
Information resources	Unaware of the alternatives Absence of technical information No demonstration to learn	• Dissemination of information and availability of technology needed
Regulation and Standards	No standard for the sector No rules about the uses and collection of refrigerants and alternatives	• Government can ensure proper standards and policy interventions.
Social issues	Fear to switch to other technology Literacy of the end users Lack of technical institutions and training	• Information dissemination needed. • Coordination between the government and other training institution needed

Source: HFC Survey 2014 (Stakeholder Consultation)

5.2 Future Actions

The preparation of a National strategy for the HFC phase-out that includes the action to undertake, the time line and the associated costs represents a way forward. Strategy must include programme on awareness raising, undertaking of demonstration/investment projects and training programmes.

5.2.1 Awareness Raising

It is important to stimulate interest – in both the "problem" (climate change) and the "remedies" (e.g., including use of LGA) – through awareness raising campaigns. This should obviously be directed towards the typical industry stakeholders and should also include policy makers, end-users and investors. Awareness of such issues should encourage decision-makers and other stakeholders of the importance of tackling climate change through approaches such as using LGA. In order to enhance the effectiveness, information should be provided by respected authorities. In addition to the general issues, awareness-raising should highlight the environmental, energy, technical, economic/life-cycle cost and other related benefits of using LGA.

Specific awareness-raising exercises, for example, in the form of seminars, workshops and similar events should be targeted specifically at individual groups of stakeholders. Rather than aiming them at "end-users", they should be further focussed towards specific sub-sectors, for example, catering, leisure, food processing. In this way, the important messages (about environmental, technical, economic, etc. aspects) can be presented in a way that is most relevant to the recipients, thereby enhancing the appeal of the LGA. Similarly, awareness-raising activities should try to focus upon specific individual LGA, rather than discussing them as a whole.

Short term activities:

- Seminar/workshop for policy makers and industry stakeholders
- Information dissemination with the importers and manufacturers and/or investors

Medium term:

- Awareness raising activities with different stakeholders focused on specific LGA
- Awareness campaign focusing the end users

Long term:

- Awareness raising activities with policy makers and investors
- Awareness raising focusing specific LGA

5.2.2 Demonstration/Investment Projects

In Bangladesh, the RAC sector is the main user of HFCs. Given this, the following demonstration/investment projects would provide a way forward to the HFC phase down as suggested by various stakeholders.

Short term

- Demonstration/Investment Projects for conversion of the production of domestic and stand-alone commercial units to hydrocarbon technology (replacement of R-134a by R-600a).

Medium term

- Recovery and recycling project for ship breaking industry.
- Demonstration/installation projects in the commercial refrigeration subsector aiming at the HFC replacement by low GWP alternatives.

- Cogeneration System with Heat Recovery Absorption Chillers providing cooling capacity as one of the alternatives to existing CFC, HCFC and HFC based Chillers.
- Demonstration/installation project to use a low GWP option for air conditioning in a public building and introduction of HFO/HC for mobile air-conditioner
- Preparation of a green building code to reduce air-conditioner use.
- Institutional strengthening and capacity building of civil defence and firefighting department towards adaptation of low GWP chemicals in fire protection system.

Long term

- Demonstration project of district cooling combined with heat recovery.

5.2.3 Training

Specialised training is considered a critical element necessary for overcoming many of the barriers. Perhaps the most important aspect related to training is to ensure that sessions are targeted at specific stakeholder groups and well-focussed on individual LGA.

Training should be dedicated to all stakeholder groups – not only service and maintenance technicians, but also design engineers, production line and factory workers and not excluding firefighting agency staff who also need to be well orientated with the relevant issues. Also, HPMP consultants and others involved in the HCFC phase-out process should also receive proper training. Training sessions should be on HCs, R-717, R-744 or low-GWP HFCs individually (rather than combined), so that an entire period can be dedicated to the critical topics. Of course, where applicable, training should comprise significant practical elements; training institutes must be well equipped with trial systems and equipment for technicians to practice on. Inclusion of case studies in countries with similar climatic, economic and social conditions will be very helpful.

On a broader level, training schemes should be set up and devoted to changing the culture of the workforce to help deal with the particular characteristics of LGA refrigerants (such as flammability, higher toxicity and higher working pressures), that would otherwise render technicians vulnerable.

Organizing training and dissemination workshops in the foam sector SMEs on low GWP alternatives would also be helpful, as the government has already imposed restriction on the import of pre-blended polyol containing HCFC-141b.

Short term

Training dedicated to design engineers, foam sector SMEs, factory workers and different sector workers and skilled personnel

Medium and long term

Training dedicated to design engineers, service and maintenance engineer & technicians.

Long term

Training dedicated to unskilled, semi-skilled technicians.

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ANNEX-A
METHOD OF DATA EVALUATION AND DELIVERABLE RESULTS

- HFC Consumption data collected through the questionnaires were cross examined with the import data obtained from NBR (Customs) to ensure the quality of data. The data were coded for computer input. The Team Leader ensured quality and accuracy of the collected data. Microsoft Excel 2007 was used for data entry. These data were then processed for different end results. For end results calculation, the following examples for service sector consumption demonstrate on how this results were achieved

    1. Estimated the total number of service centre (desk study, secondary data)
    2. From the field survey, calculation was done to estimate the average consumption for specific chemicals for specific equipment servicing for each servicing centre
    3. Average consumption for specific chemicals for specific equipment servicing was then multiplied by the estimated number of service centre

- Apart from the quantitative data, qualitative data were collected from various relevant agencies through the questionnaires. Qualitative data and information obtained from all relevant agencies including the National Ozone Unit (NOU) gave a clear picture of the respective sectors in particular on the drivers of HFCs consumption, growth and estimated HFC consumption in future year.
- Stakeholder consultations were organized in phases. The series of first consultations were made during data collection period and then in a later stage for sharing the data and to solicit opinions on projections and concerns as well as views on challenges for transition to low GWP alternatives and its impact.
- The projections and way forward were finalized based on the consultation outcomes.

ANNEX-B
LIST OF HFC IMPORTERS

Sl. No.	Name	Address
1	Ms. Naim Enterprise	79 Ashan Monzil Nawab Bari (1st Floor), Dhaka
2	Taleb Business Corporation	47 Santinagar, Dhaka
3	Santacruz	20/2 RasulgabhMohakhali, Dhaka-1212
4	Razu Enterprize	Shop # 215, Rupayan Centre, 72 Bir Uttam Ak khandoker Road, Dhaka
5	Junaid Enterprise	13 New Eskaton Road, Moghbazar, Dhaka
6	AC Bazar Industries Ltd.	Valika Woolen Mills Ltd., Nasirabad I/A, Chittagong
7	Walton Hi-tech Industries Ltd.	Chandra, Kaliakair, Gazipur
8	S.T. Trading	78 Outer Circular Road, Moghbazar, Dhaka
9	GlaxoSmithKline (BD) Ltd.	Fauzderhat I/A, Chittagong
10	Beximco Pharmaceuticals	126, Kathaldia, Auchparaton, Gazipur
11	Abbas Auto Electric	Pro. Md. Abbas Ahmed, 2 no. Stale Sonadanga, Bustand
12	Woojoo Telecom (BD) Ltd	95,Dr. Kudrat-e-Khuda Road, New Elephant Road, Dhaka
13	Advanced Chemical Industries (Ltd.) (ACI)	Water Works Road, Godhnail, 7 New hajiganj Road, Narayanganj
14	Syed Gas and Chemicals Ltd.	82 Mitijheel C/A, Dhaka-1000
15	Syed Industries Ltd.	82 Mitijheel C/A, Dhaka-1000
16	Jamuna Light House	112 BC Road, Dhaka
17	ACME Laboratories Ltd	1/4, Kalanpur, Mirpur Road, Dhaka
18	N.N Enterprise	205/D Rahman Mansion, CDA Avenue, Lalkhan Bazar, Chittagong
19	Al Hatim Refrigeration	309 Enayet Bazar Jublee Rod, Chittagong
20	Square Pharmaceuticals Ltd.	Sutrapur, Kaliarkair, Gazipur

Sl. No.	Name	Address
21	Linde (BD) Ltd.	285 Tejgaon,Dhaka1208
22	N.S Trading Company	19 Joy Kali Mondir Road, Dhaka-1203.
23	Healthcare Pharmaceutical	Gazariapara, PO Mirzaur Bazar, Joydevpur, Gazipur
24	Bangladesh Power Development Board	Wapda Duilding (9th Floor) Motijheel, Dhaka
25	H.K Trading	35, Ahsanullah Road, Islampur, Dhaka
26	Asian Refrigeration Ltd.	3 Ahsanullah Road, Dhaka
27	Saqib Enterpirse	3,Ahsanullah Road, Islampur, Dhaka
28	Titon & Company	Kawadi, Charsindur, Palash, Norshingdi
29	Arist Corporation Limited	51, Motijheel I/A, Dhaka-1000
30	Orient Export Import Company Ltd.	143, Tajkuni para, Tajgaon, Dhaka
31	Maria Enterprise	7/1, Ahsanullah Road, Islampur, Dhaka
32	UK Impex	254, Sonamia Road, Khatunganj, Chittagong
33	Reaz Enterprise	35/5, Block-F, Babar Road, Mohammadpur, Dhaka
34	Frankenfood Corporation	Kawadi, Charsindur, Palash, Narsingdi
35	Delco Engineering	58/1 Purana Paltan, Dhaka-1000
36	Hossain Enterprise	175, Mollar Tek, Uttara, Dhaka
38	Samah Razor Blade Industries	247-248 Tejgaon I/A, Dhaka
39	Syed Gas and Chemicals Ltd.	82 Mitijheel C/A, Dhaka-1000
40	Woojoo Telecom (BD) Ltd.	95,Dr. Kudrat-e-Khuda Road, New Elephant Road, Dhaka
41	N.S Trading	19 Joykali Mandir Road, Dhaka-1203
42	Aziz Trade & Engineering	225 Tejgaon I/A, Dhaka-1208
43	H.K Trading	35, Ahsanullah Road, Islampur, Dhaka
44	Syed Gas and Chemicals Ltd.	82 Motijheel C/A, Dhaka-1000

Sl. No.	Name	Address
45	N.S Trading	19 Joykali Mandir Road, Dhaka-1203
46	Frankenfood Corporation	Kawadi, Charsindur, Palash, Narsingdi
47	Al Hatim Refrigeration	309 Enayet Bazar Jublee Rod, Chittagong
48	N.S Trading	19 Joykali Mandir Road, Dhaka-1203
49	Bombay Sweets & Company	Ali Bahar, Sympur, Dhaka
50	Aziz Trade & Engineering	225 Tejgaon I/A, Dhaka-1208
51	Syed Gas and Chemicals Ltd.	82 Mitijheel C/A, Dhaka-1000
52	Tokyo Refrigeration	11/1 Ahsanullah Road, Islampur, Dhaka

ANNEX-C

LIST OF MANUFACTURING COMPANIES USING HFCs IN DIFFERENT SECTORS

Name	Type of the Company	Type of Equipment	Use of HFCs
Walton Hi Tech Industries Ltd	Manufacturer	AC, Refrigerator, Freezer	HFC-134a
Hayes (Bangladesh) Ltd	Assembler	RAC	R-410A, HFC-134a, R-407C
Butterfly Marketing Ltd.	Manufacturer	Refrigerator/AC	R-134a/R-410A
Pioneer D&C a. Mfg. Co. Pvt. Ltd.	Manufacturer	Small Commercial Refrigerator	R-134a
Classic Group	Importer	Refrigerator	R-134a
Dolphin Air Conditioning & Engineering Co.	Importer/Assembler	AC	R-134a, R-404A
Gulf International Associates Ltd.	Importer/Assembler	Central Air-conditioner/ packaged Unit / Chiller	R-134a, R-404A
Penguin Engineering Ltd.	Importer/Assembler	Central Air-conditioner/ packaged Unit / Chiller	R-134a, R-404A
Rahamania International Complex	Importer	Refrigerator/AC	R-134a
Wattson Engineering & Consultants	Importer/Assembler	Chiller/ Center AC	R-134a/ R-404A
Rahman Enterprise	Importer/Assembler	Commercial AC	R-134a/R-410A
Ila Engineering	Importer/Assembler	AC	R-410A
AB Electronics	Importer/Assembler	AC	R-410A

Name	Type of the Company	Type of Equipment	Use of HFCs
Paragon Electronics	Importer	AC	R-410A
MK Electronics	Importer	AC	R-410A
Myone	Importer/Assembler	RAC	R-134a
Limo Electronic Ltd.	Importer/Assembler	AC, Refrigerator	R-134a/R-410A
Konka Electronic	Importer/Assembler	RAC	R-134a/R-410A
Supreme Refrigeration and Air Conditioning Ltd.	Importer/Assembler	AC	R-410A/R-407C
Sitak Projousholi	Importer/Assembler	RAC	R-410A/R-407C
Aziz & Company Ltd	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Alook Refrigeration Co. Ltd	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/ R410A/R404A
Confidence Trade Ltd.	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Miller	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Haroon Engineering Ltd.	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Agragami Engineers Ltd.	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A

Name	Type of the Company	Type of Equipment	Use of HFCs
Keeco Limited Address	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Panguin Engineering Ltd.	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Gulf International Associates Ltd.	Importer/Assembler	Central air-conditioners / packaged units / chillers	R-134a/R-404A
Bengal Refrigeration Co. Ltd.	Manufacturer	Display units for storing refrigerated products	R-134a
Alook Refrigeration Co. Ltd.	Manufacturer	Display units for storing refrigerated products	R-134a
Panguin Engineering Ltd.		Display units for storing refrigerated products	R-134a
Aziz & Company Ltd.		Cold room equipment/Commercial Refrigerator/AC/Chiller	R-134a/R-410A / R -404A
Agragami Engineers Ltd.	Manufacturer/ Importer/Assembler	Cold room of super mall, Quick freezing equipment of fish freezing industries	R-134a, R-410A / R-407C/ R-404A

ANNEX-C
CCAC HFC INVENTORIES

	HFC-23	HFC-125	HFC-134a	HFC-227ea	R-404A	R-407C	R-410A	Total	Total
	(mt)	(mt)	(mt)	(mt)	(mt)	(mt)	(mt)	(mt)	(CO2eq t or kt)
Refrigeration/AC manufacturing									
Domestic refrigeration			172.4					172.4	246,532.00
Commercial refrigeration			4.8		3.1			7.9	19,020.96
Transport Refrigeration			1.1					1.1	1,573.00
Large size (industrial) refrigeration			5.46		1.7				27,741.72
Water heating heat pumps									
Air Conditioning									
--Small self-contained						0.7	2.2	2.9	5,414.20
Chillers									
--Positive Displacement Chillers			1.68		2			3.68	10,245.60
--Centrifugal Chillers			0.42					0.42	600.60
Mobile Air Conditioning									
--public transit			1.7						
Refrigeration/AC servicing	**0.9**		**189.54**		**5.47**	**2.37**	**16.78**	**215.06**	**345,045.63**
Refrigeration/AC total	**0.9**		**377.1**		**12.27**	**3.07**	**18.98**	**403.46**	**656,173.70**
Foams									
Solvents									
Aerosols									
Medical			102.45						146,503.50
Fire Suppression									
Total flooding		1.06		1.6					8,862.00
Other sectors (e.g. Glass manufacturing)									
TOTAL (all sectors)	**0.9**	**1.06**	**479.55**	**1.6**	**12.27**	**3.07**	**18.98**	**517.43**	**811,539.20**